

# The relationship between sustainability and customer satisfaction in hospitality: An explorative investigation using eWOM as a data source



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## ABSTRACT

Sustainability is a global megatrend and has gained increasing attention in the hospitality industry. To facilitate sustainable development, it is important to understand how sustainability relates to customer satisfaction. Previous studies do not consider specific sustainability measures in hospitality and neglect eWOM as an objective data source.

This study investigates the extent to which sustainability aspects play a role in eWOM and how sustainability orientation in general as well as specific sustainability measures are linked to customer satisfaction. The results indicate that although only a few online reviews contain sustainability aspects, there is a relationship between sustainability orientation and customer satisfaction that is moderated by star classification. Furthermore, the results show that the relationship differs depending on the specific sustainability measure. Among the observed measures, "dissatisfiers" as well as "satisfiers", "criticals" and "neutrals" are found, supporting Cadotte and Turgeon's categorization of attributes in the context of sustainability.

## 1. Introduction

Sustainable tourism aims to mitigate tourism's damage to the environment and society by promoting tourism that "takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities" (UNEP & UNWTO, 2005).

Sustainable hospitality aims at minimizing these negative impacts by implementing sustainability measures in accommodations (Prud'homme & Raymond, 2013).

The hospitality industry also has a strong focus on achieving customer satisfaction, which can be defined as "a psychological concept that involves the feeling of well-being and pleasure that results from obtaining what one hopes for and expects from an appealing product and/or service" (World Tourism Organization, 1985, cited in; Pizam, Shapoval, & Ellis, 2016). To facilitate sustainable development in hospitality, it is important to first gain an understanding of what creates customer satisfaction in regard to sustainability in hotels.

Current research on customer satisfaction is mainly based on surveys, which frequently suffer from social desirability bias (Fernandes & Randall, 1992; Roxas & Lindsay, 2012); only a few studies concentrating on customer satisfaction and sustainability have considered user-generated content (UGC) as a data source (Brazzite, Weber, &

Schaffner, 2016; Yu, Li, & Jai, 2017). UGC describes the exchange of information between tourists through online reviews and is also known as electronic word of mouth (eWOM). The term 'eWOM' describes "any positive or negative statement made by potential, actual or former consumers" outside of traditional buyer-seller relations (Hennig-Thurau, Gwinner, Walsh, & Gremler, 2004). EWOM is publicly available via the Internet and offers numerous ways to analyze, interpret, and manage the influence consumers may have on one another (Litvin, Goldsmith, & Pan, 2008), posing new challenges and possibilities for marketers. EWOM occurs on review sites (RS) and online travel agencies (OTAs). Examples of these platforms include [booking.com](http://booking.com) (OTA) or [tripadvisor.de](http://tripadvisor.de) (RS). EWOM provides an original, unbiased data source (Schuckert, Liu, & Law, 2015; Zhou, Ye, Pearce, & Wu, 2014).

The few studies on sustainability and customer satisfaction that used eWOM as a data source mainly focused on general attributes of green hotels (Brazzite et al., 2016; Yu et al., 2017) or ecolodges (Lu & Stepchenkova, 2012). Specific sustainability measures in hospitality, such as water and energy conservation, are rarely taken into account. To the best of our knowledge, there has been no large-scale study based on eWOM that examines the influence of sustainability measures on customer satisfaction.

Despite the increasing influence of eWOM on booking behavior and hotel reviews and the increasing public interest in sustainability, it

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remains unclear which aspects of sustainability are communicated in online reviews and how they influence customer satisfaction. Considering that sustainability in hospitality is attracting increased public awareness (FUR Forschungsgemeinschaft Urlaub und Reisen e.V., 2014), we further argue that analyzing the role of sustainability in eWOM is an important research topic.

We close the existing research gap by analyzing 52,493 online reviews from four different online platforms considering mentions of aspects of sustainability. Moreover, we examine the influence of sustainability orientation as well as specific sustainability measures on customer satisfaction. For this purpose, we use the framework of Cadotte and Turgeon (1988) to group sustainability measures into the categories of “satisfiers”, “dissatisfiers”, “neutrals”, and “criticals”. In doing so, we aim to answer the following questions:

1. To what extent do sustainability aspects play a role in eWOM?
2. To what extent is the overall sustainability orientation of a hotel connected to customer satisfaction?
3. To what extent are the sustainability measures implemented in hotels connected to customer satisfaction?

To answer these questions and close the research gap, this paper is structured as follows. First, we present an overview of the literature and the theoretical background; we then describe our research method before presenting and discussing our findings. Finally, the paper rounds off with a conclusion, including theoretical and practical implications, and the limitations to our study.

## 2. Literature review and theoretical background

The background for this research encompasses the diverse literature on customer satisfaction and that on sustainable behavior. We identified four approaches that are particularly important for the current study: 1) customer satisfaction studies, 2) customer satisfaction studies based on eWOM, 3) customer satisfaction studies in sustainable hospitality, and 4) research on appeals intended to trigger sustainable behavior.

Past studies have examined whether customer satisfaction is connected to various hotel attributes (Prayag, Hassibi, & Nunkoo, 2018). Because unidimensional concepts of satisfaction have been proven to be insufficient (Alegre & Garau, 2010), the current study is based on a two-factor theory from the work of Herzberg, Mausner, and Snyderman (1959), which allows us to better account for the complexity in creating customer satisfaction. Herzberg et al. (1959) introduced a two-factor theory on job satisfaction and suggested that job satisfaction and dissatisfaction fall between two sets of extremes: 1) the motivation continuum and 2) the hygiene continuum. On one end of the motivation continuum, there is satisfaction, and on the other end, there is no satisfaction. The hygiene continuum ranges between dissatisfaction on one end and no dissatisfaction on the other. Past research has concluded that “hygiene factors” or “dissatisfiers” (e.g., working conditions) lie on the hygiene continuum, while other factors, so-called “motivators” or “satisfiers” (e.g., opportunity for personal growth), lie on the motivation continuum. Finally, some factors appear on both continuums (e.g., salary) and are therefore both “hygiene factors/dissatisfiers” and “motivators/satisfiers”.

Drawing on Herzberg's theory, Cadotte and Turgeon (1988) proposed a categorization of attributes in the hotel context. They suggest that in regard to customer satisfaction, hotel attributes can be sorted into four categories: satisfiers, dissatisfiers, criticals and neutrals. In accordance with Herzberg et al. (1959), they describe satisfiers as attributes whose absence does not cause dissatisfaction but whose existence causes satisfaction. Dissatisfiers, on the other hand, cause dissatisfaction when absent or poorly performed but no satisfaction when provided. Further, in the case of dissatisfiers, they also cause no satisfaction when the attribute, e.g., a service, is performed very well.

Criticals, however, can cause dissatisfaction or satisfaction, depending on the situation. In the case of criticals, similar to the case of dissatisfiers, a minimum standard must be met to avoid dissatisfaction. Considering hotel attributes that fall under the category of “criticals”, a business should perform on a high level to satisfy the customer and encourage a positive response (Cadotte & Turgeon, 1988). Finally, neutrals describe attributes of a service that do not cause compliments or complaints. Cadotte and Turgeon (1988) suggest that these attributes are either not very visible to customers or are able to easily meet customers' standards. The framework from Cadotte and Turgeon (1988) offers a suitable basis for an analysis of eWOM, especially in regard to customer satisfaction.

In addition to past research on satisfaction in hospitality and tourism, many other fields of study have mined and analyzed online reviews. This indicates the increasing importance of eWOM as a data source, making it interesting to expand research on customer satisfaction using eWOM.

Concerning sustainability, studies that examine customer satisfaction are mainly based on data from surveys, interviews or experiments and lead to varied results (Prud'homme & Raymond, 2013; Robinot & Giannelloni, 2010). However, online reviews provide several advantages in regard to data quality in comparison to surveys: past survey results indicating the importance of sustainability management may suffer from social desirability bias, which is a “tendency for an individual to present him or herself, in test taking situations, in a way that makes the person look positive, with regard to culturally derived norms and standards” (Ganster, Hennessey, & Luthans, 1983, p. 322). Social desirability bias poses a problem when examining sensitive subjects, such as issues connected to ethics or sustainability (Fernandes & Randall, 1992; Roxas & Lindsay, 2012). We argue that this is the case for surveys exploring the relationship between sustainability and customer satisfaction, leading to an overestimation of the importance of sustainability in the tourism context. In contrast, eWOM provides an original, unbiased data source (Zhou et al., 2014; Schuckert et al., 2015). Online reviews provide information that can be “considered as more objective, immense, and without sample bias, because reviews are posted spontaneously without laboratory effects unlike traditional questionnaires” (Schuckert et al., 2015, p. 143). Consequently, many studies on customer satisfaction have used eWOM as a data source (Stringam & Gerdes, 2010; Zhou et al., 2014; Xie, Zhang, & Zhang, 2014; Geetha, Singha, & Sinha, 2017; Radojevic, Stanic, & Stanic, 2015; Guo, Barnes, & Jia, 2017; Liu, Teichert, Rossi, Li, & Hu, 2017; Prayag et al., 2018; Pizam et al., 2016, for a more detailed overview see Appendix A), as have a few studies concentrating on the connection between customer satisfaction and sustainability (Brazyste et al., 2016; Lu & Stepchenkova, 2012). However, these studies largely focused on general hotel attributes such as “closeness to town”, “customer service” and “room rates” in ecolodges (Lu & Stepchenkova, 2012) or green hotels (Brazyste et al., 2016; Yu et al., 2017). Specific sustainability measures in hospitality, such as water and energy conservation or sustainable purchasing, have rarely been considered in previous research.

Acknowledging previous research efforts in the field of hospitality and sustainable hospitality using eWOM as a data source, we conclude that large-scale studies that examine the connection between customer satisfaction and sustainability measures are lacking. It will thus be interesting to study customer satisfaction through a large-scale study using eWOM as a data source. Outside of research in tourism and hospitality based on eWOM, evidence exists that customer satisfaction is connected to sustainability (Dolnicar, Knezevic Cvelbar, & Grün, 2016; Miao & Wei, 2013; Chen, 2015).

The environmental psychology literature indicates that sustainability measures in hospitality have different influences on customer satisfaction (Dolnicar et al., 2016; Miao & Wei, 2013). According to Dolnicar et al. (2016), there are two important drivers of pro-environmental consumer behavior: self-interest and self-concept. Self-

interest relates to the maximization of personal utility, that is, people are willing to change their behavior in exchange for personal benefits (Dolnicar et al., 2016).

Self-concept relates to individual moral norms and to feeling good about oneself when doing good (Dolnicar et al., 2016). However, Dolnicar et al. (2016) show that most people display a lower level of environmentally sustainable behavior in the vacation context than in the home context and conclude that previous findings cannot be applied to contexts that are hedonic in nature, e.g., tourism. They further argue that previous studies conducted in the home context using self-interest appeals have been successful in triggering pro-environmental behavior because a behavioral change in this context has utilitarian benefits, e.g., cost savings. In contrast to a home setting, this is not the case in tourism settings. To underpin their argument, Dolnicar et al. (2016) provide an example revolving around the reuse of towels in a home context vs. a hotel context. They argue that in a home setting, the reuse of a towel comes along with water savings and thus cost savings for the individual. However, in a hotel, the measure does not reduce the customer's costs but instead reduces the hedonic value of the accommodation, as the reused towel will not be freshly washed or may be still damp, thereby causing the customer a certain level of discomfort.

Taking these arguments into account, it is interesting to further examine how sustainability measures are connected to customer satisfaction in a hotel setting. While Dolnicar et al. (2016) examined which appeals prove to be effective in triggering sustainable behavior among guests, the current study focuses on customer satisfaction. More specifically, it aims to identify and distinguish sustainable measures triggering customer satisfaction from measures that do not. Different measures contributing to sustainability have manifold consequences that may be differently connected to customer satisfaction. We argue that similar to the home context, self-interest and self-concept goals may be important causes of customer satisfaction when evaluating sustainability measures in hospitality.

There are measures that directly affect the guest and may lower the hedonic value of a service, similar to the example of the reuse of towels provided by Dolnicar et al. (2016). In addition, there are also sustainability measures that may increase the perceived quality of a hotel as well as those that only indirectly affect guests and may not have an impact on customer satisfaction at all. For example, environmentally friendly products, e.g., organic food, are perceived as superior in quality by many consumers. In contrast, measures to protect the natural heritage of a destination most likely only indirectly affect the guest and thus might have no impact on customer satisfaction.

We expand research on sustainability measures in hotels by concentrating on the connection between sustainability and customer satisfaction. In addition, we argue that the concepts of self-interest and self-concept might influence this relationship.

### 3. Methodology

#### 3.1. Data collection

Intermediaries in the industry, such as OTAs and RS, provide a rich database of consumer satisfaction levels, as expressed in publicly available reviews.

The German hotel industry is characterized by a highly fragmented market consisting mainly of small firms with limited marketing budgets. There are a total of 52,844 star-rated hotels in Germany (Deutscher Tourismus Verband e.V., 2016). According to a study of the German Tourism Association, 2.9 million people in Germany work in the tourism industry, accounting for 7% of total employment and generating 4.4% of the gross national product (Deutscher Tourismus Verband e.V., 2016).

Within the industry in Germany, domestic tourism plays an important role. In 2017, 366.4 million overnight stays in German hotels can be traced back to German travelers, an increase of 2.8% compared

to 2015 (Deutscher Tourismus Verband e.V., 2016). For a brief vacation, approximately three-quarters (75.2%) of Germans stay in their own country (Deutscher Tourismus Verband e.V., 2016). In 2010, Germans traveling within their own country spent 221.3 billion euros (Deutscher Tourismus Verband e.V., 2016), and 47% of Germans stated that hotels are their preferred accommodation when traveling for at least one night in Germany (Deutscher Tourismus Verband e.V., 2016).

At the same time, German tourists claim to be interested in the ecological and social consequences of their travels. In a survey from 2014, funded by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 31% of the German population considered the ecological sustainability of holiday travel to be important, while 38% would like to travel in a socially sustainable manner (FUR Forschungsgemeinschaft Urlaub und Reisen e.V., 2014). In a study from 2016, 49% of Germans stated that they would like their holiday to be ecologically compatible, while 56% would like their holiday to be socially compatible. Forty-four percent of German tourists would like their holiday to be both socially and ecologically compatible (Deutscher Tourismus Verband e.V., 2016).

To assess the importance of sustainability orientation and specific sustainability measures for tourists and to reveal possible differences, we collected user-generated reviews for a set of selected hotels in Germany. See Fig. 1 for our data collection process. First, we identified 53 hotels throughout Germany that were part of a hotel corporation engaging in sustainability management (sustainable hotels). Following the Global Sustainable Tourism Council (GSTC), a sustainable hotel refers to a hotel implementing measures that fall into the four main themes: “effective sustainability planning, maximizing social and economic benefits for the local community, enhancing cultural heritage, and reducing negative impacts to the environment” (Global Sustainable Tourism Council, 2016).

Second, we assigned a conventional hotel, e.g., a hotel that does not explicitly engage in sustainability management, to each of the sustainable hotels that was comparable with respect to location, size (number of rooms) and star classification.

In contrast to previous studies analyzing reviews, we collected data from multiple platforms to account for possible systematic differences in aggregated review scores. Booking.com, hrs.de, tripadvisor.de, and holidaycheck.de were selected as platforms from which to collect online reviews. Following Xiang, Du, Ma, and Fan (2017), the rationale for the selection was three-fold: 1) they are the four largest platforms for reviews in the hospitality industry in Germany (Warnecke, 2016) and thus widely used, 2) they represent the two main types of platforms collecting reviews in the hospitality industry in Germany, i.e., OTAs (booking.com, hrs.de) and RS (tripadvisor.de, holidaycheck.de) (Lorenzen, 2014; Warnecke, 2016) and 3) they have already been frequently used as primary data sources in academic literature within the hospitality field (e.g., Mellinas, Martinez Maria-Dolores, & Bernal Garcia, 2015; Payandeh, 2010; Xiang et al., 2017).

Guests' ratings in reviews are a reliable indicator of customer satisfaction (Gu & Ye, 2014; Hargreaves, 2012; Schuckert et al., 2015). To gather the review data, we developed a web crawler to visit the review sections of the aforementioned websites for each of the selected hotels. From March 15th to April 2nd, 2016, the crawler gathered all available reviews at a disaggregated level including review score, title, comment and publication date. To address the research questions properly and ensure comparability within the set of selected hotels, we decided to only analyze reviews written between 2014 and 2016. Consequently, we excluded older reviews, resulting in a dataset of 59,166 reviews. For all collected reviews, basic linguistic features such as review length were calculated. Due to the heterogeneity among the rating sub-categories assessed by the four intermediaries, we use only the overall review score as a proxy for customer satisfaction to ensure comparability. Because the selected online platforms use different scales to assess overall customer satisfaction, we transformed the values to a

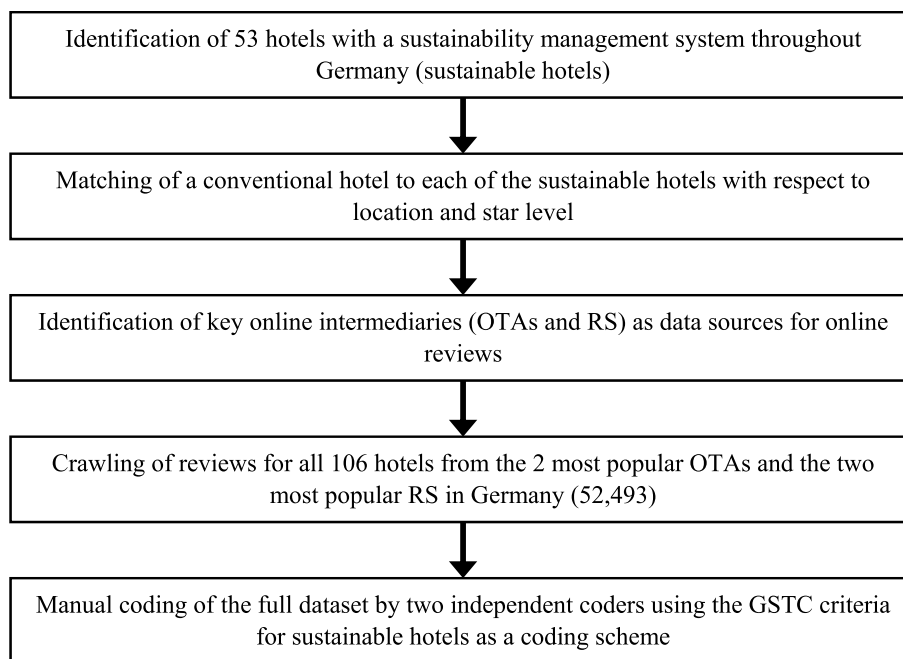


Fig. 1. Data collection process.

percentage scale for comparison. After a final check for duplicates and missing values, 52,493 full observations remained.

### 3.2. Data coding

This study uses content analysis to identify the sustainability aspects observed and mentioned either explicitly or implicitly by a hotel guest in an online review (Millar & Sammons, 2006). In this context, sustainability reflects any sustainability measure or feature of hotel management that is either implemented or absent and can refer either favorably or negatively to sustainability following the GSTC criteria for hotels. For example, the statement “I like that they offer regional and organic food” refers to two categories of the GSTC Criteria for Hotels: 1) “Local purchasing” and 2) “Sustainable Purchasing”, while the statement “Too many individually packaged items at breakfast—unnecessary packaging waste” refers to the category “Efficient purchasing/reduction of unnecessary packaging”.

Unlike previous studies, we decided not to use a text analytics tool but to assign codes manually. These tools analyze frequent words or themes but often fail to capture uncommon but relevant aspects (Guo et al., 2017; Xiang et al., 2017). By assigning codes manually, we believed we would be better able to capture the idiosyncrasies of the reviews and account for nuances. Because sustainability is a multifaceted concept and people use many different words and descriptions to address it, it is very difficult to define pre-analysis what words hotel guests might use when addressing sustainability aspects. Therefore, we believe that despite the large number of reviews, in the case of sustainability, it is a good choice to manually code the dataset to avoid the shortfalls of text analytic tools and identify all sustainability aspects (Geetha et al., 2017).

Taking rare or infrequent words into account, we were able to reveal customer preferences. Moreover, we could capture specific guest experiences that are uncommon but nevertheless offer a nuanced and deeper view into the role of sustainability in online reviews and customer satisfaction.

To code the data, we used a pre-existing framework, the 27 “Global Sustainable Tourism Criteria for Hotels and Tour Operators” developed by the GSTC, an independent organization establishing and managing global sustainable standards. Members include UN agencies, NGOs,

national and provincial governments, leading travel companies, hotels, tour operators, individuals and communities (Global Sustainable Tourism Council, 2017). According to the GSTC, the criteria were developed “to provide a common understanding throughout the world of ‘sustainable tourism’” (Global Sustainable Tourism Council, 2017). A comprehensive description of each criterion is provided by the GSTC free of charge (Global Sustainable Tourism Council, 2016).

To ensure reliability and overcome the possible biases of a single coder procedure, we decided to follow Lombard, Snyder-Duch, and Bracken (2002) and use an approach with two independent coders. Both coders were given full access to the GSTC criteria, including comprehensive descriptions of every code, and asked to read through the descriptions carefully. Next, they were asked to use the descriptions to assign codes to the reviews whenever they notice a sustainability aspect in a review. Moreover, they were asked to distinguish between a positive sentiment (a statement that praises either (1) the implementation of a certain sustainability measure or (2) how that measure is performed) or a negative sentiment (a statement that criticizes (3) the absence of a sustainability measure or (4) how that measure is performed or (5) the measure itself and/or its consequences). Table 1 depicts coding examples for different sentiments.

To test the suitability of the selected coding scheme, both coders initially coded a random sample of 10% of the dataset. On this basis, we were able to expand the coding scheme to adequately capture the full range of sustainability aspects found in the aforementioned sample. We split the GSTC criteria category “Environmentally preferable purchasing” into two categories: food (Code 17) and other products (Code 18). We added Code 28 (Sustainability concept) because many consumers mentioned the sustainability measures of the hotel in a broad sense, without referring explicitly to a specific “Sustainability management system” (Code 1, Sustainability management system, e.g., communication of certificates to guests). Because a number of people in Germany are vegetarians/vegans, which means they do not eat meat (vegetarians) or any animal products (vegans) (Mensink, Lage Barbosa, & Brettschneider, 2016), we added Code 29 (Vegetarian/vegan food). This code is different from the other food-related codes (17 and 13) because it includes persons who have special needs in regard to their food for different reasons, including ethical ones.

Furthermore, we added Code 30 (Allergies/intolerances) to account



**Table 1**  
Examples of sentiments.

Sentiment	Example	Code
Positive (implementation)	The hotel has a wonderful natural scent. Additionally, one can learn a lot about the natural surrounding and its preservation.	9 - Information and interpretation
Positive (performance)	The organic cuisine tastes great.	17 - Environmentally preferable purchasing (food)
Negative (absence)	The breakfast is ok, but there are too many single package items.	19 - Efficient purchasing/reduction of unnecessary packaging
Negative (performance)	Unfortunately, the announced e-bikes were not available or broken [...]	23 - Transport
Negative (consequences)	... of course the ecological balance sheet is important and the sacrifice of an air conditioner therefore plausible, but without one it is too hot in the rooms during summer.	20 - Energy conservation

for the rising number of people with allergies to food, dust, mold, etc. (Zuberbier, 2016). We argue that this code is relevant in providing a safe environment, as it extends the “barrier free” concept to other aspects of the hotel. Barriers in the literal sense of restricted mobility are considered under Code 7 (Buildings and infrastructure). The extended coding scheme is an important tool for future research addressing sustainability aspects in eWOM.

In a second step, both coders independently coded the full dataset using the revised version of the coding scheme. Fig. 1 provides an overview of the data collection process.

### 3.3. Assessing intercoder reliability

Following Lombard et al. (2002), two indices were chosen for the assessment of intercoder reliability. Holsti’s index was used to calculate a measure for intercoder reliability for both the full set of coded reviews and for each code of the framework. Because Holsti’s method does not account for agreements that occur simply by chance, Cohen’s Kappa was also calculated, as it accounts for chance agreement and is

generally seen as a more conservative index (Lombard et al., 2002). The results of the assessment of intercoder reliability are shown in Table 2. Both indices lead to coefficients > 0.9 for the full set of coded reviews, showing high intercoder reliability. However, 5 out of 24 codes assigned to reviews by the two coders show indices < 0.9 ranging from 0.79 to 0.88. In line with the literature, even the lowest scores for specific codes in this dataset are regarded as acceptable (Lombard et al., 2002). Thus, all codes were included in the following analysis.

### 3.4. Analytical strategy

After coding the reviews, the subsequent quantitative analysis took into account the following parameters: sustainability orientation of hotels, number of reviews including sustainability aspects, number of sustainability aspects mentioned in reviews, star classification and review score. Furthermore, we used a review platform and the size of the hotel as control variables. The sustainability orientation is measured as a binary variable, distinguishing hotels that engage in sustainable management from their assigned conventional peers. The review

**Table 2**  
Measures of intercoder reliability.

Code	Codename	Coder 1	Coder 2	Identical	Holsti’s Reliability Coefficient	Cohen’s Kappa Coefficient
Σ	All	3,239	3,277	3,083	.946286065	.911803306
1	Sustainability management system	4	6	4	.8	
2	Legal compliance	2	2	2	1	
3	Reporting and communication	0	0	0	./.	
4	Staff engagement	2	2	2	1	
5	Customer experience	6	5	5	.909090909	
6	Accurate promotion	72	83	72	.929032258	
7	Buildings and infrastructure	216	239	215	.945054945	
8	Land water and property rights	0	0	0	./.	
9	Information and interpretation	19	21	19	.95	
10	Destination engagement	0	0	0	./.	
11	Community support	0	0	0	./.	
12	Local employment	1	1	1	1	
13	Local purchasing	301	335	295	.927672956	
14	Inclusion	75	79	75	.974025974	
15	Treatment of employees	36	34	32	.914285714	
16	Cultural heritage	91	66	64	.815286624	
17	Environmentally preferable purchasing (food)	681	631	621	.946646341	
18	Environmentally preferable purchasing (other products)	41	54	39	.821052632	
19	Efficient purchasing/reduction of unnecessary packaging	74	78	69	.907894737	
20	Energy conservation	81	85	80	.963855422	
21	Water conservation	26	26	23	.884615385	
22	Greenhouse gas emissions	42	49	42	.923076923	
23	Transport	378	380	374	.986807388	
24	Wastewater	0	0	0	./.	
25	Harmful substances	6	5	5	.909090909	
26	Minimize pollution	7	8	6	.8	
27	Biodiversity conservation	33	25	23	.793103448	
28*	Sustainability concept	526	522	497	.948473282	
29*	Vegetarian/vegan food	313	317	312	.99047619	
30*	Allergies/intolerances (including food)	206	224	206	.958139535	

Note \*Code added during data analysis.

platform was also operationalized as a dummy-coded variable. The reference group comprises reviews collected from the OTA hrs.de. For each of the other platforms, a single binary variable was included. The size of the hotels was measured by the number of rooms. Both the number of rooms and the star classification were drawn from the hotel website and checked against the data on the online platforms.

After a visual inspection of outliers via box plot diagrams, we excluded reviews with a rating < 0.2 from further analysis. Overall, a total of 167 reviews were excluded due to this procedure. The remaining dataset consists of 52,326 reviews.

In the first step, we conducted multiple frequency analyses to assess 1) how many reviews include sustainability aspects, 2) which sustainability aspects are mentioned most frequently and 3) how sustainability aspects are perceived. The aim was to provide initial insights into the importance of sustainability aspects within the hospitality industry. In a second step, we developed a linear regression model to assess 4) the relationship between overall sustainability orientation and customer satisfaction and 5) whether this relationship is contingent upon the star rating of a hotel. Finally, we investigated how far specific sustainability aspects contribute to customer satisfaction by conducting a two-step statistical procedure following Lu and Stepchenkova (2012) to classify each code into one of the four groups (satisfiers, dissatisfiers, criticals or neutrals) proposed by Cadotte and Turgeon (1988). All analyses were run using the statistical software IBM SPSS.

## 4. Results

### 4.1. Descriptive statistics

Regarding the full dataset, the largest proportion (46.8%) of reviews is drawn from the OTA [booking.com](#). This finding is in line with the relatively large market share held by [booking.com](#) in the German hospitality industry. Reviews drawn from the RS make up approximately 41% of the dataset and are about equally distributed (holidaycheck.de 22.8%, tripadvisor.de 18.5%). For details, see [Table 3](#). The distribution of the collected reviews with respect to star classification differs from the actual distribution of hotels in Germany. While 3-star hotels are the largest group of hotels in Germany, the largest share of reviews in the dataset pertains to 4-star hotels. For details, see [Table 4](#). This deviation is due to the selection process for the hotels in this study, which aimed to compare hotels with a sustainability management system in place with peers that do not. With respect to sustainability, the reviews are nearly equally distributed with 25,170 reviews pertaining to conventional hotels and 27,156 to sustainable hotels.

We found a total of 3,273 sustainability aspects mentioned in our sample. Our analysis revealed a total of 2,621 (5.1%) reviews containing at least one sustainability aspect, a majority of which pertained to sustainable hotels (2,060) with the rest (561) relating to the group of conventional hotels. The largest share of sustainability aspects expressed a positive sentiment (81.7%). However, this differs notably between sustainable (86.8%) and conventional hotels (59.3%). For details, see [Tables 5 and 6](#).

Regarding the total of all reviews, the average review score is 86.23%. The group of sustainable hotels has a slightly higher average

**Table 3**

Mean review scores, review frequencies and standard deviation along various platforms.

Review Source	Mean	N	Std. Deviation
booking.com	.8500	24,496	.13428
hrs.de	.8354	6,230	.12432
tripadvisor.de	.8696	9,683	.17365
holidaycheck.de	.8619	11,917	.10664
Total	.8619	52,326	.13728

**Table 4**

Mean review scores, review frequencies and standard deviation along various star classifications.

Star Classification	Mean	N	Std. Deviation
No stars	.8806	155	.11764
3 stars	.8525	7,147	.13317
3.5 stars	.8592	3,400	.12783
4 stars	.8611	21,781	.13668
4.5 stars	.8792	12,225	.12908
5 stars	.8619	7,618	.15581
Total	.8619	52,326	.13728

score of 86.58%, while the average score is slightly lower for the group of conventional hotels at 85.85% (see [Appendix B](#)).

Our findings reveal that the majority of mentions in reviews, accounting for 79.3% of all sustainability aspects found in the review data, can be allocated to seven of the 30 codes. These are Code 17 (Environmentally preferable purchasing, 19.2%) Code 28 (Sustainability concept, 13.1%), Code 23 (Transport, 11.6%), Code 13 (Local purchasing, 10.2%), Code 29 (Vegetarian/vegan food, 9.7%), Code 7 (Buildings and infrastructure, 7.3%) and Code 30 (Allergies/intolerances, 7.2%). The other codes are relatively seldom addressed. The vast majority of mentions leading to an assignment of Code 17 (Environmentally preferable purchasing) revolve around the presence or absence of organic food. Code 28 (Sustainability concept) was exclusively assigned to reviews referring to a general sustainability, environmental or social concept. When stressing the availability of either subsidized bikes or public transportation, the coders assigned Code 23 (Transport). Regarding Code 13 (Local purchasing), with only very few expectations, the code was assigned to mentions of locally purchased food. All reviews that were assigned Code 29 (Vegetarian/vegan food) contain explicit mentions of vegetarian or vegan food. The majority of reviews assigned Code 7 (Buildings and infrastructure) refer to the building's accessibility for handicapped guests. All cases in which Code 30 (Allergies/intolerances) was assigned refer to allergies stemming from either food or bedding. It is noticeable that except for Code 28 (Sustainability concept), all of the mentioned aspects leading to an assignment of one of the seven most frequently addressed categories are aspects directly affecting the guest, e.g., quality of food, rather than aspects in favor of the environment, e.g., water and energy conservation. For details and comparisons between conventional and sustainable hotels, see [Appendix B](#).

### 4.2. Results of regression analysis

A hierarchical multiple regression analysis was conducted for each star level to determine 1) the relationship between review scores and the variable "sustainability management"; 2) whether the addition of the variable "sustainability management" improves the prediction of review scores over and above the control variables "number of rooms" and "review platform" and 3) whether there are differences in the relationship between review scores and the variable "sustainability management" and differences in the explanatory power between star levels.

For a visual inspection, we first mapped the mean review scores for both sustainable and conventional hotels along the different star classifications in a line chart. [Fig. 2](#) provides an indication of how customer satisfaction levels vary between medium-class and luxury-class hotels with respect to sustainability orientation. The lines mapping the mean review scores for the two groups cross twice. However, the largest differences between the average review scores of sustainable and conventional hotels can be observed at the 4- and 5-star levels.

For the regression analysis, we added the control variables one at a time and then, in a final step, the variable "sustainability

**Table 5**  
Frequencies of reviews with respect to sustainability aspects among groups of hotels.

Reviews	Frequency		Total
	Conventional Hotels	Sustainable Hotels	
... not containing sustainability aspects	24,609 (49.5%) 97.8%	25,096 (50.5%) 92.4%	49,705 (100%) 94.9%
... containing sustainability aspects	561 (21.4%) 2.2%	2,060 (78.6%) 7.6%	2,621 (100%) 5.1%
<b>Total</b>	<b>25,170 (48.1%) 100%</b>	<b>27,156 (51.9%) 100%</b>	<b>52,326 (100%) 100%</b>
No. of sustainability aspects found	605 (18.5%)	2,668 (81.5%)	3,273 (100%)

Note: Several reviews contain more than one sustainability aspect. The last row shows the number of all sustainability aspects found without respect to the number of reviews.

**Table 6**  
Frequencies of sustainability aspects with respect to sentiments and groups of hotels.

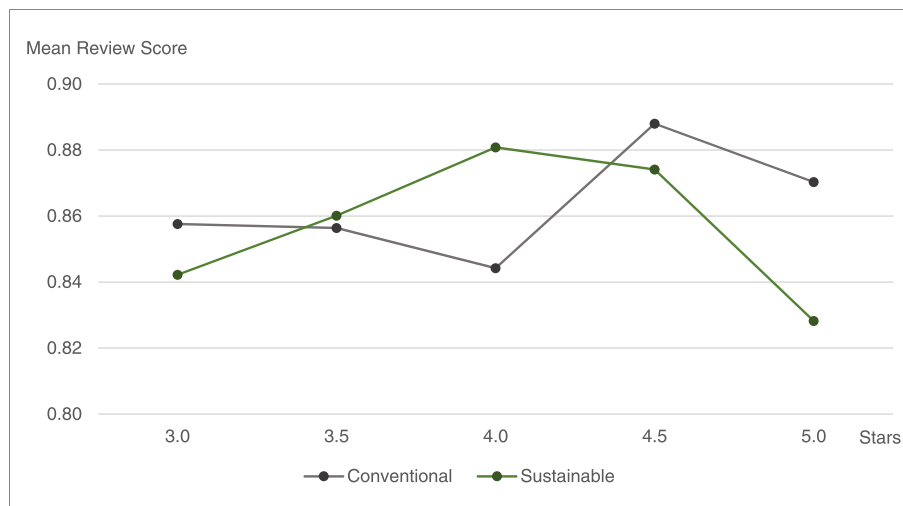
Sentiment	Frequency		Total
	Conventional Hotels	Sustainable Hotels	
positive	359 (59.3%)	2,315 (86.8%)	2,674 (81.7%)
(implementation)	358 (59.2%)	2,308 (86.5%)	2,666 (81.5%)
(performance)	1 (0.1%)	7 (0.3%)	8 (0.2%)
<b>negative</b>	<b>246 (40.7%)</b>	<b>353 (13.2%)</b>	<b>599 (18.3%)</b>
(absence)	190 (31.4%)	178 (6.7%)	368 (11.3%)
(performance)	43 (7.1%)	115 (4.3%)	155 (4.7%)
(consequences)	13 (2.2%)	60 (2.2%)	73 (2.3%)
<b>Total</b>	<b>605 (100%)</b>	<b>2,668 (100%)</b>	<b>3,273 (100%)</b>

Note: Several reviews contain more than one sustainability aspect. This table exclusively shows the frequencies of sustainability aspects with respect to sentiments.

management”. To detect differences between the star levels, we tested an individual model based upon the dataset for each star level (Models 1–15) as well as an overall model using the full dataset (Models 16–18) (see Appendix C).

The control variable “review platform” was added as a dummy-coded variable. The reference group is composed of reviews collected from the OTA hrs.de. As can be seen, both “number of rooms” (Rooms) and “review platform” (Platform = booking.com/Platform = tripadvisor.de/Platform = holidaycheck.de) were significant. “Number of rooms”

showed a marginal positive coefficient ( $< 0.000$ ), whereas the “review platform” showed small positive coefficients (0.016/0.036/0.058), suggesting that compared to hrs.de, reviews on the other platforms are likely to have a higher review score. However, the overall contribution of the control variables to the review score was small, with an R Square of 0.023 (Model 17). The variable “sustainability management” was coded as a binary variable (1 = sustainability management in place). Model 18 examined the contribution of “sustainability management” to the review score. “Sustainability management” was a statistically significant positive predictor, suggesting that hotels with a sustainability management system in place are likely to receive higher review scores than those without such a system. Looking at the effect and contribution of the variable, we see that the coefficient is small (0.006), as is its contribution to the review score, with an increase in R Square of 0.001. While it is not surprising to see the rather small explanatory power of sustainability management, keeping in mind that customer satisfaction depends on a large variety of factors ranging from destination and hotel attributes to employee-specific behavior, it is noteworthy that the different star levels yielded different performances. Explanatory power appeared to be strongest at the 4-star level, followed by the 3.5-star level, the 5-star level, the 4.5-star level and the 3-star level. Interestingly, the coefficients are reversed between the groups of hotels with lower to mid classification levels (3- to 4-star levels) and those with high classification levels (4.5- and 5-star levels). While “sustainability management” has a positive relationship to the “review score” for the first set of groups, it has a negative relationship for the latter set. This suggests that the relationship between “sustainability management” and “review score” depends on the classification level of a hotel, distinguishing between a lower standard



**Fig. 2.** Mean review scores with respect to groups of hotels.

and medium to luxury classes. Given the large sample size, the effects are relatively robust. See [Appendix C](#) for full details on each regression model.

#### 4.3. Classification of sustainability aspects

To classify each code of the framework with respect to customer satisfaction, we conducted a two-step statistical procedure proposed by [Lu and Stepchenkova \(2012\)](#). Each of the 25 codes assigned to sustainability aspects within reviews in the coding process at least once has its responses divided into three groups: positive comments, negative comments, and no comments. The latter group consists of all reviews that did not mention any sustainability aspects referring to the specific code. [Appendix D](#) provides an overview of positive and negative examples for each code.

In a first step, we checked whether the review score differed among the three groups using an independent-samples Kruskal-Wallis test. In cases in which no significant difference was found, the code was classified as “neutral”. For all cases for which the Kruskal-Wallis test indicated a significant difference between the groups, two-sample Mann-Whitney U tests were applied in a second step. In doing so, we compared the mean review scores between the “positive comment” and “no comment” groups as well as between the “negative comment” and “no comment” groups. In cases in which a significant difference was found in the mean review score between the groups “positive comment” and “no comment” but not between the groups “negative comment” and “no comment”, the code was classified as a satisfier. In cases in which no significant difference was found in the mean review score between the “positive comment” and “no comment” groups but one was found between the “negative comment” and “no comment” groups, the code was classified as a “dissatisfier”. A code was classified as “critical” when significant differences were found in both group comparisons. In all cases, the direction of the difference of the mean review score was required to be in the right direction for the code to be classified as a “satisfier”, “dissatisfier” or “critical”. Conducting the Kruskal-Wallis test, we detected significant differences among the mean review scores for the three groups of reviews for 15 of the 25 codes. However, five of the codes only consisted of either positive or negative comments. Due to the low frequency of these codes, we decided to exclude these codes from further analysis. [Appendix E](#) provides a detailed overview of the results of the Kruskal-Wallis test.

The results of the Mann-Whitney U test indicated a classification as a satisfier for two of the codes (“Cultural heritage” and “Efficient purchasing/reduction of unnecessary purchasing”). Hotel guests who mentioned sustainability aspects that positively fall under these codes were more satisfied than guests who did not. Additionally, two codes were classified as dissatisfiers (“Water conservation” and “Greenhouse gas emissions”). Hotel guests who mentioned sustainability aspects that fall under these codes negatively were less satisfied than reviewers who did not. Finally, 11 out of the 15 codes tested in the second step were classified as critical (e.g., “Energy conservation”, “Local purchasing” and “Buildings and infrastructure”). The sustainability aspects that fall under these codes had both positive and negative impacts on hotel guests’ satisfaction. [Table 7](#) provides a summary of the results of the Mann-Whitney U tests as well as an overview of the classification for each of the 25 codes.

## 5. Discussion

Only 5.1 percent of the reviews analyzed contain sustainability aspects, with “food” being most frequently mentioned. Our findings suggest that despite their claim of high interest in sustainable travel ([Deutscher Tourismus Verband e.V., 2016](#)), German tourists do not express this interest in their online reviews of hotels. Our findings contradict [Robinot and Giannelloni \(2010\)](#), who concluded that the majority of environment-related attributes have a negative effect on

hotel customers’ satisfaction if evaluated negatively but no positive effect when evaluated positively. Our results instead indicate that sustainability aspects are predominantly mentioned in a positive context, thereby supporting the findings of [Brazyte et al. \(2016\)](#). Nevertheless, we found that sustainability aspects were also mentioned negatively.

Given that in Germany, awareness of sustainability issues is relatively high both among politicians and the general population ([The Federal Government, 2016](#)), the question remains why this awareness is not mirrored in the reviews analyzed in this study. This finding seems to contradict [Bastič and Gojčič \(2012\)](#), who concluded that, compared to Italian and Slovenian tourists, Austrian and German tourists have the highest expectations regarding the ecological engagement of hotels. There appear to be three possible explanations for this apparent discrepancy. 1) Past survey results indicating the importance of sustainability management may suffer from social desirability bias, a “tendency for an individual to present him or herself, in test taking situations, in a way that makes the person look positive, with regard to culturally derived norms and standards” ([Ganster et al., 1983](#), p. 322). Social desirability bias poses a problem when examining sensitive subjects, such as issues connected to ethics or sustainability ([Fernandes & Randall, 1992](#); [Roxas & Lindsay, 2012](#)). We argue that this is also the case for surveys exploring sustainable travel behavior, and it leads to an overestimation of the importance of sustainability while traveling. 2) Hotels often do not, or do not sufficiently, communicate their sustainability measures. Thus, hotel guests may not be aware of a number of applied sustainability measures. Furthermore, OTAs and RS rarely offer categories to rate sustainability aspects. Tourists thus have no incentive to reflect upon sustainability aspects when reviewing their hotel stay online or to read about sustainability when searching for information on OTAs or RS prior to booking. By launching its “Green Leader” program in 2013, [tripadvisor.de](#) has enabled hotels to promote their sustainability efforts, setting an example for online platforms that want to incorporate sustainability into their websites ([TripAdvisor LLC, 2018a](#); [TripAdvisor LLC, 2018b](#)). The “Green Leader” program is a first step toward providing information on the sustainability engagement of a hotel. However, it does not go beyond presenting a certification and provides the customer with no further information about specific measures taken. Furthermore, it does not provide rating categories for sustainability that are displayed to other customers. 3) When actually traveling, hedonic motives may simply be more important than sustainable behavior for tourists, as previous research suggests ([Miao & Wei, 2013](#)).

Our hierarchical multiple regression analysis revealed a rather small explanatory power of sustainability management, with sustainability management having a positive effect on review ratings. While keeping in mind that there are many other aspects influencing customer satisfaction and therefore their rating of hotels on online platforms, our analysis reveals that there is a relationship between review scores and sustainability management. These findings indicate that sustainability plays a role for hotel guests, even though the content of reviews does not reflect this relationship.

Moreover, our analysis indicated that the coefficients are reversed between the groups of hotels with lower to mid classification levels (3- to 4-star levels) and those with high classification levels (4.5- to 5-star levels). While “sustainability management” has a positive relationship with the “review score” for the former set, it has a negative relationship for the latter. This indicates that the relationship between sustainability orientation and customer satisfaction is moderated by classification level. Previous research found that guests of 2- or 3-star hotels assess more basic aspects of a hotel as being important, such as bathroom, parking, hotel staff service, price, and checking in and out, while the focus of 5-star hotels needed to be on making the customer feel “at home” ([Guo et al., 2017](#)). We argue that the explanation for our finding is twofold. 1) Tourists staying in hotels of lower to mid classification (3- to 4-star level) do not expect their hotel to be luxurious. This might lead to the positive assessment of sustainability measures because they do not perceive any



**Table 7**  
Group comparisons of review scores via Mann-Whitney *U* test and classification of codes.

Code	Codename	Mean Review Score			p-Value	Classification
1	Sustainability management system	pos: .9040	vs	nc: .8597	.631	./.
		./.	vs	nc: .8597	./.	
2	Legal compliance	pos: .9200	vs	nc: .8597	.807	neutral
		neg: .7900	vs	nc: .8597	.347	
4	Staff engagement	./.	vs	nc: .8597	./.	./.
		neg: .8597	vs	nc: .8597	.173	
5	Customer experience	./.	vs	nc: .8597	./.	./.
		neg: .6240	vs	nc: .8597	.006	
6	Accurate promotion	pos: .9404	vs	nc: .8598	.000	critical
		neg: .7136	vs	nc: .8598	.000	
7	Buildings and infrastructure	pos: .9089	vs	nc: .8598	.001	critical
		neg: .7567	vs	nc: .8598	.000	
9	Information and interpretation	pos: .9047	vs	nc: .8597	.328	neutral
		neg: .7750	vs	nc: .8597	.183	
12	Local employment	pos: .9700	vs	nc: .8597	.395	./.
		./.	vs	nc: .8597	./.	
13	Local purchasing	pos: .9250	vs	nc: .8593	.000	critical
		neg: .8115	vs	nc: .8593	.036	
14	Inclusion	pos: .8804	vs	nc: .8594	.377	neutral
		neg: .6850	vs	nc: .8594	.181	
15	Treatment of employees	pos: .9467	vs	nc: .8597	.012	critical
		neg: .6737	vs	nc: .8597	.000	
16	Cultural heritage	pos: .9125	vs	nc: .8596	.001	satisfier
		neg: .8167	vs	nc: .8596	.330	
17	Environmentally preferable purchasing (food)	pos: .9038	vs	nc: .8594	.000	critical
		neg: .6530	vs	nc: .8594	.000	
18	Environmentally preferable purchasing (other products)	pos: .9047	vs	nc: .8597	.018	critical
		neg: .6667	vs	nc: .8597	.000	
19	Efficient purchasing/reduction of unnecessary packaging	pos: .9290	vs	nc: .8596	.000	satisfier
		neg: .8100	vs	nc: .8596	.068	
20	Energy conservation	pos: .9223	vs	nc: .8596	.002	critical
		neg: .7790	vs	nc: .8596	.001	
21	Water conservation	pos: .8533	vs	nc: .8597	.997	dissatisfier
		neg: .8024	vs	nc: .8597	.003	
22	Greenhouse gas emissions	pos: .9059	vs	nc: .8597	.053	dissatisfier
		neg: .7612	vs	nc: .8597	.014	
23	Transport	pos: .8926	vs	nc: .8595	.000	critical
		neg: .7802	vs	nc: .8595	.000	
25	Harmful substances	./.	vs	nc: .8597	./.	./.
		neg: .5825	vs	nc: .8597	.002	
26	Minimize pollution	pos: .9080	vs	nc: .8597	.648	neutral
		neg: .6967	vs	nc: .8597	.141	
27	Biodiversity conservation	pos: .9210	vs	nc: .8597	.068	neutral
		neg: .6880	vs	nc: .8597	.092	
28	Sustainability concept	pos: .9035	vs	nc: .8594	.000	critical
		neg: .6642	vs	nc: .8594	.000	
29	Vegetarian/vegan food	pos: .9259	vs	nc: .8595	.000	critical
		neg: .7741	vs	nc: .8595	.000	
30	Allergies/intolerances (including food)	pos: .9245	vs	nc: .8596	.000	critical
		neg: .7165	vs	nc: .8596	.000	

Note. pos = group of positive comments, neg = group of negative comments, nc = group of no comments.

constraint on luxury during their hotel stay. Furthermore, these guests perceive sustainability measures as an effort by the hotel to do something good for the environment. 2) Tourists staying in more luxurious hotels with 4.5–5 star ratings are likely to have high expectations for their hotel stay, which supports their critical perception of the hotel's sustainability measures. This applies especially to sustainability measures directly affecting the guest's comfort (Sigala, 2014). For tourists staying in more luxurious hotels, self-interest goals, i.e., the maximization of personal utility, might be more important than it is for guests of lower to mid classification hotels. A reason for this might lie in the higher price tourists most likely pay for a luxurious hotel and the corresponding higher expectations for the quality of the hotel stay.

In this study, two independent researchers coded online reviews from [booking.com](http://booking.com), [HRS.de](http://HRS.de), [tripadvisor.de](http://tripadvisor.de) and [holidaycheck.de](http://holidaycheck.de) using a coding scheme based on the GSTC criteria. We identified sustainability aspects frequently mentioned in online reviews and determined how they are connected to customer satisfaction. Our analysis revealed that sustainability measures can be classified into four groups: criticals,

satisfiers, dissatisfiers, and neutrals (see Table 7). Many codes assigned to sustainability aspects fall into the group of “criticals”, indicating the importance of the sustainability measures that fall under these codes. Criticals describe attributes of a service that can cause dissatisfaction or satisfaction, depending on the context. In the case of criticals, a minimum standard must be met to avoid dissatisfaction. To satisfy the customer and provoke a positive response, businesses should perform on a high level in regard to sustainability measures that fall under the category “criticals” (Cadotte & Turgeon, 1988). Our analysis revealed that sustainability measures that were grouped as criticals were coded, among others, as “Environmentally preferable purchasing (food)” and “Buildings and infrastructure”. Only a few codes fall into the groups of satisfiers or dissatisfiers. Some codes could not be allocated to one of the four groups of criticals, satisfiers, dissatisfiers, or neutrals because they were rarely mentioned (e.g., “Harmful substances”), while some codes were identified as “neutrals” (e.g., “Biodiversity conservation”).

According to Cadotte and Turgeon (1988), neutrals are probably either not salient to guests or easily brought up to guests' standards,

**Table 8**  
Overview of classification and frequency of codes.

Code	Codename	directly affecting hotel guests	Directly visible to hotel guests	Frequency	Classification
1	Sustainability management system	X	X	6	./.
2	Legal compliance	X	X	2	neutral
4	Staff engagement	X	X	2	./.
5	Customer experience	X	✓	5	./.
6	Accurate promotion	✓	✓	82	critical
7	Buildings and infrastructure	✓	✓	239	critical
9	Information and interpretation	X	✓	21	neutral
12	Local employment	X	X	1	./.
13	Local purchasing	✓	X	335	critical
14	Inclusion	✓	✓	78	neutral
15	Treatment of employees	✓/X	✓/X	34	critical
16	Cultural heritage	X	✓	66	satisfier
17	Environmentally preferable purchasing (food)	✓	X	629	critical
18	Environmentally preferable purchasing (other products)	✓	X	54	critical
19	Efficient purchasing	✓	X	78	satisfier
20	Energy conservation	✓/X	✓/X	85	critical
21	Water conservation	✓/X	✓/X	26	dissatisfier
22	Greenhouse gas emissions	✓/X	✓/X	49	dissatisfier
23	Transport	✓	✓	380	critical
25	Harmful substances	✓	✓	5	./.
26	Minimize pollution	✓/X	✓/X	8	neutral
27	Biodiversity conservation	X	X	25	neutral
28	Sustainability concept	X	X	522	critical
29	Vegetarian/vegan food	✓	✓	317	critical
30	Allergies/intolerances (including food)	✓	✓	224	critical

Note. ✓ = does apply to measures that fall under this code, X = does not apply to measures that fall under this code, ✓/X = whether this applies to the measures that fall under this code or not depends on the specific measure. For further explanation, see [Appendix D](#).

which is the case for some codes we allocated to the group of “neutrals” (e.g., Legal compliance, Staff engagement, Local employment). We argue that these categories are not directly visible to the guest nor do they affect them directly. For example, a guest might not notice whether the hotel employs locals but be aware of characteristics of the building (“critical”). Nevertheless, codes such as “Local purchasing” or “Environmental purchasing” would not appear to be visible to the guest but were nevertheless coded as “criticals” and frequently mentioned. We argue that these aspects are noticed more often because hotels tend to communicate these types of sustainability measures clearly to the guest, e.g., through information at the buffet.

However, this does not explain why these measures were grouped as “criticals”. One possible explanation might lie in the concept of self-interest: As “criticals” often include measures affecting the customer directly (e.g., “Transport” or “Vegetarian/vegan food”), they can help the customer to maximize personal utility, thereby fulfilling his self-interest or, when the customers' expectations are not met, causing dissatisfaction. Following this observation, we decided to categorize all codes with respect to whether the measures sorted into the code 1) directly affect a hotel guest and 2) are observable by the guest. [Table 8](#) provides an overview of this classification, also showing the frequency of the code as well as the classification based on Cadotte and Turgeon's framework. For an overview of the explanations for the categorization according to effect on and visibility to the customer, see [Appendix F](#).

Finally, we noticed particularities concerning sustainability measures that entail a trade-off between sustainability and comfort. We argue that in these cases, the customer feels “forced” to behave in a way that promotes sustainable development. This supports Dolnicar et al.'s findings, which indicate that customers often tend to hinder sustainable development with their behavior during a hotel stay. When the mere existence of a sustainability measure is criticized by customers, it may be because they either feel forced to behave in a way that supports sustainable development and/or to accept perceived discomfort due to the measure. For example, water-saving showerheads elicited negative comments due to their low water pressure (see [Appendix G](#)), which might lower the hedonic character of the hotel stay ([Dolnicar et al., 2016](#); [Miao & Wei, 2013](#)). Moreover, it is noticeable that three

sustainability measures were especially often criticized for their mere existence, encompassing 20% of the group of negative mentions: energy conservation, water conservation, and greenhouse gas emissions. An explanation for this might be that these measures are of economic interest to the hotel but do not meet the self-interest goals of the hotel guest. The customer may even perceive that these measures lower the quality of their hotel stay, which elicits negative reviews.

## 6. Conclusion

### 6.1. Theoretical contributions

Motivated by the lack of studies analyzing eWOM with regard to sustainability in the hospitality industry, we conducted an analysis of 52,493 reviews of 106 hotels in Germany on four major online platforms. By assigning codes manually, we ensured a consistent and precise process. The results of the current study provide insight into the role of aspects of sustainability in the satisfaction of German-speaking hotel guests. The present research offers theoretical implications as well as implications relevant to both hotel managers in Germany or those abroad that serve German guests as well as for OTAs and RS.

On the theoretical front, the current study seeks to offer an additional, in-depth exploration of the framework provided by [Cadotte and Turgeon \(1988\)](#). One key theoretical implication of our findings is support of this framework. We thereby present another study that strengthens the theory that customer satisfaction is not a unidimensional concept ([Pizam et al., 2016](#)). Moreover, we contribute to the literature on environmental psychology, as our results indicate that self-interest plays an important role in guests' evaluation of the sustainability measures of hotels after their stay. Some sustainability measures lower the perceived comfort of certain hotel attributes, interfering with the maximization of personal utility and thereby self-interest, which is important to the hotel guest's satisfaction ([Dolnicar et al., 2016](#)). By analyzing online reviews, we were thus able to support Dolnicar et al.'s results. Finally, we can confirm that the hedonic nature of a hotel setting plays an important role in the influence of sustainability measures on customer satisfaction. The findings of this paper highlight that

directly affect hotel guest	<b>A</b>	<b>C</b>
indirectly affect hotel guest	<b>B</b>	<b>D</b>
	unobservable to hotel guest	observable to hotel guest

**Fig. 3.** Theoretical framework to assess the prioritization of communication efforts (Note: letters show the prioritization recommended by the authors).

Cadotte and Turgeon's framework makes a strong contribution to explaining why certain sustainability aspects are more often mentioned in online reviews than others. Moreover, the current study sheds light on the dimensions of customer satisfaction and the influence of sustainability measures on customer satisfaction.

### 6.2. Managerial implications

On the practical front, the findings of this paper may suggest ways for hotel managers to communicate those sustainability measures implemented in their businesses.

Our analysis revealed that guests predominantly notice certain aspects of sustainability, e.g., food or transport. As noted earlier, the majority of these aspects directly affect the guests and are critical to achieving customer satisfaction. Hotel managers can analyze whether their sustainability efforts are observable or unobservable and whether they directly affect the hotel guest. We recommend prioritizing communication efforts according to the matrix depicted in Fig. 3. Sustainability measures that directly affect hotel guests and are not observable to them should have the highest priority in regard to communication.

One example of such a case is organic or locally sourced food. Hotel guests might perceive food to be of superior quality but might not be able to recognize whether it is organic or locally grown/sourced without being provided with additional information. As argued above, some sustainability measures that directly affect guests are already being communicated by hotels, which is the reason they are salient to the guest (e.g., “Local purchasing” or “Environmentally preferable purchasing”). Without this communication by the hotel, these measures would not be perceived by guests. According to the results of this study, hotel managers should continue to communicate sustainability efforts in these areas. In addition, measures directly affecting the guest are found to be “critical” in practically all cases. This indicates that it is especially important for hotels to perform well in regard to these measures to provoke a positive response from guests.

Another implication is especially relevant to managers of hotels in the higher price segment, e.g., 4.5- or 5-star hotels, because guest expectations are higher in these accommodations. Our findings indicate that guests tend to negatively perceive any sustainability measures that they feel lower their comfort during their stay, such as water-saving shower heads. An implication of this finding is that managers of hotels with a high star classification should focus on introducing sustainability measures that do not lower the perceived luxury of guests' stay. Concerning such measures, we argue that there are two options: 1) implementing measures that do support sustainability but do not directly affect the guest, e.g., focusing on water savings in areas that are not frequented by guests rather than in the hotel rooms; 2) applying

measures that enable guests to individually decide for themselves whether they want to contribute to sustainability, e.g., through smart meters that measure and display the current level of water consumption in comparison to average consumption per person while showering.

Our research also has implications for OTAs and RS. To encourage tourists to use a rating system and to think more about aspects of sustainability related to their last and their next trip, OTAs might introduce a new rating category in which guests can rate their stay according to sustainability criteria. By doing so, ratings would become easier to understand and would provide better information for potential customers interested in sustainability measures. Moreover, when keeping track of their reviews, hotels would receive feedback about their sustainability measures and could work to improve them based on this feedback. Because OTAs and RS are key intermediaries and therefore have high influence, they could use this power to make a contribution to sustainable hospitality. By doing so, they may also create an element of differentiation and attract sustainability-oriented tourists.

New topics emerged in our analysis, leading to an extension of the pre-existing framework. We added the following codes: “Sustainability concept” (Code 28), “Vegetarian/Vegan food” (Code 29), and “Allergies/intolerances (including food)” (Code 30). “Sustainability concept” was among the most frequently coded aspects in this study, implying that tourists notice the general sustainability concept without mentioning specifics, e.g., the existence of a certain management system including a certification.

The codes “Vegetarian/vegan food” (Code 29) and “Allergies/intolerances” (Code 30) might point to new issues arising in the realm of customer satisfaction in sustainable hospitality. These codes relate to aspects that directly affect the guest when staying in a hotel. For example, a vegan guest has his comfort directly affected by the availability of vegan food, while guests with allergies to dust are directly reliant on special bedding and carpets. Other aspects affect hotel guests more indirectly, such as the generation of electricity through renewable energy sources.

### 6.3. Limitations and future research

There are several limitations in the current paper, which grant opportunities for future research. First, our study analyzed online reviews, which are written by a very small segment of the German population. For this reason, our data are not representative of all German-speaking tourists, and additional research in this field is needed to confirm our results. As our data relate only to Germany, the findings may not be generalizable to other markets. To investigate whether cultural differences play a role in the observed effects, further research should be conducted using review data from other countries.

Moreover, the classification of hotel attributes according to Cadotte and Turgeon's framework may change over time (Cadotte & Turgeon, 1988). Considering sustainability measures in hospitality, for example, technological innovations are likely to improve performance without affecting customer satisfaction. Therefore, the results of the current study should be validated and expanded in the future.

To ensure that reviews are not manipulated and that they reflect the first-hand perceptions of actual travelers, both selected OTAs accept reviews only from travelers who have booked their hotel through their website (Booking.com BV, 2018). This does not apply to the RS. However, as customer content is the core asset of an RS, to ensure credibility, they have established complex procedures to investigate whether reviews are manipulated (TripAdvisor LLC, 2018c). However, we cannot be certain that our data selection does not contain fake reviews that were not identified by the OTAs and RS.

Finally, our data may suffer from self-selection bias because tourists self-select which hotel they stay at and, more importantly, whether they write a review reflecting their satisfaction (Li, Cui, & Peng, 2017). To overcome possible biases from fake reviews and self-selection, future research should use mixed methods to determine whether surveys of

hotel guests yield similar results to the content analysis of online reviews.

Despite the possible biases, this study helps us gain a better understanding of the role of sustainability orientation as well as specific sustainability measures in guest satisfaction. Furthermore, it provides a methodological example of how online review data can be used to explore drivers of satisfaction and dissatisfaction, including data selection, data collection, qualitative content analysis and multivariate

quantitative analysis. Therefore, this study provides useful insights for future research that add to the theoretical and methodological foundation of hospitality research and beyond.

#### Declarations of interest

None.

## Appendix A

### Literature overview

Study	Variables analyzed	Research context, method and sample size	Findings
Brazyte et al. (2016)	<ul style="list-style-type: none"> <li>Hotel ratings</li> <li>Number of sustainability aspects mentioned in comments</li> </ul>	<ul style="list-style-type: none"> <li>30 hotels with Certification for Sustainable Tourism CST Costa Rica</li> <li>264 reviews from TripAdvisor</li> <li>Content analysis</li> </ul>	<ul style="list-style-type: none"> <li>Hotel guests perceive sustainability positively</li> <li>Customers mainly discuss attributes that have direct impacts on their experience or are observable at the hotel</li> </ul>
Geetha et al. (2017)	<ul style="list-style-type: none"> <li>Customer sentiment polarity</li> <li>Review ratings</li> </ul>	<ul style="list-style-type: none"> <li>20 hotels each from budget and premium category of hotels</li> <li>Regression analysis</li> <li>Sentiment analysis</li> </ul>	<ul style="list-style-type: none"> <li>Consistency between customer ratings and actual customer feelings across hotels belonging to the two categories of premium and budget</li> <li>Customer sentiment polarity explains significant variation in customer ratings across both the hotel categories</li> </ul>
Guo et al. (2017)	<ul style="list-style-type: none"> <li>Consumer ratings</li> <li>Latent dimensions of consumer satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>266,544 online reviews from TripAdvisor</li> <li>Latent dirichlet analysis (LDA)</li> </ul>	<ul style="list-style-type: none"> <li>19 controllable dimensions that are key for hotels to manage their interactions with visitors (e.g., available car parking space and the service quality of hotel staff)</li> <li>Differences according to demographic segments</li> </ul>
Liu et al. (2017)	<ul style="list-style-type: none"> <li>Review ratings</li> <li>Hotel attributes preference of tourists from nine countries</li> </ul>	<ul style="list-style-type: none"> <li>412,784 user-generated reviews on TripAdvisor for 10,149 hotels from five Chinese cities</li> <li>Regression analysis</li> </ul>	<ul style="list-style-type: none"> <li>Foreign tourists, who speak diverse languages, differ in terms of their emphasis on the roles of hotel attributes (“Rooms,” “Location,” “Cleanliness,” “Service,” and “Value”) in forming their overall satisfaction rating for hotels</li> </ul>
Lu and Stephenkova (2012)	<ul style="list-style-type: none"> <li>Ecology attributes mentioned in reviews</li> <li>Favorability of the attitude expressed</li> <li>Overall satisfaction levels</li> </ul>	<ul style="list-style-type: none"> <li>373 reviews extracted from TripAdvisor</li> <li>Ecologies in Costa Rica</li> <li>Content analysis</li> <li>Two-step nonparametric statistical procedure</li> </ul>	<ul style="list-style-type: none"> <li>26 attributes that influence ecotourists' satisfaction with their ec lodge stays were identified and further aggregated into seven categories: ec lodge setting, room, nature, service, food, location, and value for money</li> </ul>
Radojevic et al. (-2015)	<ul style="list-style-type: none"> <li>Average ratings</li> <li>Hotel attributes</li> </ul>	<ul style="list-style-type: none"> <li>6,768 hotels located in 47 capital cities in Europe registered on <a href="http://booking.com">booking.com</a></li> <li>Linear mixed model technique</li> </ul>	<ul style="list-style-type: none"> <li>Hotel star rating is the single most important factor influencing customer experience</li> <li>Air-conditioning devices in rooms, a bar located within the hotel area, access to Wi-Fi free of charge, membership in a branded hotel chain and price have significant positive associations with customer satisfaction</li> </ul>
Schuckert et al. (-2015)	<ul style="list-style-type: none"> <li>Star categories</li> <li>Ratings</li> <li>Language of reviews (English; Non-English)</li> </ul>	<ul style="list-style-type: none"> <li>86,000 customer ratings of Hong Kong star-rated hotels from TripAdvisor</li> <li>Regression analysis</li> </ul>	<ul style="list-style-type: none"> <li>English-speaking guests prefer high-class hotels</li> <li>Non-English-speaking guests are more fastidious about five-star hotels and demand higher service quality, while English-speaking guests desire bigger rooms in four-star hotels</li> <li>Satisfaction difference is greater in lower class hotels or in hotels with fewer English-speaking guests</li> </ul>
Segarra-Ona et al. (2014)	<ul style="list-style-type: none"> <li>Customer ratings for hotels with and without ISO 14001 certifications</li> </ul>	<ul style="list-style-type: none"> <li>Ratings of 6,854 Spanish hotels with 5, 4, or 3 stars</li> <li>Data from hotels' websites and <a href="http://Booking.com">Booking.com</a></li> <li>ANOVA analysis</li> </ul>	<ul style="list-style-type: none"> <li>Most significant differences found between upscale 4-star hotels with and those without certification</li> <li>Differences relating to certification in 5- and 3-star hotels were muted</li> </ul>
Stringam and Gerdes (2010)	<ul style="list-style-type: none"> <li>Most frequently used words</li> <li>Pattern of word usage with either high or low guest ratings</li> </ul>	<ul style="list-style-type: none"> <li>60,648 consumer ratings and comments from <a href="http://expedia.com">expedia.com</a></li> <li>Content analysis</li> <li>Frequency analysis</li> </ul>	<ul style="list-style-type: none"> <li>Lack of cleanliness most often mentioned</li> <li>Hotel staff and service frequently mentioned</li> <li>When bathroom and its associated amenities mentioned, it is associated with lower ratings</li> <li>Hotel's convenience to attractions, shopping, airports, and downtown, food is associated with higher ratings</li> </ul>
Xie et al. (2014)	<ul style="list-style-type: none"> <li>Dependent variable: is RevPAR (average revenue per available room per hotel)</li> <li>Independent variables: overall rating, attribute ratings, review variation, review volume, number of management responses</li> </ul>	<ul style="list-style-type: none"> <li>Online consumer reviews and management responses of 843 hotels on <a href="http://TripAdvisor.com">TripAdvisor.com</a></li> <li>4,994 observations</li> <li>Panel data analysis</li> <li>Linear regression</li> </ul>	<ul style="list-style-type: none"> <li>Overall rating, attribute ratings of purchase value, location and cleanliness, variation and volume of consumer reviews, and the number of management responses significantly associated with hotel performance</li> <li>Variation and volume of consumer reviews moderate the relationship between overall rating and hotel performance</li> </ul>
Yu et al. (2017)	<ul style="list-style-type: none"> <li>Green practices mentioned in reviews</li> <li>Sentiment (positive/negative)</li> </ul>	<ul style="list-style-type: none"> <li>727 green reviews (reviews on green experiences)</li> <li>Top ten green hotels in the USA from TripAdvisor</li> <li>Content analysis</li> <li>Ordinal logistic regressions</li> </ul>	<ul style="list-style-type: none"> <li>Guests have both positive and negative experiences at green hotels</li> <li>“Energy”, “purchasing”, “education and innovation” are the most frequently discussed</li> <li>“Guest training”, “energy”, “water”, “purchasing” and “education and innovation” significantly influence overall satisfaction with hotels</li> <li>Advanced green practices tend to have greater impacts on customer satisfaction</li> </ul>



- Zhou et al. (2014)
- Overall satisfaction score
  - Attributes that influence customer satisfaction
  - 1,345 reviews from the international accommodation website [Agoda.com](http://Agoda.com)
  - 97 four- and five-star hotels in Hangzhou (China)
  - Coding of reviews
  - ANOVA
  - Seventeen attributes influencing customer satisfaction identified; covering range of hotel features, e.g., room facilities, the general hotel facilities, food quality, and dining environment, the price, the location, and the service and staff

## Appendix B

Mean review scores, frequencies and standard deviations with respect to sustainability codes and groups of hotels

Code	Codename	Hotel	Mean	N	STD. Deviation
0	No sustainability aspects	Conventional	.8586	24,619	.13920
		Sustainable	.8637	25,122	.13546
		All hotels	.8612	49,741	.13735
1	Sustainability management system	Conventional	./.	./.	./.
		Sustainable	.8700	6	.11278
		All hotels	.8700	6	.11278
2	Legal compliance	Conventional	.7900	1	./.
		Sustainable	.9200	1	./.
		All hotels	.8550	2	.09192
4	Staff engagement	Conventional	./.	./.	./.
		Sustainable	.7300	2	.14142
		All hotels	.7300	2	.14142
5	Customer experience	Conventional	.6100	2	.16971
		Sustainable	.6333	3	.23180
		All hotels	.6300	5	.18501
6	Accurate promotion	Conventional	.7925	44	.15306
		Sustainable	.8021	38	.16630
		All hotels	.7970	82	.15841
7	Buildings and infrastructure	Conventional	.8118	96	.15469
		Sustainable	.8485	143	.15392
		All hotels	.8338	239	.15496
9	Information and interpretation	Conventional	.8500	2	.14142
		Sustainable	.8968	19	.08253
		All hotels	.8924	21	.08561
12	Local employment	Conventional	.9700	1	./.
		Sustainable	./.	./.	./.
		All hotels	.9700	1	./.
13	Local purchasing	Conventional	.9028	54	.12688
		Sustainable	.9188	281	.09629
		All hotels	.9162	335	.10179
14	Inclusion	Conventional	./.	./.	./.
		Sustainable	.8867	78	.10116
		All hotels	.8867	78	.10116
15	Treatment of employees	Conventional	.8057	14	.19266
		Sustainable	.8270	20	.19585
		All hotels	.8182	34	.19189
16	Cultural heritage	Conventional	.8950	10	.08923
		Sustainable	.9105	56	.10541
		All hotels	.9082	66	.10264
17	Environmentally preferable purchasing (food)	Conventional	.8769	32	.12928
		Sustainable	.8843	597	.13292
		All hotels	.8839	629	.13265
18	Environmentally preferable purchasing (other products)	Conventional	.8350	4	.16902
		Sustainable	.8674	50	.15005
		All hotels	.8650	54	.15002
19	Efficient purchasing/reduction of unnecessary packaging	Conventional	.8235	23	.19718
		Sustainable	.9169	55	.08764
		All hotels	.8894	78	.13540
20	Energy conservation	Conventional	.7523	13	.17393
		Sustainable	.8953	72	.09834
		All hotels	.8734	85	.12319
21	Water conservation	Conventional	.8663	8	.13225
		Sustainable	.7994	18	.13383
		All hotels	.8200	26	.13449
22	Greenhouse gas emissions	Conventional	./.	./.	./.
		Sustainable	.8557	49	.15743
		All hotels	.8557	49	.15743
23	Transport	Conventional	.8670	100	.12325
		Sustainable	.8821	280	.11856
		All hotels	.8781	380	.11983

25	Harmful substances	Conventional	.5825	4	.07932
		Sustainable	.7100	1	./.
26	Minimize pollution	All hotels	.6080	5	.08927
		Conventional	./.	./.	./.
		Sustainable	.8288	8	.18780
		All hotels	.8288	8	.18780
27	Biodiversity conservation	Conventional	.8283	6	.17543
		Sustainable	.8889	19	.15402
		All hotels	.8744	25	.15780
		Conventional	.8500	2	.21213
28	Sustainability concept	Sustainable	.8894	520	.12338
		All hotels	.8893	522	.12352
29	Vegetarian/vegan food	Conventional	.8884	96	.13566
		Sustainable	.8872	221	.12368
		All hotels	.8876	317	.12721
		Conventional	.8619	93	.15451
30	Allergies/intolerances (including food)	Sustainable	.8658	131	.13437
		All hotels	.8623	224	.14401
<b>Total</b>		Conventional	.8585	25,224	.13947
		Sustainable	.8658	27,790	.13487
		All hotels	.8623	53,014	.13713

Note. All sustainability aspects were taken into account. Reviews containing more than one sustainability aspect are assigned to each of the relevant codes. Code 0 refers to reviews that do not contain any sustainability aspects.

### Appendix C

#### Results of stepwise regression

Independent	Dependent								
	Review Scores (3 Star Level; N = 7147)			Review Scores (3.5 Star Level; N = 3400)			Review Scores (4 Star Level; N = 21781)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	.816**	.805**	.798**	.900**	.882**	.864**	.860**	.820**	.815**
Rooms	.000**	.000**	.000**	.000**	.000**	-.001**	.000	.000**	.000**
Platform = booking.com		.002	.002		.011	.010		.029**	.029**
Platform = tripadvisor.de		.015*	.015*		.014	.014		.037**	.033**
Platform = holidaycheck.de		.041**	.040**		.060**	.057**		.071**	.064**
Sustainability management			.010**			.031**			.041**
R <sup>2</sup>	.032	.046	.047	.096	.124	.134	.000	.025	.041
F	233.887**	85.753**	70.002**	359.736**	120.041**	105.079**	.432	139.731**	187.872**
ΔR <sup>2</sup>	.032	.014	.001	.096	.028	.010	.000	.025	.016
ΔF	233.887**	35.230**	6.791*	359.736**	36.396**	39.749**	.432	186.160**	370.941**

Independent	Dependent								
	Review Scores (4.5 Star Level; N = 12225)			Review Scores (5 Star Level; N = 7618)			Review Scores (All Star Level; N = 52171)		
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Constant	.913**	.872**	.874**	.932**	.905**	.917**	.871**	.842**	.840**
Rooms	.000**	.000**	.000**	.000**	.000**	.000**	.000**	.000**	.000**
Platform = booking.com		.012*	.017**		.012	.007		.016**	.015**
Platform = tripadvisor.de		.042**	.051**		.023*	.016*		.036**	.036**
Platform = holidaycheck.de		.049**	.057**		.068**	.066**		.058**	.057**
Sustainability management			-.022**			-.031**			.006**
R <sup>2</sup>	.009	.027	.033	.035	.055	.064	.002	.023	.024
F	112.668**	86.047**	84.341**	274.969**	110.588**	103.904**	119.460**	304.694**	248.806**
ΔR <sup>2</sup>	.009	.018	.006	.035	.020	.009	.002	.021	.001
ΔF	112.688**	76.471**	75.422**	274.969**	53.855**	72.985**	119.992**	365.423**	24.703**

Note \*p < .05, \*\*p < .001. All coefficients are shown with three decimals due to their small values; 0.000 indicates that the coefficient is a minuscule, nonzero number.

Reviews for hotels with no star classification (n = 155) were excluded from the regression analysis.

## Appendix D

## Examples of sustainability aspects with respect to codes and sentiments

Code	Codename	Positive comment	Negative Comment
1	Sustainability management system	Great hotel with an organic certificate [...]	./.
2	Legal compliance	Excellent water pressure and temperature in accordance with the German Ordinance on Potable Water [...]	In room 324, the sockets are installed in close proximity to bath tub and sink. This is not permitted, according to VDE 0100-701 and should be examined!
4	Staff engagement	./.	We wanted to have breakfast together with friends and one of the group is a vegetarian. The staff was unable to put together a vegetarian breakfast and even got slightly rude. That's a no-go for a four-star hotel! A vegetarian breakfast can be almost anything – except for sausages. You should train your staff better!
5	Customer experience	./.	When checking out, we were not asked if we were satisfied with our stay. [...]
6	Accurate promotion	Me and my girlfriend spent a great weekend there. The food was absolutely delicious. The staff was super nice. Every detail in the photos corresponded to the reality. [...]	Pictures on <a href="#">booking.com</a> allow for more than the old rooms in the crown. Here, more honesty is needed [...]
7	Buildings and infrastructure	Modern, stylish hotel, cheap starting point also with public transport, barrier free, own parking space [...]	[...] Bath tub not suitable for disabled persons. [...]
9	Information and interpretation	Senior manager personally invited us to a 2-h hike to the local mountain – with lots of valuable information about the region and a tower tour [...]	For the eggs, it would have been nice to have a small sign, indicating organic or free range [...]
12	Local employment	What impresses me most is how the hotel is perceived by the locals, that there are many hard-working, German-speaking employees, the outstanding cuisine, the uncomplicated handling of the guests and the various opportunities to do something good	./.
13	Local purchasing	The food is of high quality and has regional ingredients. [...]	However, we find the claim that the ingredients come mainly from the region slightly exaggerated. Because then, instead of the many French cheeses, only the “Harzer” would have to be offered. Also, we have not seen salmon in the waters ... [...]
14	Inclusion	[...] We particularly liked the integration of people with special needs. Wonderful!	Bakery with breakfast in the same house, however hotel breakfast priced 15€ completely inappropriate and I didn't see any disabled service people.
15	Treatment of employees	[...] Overall noticed the friendly staff atmosphere, which gives a very harmonious impression and you feel right at home	Breakfast Sa., 28.3.2015. The young man who apparently had the responsibility of the breakfast area blackguarded the young ladies who seemingly made a mistake (???). Very bad style – reflects badly on the young man in the suit and on the dealing with employees in general [...]
16	Cultural heritage	Exceptional hotel, integrated in a former water tower. Very interesting! [...]	[...] It is a little dark in the hotel. But this is most likely owed to the special architecture and monument protection.
17	Environmentally preferable purchasing (food)	[...] exceptional breakfast, large selection of mostly organic quality and regional products [...]	[...] no organic quality at breakfast [...]
18	Environmentally preferable purchasing (other products)	The decor is great, and it respects environmental protection. The information about forests, etc., is appealing. There were even fair-traded towels [...]	[...] all toiletries (shampoo, etc.) are made in China [...]
19	Efficient purchasing/reduction of unnecessary packaging	The ecological concept, no disposable items, regional produce at the breakfast, friendly atmosphere without bells and whistles [...]	Egg cups made of plastic and for salt and pepper, almost every grain is packed separately. I don't understand why you can't just put salt and pepper shakers on the table – less garbage and the handling is just as easy [...]
20	Energy conservation	Concept of energy saving and waste prevention, e.g., no disposable packaging at the breakfast. [...]	The permanent balcony lighting is a waste of energy! [...]
21	Water conservation	I like that due to water treatment, tap water is prepared for drinking, which saves many water bottles. [...]	If one wants to shower early, it takes a lot of time until the water gets warm – waste of water! [...]
22	Greenhouse gas emissions	The CO2-neutral concept, great location, great rooms	Unfortunately, the advertised climate-friendly air conditioning was out of order and the heating was set to 25°, A complaint at the front desk was initially handled well, with reference to a review by a technician. Since the problem did not diminish within the next days, I complained again and received the answer that the temperature in the room should be regulated only by opening the window. NOT VERY CLIMATE-FRIENDLY!
23	Transport	Very good location near Kurfürstendamm and Bahnhof Zoo, friendly staff, ticket for public transport included [...]	Unfortunately, the announced e-bikes were not available or broken [...]
25	Harmful substances	./.	The bed sheets had a strong smell of chemistry, my wife suffered coughing attacks, and I too had a swollen nose in the morning. [...]
26	Minimize pollution	Sleeping without electrosmog was an additional highlight [...]	Strong electrosmog in the sleeping area [...]
27	Biodiversity conservation	Everything fits together. The integration of nature. The concept, with climate neutrality and environmental protection [...]	[...] the deer enclosure belonging to the hotel.
28	Sustainability concept	The ecological orientation of the hotel in its entirety was impressive. [...]	The hotel could still improve on the ecological criteria [...]
29	Vegetarian/vegan food	As a vegetarian, I rarely find a menu and a breakfast buffet that satisfies all my wishes. Here, I always have plenty of choices and the kitchen is flexible. [...]	[...] The kitchen is not at all prepared for vegetarians. [...]
30	Allergies/intolerances (including food)	I am allergic and even got gluten-free bread. Very good! [...]	Since we are allergy sufferers, a clear indication of “pets allowed” would be desirable [...]

Appendix E

Group comparisons of mean review scores via Kruskal-Wallis test

Code	Codename	Mean Review Score			Kruskal-Wallis test (p-value)
		positive	Negative	No Comment	
1	Sustainability management system	.9040	./.	.8597	./.
2	Legal compliance	.9200	.7900	.8597	.608
4	Staff engagement	./.	.8597	.8597	./.
5	Customer experience	./.	.6240	.8597	./.
6	Accurate promotion	.9404	.7136	.8598	.000
7	Buildings and infrastructure	.9089	.7567	.8598	.000
9	Information and interpretation	.9047	.7750	.8597	.235
12	Local employment	.9700	./.	.8597	./.
13	Local purchasing	.9250	.8115	.8593	.000
14	Inclusion	.8804	.6850	.8594	.248
15	Treatment of employees	.9467	.6737	.8597	.000
16	Cultural heritage	.9125	.8167	.8596	.003
17	Environmentally preferable purchasing (food)	.9038	.6530	.8594	.000
18	Environmentally preferable purchasing (other products)	.9047	.6667	.8597	.000
19	Efficient purchasing/reduction of unnecessary packaging	.9290	.8100	.8596	.000
20	Energy conservation	.9223	.7790	.8596	.000
21	Water conservation	.8533	.8024	.8597	.080
22	Greenhouse gas emissions	.9059	.7612	.8597	.006
23	Transport	.8926	.7802	.8595	.000
25	Harmful substances	./.	.5825	.8597	./.
26	Minimize pollution	.9080	.6967	.8597	.289
27	Biodiversity conservation	.9210	.6880	.8597	.041
28	Sustainability concept	.9035	.6642	.8594	.000
29	Vegetarian/vegan food	.9259	.7741	.8595	.000
30	Allergies/intolerances (including food)	.9245	.7165	.8596	.000

Appendix F

Classification of codes with respect to effect and visibility

Code	Codename	Directly affect Guest	Observable by Guest	Explanation
1	Sustainability management system	X	X	The presence of a sustainability management system itself has usually no points of contact with guests. It is the corresponding measures that may or may not affect the guest. Accordingly, a sustainability management system does not become visible to guests unless a hotel communicates its presence.
2	Legal compliance	X	X	Measures in this field may be manifold. Guests expect hotels to comply with legal requirements but are in most cases not able to determine whether this is the case. The guest is directly affected by the quality of products and services, which in many cases may be independent from legal compliance.
4	Staff engagement	X	X	Measures in this field mostly revolve around employee training and knowledge transfer. These measures are usually not visible to guests. Accordingly, guests can only evaluate the level of service quality, which may depend on training.
5	Customer experience	X	✓	Measures in this field revolve around monitoring guest satisfaction. Guests will take notice whether a hotel does collect information, and it may be a source of (dis)satisfaction; however, it does not directly affect them.
6	Accurate promotion	✓	✓	Whether the prepurchase and/or onsite information is accurate does directly affect the guest, since it is a decision-making parameter. In most cases, guests are incapable of judging the accuracy until they consume the service onsite.
7	Buildings and infrastructure	✓	✓	Measures in this field mainly revolve around accessibility for disabled and elderly guests. Whether a hotel meets the requirements of these guests directly affects and is visible to them.
9	Information and interpretation	X	✓	Measures in this field revolve around providing information about the natural surroundings and local culture. Thus, if a hotel engages in these measures, it will be visible to the guest but not affect him/her directly.
12	Local employment	X	X	Whether a hotel employs local residents is in most cases difficult to perceive for the guest.
13	Local purchasing	✓	X	In most cases, consumer products do directly affect the guest; however, unless communicated by the hotel, these products remain unobservable to the guest.
14	Inclusion	✓	✓	Whether a hotel applies an inclusive concept is observable to guests, as they will interact with disabled employees unless they are working in sections that are not accessible for guests. The interaction with disabled people may be different but should still lead to the desired result. Accordingly, we argue that guests are rather not directly affected.
15	Treatment of employees	X	X	The way employees are treated may in areas be observable by guests, for example, when communicating in service areas, and in areas not observable, for example, in back office meetings. However, usually the guest is not directly affected by measures in this field.
16	Cultural heritage	X	✓	Measures in this field revolve around promoting and protecting the cultural heritage. Thus, if a hotel engages in these measures, it will be visible to the guest but not affect him/her directly.
17	Environmentally preferable purchasing (food)	✓	X	Most food products that are considered environmentally and/or socially friendly like organic and fair-trade products cannot be distinguished from substitutes that do not meet these requirements without communication measures. For example, a restaurant guest may not be able to evaluate whether a steak on his plate is an organic steak or not. However, it does directly affect guests because food products are directly consumed and attributes like organic or fair trade are considered to indicate superior quality.
18	Environmentally preferable purchasing (other products)	✓	X	Corresponding to food, environmental and/or social friendliness is also seen as a quality feature, especially for consumer products such as cosmetics and toiletries but also for products with less direct effects such as furniture or construction materials. In most cases, the attribute of environmental and/or social friendliness needs to be highlighted in order to be recognizable by the guest.



19	Efficient purchasing/reduction of unnecessary packaging	x	✓/x	Measures in this field may or may not be visible to guests depending on the area in which they are applied. For example, measures to reduce waste in the kitchen are most likely not visible to guests, whereas a guest is able to judge measures taken with the packaging of toiletries in the bathroom. However, neither measure directly affects the guest.
20	Energy conservation	✓/x	✓/x	Energy conservation measures may or may not directly affect guests. For example, energy saving lamps may be a source of (dis)satisfaction, since they are usually less bright. On the other hand, a hotel could apply energy conservation measures within areas such as the kitchen, which are not necessarily visible and do not affect the guest.
21	Water conservation	✓/x	✓/x	Water conservation measures may or may not directly affect the guest. For example, water-saving shower heads may be a source of (dis)satisfaction, whereas water-saving measures within areas like the kitchen do not necessarily become visible and do not affect the guest.
22	Greenhouse gas emissions	✓/x	✓/x	Measures to lower greenhouse gas emissions may or may not directly affect the guest. For example, the elimination of an air conditioning system may be a source of (dis)satisfaction, whereas measures like the use of electric cars do not necessarily become visible and do not affect the guest.
23	Transport	✓	✓	Alternative transport options like bikes or public transportation may be viewed as an additional service. Thus, measures in this field directly affect the guest and become visible to those who are looking for them.
25	Harmful substances	✓/x	x	The use or elimination of harmful substances within guest sections may directly affect the guest. However, most likely it is not visible to the guests unless usage is witnessed or can be deduced by smell.
26	Minimize pollution	✓/x	✓/x	Comments within this code dealt exclusively with electrical smog. However, guests who are sensitive to this may be able to judge whether there is or is not (too much) electrical smog. Others would most likely not notice.
27	Biodiversity conservation	x	x	Measures in this field revolve around biodiversity conservation, especially in regard to minimizing the impact the hotel business exerts on the natural surroundings. In most cases, this is not visible to the guest and does not affect him.
28	Sustainability concept	x	x	A sustainability concept does not necessary include measures that directly affect a guest. Accordingly, it does not necessary become visible unless it is actively communicated.
29	Vegetarian/vegan food	✓	✓	Whether a hotel offers vegetarian and vegan food does directly affect vegetarian and vegan guests. Since these guests look for specific meals, measures in this field become visible to them without additional communication.
30	Allergies/intolerances (including food)	✓	✓	Whether a hotel meets the requirements of allergic guests directly affects these guests. Since these guests look for specific attributes/offers, measures become visible without active communication.

Note: This categorization is suggested by the authors and based on the sustainability aspects found in the dataset.

### Appendix G

Frequencies and examples of negative comments on sustainability aspects with respect to codes

Code	Codename	N (total)	N (negative Consequences)	Negative Comment (Negative Consequences)
7	Buildings and infrastructure	239	11 (4.60%)	I unfortunately received a room with a bathroom that was adapted to the needs of the disabled, and which appeared very clinical
16	Cultural heritage	66	1 (1.52%)	[...] It is a little dark in the hotel. But this is most likely owed to the special architecture and monument protection. [...]
17	Environmentally preferable purchasing (food)	631	10 (1.58%)	Bland food with “too many“ organic elements, organic does not necessarily mean tofu [...]
20	Energy conservation	85	16 (18.82%)	[...] No air conditioning and not possible to open the windows on the hottest day of the year – probably the price we have to pay for sustainable living? [...]
21	Water conservation	26	5 (19.23%)	[...] What really bothered me was this annoying water-saving showerhead. You had to actively search for the water get to get wet [...]
22	Greenhouse gas emissions	49	11 (22.45%)	[...]Very noisy due to in-house power plant [...]
27	Biodiversity conservation	25	3 (12.00%)	[...] Unfortunately, a duck couple lives at the bathing platform and pollutes everything, which takes away the pleasure of swimming in the lake
28	Sustainability concept	522	8 (1.53%)	Too biased eco-socialist interpretation. Including Che Guevara counterfeit on the magazines. The right way is the Cuban way! Too much ideology, too little hotel [...]
29	Vegetarian/vegan food	317	6 (1.89%)	In the menu, out of three options, there were only 1 conventional menu (with meat) and 2 vegetarian menus. The buffet consisted of only vegetarian and vegan food, so it was completely without meat and fish. The hotel was labeled “Bio-Hotel”, but there was no indication of preference for vegetarians [...]
30	Allergies/intolerances (including food)	224	2 (0.89%)	[...] the hotel advertises to be suitable for allergy sufferers. However, this also means that you feel like in a hospital: linoleum floors, starched laundry without softeners [...]

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