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Online persuasion of review emotional intensity: A text mining analysis of restaurant reviews

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Abstract: Consumer-generated restaurant reviews are important sources in consumers' purchase decisions. The purpose of this study is to explore the impact of emotional intensity on perceived review usefulness as well as the moderating effects of review length and reviewer expertise. Data from 600,686 reviews of 300 popular restaurants in New York City were collected from Yelp.com using a web data harvesting technique. Using a text mining approach and econometric analysis, empirical results show that (1) positive emotional intensity has a negative impact on perceived review usefulness, whereas negative emotional intensity has a positive impact on perceived review usefulness; (2) among the two most prevalent discrete negative emotions in online reviews (i.e., anger and anxiety), reviews expressing anger are more useful than those expressing anxiety; and (3) review length and reviewer expertise can moderate the effect of emotional intensity on perceived review usefulness.

Keywords: emotional intensity, discrete emotion, review usefulness, review length, reviewer expertise

Highlights

- This study explores the impact of emotional valence (either positive or negative) and discrete emotional contents (e.g., anger and anxiety) of reviews on perceived review usefulness.
- Text mining approach and econometric analysis are used.
- Positive emotional intensity has a negative impact on perceived review usefulness, whereas negative emotional intensity has a positive impact on perceived review usefulness.
- Reviews expressing anger are more useful than those expressing anxiety.
- Review length and reviewer expertise can moderate the effect of emotional intensity on perceived review usefulness.

1. Introduction

To reduce uncertainty and risk, customers often read product reviews online to make informed purchase decisions (Basuroy et al., 2003; Hlee et al., 2018). Helpful reviews exert stronger influences on subsequent customers' purchase decisions and product sales compared to reviews perceived as unhelpful (Luca, 2011); therefore, the determining factors behind perceptions of review helpfulness warrant exploration. Recent studies have revealed that various aspects of review text can affect the perceived usefulness of online reviews, including review length (Filieri et al., 2019; Hlee et al., 2019; Kwok & Xie, 2016; Liang et al., 2019; Yang et al., 2017a), review readability (Fang et al.,2016; Liu & Park, 2015; Liang et al., 2019; Yang et al., 2017a), review explanatory cues (Li et al., 2019; Moore, 2015), and review content concreteness (Shin et al., forthcoming), etc.

Emotional expressions are pervasive in online reviews and other forms of computer-mediated communication (Lee et al., 2017). In fact, the anonymous environment of online review websites enables consumers to share their emotions more easily. Sevaral pioneer studies have focused on the impact of emotional content on the helpfulness of online reviews (Ahmad & Laroche, 2015; Lee et al., 2017; Peng et al., 2014; Ullah et al., 2015; D. Yin et al., 2014); however, results have been inconsistent. Ullah et al. (2015) indicated that movie reviews with more emotional content were perceived as more helpful than reviews with less emotional content. Based on reviews of seven products (including search goods and experiential goods) from Epinions.com, Peng et al. (2014) found emotional intensity to exert a negative impact on review helpfulness, although this effect only applied to positive emotions. These contradictory findings can be partially explained by the valence of emotions, the discrete emotions contained in online reviews, as well as potential moderators like review length and reviewer expertise.

First, emotions can be divided into positive and negative emotions by valence (Ullah et al., 2015), both of which can influence consumers' judgement in distinct ways (Malik & Hussain, 2017). According to attribution theory, consumers could make different causal attributions in response to positive and negative information in online reviews (Chen & Lurie, 2013; Morewedge, 2009). Moreover, the negativity bias effect suggests that negative information plays a greater role than positive ones in consumer judgement and decision-making (Rozin & Royzman, 2001). Second, consumers encounter various emotions during consumption (Richins, 1997), each with unique appraisal dimensions that can influence consumer reactions beyond the simple valence of the emotion (i.e., either positive or negative), such as certainty, arousal and control (Ahmad & Laroche, 2015; Nabi, 2003; Smith & Ellsworth, 1985; D. Yin et al., 2014). For instance, both anger and anxiety are negative emotions but may have different influences due to their different levels of arousal. As such, it is intriguing to investigate the impacts of emotional valence and discrete emotional contents on consumers' responses. In addition, the elaboration likelihood model (ELM, Petty & Cacioppo, 1986) suggests that information load could influence individuals' information processing, such that people tend to rely on peripheral cues for judgements and decision-makings, like affective cues in review content, and reviewers' expertise shown in their profiles. Moreover, reviewer expertise is an important factor influencing consumers' causal attributions of online reviews (Folse, Porter III, Godbole, & Reynolds, 2016; Quaschning, Pandelaere, & Vermeir, 2015). Therefore, this study seeks to reconcile the inconsistent findings by exploring the moderating effects of review length (representing information load) and reviewer expertise on the role of emotional content in consumers' responses.

Given the intangible and hedonic nature of service and experiential products, the consumption process is primarily emotional and sensory; consumers purchase such products for intrinsic enjoyment rather than functionality (Moore, 2015; Pan & Zhang, 2011). As such,

customers are more likely to evaluate these products based on subjective emotional experiences like excitement and fun. Therefore, it is meaningful to study the role of emotional content in online reviews of experiential-oriented hospitality products. Although prior studies have examined the roles of emotions in product reviews, scant efforts have sought to investigate the function of emotions in the service and hospitality industries (Lu & Stepchenkova, 2015). Lee et al. (2017) conducted the only hospitality study to date that has examined the role of negative emotional expressions embedded in online consumer reviews on perceived helpfulness. The authors found that negative emotional intensity had a positive impact on perceived helpfulness. However, the authors did not take positive emotional intensity, discrete emotions and the possible moderating effects of review length and reviewer expertise into account.

To address the aforementioned gaps in the research literature, a research framework was proposed based on attribution theory and ELM. Specifically, this study investigates the impact of emotional valence (either positive or negative) and discrete emotional contents (e.g., anger and anxiety) of reviews on perceived review helpfulness in the context of the restaurant industry. This study also attempts to examine the moderating effects of review length and reviewer expertise on the relationships between the emotional intensity of reviews and perceived review helpfulness. Specifically, we attempt to answer the following research question: Do customers find the emotional intensity of reviews more or less helpful depending on perceived reviewer expertise and review length?

2. Literature Review

2.1 Emotional Intensity

Emotion can be defined as "a mental state of readiness that arises from cognitive appraisals of events or thoughts" (Bagozzi et al., 1999, p. 184). An array of emotions can be felt in a consumption situation (Ahmad & Laroche, 2015). For example, customers may feel pleasant when receiving unexpected high-quality service; in contrast, customers may experience anger in response to core service failures, and dealing with unresponsive or impolite employees. Intensity is an important characteristic of emotion. Emotional intensity, alternatively termed as affect intensity, refers to the strength with which emotions are experienced (Larsen & Diener, 1987). Depending on the subjects of emotions, there are two types of emotional intensity. The first type is called subjective emotional intensity, which refers to the intensity of individuals' emotional responses towards emotion-provoking stimuli (Larsen & Diener, 1987). The second type of emotional intensity refers to the intensity of emotions in emotion-laden stimuli, such as texts and pictures. In the context of online reviews, emotional intensity refers to the intensity or strength of emotional expressions in a review. More specifically, emotional intensity of a review can be reflected in the number of positive or negative emotional expressions in a review (Lee et al., 2017; Peng, et al., 2014), the number of exclamation marks used in a review (Li & Zhan, 2011; Folse et al., 2016), use of capitalizations and emoticons (Folse et al., 2016), as well as the level of arousal associated with positive and negative emotions (Li & Zhan, 2011; Reisenzein, 1994).

The roles of emotions in information processing and persuasion have been researched extensively (e.g., DeSteno et al., 2004; Tiedens & Linton, 2001). The role of emotions in online reviews can be explained by the elaboration likelihood model (ELM; Petty & Cacioppo, 1986). According to this theory, when individuals' motivation and information processing ability are high, people tend to think deliberately about cognitive information. By

contrast, when cognitive resources are limited, individuals rely more often on peripheral cues, which can be easily processed without critical thinking (e.g., affective cues) to make judgements and decisions. In the context of online reviews, a large volume of product reviews present consumers with a vast information load when making purchase decisions, thus limiting cognitive resources when attempting to process such large amounts of information. As such, consumers are likely to rely on peripheral cues to make judgements and decisions while reading online reviews; for example, affective information attracts more attention and more easily processed than cognitive information (Knickerbocker et al., 2015).

However, ELM alone is not adequate to reveal the influence of emotional intensity on persuasion (Peng et al., 2014). The direction of the influence of emotional intensity on persuasion can be further explained by attribution theory. Attribution theory suggests that individuals tend to infer the causes of events or others' attitudes and behaviors, and the causes can be attributed to either internal (personal) causes or external (environmental) forces (Folkes, 1988). As such, consumers could attribute the emotional expressions in online reviews to either internal factors (reviewers' characteristics) or external factors (e.g., service quality). Emotional intensity could have either positive or negative impact on persuasion depending on the causal attributions. For example, negative emotional intensity could increase persuasion if it is attributed to service quality, and it could decrease persuasion if it is attributed to reviewers' irrationality (Kim & Gupta, 2012).

Only a few studies have been conducted so far on the role of emotional intensity in online reviews, and these studies exerted mixed findings. Peng et al. (2014) found that positive emotional intensity had a significant negative impact on review helpfulness. However, Kim and Gupta (2012) found that positive emotional expressions did not have a significant impact on consumers' responses. Li and Zhan (2011) found that negative emotional intensity had a significantly negative impact on review helpfulness, whereas Lee et

al. (2017) found that negative emotional intensity had a significantly positive impact on review helpfulness. In fact, the influence of emotional intensity on online reviews' persuasion effect depends on a number of factors, such as characteristics of emotions (e.g., valence), product categories, review length, consumers' involvement, reviewers' characteristics etc. The current study seeks to disentangle the complex role of emotional intensity on persuasion through exploring the influence of valence of emotions, discrete emotions, review length and reviewer's expertise based on relevant theories and empirical research.

2.2 Review Helpfulness

As an important indicator of the persuasion effect of online reviews, perceived helpfulness of online reviews has been studied extensively. To provide an overview of research progress of the review helpfulness and to frame the current study within this field, a systematic literature study was conducted. By using search terms such as "review helpfulness", "review usefulness" and "review value", studies on online review helpfulness in the hospitality management literature are summarized in Table 1.

<Insert Table 1 Here>

Drawing upon Table 1, it is found that the functionality of online review helpfulness has been piquing substantial scholarly interest over the years. In general, previous literature revealed that perceived review helpfulness is affected by review rating (e.g., rating valence and rating extremeness), review text characteristics (e.g., review length, review readability, review concreteness, and review sentiment), review embedded photo (e.g., number of review photos and photo content), and reviewer characteristics (e.g., reviewer identity and reviewer information disclosing). There is only one study conducted by Lee et al. (2017) to date in hospitality management that has investigated the role of review emotion in review

helpfulness. If the literature review scope is extended beyond hospitality management, several more studies are found, although results from these studies are controversial (Baek et al., 2012; Peng et al., 2014; Ullah et al., 2015). However, the majority of review helpfulness studies regarded emotion as a single continuum from positive to negative, or simply classified them into negative and positive ones according to emotion valence. Nevertheless, some researchers (e.g., D. Yin et al., 2014) argued that important nuances in emotions are not captured in the overall valence approach and that focusing on discrete emotions is more meaningful in understanding consumers' perceptions to specific emotional content.

3. Hypotheses Development

The present study proposes that perceived review helpfulness is different depending on emotional intensity of review content. Literature suggests that the role of emotional intensity might be different depending on emotional valence and different discrete emotional content (Ullah et al., 2015; Peng et al., 2014; D. Yin et al., 2014). Hence this study investigates the role of emotional intensity by its valence (positive or negative) and discrete emotional content (specific emotions like anger and anxiety). In addition, the ELM suggests that high information load may hinder people's information processing ability, and hence makes people rely more on peripheral cues to make judgements, such as affective cues (Zhang et al., 2016). Furthermore, reviewer expertise has been identified as an important factor influencing consumers' causal attributions of online reviews (Folse et al., 2016; Quaschning et al., 2015). Therefore, review length, which represents information load in online reviews, and reviewer expertise were selected as the potential moderators on the relationship between emotional intensity and review helpfulness. Figure 1 below shows the research model we used to test these relationships. The main hypotheses are formulated in the following sections.

<Insert Figure 1 Here>

3.1 Emotional Intensity and Review Helpfulness

Emotions the consumer experienced in real-world situations are likely to be expressed in the online reviews. The emotional content of an online review reflects the subjective feelings and emotions consumers experienced during the consumption of products or services (i.e., consumption emotions) (Ahmad & Laroche, 2015; D. Yin et al., 2014).

Based on the valence of emotions in online reviews, emotional content can be categorized into positive or negative emotional content (Ullah et al., 2015). According to negativity bias effect in psychology, human beings tend to place more weight on negative entities, such as negative emotions, thoughts, or events, than neutral or positive entities (Rozin & Royzman, 2001). Adverse characteristics could generate "larger, more consistent, more multifaceted or more lasting effects" than good ones (Baumeister et al., 2001, p. 325), presumably because negative information is considered more diagnostic and thus more useful in decision making (Baumeister et al., 2001; Fiske, 1980). Garcia et al. (2012) found that negative words contain more information than positive words, as the informativeness of a word increases uniformly with the decrease of its valence. Therefore, it is not surprising that negative information tends to influence evaluations more strongly than comparable positive information.

Several studies have provided empirical evidence of the negativity bias effect in online review. For example, it was found that positive reviews show a weaker influence on consumers' purchase decisions (Basuroy et al., 2003; Chevalier & Mayzlin, 2006), and positive reviews are perceived less helpful compared to negative reviews (Cao et al., 2011; Li et al., 2017; Wu, 2013). However, these studies merely considered review ratings or whether reviews mentioned 'cons' to test the negativity bias effect rather than incorporating positive and negative emotional content. In line with the negativity bias effect, the present study argues that an online review may be perceived as more helpful if it contains more negative emotional content. On the contrary, reviews with more positive emotional content may be less valued, as consumers are more likely to attribute positive reviews to reviewers themselves, and reviews may be written to justify astute choices (Chen & Lurie, 2013). In addition, more positive emotional content may arouse consumers' concerns that such reviews are promotional or fraudulent (e.g., written to obtain an incentive from a firm), hence

compromising review trustworthiness (Mayzlin et al., 2014). Based on the preceding discussion, the following hypotheses are proposed:

Hypothesis 1 (H1)*: Positive review emotional intensity has a negative influence on perceived review helpfulness.*

Hypothesis 2 (H2)*: Negative review emotional intensity has a positive influence on perceived review helpfulness.*

3.2 Discrete Negative Emotions and Review Helpfulness

In psychology, two dominant approaches have been used to describe emotions: the dimensional approach and the discrete approach (D. Yin et al., 2014). The dimensional approach considers emotions to be continuous and associated with several dimensions (Lopatovska & Arapakis, 2011). This viewpoint is grounded in the cognitive appraisal theory of emotions, which suggests that emotions can be described using various appraisal dimensions (D. Yin et al., 2014). Among those identified in the literature, valence and arousal are the most important and widely applied (Barrett, 1998; Floyd, 1997). The discrete emotion approach suggests that humans share several basic and universal emotions, which can be experienced separately but are universally recognized (Ekman, 1992); examples include happiness, anxiety, and anger. Given that negative online reviews have been found to be highly influential in consumers' decision making (Basuroy et al., 2003; Chevalier & Mayzlin, 2006; Sparks et al., 2016), and because negative emotions are always associated with greater efforts of service recovery in a hospitality setting (Sparks et al., 2016), it is important to identify the effects of specific negative emotions and separate them from global negativity bias (D. Yin et al., 2014). Within negative emotional content in online reviews, anger and anxiety, are two prevalent discrete negative emotions that exert strong influences on perceived review helpfulness (Malik & Hussain, 2017; D. Yin et al., 2014). Moreover, regarding the relevance to e-commerce settings, anger and anxiety are two of the most

commonly encountered emotions in the seller online reviews (D. Yin et al., 2014). Accordingly, this study focuses on the impacts of these discrete negative emotions on review helpfulness.

Anger is defined as an emotional state ranging from irritation to rage that results from perceived threat (Kopper & Epperson, 1996). Anxiety represents an emotional state characterized by worry, nervousness, or uneasiness due to a sense of ambiguity or uncertainty (Estes & Skinner, 1941; D. Yin et al., 2014). Although these discrete emotions are both negative, they have distinct characteristics in terms of other emotional dimensions, such as arousal and certainty. Arousal refers to emotional intensity, characterized by one's level of mental alertness and physiological activity (Lane et al., 1999; Mehrabian, 1996). Certainty refers to the degree of predictability of emotional stimuli (Smith & Ellsworth, 1985).

The psychological literature has suggested that arousal and certainty of emotions have substantial impacts on information processing (Sanbonmatsu & Kardes, 1988; Tiedens & Linton, 2001). Emotional arousal could modulate the allocation of attentional resources, with more attention allocated to high-arousal emotional stimuli (Lang et al., 1999; Leite et al., 2012). As such, emotional content with a higher level of arousal is more salient and has a considerable effect on review readers' judgement and decision making. Emotional certainty leads to feelings of certainty about situations and outcomes, increasing individuals' confidence in subsequent judgements (Tiedens & Linton, 2001). Information that is characterized by greater certainty and confidence is perceived as more useful and trustworthy than more ambiguous information (Sniezek & Van Swol, 2001). Therefore, online reviews containing negative emotional content and a higher level of certainty are more likely to be deemed helpful (Ahmad & Laroche, 2015). The literature has also indicated that anger involves a higher level of arousal and is associated with greater certainty compared to anxiety (Ahmad & Laroche, 2015; Clark et al., 1984; Tiedens & Linton, 2001; D. Yin et al., 2014).

By contrast, anxiety features low certainty and low arousal (D. Yin et al., 2014). Thus, the authors propose a third hypothesis regarding the distinct roles of these two discrete negative emotions.

Hypothesis 3 (H3)*: Anger-related review emotional intensity has a stronger influence on perceived review helpfulness than anxiety-related review emotional intensity.*

3.3 Moderating Effect of Review Length

Review length refers to the number of words typed in an online review (Li et al., 2017). The role of review length on review helpfulness has been well researched, with scholars agreeing that review length exerts a positive impact on review helpfulness given that longer reviews contain more detailed information about products and are more helpful when consumers make judgements and decisions (Mudambi & Schuff, 2010; Pan & Zhang, 2011). The present study argues that review length has a moderating effect on the impact of emotional content on review helpfulness.

For online reviews with fewer words, more emotional content—whether positive or negative—could lead to perceptions of reviews being overly emotional or subjectively biased, further decreasing the trustworthiness and perceived helpfulness of online reviews (Connors et al., 2011; Filieri, 2016). Conversely, when reviews contain more words, the cognitive content is likely to increase such that online reviews with more emotional content are considered more informative and more helpful. A blend of objective and subjective content reportedly has a positive impact on review helpfulness (Ghose & Ipeirotis, 2011). Compared to briefer online reviews, the adverse effect of positive emotional content on review helpfulness can be attenuated, and the positive impact of negative emotional content on review helpfulness can be strengthened in longer online reviews.

The moderating effect of review length on the role of emotional content can be explained by ELM, which posits that individuals tend to rely on peripheral cues to make

judgements and decisions when their information processing is limited (Petty & Cacioppo, 1986). Online reviews may lead to a higher information load when containing more words and information, in which case readers' information processing may be hindered (Zhang et al., 2016). Affective information in longer reviews can function as peripheral cues that are more easily processed, attract readers' attention, and may directly reflect reviewers' positive or negative attitudes (Knickerbocker et al., 2015; Petty & Cacioppo, 1986; Zhang & Buda, 1999). As such, emotional content, whether positive or negative, likely increases perceived helpfulness in longer online reviews. Given these suppositions, the following hypotheses are proposed:

Hypothesis 4a (H4a)*: The negative influence of positive emotional content on review helpfulness can be attenuated by review length. Specifically, the negative impact of positive emotional content on review helpfulness is weaker for a review with more words than for one with fewer words.*

Hypothesis 4b (H4b)*: The positive influence of negative emotional content on review helpfulness can be accentuated by review length. Specifically, the positive impact of negative emotional content on review helpfulness is stronger for a review with more words than for one with fewer words.*

3.4 Moderating Effect of Reviewer Expertise

Reviewer expertise reflects one's knowledge and experiences related to the goods or services under review (Fang et al., 2016; Lee et al., 2011). To invite reviewer participation, many online websites have incorporated ranking or 'badge' systems to signify reviewers' expertise, knowledge, and contributions to the online community. For example, TripAdvisor employs a badge system based on reviewers' contributions through reviews and photos, travel experiences, expertise, and number of received helpfulness votes (TripAdvisor, 2017). Reviewer expertise is an important cue of source credibility, based on which consumers make

judgements about the reliability of online reviews, especially when presented with a large volume (Filieri, 2015; Lee et al., 2011). As such, online reviews written by reviewers with expertise may be perceived as more reliable, persuasive, and helpful (Li et al., 2017; Mackiewicz, 2010; Mackiewicz & Yeats, 2014).

According to attribution theory, individuals make causal inferences about events and others' attitudes and behaviors that may shape their own attitudes and behaviors (Folkes, 1988). In the context of online reviews, a review is perceived as more useful if it is attributed to the quality of products/services but less helpful if it is ascribed to a reviewer's self-serving motivations or idiosyncratic characteristics (e.g., personal preferences or biased opinions) (Quaschning et al., 2015; Sen & Lerman, 2007). Reviewers' expertise will likely change consumers' causal inferences about online reviews. When an online review is composed by a reviewer with expertise, the content will more likely be attributed to the product/service and will thus be perceived as more helpful even if it contains more positive or negative emotional content.

Essentially, expert reviewers are believed to express objective judgements. Reviewers written by individuals without expertise are assumed to contain more emotional content, which could lead consumers to make causal attributions to the reviewer's idiosyncratic characteristics (i.e., personal preferences or biased opinions due to non-product related reasons) regardless of positive or negative emotions expressed in the review. Therefore, when an online review is drafted by a reviewer with expertise, the positive impact of negative emotional content on perceived review helpfulness may be strengthened, whereas the negative impact of positive emotional content on perceived review helpfulness may be weakened. By contrast, when an online review is written by a reviewer without expertise, the positive impact of negative emotional content on review helpfulness should be attenuated,

and the negative impact of positive emotional content on review helpfulness should be amplified. On this basis, the following two hypotheses are proposed:

H5a*: The negative influence of positive emotional content on review helpfulness can be attenuated by reviewer expertise. Specifically, the negative impact of positive emotional content on review helpfulness is weaker for a review written by a reviewer with expertise than for one written by a reviewer without expertise.*

H5b*: The positive influence of negative emotional content on review helpfulness can be accentuated by reviewer expertise. Specifically, the positive impact of negative emotional content on review helpfulness is stronger for a review written by a reviewer with expertise than for one written by a reviewer without expertise.*

4. Methodology

4.1. Data

Data in this study were obtained from one of the largest online review platforms in hospitality industry, Yelp.com, which specializes in restaurant reviews. We collected the online reviews of the 300 popular restaurants (in terms of number of reviews posted) in the US, which boasts a well-developed hospitality and tourism industry. These restaurants cover an array of categories ranging from fine dining to causal and from full service to limited service. In summary, there were three different levels of data, including review-level data, reviewer-level data, and restaurant-level data. Based on the uniquely identifiable common variable, we combined these three-level datasets and got the final review-level dataset including the correspondent reviewer and restaurant information. To reduce the noise, reviews that contained no text content and reviews that were written in non-English were removed. All restaurant reviews were included in the dataset, constituting 600,686 reviews from 300 restaurants.

4.2. Variable Operationalization

The proposed variables were operationalized based on research on online reviews. Table 2 displays the dependent variables, independent variables, moderating variables, control variables, and how they were measured; Table 3 presents the descriptive analysis of the proposed variables.

<Insert Table 2 Here>

<Insert Table 3 Here>

Dependent Variables. *Review usefulness* indicates "the total number of usefulness votes for each review, reflecting the number of times online review readers clicked the

"Useful" tab in response to the question "Was this review […]?" appearing near the end of each review" (Yang et al., 2017a, p. 825).

Independent Variables. *Positive emotions* were measured as (# of positive emotion-related words / # of words in a review) × 100 (e.g., "happy", "pretty", "good"). *Negative emotions* were measured as (# of negative emotion-related words / # of words in a review) × 100 (e.g., "hurt", "ugly", "nasty"). *Anxiety emotions* were measured as (# of anxiety-related words / # of words in a review)*100 (e.g., "worried", "nervous"). *Angry emotions* were measured as (# of anger-related words / # of words in a review) × 100 (e.g., "hate", "kill", "annoyed"). The Linguistic Inquiry and Word Count (LIWC) program was used to analyze these emotion variables (Pennebaker et al., 2007), and it has been used frequently in information systems (Ludwig et al., 2013; Yin et al., 2014a; Hong et al., 2016).

Moderating variables. The first moderating variable was review length, measured by the number of words in a specific review. The second moderating variable was the reviewer's Elite status as determined on Yelp.com, coded as 1 if a reviewer was labeled Elite in the year when his/her review was posted and coded as 0 otherwise.

Control variables. To isolate the impact of the emotional intensity contained in a review, we controlled for factors identified as important in previous literature, including review rating, review readability, review posting date, and the reviewer's number of friends on Yelp.com (Li et al., 2019; Park and Nicolau, 2015; Yang et al., 2017a). Regarding the calculation of review readability, please refer to Gunning's (1969) study. To account for systematic differences among restaurants, we also controlled for restaurant-specific fixed effects by creating restaurant dummies. The measurement of each variable is listed in Table 2.

Moreover, a correlation analysis was conducted, and the results were shown in Table 4. It was found that all the absolute values of correlation coefficients are below 0.5. Therefore, there is no multicollinearity issue in this current study.

<Insert Table 4 Here>

4.3. Econometric specification—Negative binomial regression 2 model

According to Fig. 2, the variable of review usefulness was a count variable as only few reviews received a high volume of votes. Moreover, its variance (=7.09) exceeded its mean (=0.93), therefore, a negative binomial regression with robust standard errors (Cameron and Trivedi, 2005) was an appropriate method for this study.

<Insert Figure 2 about Here>

$$\begin{aligned}\text{Usefulness}_{ijk} = {} & \beta_{10} + \beta_{11}\text{Stars}_{ijk} + \beta_{12}\text{Readability}_{ijk} + \beta_{13}\text{Date}_{ijk} + \beta_{14}\text{Friends}_{j} \\ & + \beta_{15}\text{Posemo}_{ijk} + \beta_{16}\text{Negemo}_{ijk} \\ & + \beta_{17}\text{Length}_{ijk} + \beta_{18}\text{Length}_{ijk} \times \text{Posemo}_{ijk} + \beta_{19}\text{Length}_{ijk} \times \text{Negemo}_{ijk} \\ & + \beta_{110}\text{Elite}_{j} + \beta_{11}\text{Elite}_{j} \times \text{Posemo}_{ijk} + \beta_{111}\text{Elite}_{j} \times \text{Negemo}_{ijk} \\ & + \textstyle\sum_{J} \lambda_{j} * \text{R}_{\text{j}} + \varepsilon_{ijk} \end{aligned} \quad (1)$$

$$\begin{aligned}\text{Usefulness}_{ijk} = {} & \beta_{20} + \beta_{21}\text{Stars}_{ijk} + \beta_{22}\text{Readability}_{ijk} + \beta_{23}\text{Date}_{ijk} + \beta_{24}\text{Friends}_{j} \\ & + \beta_{25}\text{Posemo}_{ijk} + \beta_{26}\text{Anx}_{ijk} + \beta_{27}\text{Anger}_{ijk} \\ & + \beta_{28}\text{Length}_{ijk} + \beta_{29}\text{Length}_{ijk} \times \text{Posemo}_{ijk} + \beta_{210}\text{Length}_{ijk} \times \text{Anx}_{ijk} \\ & + \beta_{211}\text{Length}_{ijk} \times \text{Anger}_{ijk} \\ & + \beta_{212}\text{Elite}_{j} + \beta_{213}\text{Elite}_{j} \times \text{Posemo}_{ijk} + \beta_{214}\text{Elite}_{j} \times \text{Anx}_{ijk} \\ & + \beta_{215}\text{Elite}_{j} \times \text{Anger}_{ijk} \\ & + \textstyle\sum_{J} \lambda_{j} * \text{R}_{\text{j}} + \varepsilon_{ijk} \end{aligned} \quad (2)$$

where i represents the review ($i = 1, \dots, I$), j represents the reviewer ($j = 1, \dots, J$), and k represents the restaurant ($k = 1, \dots, K$); R_j indexes a vector of restaurant fixed effects, and ε_{ijk} denotes the standard error with a normal distribution.

5. Estimation Results

Results of the negative binomial regression 2 model are presented in Tables 5, 6, and 7. The number of usefulness votes a review received was treated as the dependent variable. The model specification was tested by using a likelihood-ratio test, indicating that the Poisson regression model was an appropriate choice for data analysis.

Table 5 shows the direct influences of emotional content in a review on perceived review usefulness. Model 1.1 included only the control variables as independent variables. Based on Model 1.1, Model 1.2 included our variables of interest, namely positive and negative emotions. Then, negative emotion was decomposed into two categories (i.e., anxiety and anger), incorporated into Model 1.3, and estimated simultaneously. The estimation results of Model 1.2 in Table 5 reveals that positive emotional content exerted a negative impact on review helpfulness ($\beta = -0.067$, $p < 0.01$), whereas negative emotional content had a positive effect on review helpfulness ($\beta = 0.014$, $p < 0.01$); therefore, Hypothesis 1 (i.e., positive review emotional intensity has a negative influence on perceived review helpfulness) was supported, as was Hypothesis 2 (i.e., negative review emotional intensity has a positive influence on perceived review helpfulness). In other words, review text containing more negative emotional content tended to receive more usefulness votes, whereas fewer usefulness votes were received if review text included more positive emotional content. Moreover, among the two discrete negative emotions, angry emotional content exerted a substantial positive impact on review helpfulness ($\beta = 0.053$, $p < 0.01$), while anxiety contents had a significant but weak impact on review helpfulness ($\beta_{Anxiety}=0.031$, $p < 0.1$) at a 95% significance level; hence, Hypothesis 3 was supported (i.e., anger-related review emotional intensity has a stronger influence on perceived review helpfulness than anxiety-related review emotional intensity).

<Insert Table 5 Here>

To test the moderating effects of review length and reviewer expertise, a series of alternative models were estimated. Tables 6 and 7 list the moderating effects of review length and reviewer expertise on the impact of emotional content. Within Table 6, Model 2.1 indicates the moderating effect of review length on the influence of emotional content in a review on perceived review usefulness; Model 2.2 reveals the moderating effect of reviewer expertise on the influence of emotional content in a review on perceived review usefulness. In Table 7, negative emotions in Table 6 are decomposed into two categories (i.e., anxiety and anger) to test the moderating effects of review length and reviewer expertise on the respective influences of positive emotions and the two negative emotion categories.

<Insert Table 6 Here>

<Insert Table 7 Here>

According to the estimation results of Models 2.1 and Model 3.1 in Tables 6 and 7, the coefficient of the interaction term between review length and positive emotional content was positive and statistically significant (Model 2.1: $\beta_{positive*length}$= 0.0003438, $p < 0.01$; Model 3.1: $\beta_{positive*length}$= 0.0003408, $p < 0.01$), and similar result was found for the coefficient of the interaction term between review length and negative emotional content (Model 2.1: $\beta_{negative*length}$ = 0.0001829, $p < 0.01$). Consistent with the estimation results of Model 2.1, Model 3.1 revealed that the coefficient of the interaction term between review length and anger-related content was positive and significant ($\beta_{anger*length}$ = 0.0002746, $p < 0.01$), and similar result was found for the coefficient of the interaction term between review length and anxiety-related content ($\beta_{anxiety*length}$ = 0.0003321, $p < 0.01$). To illustrate the

moderating effects of review length, a marginal effect was calculated using STATA 16 (see Figures 3 and 4). Figure 3 displays the degree of change in number of usefulness votes with the change in positive emotional intensity based on review length (length=20, 50, 100, 150, 200). It shows that the negative effect of positive emotional content on review helpfulness was weaker for a review containing more words than for one containing fewer words, indicating that the negative influence of positive emotional intensity on review usefulness was attenuated with the increase of review length; thus, Hypothesis 4a was supported. Figure 4 displays the degree of change in number of usefulness votes with the change in negative emotional intensity based on review length (length=20, 50, 100, 150, 200). It shows that the positive effect of negative emotional content was stronger for a review with more words than for one with fewer words, suggesting that the positive influence of negative emotional intensity on review usefulness was accentuated with the increase of review length; thus, Hypothesis 4b was supported.

<Insert Figure 3>

<Insert Figure 4>

According to the estimation results of Models 2.2 and 3.2 in Tables 6 and 7, the coefficient of the interaction term between reviewer expertise and positive emotional content was positive and statistically significant (Model 2.2: $\beta_{positive*expertise} = 0.0184995$, $p < 0.01$; Model 3.2: $\beta_{positive*expertise} = 0.0189988$, $p < 0.01$). According to the estimation results of Model 2.2 in Table 6, the interaction term between reviewer expertise and negative emotional content was negative and significant ($\beta_{negative*expertise} = -0.0215801$, $p < 0.01$). Consistent with the estimation results of Model 2.2, Model 3.2 showed that the coefficient of the interaction term between reviewer expertise and negative anger content was also negative and significant

($\beta_{anger*expertise}$ = -0.060233, $p < 0.01$), although the coefficient was insignificant for the interaction term between reviewer expertise and anxiety-related content ($\beta_{anxiety*expertise}$ = -0.0097543, *NS*). To illustrate the moderating effects of reviewer expertise, a marginal effect was calculated using STATA 16 (see Figures 5 and 6). Figure 5 displays the degree of change in number of usefulness votes with the change in positive emotional intensity for elite and non-elite reviewers. It shows that the negative influence of positive emotional intensity on review usefulness is stronger for reviews written by elite reviewers than for those written by non-elite reviewers, implying that reviewer expertise strengthened the negative influence of positive emotional intensity on review usefulness; hence, Hypothesis 5a was not supported. Figure 6 displays the degree of change in number of usefulness votes with the change in negative emotional intensity for elite and non-elite reviewers. It shows a steeper line for non-elite reviewers compared to that of elite reviewers, indicating that the positive role of negative emotional intensity is attenuated by reviewer expertise. Therefore, Hypothesis 5b was not supported.

<Insert Figure 5>

<Insert Figure 6>

Model 3.3 in Table 7 simultaneously tested the moderating effects of review length and reviewer expertise on the influence of emotional content in a review on perceived review usefulness. The estimation results of Model 3.3 were quantitatively consistent with those of Models 2.1–2.2 and 3.1–3.2, respectively.

Table 8 summarizes the hypotheses testing results.

<Insert Table 8 Here>

6. Conclusions and Discussion

6.1 Findings and Discussion

This study examined the impact of emotional content, including positive emotions, negative emotions, and two discrete negative emotions, on perceived review helpfulness along with the moderating effects of review length and reviewer expertise on the relationship between emotional content and review helpfulness. Research hypotheses were proposed based on ELM and attribution theory and then tested based on restaurant online reviews posted on Yelp.com. A negative binomial regression model was used to analyze the data, and key findings from this study and discussion are summarized below.

First, results indicate that positive emotional content exerted a negative impact on perceived review helpfulness, whereas negative emotional content exerted a positive impact on perceived review helpfulness. This finding supports the negativity bias effect identified in studies on online review helpfulness (Cao et al., 2011; Sen & Lerman, 2007; Wu, 2013). Specifically, online reviews with more negative emotional content attract more attention, are more diagnostic, and have a positive impact on review helpfulness. Conversely, online reviews with more positive emotional content could be attributed to self-serving purposes, such as justification of a good choice (Chen & Lurie, 2013) and may thus seem less helpful.

Second, among the two most prevalent discrete negative emotions in online reviews (i.e., anger and anxiety), reviews containing more angry-related emotional contents were found to be more helpful than reviews with more anxious emotional content. In contrast to research by D. Yin et al. (2014), who reported that online reviews containing anxiety-related emotional content were perceived as more helpful than reviews containing anger-related emotional content, the present study concludes that online reviews with more anger-related emotional content were more helpful than those with more anxiety-related emotional content. These inconsistent results can be partly attributed to the different contexts (tangible products

vs. services/experiences) used in these studies. According to a recent study by Ren and Hong (2019), anger-related emotional content in online reviews showed a greater negative impact on review helpfulness for experiential products than for search goods. Furthermore, the finding in this study related to anxiety is consistent with Ahmad and Laroche (2013), who found that reviews containing more anxiety-related content may be perceived as less helpful because they are deemed less certain, and reviews containing emotions associated with certainty (e.g., anger) would be expected to have a positive effect on review helpfulness.

Third, our findings indicate that review length may mitigate the negative effect of positive emotional content on review helpfulness, and strengthen the positive effect of negative emotional content on review helpfulness. In other words, the negative effect of positive emotional content on review helpfulness was weaker for reviews containing more words, whereas the positive effect of negative emotional content on review helpfulness was stronger for a review containing more words. The significant moderating effect of review length on emotional content is in line with ELM, implying that emotional information can provide peripheral cues under a high information load (Knickerbocker et al., 2015; Petty & Cacioppo, 1986; Zhang & Buda, 1999) and exerting a greater impact on review helpfulness in longer reviews.

Fourth, this study yields some interesting findings regarding the moderating effects of reviewer expertise, although such findings are inconsistent with Hypothesis 5. Specifically, this study found that the negative role of positive emotional intensity in review helpfulness was strengthened by reviewer expertise, and the positive role of negative emotional intensity on review helpfulness was weakened by reviewer expertise. These findings are consistent with existing literature on that online reviews written by expert reviewers tend to be perceived as more objective and unbiased (Li et al., 2017; Mackiewicz, 2010; Mackiewicz & Yeats, 2014), and hence the positive role of negative emotional content becomes less

important. Moreover, because of the common belief that experts should be more objective and unbiased, too many positive emotional words used by expert reviewers could be attributed to reviewers' personal factors, such as irrationality, receiving incentives or being paid by the reviewed businesses. Therefore, the negative role of positive emotional intensity was strengthened for expert reviewers compared to the reviews written by non-expert reviewers.

6.2 Theoretical Implications

This study attempts to make four theoretical contributions to scholarship on online review helpfulness. First, this research is among the first to investigate the role of emotional content on review helpfulness in a hospitality context. Due to the experiential nature of the hospitality industry, emotional experience is especially important for consumers. However, most studies on the emotional content of online reviews have been conducted in tangible, utilitarian product contexts. To the best of the authors' knowledge, only one study has been carried out in the hospitality context (Lee et al., 2017). Lee et al. (2017) investigated the moderating effect of negative emotional intensity on the relationship between hotel review valence and review helpfulness. They defined negative emotional intensity as a single continuum from positive to negative, that is, minimum value denotes extremely positive emotion and the maximum value denotes extremely negative emotion. The present study makes a unique contribution to the literature by distinguishing the roles of positive and negative emotional content along with two discrete negative emotions (i.e., anger and anxiety) on review helpfulness in a restaurant review context.

Second, based on the emotional content embedded in restaurant online reviews, this study corroborates the negativity bias effect of online reviews from previous work (Cao et al., 2011; Sen & Lerman, 2007; Wu, 2013); that is, negative online reviews are more influential for consumers' decision making and thus are perceived as more helpful. More importantly,

this study helps to disentangle the global negativity bias effect by investigating the roles of two common discrete negative emotions in online reviews. Our findings suggest that the negativity bias effect in online review helpfulness in a restaurant context is mainly driven by anger-related emotions in reviews, whereas anxiety had a weaker impact on review helpfulness.

Third, this study contributes to the online review literature by uncovering the negative impact of positive emotional content on review helpfulness. Although the role of negative emotional content has been discussed frequently in the review helpfulness literature, few studies have attended to the role of positive emotions in online reviews. The negative effects of positive emotions in online reviews was found to be consistent with the actor–observer bias effect, wherein people tend to attribute others' behavior to dispositional or internal causes but attribute their own behavior to situational or external factors (Jones & Nisbett, 1987).

Last but not least, this study expands the existing online review helpfulness literature by identifying two boundary factors for the influence of emotional content, review length and reviewer expertise, which have not been examined before. Results suggest that review length could mitigate the negative effect of positive emotional content on review helpfulness and strengthen the positive effect of negative emotional content on review helpfulness; while reviewer expertise could strengthen the negative role of positive emotional intensity in review helpfulness and mitigate the positive influence of negative emotional intensity on review helpfulness.

6.3 Practical Implications

Managerially, this study yields several important implications for online review platforms and hospitality industry practitioners. First, the results could aid restaurant managers and online review sites in detecting potentially influential online reviews. Online

reviews with more negative emotional content, especially anger-related emotions, tended to indicate a service failure during a reviewer's consumption experience. Therefore, restaurant managers should reply to such reviews immediately and strive to compensate for the service failure. In their responses, managers should apologize sincerely to reviewers who experienced negative emotions while dining in the restaurant in addition to investigating the service failures before providing appropriate compensation, such as a coupon for a subsequent visit. This type of response may help restaurants retain existing customers and minimize the adverse effects of negative online reviews on new customers. More importantly, restaurant managers should deal with service failures immediately and effectively to reduce the amount of negative online reviews, especially negative reviews with anger-related emotions. A superior recovery after a service failure could relieve customers' negative emotions and increase customer satisfaction (del Río-Lanza, Vázquez-Casielles, & Díaz-Martín, 2009; Matos, Henrique, & Rossi, 2007), and hence lead to less negative emotions and less negative online reviews. Effective service recoveries can be enabled through appropriate empowerment and training among the frontstage service employees (Wirtz & Lovelock, 2017). Further, as angry customers are more likely to spread negative word-of-mouth, contact employees can be trained to recognize angry customers through their facial, postural, and verbal emotional cues (Mattila & Ro, 2008), and pay more attention to the service recovery to the angry customers.

Second, our results indicate that briefer online reviews containing more emotional content (regardless of whether the content was positive or negative) were considered less useful. Therefore, longer online reviews containing more positive emotional content should be highlighted or placed in highly visible locations on the review website, as they are helpful and may increase consumers' purchase intentions. Moreover, restaurant managers should pay greater attention to longer online reviews with more negative emotional content and

immediately take actions to address reviewers' alleged service failures, as such reviews are more influential for consumers' decision making and can exert adverse effects on consumers' purchase intentions. In addition, restaurants could encourage customers to write longer online reviews through providing a structure of the review as a reminder of customer experiences, such as service staff, food quality, location and value for money etc. It has been found that social norms help stimulate consumers to write longer product reviews (Burtch, Hong, Bapna, & Griskevicius, 2017). Hence, restaurants could remind their customers the number of customers who have already submitted reviews and also highlight longer reviews as helpful reviews.

Third, findings suggest that reviewer expertise could strengthen the negative influence of positive emotional intensity but mitigate the positive influence of negative emotional intensity on review helpfulness. As opinion leaders in the online review community, expert reviewers are thought to be more credible and objective, resulting in a greater influence on consumers' decision making (Li et al., 2017). However, using many strong positive emotional expressions could decrease the persuasion effect of reviews written by expert reviewers, as they could be suspected to be irrational or motivated by incentives. Therefore, while inviting expert reviewers and opinion leaders on customer review sites, restaurant managers should encourage them to use less emotional expressions, but more cognitive content to make their reviews more persuasive. In addition, managers could pay special attention to and carefully address reviews with negative emotional content written by non-expert reviewers, as they possess greater influence on customer responses than reviews with negative emotional content written by expert reviewers.

6.4 Limitations and Future Research

Despite the important theoretical and practical implications outlined in this study, it is not without limitations. First, findings are based on online reviews posted on Yelp.com and

may therefore be applicable solely to the restaurant context; subsequent research should consider other hospitality and service contexts to examine the generalizability of these findings. Second, the emotional content used in this study was operationalized based on discrete emotions identified through text mining, which cannot capture continuous changes in specific emotional appraisal dimensions such as valence, arousal, and control (G. Yin et al., 2014). Future research could further test the impacts of specific appraisal dimensions of emotional content on review helpfulness. Third, this study suggests that more positive emotional content in an online review may diminish perceived helpfulness; however, positive reviews tend to evoke positive attitudes towards service providers, resulting in greater purchase intentions (Vermeulen & Seegers, 2009). As such, positive emotional content may have a complex effect on consumers' purchase intentions, which warrants more attention in future research. The authors suggest exploring the conditions under which positive emotional content might increase perceived review helpfulness and purchase intentions. Finally, the positive and negative emotional intensity were calculated by using LIWC, one of the leading text mining tools. Although plenty of previous studies have applied this tool, the reliability issue of using it still remains. In other words, it cannot be guaranteed that these emotional variables are measured correctly, especially when reviewers use cynical expressions, along with some slangs and typos. Thus, the future studies could further discuss this issue to ensure that econometric analysis is on the basis of accurate variable measurements.

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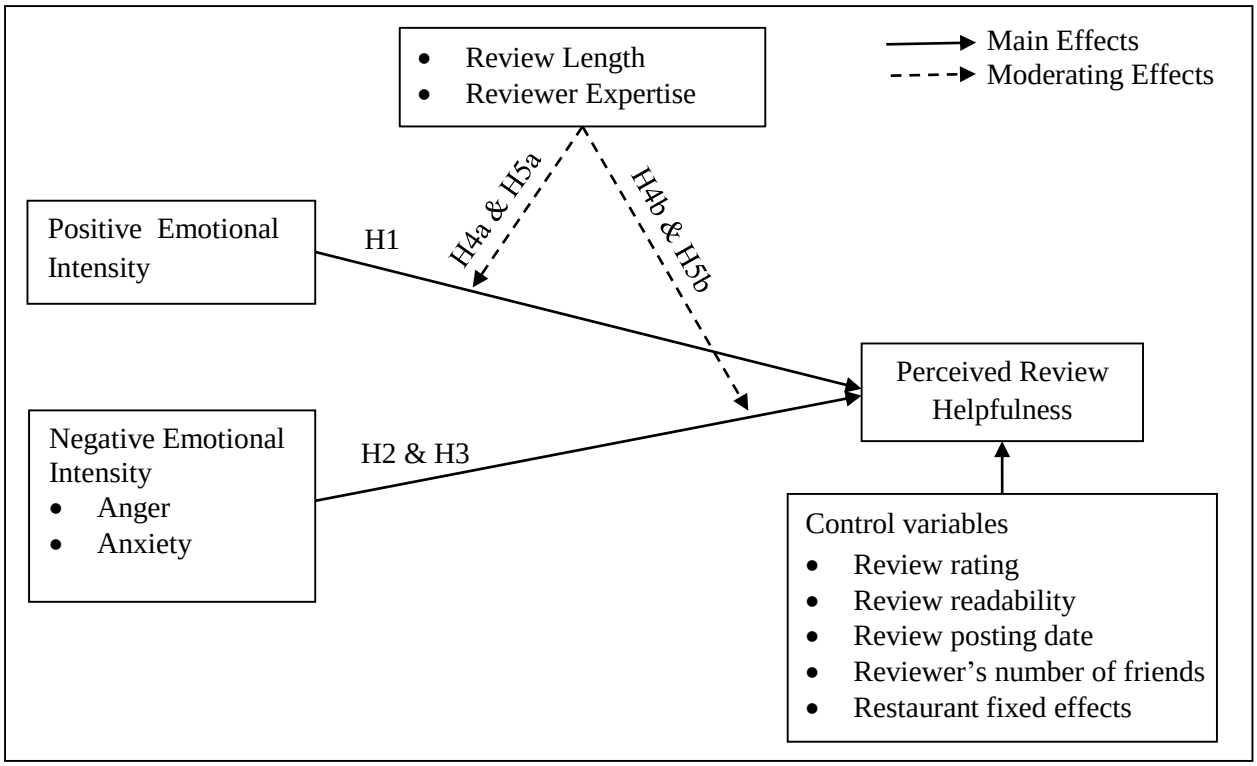

Figure 1. Research Model

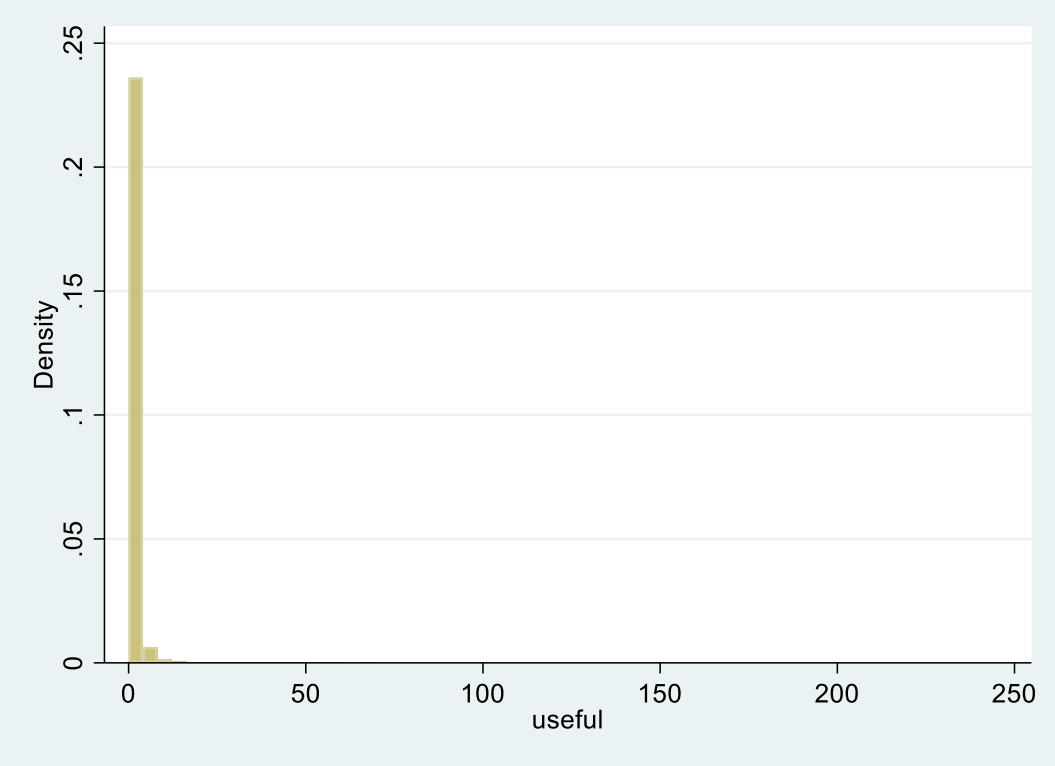

Figure 2. Histogram of Review Usefulness Votes

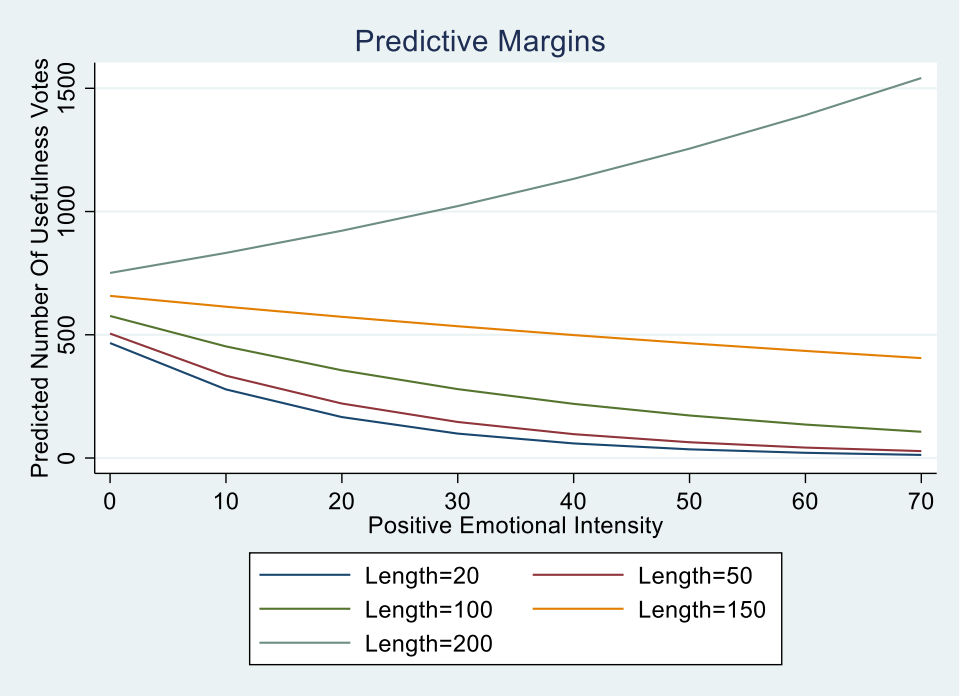

Figure 3. The Interaction Effect of Review Length and Positive Emotional Intensity

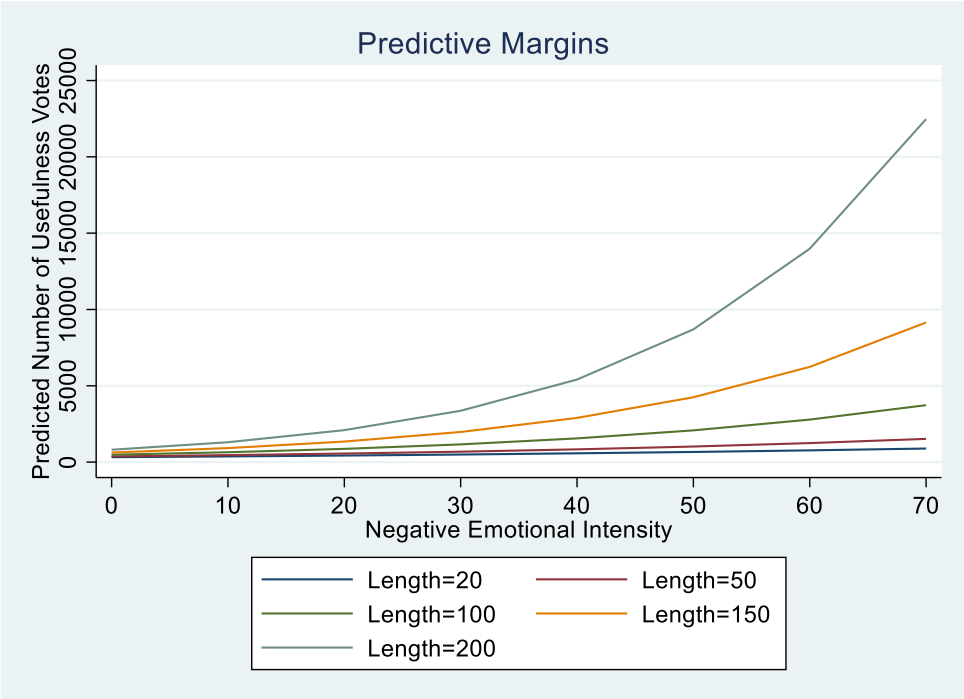

Figure 4. The Interaction Effect of Review Length and Negative Emotional Intensity

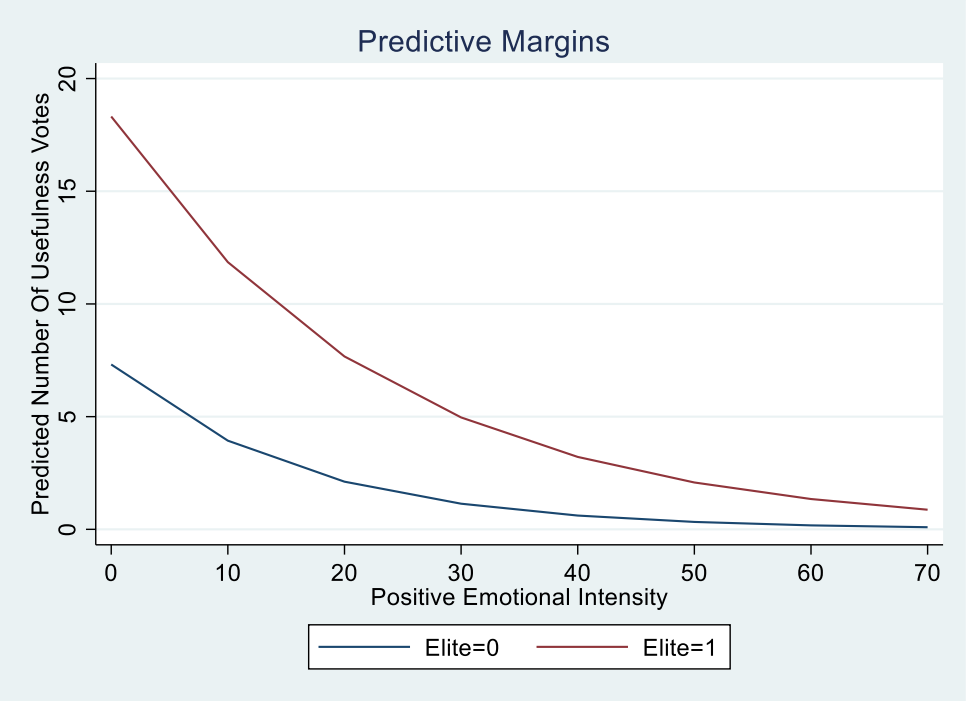

Figure 5. The Interaction Effect of Reviewer Expertise and Positive Emotional Intensity

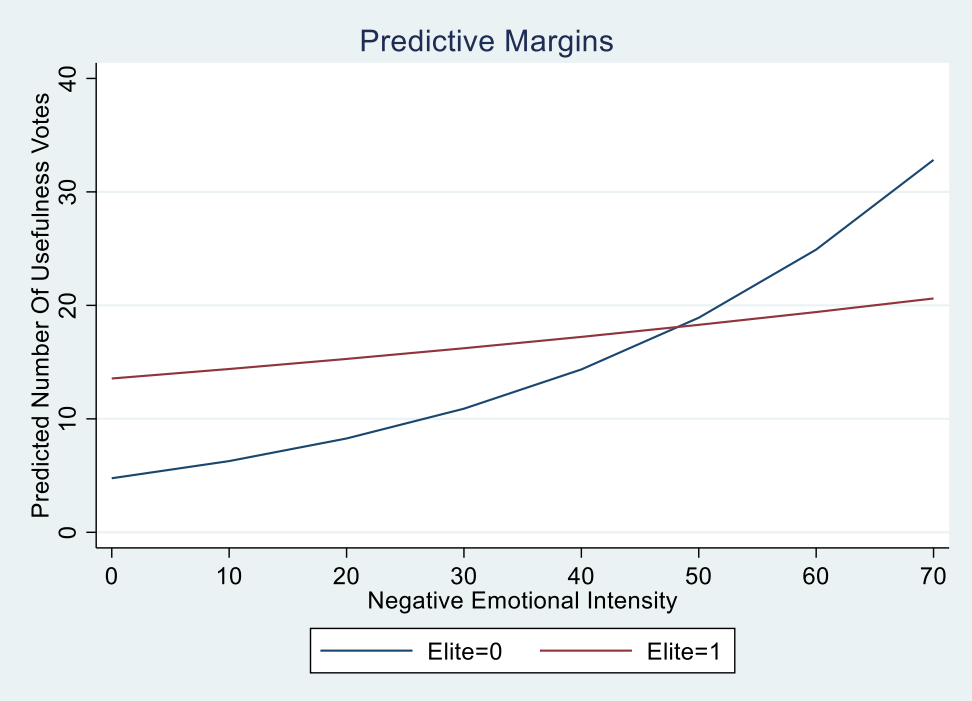

Figure 6. The Interaction Effect of Reviewer Expertise and Negative Emotional Intensity

Table 1. Summary of Literature on Review Helpfulness

Reference	Data Source	Method	Findings
Shin et al. (forthcoming)	Participants who read travel reviews from Naver	Laboratory experiment	The main effect of review concreteness on review helpfulness is significant, however, the interaction effect of temporal distance and risk–benefit tendency is insignificant.
Li et al. (2019)	Yelp restaurant reviews	Regression analysis	Temporal cues, explanatory cues, and sensory cues of online restaurant reviews have significantly positive effect on perceived review helpfulness; while the review ratings and reviewer's identity (elite or not) are the two most important factors explaining review helpfulness.
Liang et al. (2019)	TripAdvisor hotel reviews	Regression analysis	Reviews with long, readable and extreme ratings, and reviewers who are non-local, disclose geographical information, and have high reputation and poor review experience are identified as more helpful.
Filieri et al. (2019)	TripAdvisor hotel reviews	Regression analysis	Reviews with extremely negative ratings tend to be perceived as more helpful, and the relation is strengthened when the review is long, easy to read, and when the reviewer is an expert or discloses his/her geographical information.
Hlee et al. (2019)	Yelp restaurant reviews	Regression analysis	Reviews with more words and images, and reviewers who receive elite identity and have more friends are positively associated with review helpfulness.
Ma et al. (2018)	Hotel reviews from TripAdvisor and Yelp	Deep learning	User-provided photos alone do not provide sufficient cues for predicting helpfulness of reviews, but the combination of review texts and photos considerably improves the predicting performance.
Lee et al. (2017)	TripAdvisor hotels reviews	Sentiment mining, Regression analysis	Reviews with negative ratings are perceived as more helpful than positive ratings, but this association is diminished when intense negative emotions are expressed in review content.
Li et al. (2017)	Yelp hotel reviews	Sentiment mining, Regression analysis	The valence of review sentiment negatively affects useful votes, and reviewer's elite identity can mitigate the negativity bias.

Yang et al. (2017a)	Yelp restaurant reviews	Regression analysis	Review length and number of food and beverage images are positively related with review usefulness, while the relation is negative between review readability and review usefulness.
Yang et al. (2017b)	TripAdvisor hotel reviews	A conjoint analysis approach	Review rating and the reviewer's historical helpful votes are the two most important factors in explaining review helpfulness.
Kwok & Xie (2016)	TripAdvisor hotels reviews	Regression analysis	Review helpfulness is negatively affected by rating and number of sentences in a review, but positively affected by manager response and reviewer experience in terms of reviewer status, years of membership, and number of cities visited.
Fang et al. (2016)	TripAdvisor attraction reviews	Regression analysis	Reviews with extreme ratings and high readability and reviewers with high ratings and high skewness of historical rating distribution receive more helpfulness votes.
Liu & Park (2015)	Yelp restaurant reviews	Regression analysis	Review qualitative characteristics, including readability and perceived enjoyment, make greater contributions to explaining review usefulness than review quantitative and reviewer characteristics.
Park & Nicolau (2015)	Yelp restaurant reviews	Regression analysis	Reviews with extreme ratings (positive or negative) are perceived as more useful than reviews with moderate ratings.
Chen & Lurie (2013)	Yelp restaurants reviews	Regression analysis, Laboratory experiment	Review helpfulness has a negative relationship with review rating, but this relationship is not significant for reviews containing temporal contiguity cues.
Lee et al. (2011)	TripAdvisor hotels reviews	Spearman's rho, ANOVA	Helpful reviewers are those who have more travel experience, post reviews more frequently, and provide lower review ratings.

Table 2. Variable Measurement

Variable	Description
Dependent variables	
UsefulVote_{ijk}	Number of usefulness votes a review received
Independent variables	
Positive_{ijk}	Proportion of positive emotion-related words in a review (# of positive emotion-related words / # of words in a review) × 100 (e.g., "happy", "pretty", "good")
Negemo_{ijk}	The proportion of negative emotion-related words in a review (# of negative emotion-related words / # of words in a review) × 100 (e.g., "hurt", "ugly", "nasty")
Anx_{ijk}	The proportion of anxiety-related words in a review (# of anxiety-related words / # of words in a review) × 100 (e.g., "worried", "nervous")
Anger_{ijk}	The proportion of anger-related words in a review (# of anger-related words / # of words in a review) × 100 (e.g., "hate", "kill", "annoyed")
Moderators	
Length_{ijk}	Number of words in a review
Elite_{ijk}	1 = reviewer labeled Elite in the year he/she posted this review; 0 = otherwise
Control variables	
Stars_{ijk}	Review rating
Readability_{ijk}	Gunning–Fog Index (FOG) readability index for review text. FOG (Gunning, 1969) is one of the most representative review-readability measurement methods used in online review studies (Li et al., 2017). The FOG score index ranges from 1 to 12, indicating the required grade level to understand the review text; the lower the grade, the better the readability.
Date_{ijk}	Number of days since a review was posted
Friends_{j}	Number of reviewer's Yelp.com friends

Table 3. Variable Description

Variable	Obs.	Mean	Std. Dev.	Min	Max
UsefulVote_{ijk}	600,686	.9258315	2.6618	0	232
Posemo_{ijk}	600,686	6.426902	4.224564	0	100
Negemo_{ijk}	600,686	1.067146	1.597173	0	100
Anx_{ijk}	600,686	.1402033	.5492182	0	50
Anger_{ijk}	600,686	.2094003	.6822883	0	50
Stars_{ijk}	600,686	3.988968	1.115831	1	5
Length_{ijk}	600,686	115.3084	103.1746	0	1031
Readability_{ijk}	595,412	6.408707	1.561661	2.8	12
Date_{ijk}	600,683	1612.639	1050.572	0	5132
Elite_{ijk}	593,173	---	---	0	1
Friends_{j}	600,319	149.4252	356.122	0	13558

Table 4. Results of Correlation Analysis

	UsefulVote	Posemo	Negemo	Anx	Anger	Length	Stars	Readability	Date	Friends
UsefulVote	1.0000									
Posemo	-0.1060***	1.0000								
Negemo	0.0173***	-0.1683***	1.0000							
Anx	0.0068***	-0.0613***	0.3897***	1.0000						
Anger	0.0218***	-0.0900***	0.4977***	0.0445***	1.0000					
Length	0.2843***	-0.3108***	0.0010	0.0102***	0.0095***	1.0000				
Stars	-0.0351***	0.2708***	-0.2855***	-0.0799***	-0.1648***	-0.1152***	1.0000			
Readability	0.1046***	-0.2974***	-0.0052***	0.0112***	0.0031**	0.4042***	-0.1032***	1.0000		
Date	0.0606***	-0.0814***	0.0250***	0.0269***	0.0390***	0.1310***	-0.0229***	0.0757***	1.0000	
Friends	0.4030***	-0.0691***	-0.0108***	0.0020	-0.0032**	0.1725***	0.0276***	0.0855***	0.0406***	1.0000

Note: Asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.

Table 5. Empirical Results — Direct Effects of Emotional Content

	Model 1.1	Model 1.2	Model 1.3
Constant	-1.081912***	-0.6711183***	-.6756555***
	(-20.89)	(-12.96)	(-13.09)
Stars	-0.1434576***	-0.0846272***	-.0835406***
	(-69.15)	(-38.00)	(-38.43)
Readability	0.1337007***	0.0948532***	.0948493***
	(93.09)	(65.46)	(65.62)
Date	0.0001937***	0.0001854***	.0001844***
	(82.07)	(79.04)	(78.57)
Friends	0.0018045***	0.0017457***	.0017454***
	(192.27)	(190.59)	(190.65)
Posemo		**-0.067495*** **	**-.0673983*** **
		(-87.58)	**(-87.81)**
Negemo		**0.013581*** **	
		(7.87)	
Anxiety			**.0309241*** **
			(5.98)
Anger			**.0526425*** **
			(14.14)
Restaurant Fixed Effects	Yes	Yes	Yes
Alpha	1.792003	1.722045	1.720724
Likelihood-ratio test of alpha = 0	4.8e+05 (P=0.000)	4.6e+05 (P=0.000)	4.6e+05 (P=0.000)
Log Likelihood	-705035.4	-700860.84	-700769.75
LR Chi-Square	107950.89	116300.00	116482.18
Pseudo R^2	0.0711	0.0766	0.0767

Note: Values in parentheses indicate the *z* ratio. Asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.

Table 6. Empirical Results — Moderating Effects of Review Length and Reviewer Expertise

	Model 2.1 New	Model 2.2 New
Constant	-.5296358*** (-10.66)	-.7398659*** (-14.63)
Stars	-.0875653*** (-39.77)	-.1130917*** (-52.22)
Readability	.001614 (1.28)	.0706434*** (52.27)
Date	.0001538*** (67.73)	.0001978*** (85.95)
Friends	.0013834*** (172.44)	.001062*** (139.25)
Posemo	**-.0584911*** (-60.48)**	**-.0620062*** (-71.77)**
Negemo	**.0108982*** (4.99)**	**.0275637*** (14.80)**
Length	**.0026447*** (46.70)**	
Length × Posemo	**.0003438 *** (35.75)**	
Length × Negemo	**.0001829*** (9.19)**	
Elite		**.9215195*** (81.90)**
Elite × Posemo		**.0184995*** (11.70)**
Elite × Negemo		**-.0215801 *** (-5.93)**
Restaurant Fixed Effects	Yes	Yes
Alpha	1.423684	1.41066
Likelihood-ratio test of alpha = 0	3.7e+05 (P=0.00)	3.4e+05 (P=0.00)
Log Likelihood	-682529.52	-673828.44
LR Chi-Square	152962.65	151418.91
Pseudo R^2	0.1008	0.1010

Note: Values in parentheses indicate the *z* ratio. Asterisks indicate that the coefficient is significant at the **5% and ***1% level.

Table 7. Empirical Results for Discrete Emotions — Moderating Effects of Review Length and Reviewer Expertise

	Model 3.1	Model 3.2	Model 3.3
Constant	-.5110726*** (-10.32)	-.7262524*** (-14.42)	-.6495263*** (-13.30)
Stars	-.0913393*** (-42.77)	-.11378*** (-53.80)	-.1100686*** (-52.15)
Readability	.0012737 (1.01)	.0702426*** (52.11)	-.0016068 (-1.32)
Date	.0001528*** (67.26)	.0001969*** (85.53)	.0001658*** (73.98)
Friends	.0013821*** (172.41)	.0010612*** (139.28)	.0009179*** (134.97)
Posemo	**-.0586029*** (-61.05)**	**-.0623555*** (-72.56)**	**-.0507635*** (-51.58)**
Anxiety	**-.0010797 (-0.16)**	**.0394829*** (7.08)**	**.0047891 (0.71)**
Anger	**.0402073*** (8.43)**	**.0778936*** (19.40)**	**.0499717 *** (10.53)**
Length	**.0027358*** (52.70)**		**.0025645*** (50.88)**
Length × Posemo	**.0003408*** (35.68)**		**.0001972*** (21.00)**
Length × Anxiety	**.0003321 *** (5.46)**		**.000451*** (7.55)**
Length × Anger	**.0002746*** (6.07)**		**.0005158*** (11.90)**
Elite		**.9102465*** (86.84)**	**.7671217*** (75.06)**
Elite × Posemo		**.0189988*** (12.09)**	**.0197397*** (12.78)**
Elite × Anxiety		**-.0097543 (-0.93)**	**-.0342906*** (-3.36)**
Elite × Anger		**-.060233*** (-7.29)**	**-.0724338*** (-9.49)**
Restaurant Fixed Effects	Yes	Yes	Yes
Alpha	1.422823	1.409217	1.211181
Likelihood-ratio test of alpha=0	3.7e+05 (P=0.00)	3.4e+05 (P=0.00)	3.0e+05 (P=0.00)
Log Likelihood	-682478.89	-673713.84	-659936.56
LR Chi-Square	153063.91	151648.10	179202.67
Pseudo R^2	0.1008	0.1012	0.1195

Note: Values in parentheses indicate the *z* ratio. Asterisks indicate that the coefficient is significant at the **5% and ***1% level.

Table 8. Summary of Hypotheses Testing Results

Hypotheses	**Empirical Support**
Hypothesis 1 (H1): Positive review emotional intensity has a negative influence on perceived review helpfulness.	Supported
Hypothesis 2 (H2): Negative review emotional intensity has a positive influence on perceived review helpfulness.	Supported
Hypothesis 3 (H3): Anger-related review emotional intensity has a stronger influence on perceived review helpfulness than anxiety-related review emotional intensity.	Supported
Hypothesis 4a (H4a): The negative influence of positive emotional content on review helpfulness can be attenuated by review length.	Supported
Hypothesis 4b (H4b): The positive influence of negative emotional content on review helpfulness can be accentuated by review length.	Supported
Hypothesis 5a (H5a): The negative influence of positive emotional content on review helpfulness can be attenuated by reviewer expertise.	Unsupported
Hypothesis 5b (H5b): The positive influence of negative emotional content on review helpfulness can be accentuated by reviewer expertise.	Unsupported