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What attributes affect customer satisfaction in green restaurants? An aspect-based sentiment analysis approach

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ABSTRACT

Amid a heightened focus on sustainable consumption, restaurants are increasingly adopting green practices. Yet, understanding determinants of satisfaction in green restaurants remains unexplored. Analyzing 85,337 TripAdvisor reviews from US Green Restaurant Association certified restaurants, and leveraging BERTopic and aspect-based sentiment analysis, our study reveals previously unidentified subtopics, like “pet-friendly,” and indicates that after food, value, and service, green attributes significantly affect satisfaction, surpassing atmosphere. Additionally, we studied ramifications of not mentioning aspects in reviews, showing an insignificant difference in satisfaction between reviews without green attributes and those with neutral sentiment scores, highlighting the importance of promoting and delivering green initiatives.

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Introduction



A heightened emphasis on environmental considerations has recently steered consumer behavior towards sustainable consumption (Wang et al., 2018), fostering the evolution of the green marketing paradigm and an expansion in research probing into green consumption and practices (Kumari et al., 2022; Trang et al., 2019). The criticality of sustainable consumption and green initiatives is swiftly being acknowledged in the tourism and hospitality sectors (Casado-Díaz et al., 2020; Chua & Han, 2022; Shin & Kang, 2021), notably within restaurants (Hwang et al., 2019; Moon et al., 2023).

With tremendous amounts of food and plastic waste, and water and energy required to keep them running, restaurants significantly impact the environment (Kasim & Ismail, 2012). Recognizing the strong ties between restaurants and society, adopting green practices has emerged as a key marketing tactic for securing a competitive edge (Namkung & Jang, 2016; Nicolau et al., 2020). By definition, restaurants categorized as “green” aim to reduce the negative impact of their operations on the environment (Lorenzini, 1994). While consumers are increasingly concerned about green consumption when dining out (Neff et al., 2015), in their review of green hospitality research, Kim et al. (2017) discovered that only 10% of studies focused on issues

related to green restaurants, meaning this area is still in its early stages of development (Madanaguli et al., 2022).

Though some studies have attempted to understand how adopting green practices affects customer perceptions, most have employed surveys or experimental designs that involve predefined scenarios or questions (Kwok & Huang, 2019; Quan et al., 2022; Quan et al., 2023). However, customers may overlook green environmental practices, which are primarily back-of-house operations (Peiró-Signes et al., 2014). Therefore, the assumption made in scenario-based studies, where customers are presumed to be aware of green practices, may not necessarily hold in real-world situations (Park, Chae, & Kwon, 2020). So, using other methods and data sources to assess the actual perceptions and needs of green restaurant customers is imperative.

Until now, only a few studies have utilized big data approaches and unstructured data, such as online reviews, to explore constructs associated with green restaurants (Han, 2021). Moreover, one of the most critical gaps in the current literature on green restaurants and green marketing, which is still limited and underdeveloped (Higgins-Desbiolles et al., 2019), is the investigation of factors affecting customer satisfaction (Arun et al., 2021; Rodríguez-López et al., 2020). As mentioned, asking consumers directly about their experience with green attributes, which is common in survey-based

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methods (Chan, 2014; Chan & Marafa, 2016), will encourage people to think about them while customers might not be interested in and pay attention to the restaurants' green attributes (Park et al., 2021). Therefore, investigating green restaurants using online reviews that reflect the customers' actual behavior and expectations (Xu, 2020) is essential to determine whether customers recognize the green restaurants' distinctive attributes and whether they affect customers' perceptions and behaviors.

To the best of our knowledge, no study has addressed green restaurant customer satisfaction using a data-driven and sentiment analysis approach. The nearest research is the study by Park, Chae, and Kwon (2020), in which authors addressed green restaurants' customer satisfaction by assigning each review the distribution value of its predominant mentioned attributes. This approach ignores the existence of other attributes in reviews and overlooks the effect of customers' feelings in determining their overall satisfaction (Hu et al., 2014), which is reflected by the rating. For example, in the review, "Ate there on Wednesday this week. French onion soup was great. Steak cooked to my instructions and was delicious. Tables are kinda tight with little privacy for a conversation", with the rating 2, the predominant topic is food and the sentiment toward it is highly positive. Still, the rating shows that what actually is affecting overall satisfaction is the salient sentiment toward the atmosphere. So, it is imperative to consider customers' feelings toward the different attributes in the review to reach a more reliable and valid result about the drivers of customer satisfaction.

Based on the aforementioned gaps, this study has two research questions. First, what topics do green restaurant customers write about in their reviews? Although previous studies have investigated this question, they all relied on classic topic modeling algorithms (Park et al., 2021; Park, Chae, & Kwon, 2020; Park, Kim, & Kwon, 2020). Using more sophisticated big data analytical method is urgent and can minimize bias and enhance the dependability of the analysis outcomes, bringing them closer to actuality (Kim & So, 2022; Song et al., 2019), and also permits scholars to adopt novel theory approaches and reevaluate earlier unresolved problems and age-old questions (Hannigan et al., 2019). As a result, this study uses a new advanced neural network-based topic modeling algorithm, BERTopic (Grootendorst, 2022), to discover subtle topics in green restaurants' online reviews.

The second question is, what attributes significantly affect green restaurants' customer satisfaction? To answer this question, we augment our topic modeling with aspect-based sentiment analysis to investigate the

effect of customers' feelings toward different attributes of green restaurants on the review ratings, indicating customers' overall satisfaction. Also, previous studies have shown that many customers do not notice green attributes and may remain silent in mentioning them in reviews (Park et al., 2021); acknowledging their finding, we further compare the effect of remaining silent about green and mentioning them with different sentiment scores that accounts for both polarity and intensity of feeling to reach a deeper understanding of customers perceptions and needs (Chakraborty et al., 2022).

Overall, in contrast with previous studies that depended on prior researchers' knowledge and were unavoidably subjective, this study gathers big data from real-world situations and tests and justifies the theory objectively (Chaturvedi et al., 2022; Han & Hyun, 2017a; Hwang & Lee, 2019). By analyzing user-generated content from one of the most famous online review platforms, this study provides meaningful theoretical and managerial insight from the unstructured textual content of reviews to extend the current literature on green marketing and green restaurants and help green restaurant managers better understand their customers' needs and expectations.

Literature review

Online reviews in restaurant studies

Online reviews, a form of user-generated content, are pivotal in shaping customer perceptions and purchase decisions (Belarmino et al., 2020; Gao et al., 2020; Lee et al., 2021). They guide potential customers (Chen et al., 2015) and give businesses critical feedback to refine their offerings (Gao et al., 2018). Thus, online reviews foster a win-win relationship between consumers and businesses (Alaei et al., 2019; Schuckert et al., 2015; Tanrisevdi et al., 2022).

Online reviews typically consist of two types of feedback: qualitative and quantitative. Qualitative feedback refers to a written description of the customer's experience with a product or service, while quantitative feedback is a numerical score that rates the overall satisfaction level and originates from the feelings within the qualitative content (Hu et al., 2014; Jia, 2018). Therefore, the score indicates the customer's satisfaction, and the review content explains the customer's reasoning behind the rating (Xu et al., 2019; Zablocki et al., 2018).

In sectors like hospitality, where quality is assessed post-consumption, potential customers often rely on others' experiences due to uncertainty (Litvin et al., 2008; Wang et al., 2021). Online reviews, detailing actual

experiences, help mitigate these concerns and guide decisions (Heng et al., 2018; Kim & Im, 2018). Unlike traditional surveys, online reviews minimize respondent biases (Chatterjee, 2019; Chatterjee et al., 2021) and offer a broader sample (Lv et al., 2021). Consequently, the hospitality sector has increasingly emphasized analyzing these reviews and their rating (K. Lee et al., 2022; Lv & Wu, 2021; Yang et al., 2016) as they act as indicators of customer satisfaction, highlighting service and product features needing enhancement (Chatterjee, 2020; Liu et al., 2022; Zhu et al., 2020).

Online reviews are an affordable and promising way to capture and analyze customer feedback (Jia, 2018) to improve restaurant service quality and increase profit, as even an increase of one star in the rating could lead to a 5–9% increase in restaurants' revenue (Luca, 2016). In this regard, identifying the topics discussed in the reviews (Egger et al., 2022), investigating the factors affecting customer satisfaction based on content, feeling, and emotions of online reviews (Burkov et al., 2023; Calheiros et al., 2017; Pashchenko et al., 2022), examining the inconsistency of the content and the ratings (Luo & Xu, 2021), sentiment scoring (Chakraborty et al., 2022; Lohith et al., 2023), and investigating the language structure (Baker & Hashimoto, 2023) are among the concerns that have been researched in this area in recent years. This study focuses on the satisfaction factors in green restaurants.

Green restaurants

Green restaurant practices encompass health, environmental, and social aspects (Choi & Parsa, 2006). Typically, these restaurants aim for environmental friendliness and energy efficiency to reduce their carbon footprint (Dipietro and Gregory, 2013), emphasizing the three R's (reduce, reuse, recycle) and two E's (energy, efficiency) (Gilg et al., 2005). While incorporating green practices in a restaurant may seem like a positive step toward promoting environmental sustainability (Eren et al., 2023; M. Kim & Hall, 2020), it may not always generate positive customer perceptions. Such practices are not always as visible to customers as other marketing efforts (Park et al., 2021; Yadav et al., 2016). Moreover, certain green practices may garner more attention from consumers (Shapoval et al., 2018). As a result, both managers and researchers must consider customers' perceptions and understandings of the green attributes of restaurants (Rodríguez-López et al., 2020).

Restaurants prioritizing green and sustainable practices seek third-party certifications, such as the Green Restaurant Association (GRA), Green Seal, and Green Kitchen, to substantiate their claims (Dipietro and

Gregory, 2013). By adhering to established green standards, these certifications are a credible indicator of a restaurant's commitment to environmentally friendly practices, helping make a restaurant's green practices more visible to consumers seeking green dining options (Akenji, 2014). However, previous studies suggest that certification does not necessarily increase customer recognition of sustainable practices (Geerts, 2014), and green practices may still remain unknown to customers (Peiró-Signes et al., 2014). Yet, it can help restaurateurs develop clear internal policies and effectively implement green initiatives, which may improve functional green attributes, leading to an increased perception of the restaurant as green among consumers (Park, Chae, & Kwon, 2020; Tan & Yeap, 2012).

Generally, customers consider restaurant quality a multi-dimensional construct mainly consisting of food, service, value, and atmosphere (Liu & Tse, 2018; Rodríguez-López et al., 2020). In the green restaurants' context, previous studies showed that apart from adopting eco-friendly practices, green restaurants must offer top-notch food and service and a cheerful ambiance to ensure their customers' satisfaction (Shapoval et al., 2018; Trafialek et al., 2019; Wu et al., 2019). Moreover, Certain aspects hold greater significance in determining customer satisfaction or dissatisfaction than others (Bilgihan et al., 2017; Slack et al., 2020), implying customers might not value the benefits of green as much as other restaurant attributes, such as high-quality food and service (B. Choi & La, 2013). Consequently, they may hesitate to trade these core attributes for environmental benefits (Gao & Mattila, 2014; Ginsberg, 2004). Therefore, it is imperative to thoroughly investigate the factors influencing customer satisfaction while considering green aspects (Park, Chae, & Kwon, 2020).

Evaluating constructs such as customer satisfaction using online reviews is one of the most overlooked topics within green restaurants' research (Arun et al., 2021; Rodríguez-López et al., 2020). This research stream is necessary for concluding a reliable and real-life result about what customers need in green restaurants (Wu et al., 2019). Meanwhile, most of the previous studies used survey-based methods and predetermined aspects to investigate green restaurants' customer satisfaction (Cantele & Cassia, 2020; H. Choi et al., 2021; Higgins-Desbiolles et al., 2019; Prayag et al., 2018). This approach is problematic since customers should consider and recall the factors researchers want from them. In contrast, customers' primary concerns and needs may not be those factors (Arun et al., 2021; Park et al., 2021). As a result, despite the steady increase in the number of green restaurants, the research on green restaurant

customers has mainly remained theoretical, highlighting a significant gap in understanding green restaurant customers' genuine preferences and expectations (Park et al., 2021).

To the best of our knowledge, there are only four studies that used green restaurant online reviews to identify green-related topics that customers mentioned in their reviews (Park et al., 2021; Park, Chae, & Kwon, 2020,) and evaluate customer satisfaction considering these topics (Park, Chae, & Kwon, 2020). Table 1 summarizes and compares them with the current study. Park, Chae, and Kwon (2020) used structural topic modeling to extract green related topics ("Local or organic ingredients" and "Vegetarian or healthy options") from green-certified restaurant reviews. Based on their findings, customers associate a "green" image with green-certified restaurants with a higher green score and certification history. Park, Chae, and Kwon (2020) compared the topic prevalence and content of green and non-green restaurant reviews and revealed that sustainable topics were more commonly discussed in reviews of certified green restaurants. Park et al. (2021) constructed a topic-level network and a green-restaurant network to determine the image categories and their most readily remembered attributes. They found that the most salient characteristic of green restaurants in customers' minds is food quality. Park, Chae, and Kwon (2020) investigated how mentioning green restaurant topics affects customers' overall ratings. Treating the review's dominant topic weight as independent variables and ignoring other topics in each review, they found that the topic weights of attributes such as food and service have more effect on satisfaction than green. Still, as mentioned earlier, we need to account for customers' feelings toward different service attributes to have a reliable result about factors affecting customer satisfaction (Hu et al., 2014). As a result, in this research, we first identify the hidden topics of green restaurant online reviews in the first study using a new advanced topic modeling algorithm. In the second study, after aspect-based sentiment analysis, meaning assigning a sentiment score to each aspect within reviews, we investigate the factors

affecting overall satisfaction. As previous studies have shown that many customers do not mention green attributes in their reviews, we also compare the effect of not mentioning green attributes with mentioning them with different sentiments on overall satisfaction.

Topic modeling

Identifying the shared characteristics among data points is a crucial objective of data analytics. In the context of text analysis, this involves identifying the events or concepts that a document pertains to. Humans may easily understand the information in a document, but for a program, it is limited to the written text alone and not the underlying subject matter. To overcome this challenge, data scientists employ topic modeling (Luo et al., 2020; Vayansky & Kumar, 2020).

Although there are different topic modeling algorithms (Egger & Yu, 2022; Vayansky & Kumar, 2020), most previous marketing and tourism research used classic algorithms such as Latent Dirichlet Allocation (LDA) or Structural Topic Modeling (STP) (Burkov et al., 2023; Egger, 2022; Manthiou et al., 2023; Reisenbichler & Reutterer, 2018). Besides the need for intensive hyperparameter tuning, one of the major limitations of such methods is that the arrangement of words within a document doesn't affect their meaning, as these algorithms assume that words are independent of each other. This concept is called the "bag of words" assumption. However, in real-world linguistic data, the order of words plays a significant role. Unfortunately, no optimization or additional steps can correct such limitations (Blei, 2012; Vayansky & Kumar, 2020).

To address the limitation of the bag of words topic modeling algorithms, which ignores semantic relationships among words and their context, leading to representing documents inaccurately, word embedding neural network based models such as BERTopic have been proposed (Grootendorst, 2022). BERTopic uses pretrained language models to transform documents into embedding representations, reduces the dimensionality of these embeddings, and clusters them. Term frequency-inverse

Table 1. Most related research.

Article	Topic extraction	Sentiment Extraction	Effect of topics on satisfaction
Park, Chae, Kwon, and Kim (2020)	Structural topic modeling	-	-
Park, Chae, and Kwon (2020)	Structural topic modeling	-	-
Park et al. (2021)	Structural topic modeling	-	-
Park, Chae, and Kwon (2020)	Structural topic modeling	-	One predominant topic weight in each review as the independent variable to explain the review rating
This research	Bertopic	Aspect-based sentiment analysis	Using five-level aspect-based sentiment analysis to explain ratings as the indicator of overall satisfaction

document frequency (TF-IDF) is then used to extract topic representations from the clusters of documents and enables BERTopic to generate topic-word distributions for each cluster (Grootendorst, 2022). Comparing several topic modeling algorithms, Egger and Yu (2022) showed that BERTopic stands out for its exceptional performance compared to other models and is a highly effective topic modeling algorithm.

Finally, it should be mentioned that because of the bag of words assumption and the existence of contrastive words such as “but,” “not,” and “despite,” which can reverse the sentiments, no emotional characteristics cannot necessarily be assigned to the extracted topics. For example, “The food was pretty bad, not good at all” and “The food was pretty good, not bad at all” have the same word frequencies but opposite meanings, or “The food was good” and “The food was not good” have opposite meaning only because of the word “not” (Chakraborty et al., 2022). Therefore, to explore the drivers of overall satisfaction, which is indicated by the reviews rating and originated from the feelings within the content of the review (N. Hu et al., 2014), we should extract both the topics and their sentiments to reach a more reliable and valid result.

Aspect-based sentiment analysis

Sentiment analysis is a set of methods, techniques, and tools to identify and extract information such as attitudes and emotions toward individuals and attributes (Birjali et al., 2021; Mäntylä et al., 2018). It can be done at three levels; document, sentence, and aspect. Document sentiment analysis aims to uncover the general opinion expressed in a document, while sentence sentiment analysis focuses on each sentence’s sentiment. However, some services and products, such as restaurants or laptops, may attract numerous opinions addressing several aspects of them. In such cases, aspect-based sentiment analysis (ABSA) can provide a more detailed and nuanced analysis (Chebolu et al., 2022; Wankhade et al., 2022).

Sentiment analysis primarily employs two methods: lexicon-based and machine learning approaches. In lexicon-based analysis, sentiment is determined using a sentiment dictionary, whereas machine learning relies on labeled data to train algorithms for predicting sentiment in text (Jain et al., 2021; Lohith et al., 2023; Wankhade et al., 2022). There are also other methods, such as transfer learning, a cutting-edge artificial intelligence technique that allows a pretrained model to apply its acquired knowledge to a new model and is beneficial for transferring knowledge between different domains. Compared to training a new model from scratch, this approach can yield impressive accuracy and results in significantly less time (Chan et al., 2022; Wankhade et al.,

2022). In sentiment analysis, transfer learning is utilized to classify sentiments between different fields and has proven effective, especially when labeled data sets are unavailable and tasks share similarities (Hartmann et al., 2019; Liu, 2022).

Methodology

Data gathering and cleaning

Like other studies regarding green restaurants’ online reviews (please see Table 1), we also considered restaurants with GRA certification. GRA has implemented a certification program in the United States that promotes environmentally conscious practices within the food service industry. It is based on eight environmental standards, including sustainable food sourcing, energy conservation, efficient water usage, waste reduction and recycling, sustainable and durable goods and building materials, reusable utensils or environmentally friendly disposable ones, chemical and pollution reduction, and education and transparency (Green Restaurant Association Certification Standards), which are aligned with green attributes scholars have proposed in the past (Choi & Parsa, 2006; Schubert et al., 2010).

We first extracted a list of certified restaurants from the GRA website. Then, we wrote a customized web scraper with selenium library in Python to scrape the reviews, dates, and ratings for all the certified restaurants available on TripAdvisor. Our final dataset included 85,337 English reviews, alongside their corresponding rating from April 2008 to September 2022, from 120 green restaurants, mostly located in California, Illinois, Pennsylvania, Texas, and New York, which are the states with the most green restaurants. Regarding cleaning, we used several general text-cleaning techniques. First, we removed stopwords such as “the” and “a,” etc., since these words do not add meaningful information to the textual data. We used the list of stopwords from the NLTK library; however, we removed the words “not,” “very,” and “can” from the list since these words mean something. For example, “very delicious” is different from “delicious.” We also removed special characters like “#,” numbers, “HTTP,” and website addresses. Finally, we transformed all the words into their lowercase version and used “?” “!” symbols to separate review sentences. We should mention that since we used models that do not need heavy cleaning, we did not use stemming or lemmatization. Figure 1 shows the flowchart of the study.

Study 1: identifying topics

Previous studies mostly used topic modeling algorithms that do not account for the meaning and context of the

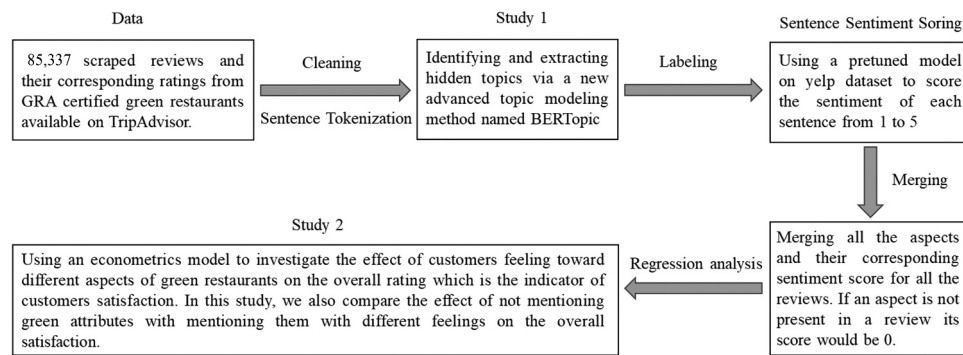


Figure 1. Flowchart of study. [alt] A diagram showing the steps of the study, including data introduction, topic modeling, labeling, merging, and regression analysis

words; to deal with this challenge, we used one of the most recent words embedding neural network based topic modeling algorithms named BERTopic (Grootendorst, 2022). It has many advantages, such as there is no need for heavy cleaning before topic modeling, and it also can identify fine hidden topics. On the other side, one of the challenges could be the number of outliers and found topics; however, outliers can be reduced and attached to their nearest topic cluster, and topics can be merged to create more representative clusters. Regarding sentence tokenization, the main reason is that BERTopic will assign one topic to each input document, so instead of treating the review as the input, we used the sentences as input. We assume that there is only one topic in each sentence. Similar to previous research (Chakraborty et al., 2022), we checked for sentences with more than one topic, which were less than 1.5% of the dataset; therefore, the assumption had minimal impact on our results.

Since there is no need to do comprehensive fine-tuning to use BERTopic, we used most of the predetermined hyperparameters; however, using the try-and-error method, we made some adjustments to get to the best subjective and objective result; although the primary metric remained the judgment of researchers (Grootendorst, 2022). Regarding the encoding model, different sentence encoders can be used; however, since our inputs were sentences that were mostly short, we used the “universal sentence encoder,” which is specifically for short text. We used topic coherence, meaning how often the top words co-occur in a topic, to measure the quality of topic modeling objectively (Röder et al., 2015). Our model reached 0.67, a high value compared to other related studies, mostly around 0.5–0.6. we should emphasize that this metric is only an indication, and the best metric is the researchers’ evaluation (Grootendorst, 2022; Hannigan et al., 2019). Finally, we reduced the number of outliers using the embedding strategy and merged the close topics to reach the final result.

Sentiment extraction using transfer learning

Most of the previous studies in the restaurant literature used famous lexicons such as AFINN or VADER to extract the reviews’ sentiment (Mariani & Baggio, 2021; Tsao et al., 2019). When analyzing restaurant reviews, it is crucial to remember that lexicons cannot accurately determine the sentiment because they cannot understand the domain context, which can significantly affect research findings. For instance, “My food was so greasy” is clearly negative, but AFINN and VADER would classify it as neutral with a sentiment score of 0. Another way to extract sentiment is using humans or manual labeling, which is a very time and energy consuming task, even for creating a training dataset to train a machine learning model (Chakraborty et al., 2022). Transfer learning could be beneficial in dealing with these problems (Li et al., 2023). For example, Li et al. (2023) used a pretrained model to extract sentiments from restaurant reviews and then used them as features to predict restaurant survival.

Lately, there has been a significant focus on knowledge transfer, and it plays a crucial role in implementing tourism big data mining research into practical applications (Li et al., 2019). Therefore, we used a model from Hugging Face, trained on Yelp business reviews,¹ including restaurants, to take advantage of knowledge transfer. The model’s output is a number from 1 to 5 per input. Figure 2 shows the output for “My food was so greasy.” As can be seen, because of its training dataset nature, this model can correctly classify this sentence as very negative. Accordingly, we gave each sentence as input to this model to get a rating. Finally, we aggregated and merged all the topics and their sentiments for each review. Like previous studies (Chakraborty et al., 2022), we also assumed that the aspect-level sentiment score of a review is the mean of the sentiment scores of all sentences which mention that category.

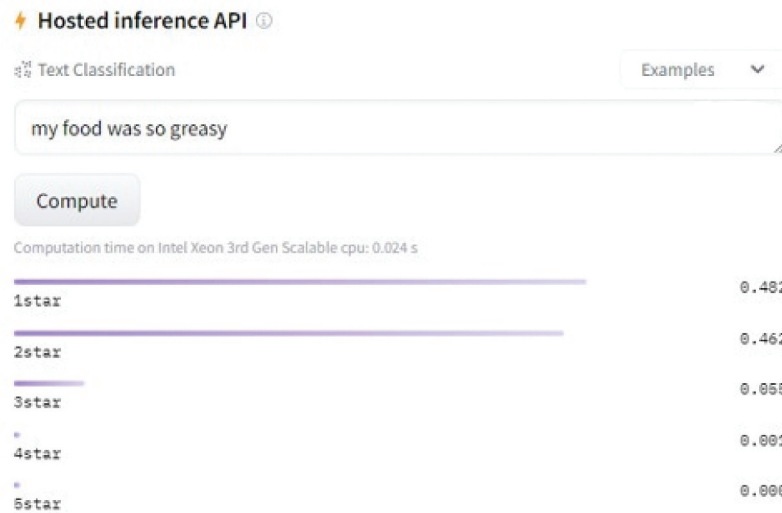


Figure 2. The pretuned model output example. [alt] A screenshot taken from hugging face model API showing the output of the model used in the study

Study 2: explaining satisfaction

In restaurant customer satisfaction research, surveys are the primary data collection method. Surveys are expensive, susceptible to response biases, and will rapidly become obsolete (Bi et al., 2019; Culotta & Cutler, 2016; Gan et al., 2016); however, customers' online reviews and ratings contain their real feelings and perceptions about the received product or service and are free of biases such as self-selection bias (Chatterjee, 2019; Chatterjee et al., 2021) and reflect their actual behaviors and desires (Park et al., 2021). Since online reviews' numeric ratings, indicating customers' satisfaction (Liu et al., 2022; Xu, 2020), are aligned with the sentiments conveyed in the textual content (Hu et al., 2014), in this study, we investigate the effect of customers' sentiment toward green restaurants aspects on the customers' satisfaction.

Previous studies introduced many aspects and attributes affecting restaurants' customer satisfaction (Choi et al., 2021; Gan et al., 2016; Oh & Kim, 2021). Common attributes such as food, service, atmosphere, and value/price are the cardinal features in almost every study. Some previous research has also shown that green attributes will lead to customers' patronage and satisfaction (Arun et al., 2021; Trafialek et al., 2019). Therefore, we hypothesize that the core extracted aspects and their corresponding sentiments significantly affect the overall ratings and propose an econometric model (Equation (1)) to investigate the hypothesis. Our main goal is to determine the statistically significant factors affecting customers' satisfaction in green restaurants. We also added review length as a control variable (Li et al.,

2023). We used the same model in two different settings to not only investigate the aspects affecting customer satisfaction but also explore the effect of mentioning aspects with different sentiments on satisfaction compared to not mentioning them at all.

$$\begin{aligned} Reviewrating_i = & \beta_0 + \beta_1 food_i + \beta_2 value_i + service_i \\ & + \beta_4 atmosphere_i + \beta_5 green_i \\ & + \beta_6 lenreview_i \end{aligned} \quad (1)$$

Results

Study 1: identifying topics

Before diving into the result of topic modeling via BERTopic, we illustrate a word cloud for the dataset. Figure 3 shows the word cloud of the reviews. As can be seen, words such as "food," "service," "staff," and "menu" are among the most used words.

Using BERTopic as our topic modeling method, 298 topics were extracted and named. We merged the close topics to reach the final result. We labeled one topic as "NEWS," which are sentences that do not contain any satisfaction related topic. To be more specific, these sentences are more news than reviews; for example, a customer wrote, "I bought dinner there to eat on the road." or "First time visit for us !." Finally, we reached 35 subtopics to form five main topics. Table 2 shows the extracted subtopics and topics alongside their corresponding words and sentences and compares our findings with previous survey-based restaurant studies investigating factors affecting customer satisfaction.



Figure 3. Online reviews word cloud. [alt] A word cloud of the reviews showing the most frequent words such as food, restaurant, good, etc.

Study 2: explaining satisfaction

As mentioned earlier, we used the same model in two different settings to address our main question, the aspects affecting customers' satisfaction in green restaurants, and investigate the effect of not mentioning some aspects. For our first setting, we only considered 2,140 reviews containing all the aspects (Luo et al., 2021). Table 3 demonstrates the correlation matrix of all independent variables, which indicates that there is no strong correlation (<0.7) among the variables (Chatterjee, 2019; Mittal & Agrawal, 2022). We also computed variance inflation factor (VIF) values that were less than four for all variables, indicating that multi-collinearity is not present in the model (Chatterjee, 2020).

We also tested for heteroscedasticity using the Breusch-Pagan Test (Breusch & Pagan, 1979), which indicated the presence of heteroscedasticity; as a result, we used robust standard errors (Wooldridge, 2019). Table 4 shows the result of regression and VIF values.

The findings reveal that the satisfaction of customers is largely influenced by the sentiments expressed towards the pivotal attributes. As a result, our initial hypothesis, which stated that customers' satisfaction levels are determined by their opinions on green restaurant features mentioned in reviews, is supported by the results, as all the t-values are significant at $p < 0.01$. Moreover, t-values of the core attribute sentiments shows that food has the most significant impact on customer satisfaction, followed by value, service, green, and atmosphere, respectively. This emphasizes the relative importance of these attributes in shaping customers' perceptions of restaurant experiences. Finally, the R^2 of the model is 0.535, which is higher than the recommended thresholds of 0.10 (Falk & Miller, 1992), 0.13 (Cohen, 2013), and even higher than 0.20 (Hair et al., 2011).

In the second setting, we want to consider all the reviews, including reviews that do not include one or more aspects. To be more specific, treating aspects' sentiments as ordinal variables, we are looking to investigate the effect of sentiments toward aspects on satisfaction compared to a base group that is "not mentioning those aspects" (Wooldridge, 2019). In this setting, our dataset consisted of all 85,337 reviews. Our model is the same as the previous setting; the only difference is that we treated our aspect variables as ordinal and removed the category 0 in each aspect as the base group. Table 5 demonstrates the correlation matrix of all independent variables and ensures that there is no strong correlation (<0.7) among the variables; again, we computed variance inflation factor (VIF) values that were less than four for all variables, indicating that multi-collinearity is not present in the model. Again, we also tested for heteroscedasticity using the Breusch-Pagan Test, indicating the presence of heteroscedasticity; as a result, we used robust standard errors. Table 6 shows the result of regression and VIF values.

According to the results, mentioning green restaurant attributes with different sentiments has a statistically significant effect (at $p < 0.01$ level) on satisfaction compared to not mentioning them at all for all feature-sentiment pairs except for the green feature with a score of 3 ($t = -1.420$, $p = 0.155$). By analyzing the t-values of the differences, we can identify which scores of each mentioned feature have the highest positive or negative effect on satisfaction relative to not mentioning that specific feature. For instance, when it comes to value attributes, mentioning it with a score of five has the most positive effect on satisfaction compared to not mentioning it at all. Moreover, The R^2 of the model is 0.485, which is again



Table 2. Extracted topics via BERTopic.

Topic	Subtopic	Top words	Example Sentence	Previous survey-based studies
Food	Diet Restrictions	gluten_free_food_allergies	we were surprised to find gluten free pizza for my wife and she enjoyed it they have got fantastic milk shakes, along with a very handsome selection of beers i enjoyed the pickles as they had a great vinegar taste	Harrington et al. (2011), Longart (2010), Han and Hyun (2017c), Lee and P. Liu and Tse (2018), Namkung and Jang (2008), J. Lee and Whaley (2018)
	Drink	wine_beer_cocktails_list		
	Flavor	food_delicious_taste_flavor		
Food	Food Presentation	presentation_prepared_presented_food	each plate and glass presentation was impeccable	H. Choi et al. (2021), Jang et al. (2011), Namkung and Jang (2008), Yu et al. (2018)
		meal_dishes_food_chef	the best food we have had for a long time	Gupta et al. (2019), J. Lee and Whaley (2018), Wu and Mohi (2015)
	Food Texture	texture_textures_flavors_flavor	i loved the texture, the fluffy with the crunch from the brulee	Pantelidis (2010), Wu and Mohi (2015), P. Liu and Tse (2018), Wu and Mohi (2015)
		chicken_salad_cheese_breakfast	we both had burgers that were very good	P. Liu and Tse (2018)
	Menu Variety	menu_choices_items_options	the menu was interesting and varied	Chun and Nyam-Ochir (2020)
		portions_plates_small_portion	the portions are overwhelming	Pantelidis (2010), Wu and Mohi (2015)
	Portion Size	cold_hot_warm_temperature	sweet rolls are available but served cold, not warm and fresh out of the oven	P. Liu and Tse (2018), Namkung and Jang (2008)
		atmosphere_ambiance_romantic_service	the place looked great and had a very nice vibe to it	P. Liu and Tse (2018), Namkung and Jang (2008)
	Ambiance	music_live_jazz_piano	they have live music every saturday which was a bonus	P. Liu and Tse (2018), Wu and Mohi (2015), Yu et al. (2018)
		patio_outside_outdoor_seating	we sat outside they had patio heaters and blankets and it was just perfect	P. Liu and Tse (2018), Wu and Mohi (2015), Yu et al. (2018)
Atmosphere	Building Exterior	restaurant_clean_atmosphere_cozy	on a positive note, the place seemed to be very clean	P. Liu and Tse (2018), Wu and Mohi (2015), Yu et al. (2018)
		decor_rustic_modern_interior	indoors is a barn type structure, really cool	P. Liu and Tse (2018), Pantelidis (2010), Namkung and Jang (2008), Yu et al. (2018)
	Decor	dress_jacket_wear_code	the wait staff was professional and efficient while dressed in their formal attire	P. Liu and Tse (2018)
		kids_adults_children_kid	they are very kid friendly, fyi	P. Liu and Tse (2018)
	Dress Code	parking_view_place_village	good location, easy access	Jang et al. (2011)
		loud_noisy_noise_conversation	it is a noisy place as you would expect so it is not conducive to conversation	P. Liu and Tse (2018)
	Noise	dog_dogs_patio_friendly	a couple really nice features outside of the fact they allow dogs outside	P. Liu and Tse (2018)
		restrooms_restrooms_bathroom_restroom	the restrooms were filthy and appeared to have not been cleaned for several days	P. Liu and Tse (2018)
	Restroom	table_bar_tables_sat	the table are bare wood with booths along the wall and the bar in plain view	P. Liu and Tse (2018)
		manager_owner_asked_came	i wish we were able to speak to the manager one final time but we just wanted to get out of there at that point	P. Liu and Tse (2018), Namkung and Jang (2008)
Service	Seating Area	service_excellent_slow_friendly	the service was quick and pleasant	P. Liu and Tse (2018), Namkung and Jang (2008)
		staff_friendly_server_waiter	the serving staff is friendly and energetic and, i might add, hard core honest as my wife forgot her purse and they picked it up and held it for us until we could retrieve it	Jang et al. (2011), P. Liu and Tse (2018), Namkung and Jang (2008)
	Managerial	seated_wait_bar_minutes	it is a big spot do not worry about waiting in line to get in	Ryu et al. (2012)
		expectations_hype_high_exceeded	it was much better than i expected	Jin et al. (2012)
	Service Quality	experience_restaurant_disappointed_dining	we came another time and were not disappointed	Jang et al. (2011), P. Liu and Tse (2018), Pantelidis (2010),
		price_prices_reasonable_worth	it is very expensive for what you get	Sivadas and Jindal (2017)
	Waiters	recommend_restaurant_highly_would	this restaurant was recommended to us by locals and we would like to recommend this restaurant to visitors and residents as well	Cakıcı et al. (2019), P. Liu and Tse (2018), Jang et al. (2011), P. Liu and Tse (2018), Yu et al. (2018),
		back_definitely_go_would	we will definitely come back	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
	Value	fresh_ingredients_food_quality	the food was fresh and unique	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		healthy_health_food_options	you can get very good healthy food there and we really appreciate	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
Green	Revisit	farm_table_local_locally	where possible, the food is locally sourced and the culinary philosophy is green and tasteful	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		organic_locally_local_fresh	this place describes itself as seasonal dining, locally grown produce and organic ingredients, fresh wild and sustainable seafood	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
	Fresh Materials	vegetarian_vegan_kale_sprouts	very limited selection for vegetarians who do not eat eggs	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		healthy_health_food_options	you can get very good healthy food there and we really appreciate	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
	Local Ingredients	farm_table_local_locally	where possible, the food is locally sourced and the culinary philosophy is green and tasteful	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		organic_locally_local_fresh	this place describes itself as seasonal dining, locally grown produce and organic ingredients, fresh wild and sustainable seafood	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
	Organic	vegetarian_vegan_kale_sprouts	very limited selection for vegetarians who do not eat eggs	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		healthy_health_food_options	you can get very good healthy food there and we really appreciate	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
	Veggie	farm_table_local_locally	where possible, the food is locally sourced and the culinary philosophy is green and tasteful	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)
		organic_locally_local_fresh	this place describes itself as seasonal dining, locally grown produce and organic ingredients, fresh wild and sustainable seafood	DiPietro and Gregory (2013), Jang et al. (2011), Kwok et al. (2016)

1. The bold subtopics are new compared to previous related studies (please see Table 1).

Table 3. Correlation matrix for the first setting.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) food	1.000					
(2) value	0.400*	1.000				
(3) service	0.387*	0.302*	1.000			
(4) atmosphere	0.252*	0.224*	0.300*	1.000		
(5) green	0.305*	0.224*	0.239*	0.157*	1.000	
(6) length	−0.221*	−0.201*	−0.266*	−0.183*	−0.162*	1.000

*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 4. Result of first setting regression.

DV: Review rating	β	St.Err.	t-value	p-value	[95% Conf	Interval]	VIF
food	.436	.025	17.74***	0.000	.388	.484	1.39
value	.191	.016	12.29***	0.000	.161	.222	1.31
service	.168	.015	11.74***	0.000	.140	.196	1.26
atmosphere	.097	.015	6.52***	0.000	.068	.126	1.15
green	.133	.016	8.23***	0.000	.101	.164	1.14
length	.000	.000	1.84	0.066	.000	.000	1.12
Constant	.603	.093	6.51***	0.000	.422	.785	-
R-squared	0.535		Number of obs		2140		
F-test	333.36		Prob > F		0.000		

*** $p < .01$, ** $p < .05$, * $p < .1$, VIF = Variance inflation factor.

higher than the recommended thresholds. The results will be discussed in the next section.

Discussion

Green practices in restaurants can be costly for both businesses and customers (Baloglu et al., 2020; Choi & Parsa, 2006), and still, may be overlooked by customers (Peiró-Signes et al., 2014). Previous research has explored the impact of these practices on customer perceptions, assuming a certain level of customer knowledge (Han, 2021; Kwok & Huang, 2019; Prayag et al., 2018). However, actual customer awareness of these practices may not always be accurate (Park, Chae, & Kwon, 2020), highlighting the need to consider it when evaluating the effectiveness of green practices.

In our first study, we investigated customer perceptions in green restaurants by analyzing online reviews through BERTopic, providing profound insights into genuine customer opinions and experiences without bias or preconceptions (Lu & Stepchenkova, 2014; Park et al., 2021). We unearthed new topics, such as cleanliness, restroom, food presentation, texture, temperature, dress code, kid-friendly, pet-friendly, and managerial roles, not identified in prior studies (Park et al., 2021; Park, Chae, & Kwon, 2020) and scarcely explored regarding their impact on customer satisfaction (Alves, 2022; H. Kim & Bachman, 2019; Özel, 2015). While the influence of food, value, service, and atmosphere on satisfaction is well-documented (Rodríguez-López et al., 2020), there is a notable research gap concerning underexplored topics

like kid-friendly (Please see Table 2 for a comparison of our findings with previous survey-based restaurant satisfaction studies).

Food takes center stage in the restaurant industry, making green initiatives tied to food, such as locally sourced and sustainable farming, resonate more effectively with customers. Studies indicate that consumers increasingly prioritize health and environmental concerns and gravitate towards organic or locally sourced pro (Kim et al., 2017; Sustainability n.d.; Verain et al., 2015). Overall, customers are more responsive to food-centric initiatives than broader environmental efforts, showing customers' tendency to evaluate and remember attributes that align with their pre-existing beliefs and memories (Park, Chae, & Kwon, 2020).

Green restaurants must understand what factors lead to customer satisfaction, especially when eco-friendliness is not a top priority for some customers (Gao & Mattila, 2014). Therefore, in our second study, we used reviews to analyze how customer sentiments towards different aspects affect satisfaction in two regression setting. The results of the first setting show that, like previous studies, food, service, and value are the most significant aspects affecting customers' satisfaction (Park, Chae, & Kwon, 2020); however, when customers are aware of the green attributes, they put more emphasis on green features of the restaurant than its atmosphere. As a result, managers should increase their green practice promotions and communications to elevate their customers' awareness of such aspects, leading to more informed customers.

Table 5. Correlation matrix for the second setting.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) food	1.000					
(2) value	0.028*	1.000				
(3) service	0.003	0.058*	1.000			
(4) atmosphere	−0.013*	0.029*	0.011*	1.000		
(5) green	0.009*	0.027*	−0.025*	0.005	1.000	
(6) length	0.046*	0.153*	0.100*	0.138*	0.146*	1.000

*** $p < .01$, ** $p < .05$, * $p < .1$.

The results of the second setting show that mentioning an aspect is different from not mentioning it in determining the satisfaction level, except for one aspect-sentiment pair, green-3, indicating that except for green features, other aspects should get positive sentiments (more than 3) to influence customer satisfaction positively, which is aligned with a recent study that showed 3-star ratings are not good for products and services, leading to a 67% decrease in potential customers' trust in buying those products and services (Jabbour, 2023). Overall, noticing greenness has no significant difference from not noticing it for customers if it does not trigger a positive or negative (more or less than 3) feeling, suggesting that green attributes not only need to be perceived but also need to be at a satisfactory level to have a positive effect on satisfaction; otherwise, it is like they remained unnoticed.

To the best of our knowledge, we are the first study investigating the effect of remaining silent about green aspects on satisfaction compared to mentioning them. This is important since it shows that customers do not compromise on restaurants' common attributes; even a mediocre performance leads to dissatisfaction. However, customers are more flexible regarding green aspects, and the effect of mentioning a mediocre performance on satisfaction has no significant difference from not mentioning them at all. As a result, customers not only need to notice green attributes but also perceive a top-notch performance of green practices so that green restaurants could benefit from their costly green investments (Baloglu et al., 2020).

Theoretical and managerial implications

This research offers valuable theoretical and managerial perspectives that expand the existing knowledge on green marketing and restaurants and assists green restaurant managers in gaining a better understanding of their customers' preferences and needs.

On the theoretical side, this study shed more light on green restaurants' customers' perceptions by not only extracting green topics such as healthy, fresh, and vegetarian food and local and organic ingredients but also identifying new hidden topics such as kid-

friendly and pet-friendly, which recently have got attention in hospitality and tourism research (S  raphin & Gowreesunkar, 2020) and show the impact of the kids' and pets' satisfaction as part of the families on customers' experience and satisfaction (Quan et al., 2023). Compared to previous studies, we also found topics such as food presentation, food texture, food temperature, cleanliness, dress code, and restrooms, which could not be found in previous research (Park et al., 2021; Park, Chae, & Kwon, 2020, 2020).

Moreover, our results show that when customers are aware of green practices, after food, value, and service, they put more weight on green aspects than the atmosphere in determining their satisfaction level. The higher importance of food, value, and service in satisfaction is aligned with previous studies (Nandini & Kumar, 2019; Shapoval et al., 2018; Trafialek et al., 2019), but the finding that green attributes are more important than the atmosphere for customers who recognize the restaurants' green features is new compared to the previous studies which suggested that green importance would place after all the restaurants' common attributes (Park, Chae, & Kwon, 2020). Additionally, unlike other aspects, which should have highly positive feelings to affect satisfaction positively, there is no significant difference between not mentioning the green attribute and mentioning it with a sentiment 3, indicating noticing green attributes doesn't affect customer satisfaction if it doesn't trigger strong feelings and a mediocre performance in green attributes is not different from not being green in the customers' mind.

On the managerial side, our results urge green restaurant managers to promote the visibility of their green practices, particularly environmental practices. One effective way is through innovative advertising visuals like table placards and menu notations. Additionally, campaigns centered around health and sustainability can be used, along with training servers to give special greetings that attract and focus customer attention, which is very important since frontline employees can effectively communicate green attributes when they receive proper training and motivation; therefore, organizations should invest significant time and resources to

Table 6. Result of second setting regression.

DV: Review rating	β	St.Err.	t-value	p-value	[95% Conf	Interval]	VIF
food: base 0	0	.	.	.	.	.	.
1	-1.118	0.028	-39.500***	0.000	-1.173	-1.062	1.22
2	-1.052	0.016	-63.750***	0.000	-1.084	-1.020	1.61
3	-0.314	0.011	-27.950***	0.000	-0.336	-0.292	1.90
4	0.160	0.008	19.430***	0.000	0.144	0.176	2.50
5	0.338	0.008	41.69***	0.000	0.322	0.354	2.06
value: base 0	0	.	.	.	.	.	.
1	-0.526	0.017	-30.450***	0.000	-0.560	-0.492	1.11
2	-0.570	0.016	-34.540***	0.000	-0.602	-0.537	1.13
3	-0.182	0.010	-17.910***	0.000	-0.202	-0.162	1.11
4	0.094	0.007	13.390***	0.000	0.080	0.107	1.12
5	0.250	0.005	47.450***	0.000	0.240	0.261	1.14
service: base 0	0	.	.	.	.	.	.
1	-0.738	0.018	-40.080***	0.000	-0.775	-0.702	1.14
2	-0.636	0.017	-38.530***	0.000	-0.669	-0.604	1.13
3	-0.208	0.011	-19.500***	0.000	-0.229	-0.187	1.11
4	0.039	0.008	4.740***	0.000	0.023	0.055	1.10
5	0.214	0.005	42.310***	0.000	0.204	0.224	1.17
atmosphere: base 0	0	.	.	.	.	.	.
1	-0.260	0.017	-15.020***	0.000	-0.294	-0.226	1.05
2	-0.262	0.017	-15.220***	0.000	-0.296	-0.229	1.05
3	-0.062	0.010	-6.420***	0.000	-0.081	-0.043	1.06
4	0.059	0.006	9.280***	0.000	0.047	0.072	1.07
5	0.221	0.007	31.230***	0.000	0.207	0.234	1.06
green: base 0	0	.	.	.	.	.	.
1	-0.158	0.028	-5.710***	0.000	-0.212	-0.104	1.01
2	-0.319	0.028	-11.260***	0.000	-0.374	-0.263	1.01
3	-0.024	0.017	-1.420	0.155	-0.058	0.009	1.01
4	0.100	0.008	11.910***	0.000	0.084	0.116	1.02
5	0.223	0.009	25.620***	0.000	0.206	0.240	1.01
length	0	0	5.660***	0.000	0.000	0.000	1.51
Constant	4.351	0.009	494.160***	0.000	4.334	4.369	-
R-squared		0.485			Number of obs		85337
F-test		2168.652			Prob > F		0

*** $p < .01$, ** $p < .05$, * $p < .1$, VIF = Variance inflation factor.

internalize green values within themselves (Sirianni et al., 2013). Another approach to raising customer awareness is to promote green endeavors on social media or review platforms (Park et al., 2021).

Moreover, the results suggest that green restaurant managers should continue to focus on the most critical common attributes in restaurants, which are food, service, value, and atmosphere; meanwhile, they not only need to communicate their green attributes more effectively to elevate customers awareness of the green practices and their consequences (Han, 2020) but also should provide them at a satisfactory level to benefit from their effect on customers. Therefore, if green restaurant managers want to satisfy their customers, they should put more weight on communicating their green practices and provide a good level of green quality to ensure that customers not only perceive the greenness but also has a salient positive feeling toward it. Therefore, it is more important and influential for green restaurants to ensure that their customers are aware of the green initiatives rather than just obtaining green certification (Dipietro and Gregory, 2013). Based on the significant importance of food on satisfaction levels and the fact that almost all the found green topics are food-related,

our study also suggests that green restaurant managers need to put more effort into making innovations in their food to create a sustainable competitive advantage from being green (Park et al., 2021).

Limitations and future research

Like other studies, this research is not without limitations. First, we utilized customer review comments from a review platform, TripAdvisor, one of the most widely used online review platforms in marketing and hospitality, and tourism research (Luo et al., 2021). As a result, our conclusions are limited to the TripAdvisor community. We suggest that future studies gather data from multiple sources for more generalizable results (Mariani & Baggio, 2021).

Second, we investigated how customers view certified green restaurants. As a result, it solely reflects customers' opinions regarding certified green restaurants. Customers who visit certified green restaurants are more inclined to talk about their experiences with sustainable practices (Park, Chae, & Kwon, 2020). So, it could be beneficial for future studies to compare certified and noncertified restaurants regarding the factors affecting customer satisfaction.

Third, since we used online reviews, our findings are limited to aspects and opinions mentioned in the platform. Future studies could augment online reviews with direct opinions from customers to get a more comprehensive perspective on green restaurant customers (Kim & Chae, 2018). Fourth, through topic modeling, some subcategories not frequently present in the dataset may not be identified. An instance of this is the absence of a topic related to environmental green practices, a crucial component of restaurants' green practices (Choi & Parsa, 2006).

Finally, studies have shown that customers may have different perceptions of green practices based on personal characteristics such as gender, income, and self-perceptions (Hu et al., 2010; Kwok et al., 2016). However, this study could not explore these factors due to the limitations of online user-generated content. As a result, we suggest that future research incorporate customers' demographic information.

Conclusion

In the evolving landscape of sustainable consumption, the hospitality sector, and more specifically, restaurants, have been at the forefront of integrating green practices (Han & Hyun, 2017b; Han et al., 2019; Moon et al., 2023). This research embarked on a journey to bridge the existing knowledge gap concerning the determinants of customer satisfaction in green restaurants. Through the meticulous analysis of 85,337 English reviews from TripAdvisor of GRA-certified restaurants, we employed the sophisticated BERTopic neural network-based topic modeling algorithm and aspect-based sentiment analysis.

Our findings unveiled previously uncharted subtopics, such as "pet-friendly," enriching the discourse on green restaurant attributes. More crucially, the study established that after primary factors like food, value, and service, green attributes play a pivotal role in shaping customer satisfaction, even surpassing the influence of the atmosphere. This underscores the imperative for green restaurants to not only promote but also effectively implement green initiatives. Furthermore, the nuanced exploration into the effects of omitting mentions of green aspects in reviews revealed intriguing insights. While the absence of green attributes in reviews showed a negligible difference in satisfaction relative to mentioning them with the score of 3, a neutral sentiment, the absence of other restaurant attributes presented a marked difference compared to mentioning with different levels of sentiments, emphasizing the importance of their quality level in the overall dining experience.

In light of the research objectives set forth at the outset, this study successfully met its goals. We have not only deepened the understanding of the factors influencing customer satisfaction in green restaurants but also provided actionable insights for restaurant managers and stakeholders. By highlighting the importance of both promoting and actualizing green initiatives alongside other essential restaurant attributes, this research paves the way for a more sustainable and customer-centric approach in the green restaurant industry.

Note

1. Available From <https://huggingface.co/nihaldsouza1/yelp-rating-classification>

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