PERCEPTIONS VERSUS PERFORMANCE IN HOTEL SUSTAINABILITY: Evidence from Expedia and Booking.com

Pre-publication for open peer review
4th November 2025

ABSTRACT

We analyzed 6,696 hotels across the world's top 100 city destinations, matching Expedia's customer-submitted eco-friendliness ratings with Booking.com's sustainability data (self-reported practices and third-party certifications). Result: eco-friendliness ratings are driven almost entirely by overall guest satisfaction, with sustainability indicators adding no meaningful explanatory power. In other words, "eco" ratings reflect how much guests liked their stay, not how sustainable the hotel is.

For industry, this means that certification and self-reporting currently have little effect on perceptions or satisfaction — they support compliance more than marketing. A single eco-rating remains a weak KPI and a noisy proxy for customer perceptions of sustainability performance. To close the perception gap, hotels and platforms must integrate visible, guest-relevant sustainability actions into the experience and communication flow, rather than relying on badges or back-of-house practices alone.

Authors:

Eva Martin-Fuentes, Universitat de Lleida, Spain
Juan-Pedro Mellinas, Universidad de Murcia, Spain
Cèsar Fernández, Universitat de Lleida, Spain
Xavier Font, University of Surrey, UK

Customer 'eco-friendliness' ratings ≠ self-reported or verified sustainability

- Expedia's customer-submitted eco-friendliness ratings are almost entirely explained by overall guest satisfaction, not by the sustainability actions (self-reported or third-party certified) listed on Booking.com. A single "eco" rating is therefore a weak KPI and a noisy proxy for real performance.
- This gap reflects how guests conflate service quality with environmental responsibility. Certification and reporting currently have limited influence on perceptions or satisfaction. To shift this, sustainability needs to be visible, relevant, and experientially integrated—something guests can notice and value, not just paperwork behind the scenes.

What hotels should do

- Do not stop at certification compliance. Focus on sustainable experience design: surface sustainability where it adds customer value and where guests can see and feel it.
- Make sustainability tangible in the guest journey: connect visible actions (e.g. refill stations, local sourcing, energy-saving features) to clear, simple explanations so guests can link them to their stay experience.
- Actively prompt guest recognition: highlight key sustainability actions at relevant touchpoints (check-in, in-room, checkout) and invite feedback, so ratings reflect noticed behaviors rather than hidden practices.

What platforms should do

- Don't over-rely on badges to nudge choice; combine certification with clear, guest-relevant sustainability messaging.
- Do not stop measuring customer-submitted eco-friendliness ratings. They are key to promoting customer awareness, even if they currently do not reflect certified practices.
- Track perceived eco-friendliness over time, to detect change as salience grows.
- Collaborate across platforms to align questions, messaging, and evidence standards so that sustainability signals are clearer, more consistent, and more credible for guests.

Perceptions versus performance in hotel sustainability: Evidence from Expedia and Booking.com

Abstract

This study investigates whether consumer ratings of hotel eco-friendliness reflect actual sustainability performance. Using data from 6,696 hotels in the world's 100 leading destinations, we compared Expedia's post-travel, customer-submitted eco-friendliness ratings with sustainability information reported on Booking.com, including both self-reported practices and third-party certifications. Support Vector Machine regression analysis shows that eco-friendliness ratings are explained almost entirely by overall guest satisfaction, with sustainability indicators contributing little explanatory power. This suggests that ratings conflate general service impressions with perceptions of environmental responsibility, limiting their value as measures of sustainability performance. While plausible explanations such as response biases and the limited salience of many certified practices warrant further research, our findings provide robust evidence that single survey items on eco-friendliness should be interpreted with caution. For platforms and policymakers, the results highlight the need to make sustainability cues more visible and directly tied to the consumer experience if ratings are to support informed choice.

Keywords: sustainability, satisfaction, certification, Booking.com, Expedia, halo effect

Research highlights

- Expedia eco-friendliness ratings capture guest impressions, not sustainability performance.
- Sustainability practices and certifications have little effect on perceived eco-friendliness.
- Platforms must validate and link sustainability cues more clearly to guest experiences.

Introduction

Much research has examined whether consumers understand and care about sustainability. While self-reported surveys consistently suggest they do (Han, 2021), the proportion of hotel reviews mentioning sustainability remains low (Pacheco et al., 2024; Gil-Soto et al., 2019). Suggested reasons include limited guest awareness of initiatives and stronger focus on tangible hotel features, or dissatisfaction with how efforts are communicated (Yi et al., 2018; Yu et al., 2017, Ettinger et al., 2021; Font et al., 2025).

Current thinking is that sustainability communication is more persuasive when timely and reliable. Yet certification displays, which should counter skepticism, have little impact on hotel choice (Assaker & O'Connor, 2023). TripAdvisor's discontinued GreenLeader program highlighted certified hotels, but Gil-Soto et al. (2019) found no link with review content. More recently, scholars suggest adding "eco-friendliness" to core review attributes (Mariani & Borghi, 2021) so providers gather specific feedback that eco-conscious consumers can use

to evaluate sustainability before booking (Mariani & Borghi, 2020). These assumptions remain untested.

Online satisfaction surveys capture experiences but are prone to response biases (Han & Anderson, 2020; Smironva et al., 2020). The halo effect means overall impressions shape trait judgments (Nicolau, Mellinas, & Martin-Fuentes, 2020b); cognitive ease refers to mental shortcuts (Kahneman, 2011); social desirability bias leads to socially acceptable answers (Nederhof, 1985); pseudo-opinion bias to responses without knowledge (Andersen et al., 2023); acquiescence to agreeing regardless of content (Kuru & Pasek, 2016); and automation to habitual rather than deliberate responses (Krosnick, 1991). This list is not comprehensive but illustrates why relying on consumer surveys for sustainability insights is problematic.

Another explanation for the weak certification–perception link is that many certified practices are not salient to guests. Research warns of "sustainability myopia," where providers emphasize credentials at the expense of meaningful experiences (Hanna et al., 2018). From a service-dominant logic perspective, sustainability value is co-created during service encounters, making abstract or back-of-house certifications less influential than visible practices (Font et al., 2021). Excessive or irrelevant information can also be perceived as greenwashing, reducing value and behavioral intentions (Font et al., 2025). Certifications may therefore fall into the "sin of irrelevance" (de Freitas Netto et al., 2020), highlighting truthful but unimportant attributes. Still, how sustainability is communicated matters: point-of-sale displays can affect consumer choice, but only when presented clearly and meaningfully (Grimmer et al., 2023).

Methodology

This study examines whether customer perceptions of eco-friendliness provide a reliable measure, focusing on hotels in the world's top 100 city destinations as ranked by Euromonitor (2023). This city-level approach ensures greater consistency than if countries or regions had been used.

We combined data from two sources. Both Expedia.com and Booking.com provide sustainability information about properties based on independent third-party certification. Booking.com also displays properties based on practices that are self-reported by properties. From Booking.com, we obtained information on sustainability practices classified into four levels: scores 1–3 represent self-reported practices, while score 4 indicates third-party certification. This data was downloaded in November 2023. Booking.com allowed us to contrast self-reported with independently verified practices, with over 25% of properties reporting sustainability information. Additional Booking.com variables included location, hotel identity, chain affiliation, price, hotel category (stars), overall score, and number of reviews. From Expedia.com, we collected customer review data in October 2024, including overall satisfaction ratings, four sub-ratings (property cleanliness, staff and service, property condition, and amenities), and the post-travel eco-friendliness customer rating introduced in autumn 2023, along with basic hotel

characteristics to cross-reference against Booking.com entries. Our final sample is 6,222 hotels that had more than 100 customer reviews in both Booking.com and Expedia.

We conducted a regression analysis of the eco-friendliness variable to assess its predictive quality against the other variables that define the model: hotel category or stars (s), rating (r), belonging to a chain (c), price (p), number of reviews (nr), and sustainability level (sl), aiming to identify possible bias effects. The regression analysis was performed using machine learning models based on Support Vector Machine, SVM (Vapnik, 1997). Because it incorporates non-linear kernels, SVM is well suited for classification and regression problems across diverse scenarios and often outperforms other methods.

Non-linear kernels apply some sort of transformation function to a linear classifier/ regressor. A linear SVM is based on determining a set of hyperplanes that optimally classifies a set of p n-dimensional points x_i, with 1<=i<=p. Kernels perform a transformation (k) over two points ($k(x_i, x_j)$) and then proceed to a linear classification. We applied support vector machine (SVM) regression, a method suitable for non-linear modelling, using a standard train-test-validation approach with optimized hyperparameters. We tested three kernel types: linear, polynomial with degree 2 and radial basis functions (RBF), each with its corresponding tune parameters.

Our first task before determining the regression models is a hyperparameter optimisation for each kernel type. We have tuned two parameters, 1) the regularisation parameter (C), which weights the loss function when optimizing the penalty, and 2) the epsilon parameter, which determines the no penalty range during the training process. The dataset consists of 6,222 items, which we split as follows: 60% for training the models, 20% for testing and hyperparameter optimization, and the remaining 20% was held out as a validation set for final performance evaluation. All variables were normalised, allowing comparability.

For polynomial and RBF kernels, the gamma parameter (also known as kernel coefficient) is set to the inverse number of features. As model evaluation metrics we take the Mean Squared Error (MSE), which is the average squared difference between observed (y) and predicted values ($\hat{y}$), defined as:

$$MSE = \frac{\sum_{i=1}^{n}(y - \hat{y})^2}{n}$$

with n being the number of samples.

Next, the coefficient of determination (rating, R^2) explains the proportion of the predicted variable that is explained from the predictor variables. It is defined as:

$$R^2 = 1 - \frac{MSE}{var(y)}$$

with $var(y)$ being the variance of y, defined as:

$$var(y) = \frac{\sum_{i=1}^{n}(y - \overline{y})^2}{n - 1}$$

where $\overline{y}$ is the mean of y.

Under these settings, Table 1 shows the MSE and rating values for eco-friendliness. Linear and RBF kernels show a similar performance, much higher than polynomial degree 2 kernels. To determine the contribution of each predictor variable to the evaluation metrics, we conduct a feature importance analysis by permuting, one by one, the predictor variables for the linear kernel.

Table 1: MSE and R^2 (Rating) values for eco-friendliness prediction with predicting variables: r, s, c, nr, p, sl

	Kernel		
	Linear C: 0.3	***Polynomial C: 1.2***	***RBF C: 4.0***
MSE	0.23	43.375	0.258
R^2 (Rating)	0.794	-37.879	0.768

Table 2 shows the metric values when permuting a predictor variable. Clearly, guest satisfaction rating (*r*) is the predictor variable that by far explains most of the correlation. We can conclude that the remaining predictors have a low impact on explaining eco-friendliness ratings.

The process of permuting a predictor variable is equivalent to removing its influence from the model, allowing us to observe the extent to which each variable contributes to the prediction of eco-friendliness. When the sustainability level (*sl*) variable is permuted (i.e., removed), the MSE increases to 0.232 (Table 2). By comparison, the baseline MSE for the linear kernel is 0.23 (Table 1), meaning that the sustainability level contributes only 0.002 to the prediction accuracy. Otherwise, it can be observed that permuting rating (*r*) clearly degrades the performance's model.

Given that eco-friendliness ratings range from 2 to 10, this small difference indicates that the sustainability level (*sl*) has a minimal impact on how users perceive eco-friendliness. Its predictive power is comparable to other low-impact variables, such as hotel category (*s*), chain affiliation (*c*), price (*p*), or number of reviews (*nr*). This result suggests that sustainability certifications have a negligible influence on guests' perceptions of a hotel's environmental performance, which is an unexpected result, particularly for sustainability level (*sl*).

Table 2: MSE and R^2 (Rating) values for eco-friendliness prediction permuting a predictive variable. Kernel: Linear. C=0.3

	Variable permuted					
	r	**sl**	**s**	**c**	**p**	**nr**
MSE	2.042	0.232	0.23	0.231	0.232	0.23
R^2 (Rating)	-0.83	0.792	0.794	0.793	0.792	0.794

To test whether combinations of variables could improve predictive accuracy, we ran models incorporating pairs of predictors (e.g. satisfaction + stars, satisfaction + price) as can be observed in Table 3. The addition of secondary variables, in Table 4, did not improve the explanatory fit beyond the baseline satisfaction model. In some cases, the R^2 (Rating) marginally decreased, further underlining the limited role of structural or sustainability attributes. These refinements confirm that the earlier findings are not artefacts of unnormalised inputs or limited validation protocols.

Table 3. Selected one-variable correlation with eco-friendliness rating (R)

Predictor variable	MSE	R^2 (Rating)
Satisfaction rating (r)	0.230	**0.772**
Sustainability level (sl)	0.982	0.028
Hotel category (stars) (s)	0.858	0.151
Chain affiliation (c)	1.013	-0.002
Price (p)	0.877	0.132
Number of reviews (nr)	1.074	-0.063

Table 4. Selected two-variable correlations with eco-friendliness rating (R)

Variable pair	MSE	R^2 (Rating)
Satisfaction + Stars	0.234	0.768
Satisfaction + Chain affiliation	0.226	0.777
Satisfaction + Price	0.230	0.772
Stars + Price	0.797	0.211
Stars + Sustainability level	0.837	0.172

Lastly, to double check the negligible impact of variables, except for guest satisfaction rating (*r*), in eco-friendliness prediction, we performed two additional regression analyses.

First, the data was split into two sets: self-reported and certified sustainability practices. For both sets, the best regression model is polynomial with regularization parameters (*C*): 0.1 and 0.4 respectively. The model gave MSE=0.27 and R^2 (Rating)=0.736 for self-reported sustainability, and MSE=0.118 and R^2 (Rating)=0.731 for certified sustainability. Table 5 rows 5.1. and 5.2 show the MSE and R^2 (Rating) values of both models when permuting their corresponding variables.

Second, we split the data based on its chain affiliation. The best regression model was linear for non-affiliated hotels and polynomial for affiliated hotels, with regularization parameters (C): 1.3 and 0.2 respectively. The model gave MSE=0.245 and R^2 (Rating)=0.798 for non-chain affiliated hotels, and MSE=0.211 and R^2 (Rating)=0.734 for chain-affiliated hotels. Table 5 rows 5.3. and 5.4. show the MSE and R^2 (Rating) values of both models when permuting their corresponding variables.

Table 5: MSE and R^2 (Score) values when permuting predictor variables

Subsample	***Kernel (C)***	***Variable***	***MSE***	***R^2 (Rating)***
5.1. Self-reported sustainability	Polynomial (0.1)	r	2.018	-0.809
		s	0.241	0.784
		c	0.236	0.788
		p	0.248	0.778
		nr	0.240	0.785
5.2. Independently certified	Polynomial (0.4)	r	1.820	-0.632
		s	0.297	0.734
		c	0.050	0.726
		p	0.307	0.725
		nr	0.307	0.725
5.3. Non-chain affiliated	Linear (1.3)	r	1.825	-0.636
		s	0.246	0.779
		p	0.248	0.778
		nr	0.240	0.785
		sl	0.246	0.779
5.4. Chain affiliated	Polynomial (0.2)	r	2.067	-0.853
		s	0.236	0.788
		p	0.237	0.787
		nr	0.236	0.789
		sl	0.237	0.787

The analysis shows that, except for overall customer satisfaction rating (r), no predictive variable significantly explains eco-friendliness. This result holds true for the entire dataset as well as for subsets split by self-reported or certified sustainability, and for hotels with or without chain affiliation. As graphical evidence of how eco-friendliness is correctly predicted, Figure 1 plots its sampled and predicted values for an SVM regression with the linear kernel. The lower figure plots a zoomed in view. Figure 2 plots the same results as Figure 1 but ordering the predicted and sampled values improves the visualization of the predicted error.

Figure 1: Eco-friendliness prediction with linear kernel model

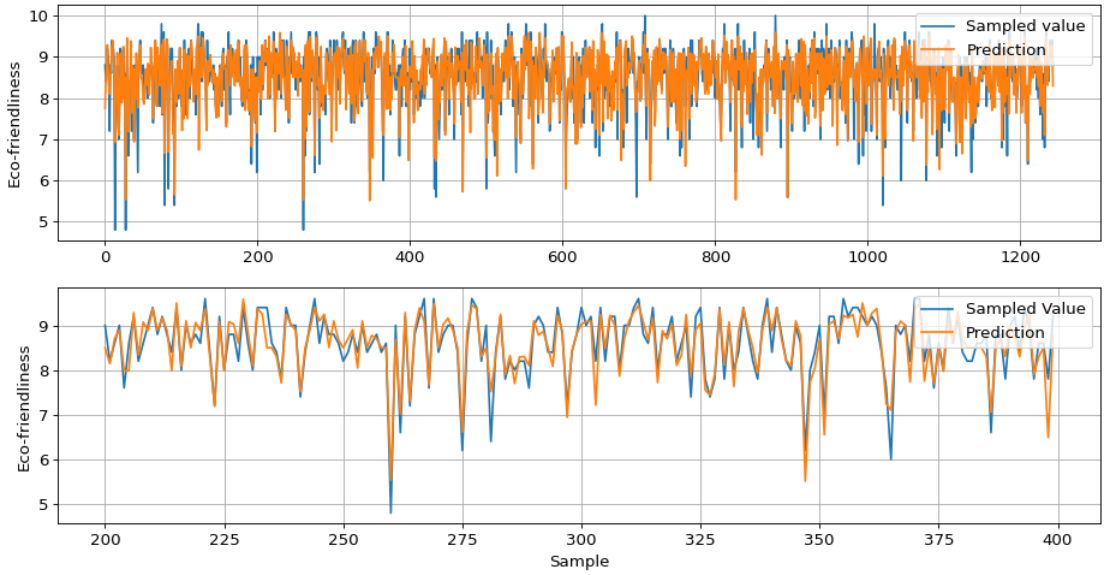
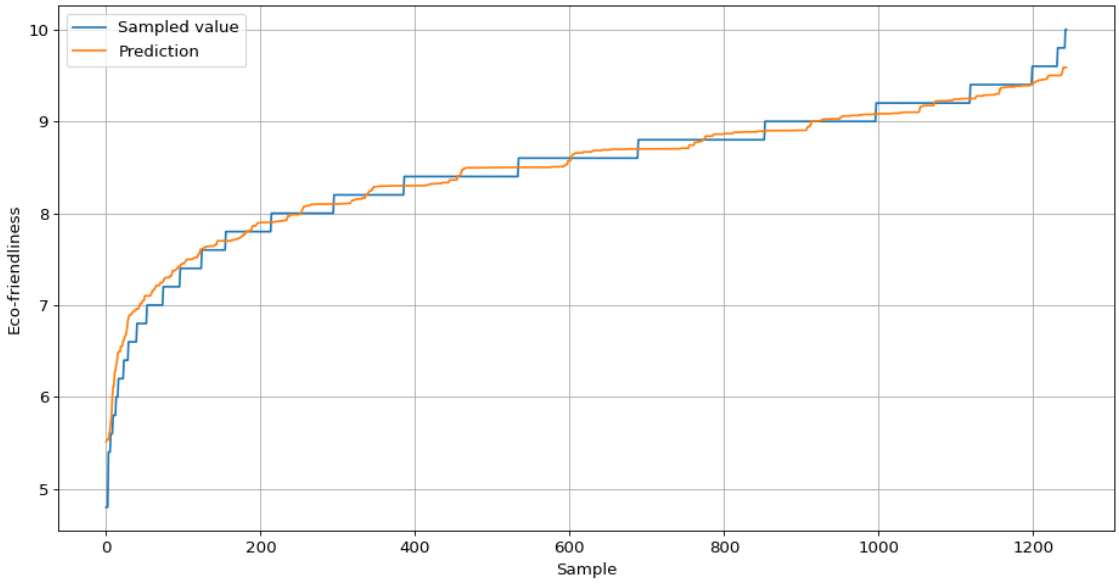


Figure 2: Eco-friendliness prediction with linear kernel model and ordered samples



Conclusions

Our analysis shows that overall guest satisfaction is the only consistent predictor of perceived eco-friendliness. Neither reported sustainability practices nor independent certifications explain variation in eco-friendliness ratings, and this holds across all hotel subgroups and model specifications. In other words, Expedia's post-travel, customer-submitted eco-friendliness ratings function primarily as a proxy for general satisfaction rather than a measure of sustainability performance. The dominance of satisfaction

illustrates a halo effect and cognitive ease (Nicolau et al., 2020; Kahneman, 2011): guests conflate overall service quality with environmental responsibility. This is the only conclusion directly supported by our dataset, and it suggests that a single survey item on eco-friendliness (as proposed by Mariani & Borghi, 2021) is insufficient to distinguish informed evaluations from impressionistic responses.

Beyond this, there are plausible but untested explanations. Response biases such as social desirability (Nederhof, 1985), pseudo-opinions (Andersen et al., 2023), acquiescence (Kuru & Pasek, 2016) or response automation (Krosnick, 1991) may help explain why consumers provide ratings without knowledge of sustainability practices. Similarly, prior research indicates that many sustainability practices are either invisible to guests (Hanna et al., 2018; Font et al., 2021) or perceived as irrelevant to their stay (Font et al., 2025). While our findings are consistent with these interpretations, these mechanisms were not directly tested here. Together, these explanations highlight promising avenues for future research.

These findings highlight the limits of current platform approaches. Unless sustainability information is made more visible and tied to meaningful aspects of the guest experience, eco-friendliness ratings will continue to reflect general impressions of service quality rather than actual environmental performance (Grimmer et al., 2023; Font et al., 2021; 2025). Stronger validation, clearer communication, and integration of sustainability into the service encounter are therefore essential if platforms wish to align consumer perceptions with genuine sustainability outcomes. Repeating this study periodically would help platforms track whether traveler awareness and responses evolve over time, ensuring that industry strategies remain aligned with both regulatory expectations and consumer behavior.

Impact statement

The results highlight the need to integrate “eco-friendliness” more visibly into the consumer experience, since current ratings mainly reflect overall satisfaction rather than verified sustainability practices. Certification and reporting therefore have limited influence on perceptions of environmental performance. This raises risks for platforms if certification is treated primarily as a marketing signal, because it does not currently translate into higher satisfaction or stronger eco-friendliness ratings. In parallel, the EU’s forthcoming Empowering Consumers for the Green Transition Directive will require that all environmental claims be independently verified. While our study did not evaluate regulation directly, the findings suggest that, in its current form, certification may be more effective as a due diligence mechanism for compliance than as a consumer communication tool.

Statement of use of AI

The authors used ChatGPT (OpenAI) to assist with language editing of the manuscript. All content was subsequently reviewed and revised by the authors, who take full responsibility for the final manuscript.

Acknowledgements

This study was funded by the Spanish Ministry of Science and Innovation Spanish MCIN/AEI/10.13039/501100011033/ FEDER, UE within the RevTour project [Grant Id. PID2022-138564OA-I00] "Use of online reviews for tourism intelligence and for the establishment of transparent and reliable evaluation standards".

References

Andersen, H., Mayerl, J., Wolter, F., & Junkermann, J. (2023). Pseudoopinions in online surveys: Evidence to recontextualize the imputed meaning hypothesis. Survey Research Methods, 17(2), 205–217.

Assaker, G., & O'Connor, P. (2023). The importance of green certification labels/badges in online hotel booking choice: A conjoint investigation of consumers' preferences pre and postCOVID19. Cornell Hospitality Quarterly, 64(4), 401–414.

de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. Environmental Sciences Europe, 32(1), 19.

Ettinger, A., GrabnerKräuter, S., Okazaki, S., & Terlutter, R. (2021). The desirability of CSR communication versus greenhushing in the hospitality industry: The customers' perspective. Journal of Travel Research, 60(3), 618–638.

Euromonitor International (2023) Top 100 City Destinations Index 2023 | Market Research Report https://www.euromonitor.com/top-100-city-destinations-index-2023/report

Font, X., Andreu, L., Mattila, A. S., & Aldas-Manzano, J. (2025). Sustainability information overload: Its effect on customers' greenwashing perceptions, perceived value, and behavioral intentions. Journal of Hospitality and Tourism Management, 62, 196–204.

Font, X., English, R., Gkritzali, A., & Tian, W. S. (2021). Value co-creation in sustainable tourism: A service-dominant logic approach. Tourism Management, 82, 104200.

Gil-Soto, E., Armas-Cruz, Y., Morini-Marrero, S., & Ramos-Henríquez, J. M. (2019). Hotel guests' perceptions of environmental friendly practices in social media. International Journal of Hospitality Management, 78, 59–67.

Grimmer, M., Kilburn, A. P., & Miles, M. P. (2023). When and how does communicating sustainability at the point of sale affect consumer choice? Journal of Sustainable Tourism, 31(7), 1524–1542.

Han, H. (2021). Consumer behaviour and environmental sustainability in tourism and hospitality: A review of theories, concepts, and latest research. Journal of Sustainable Tourism, 29(9), 1537–1554.

Han, S., & Anderson, C. K. (2020). Customer motivation and response bias in online reviews. Cornell Hospitality Quarterly, 61(2), 142–153.

Hanna, P., Font, X., Scarles, C., Weeden, C., & Harrison, C. (2018). Tourist destination marketing: From sustainability myopia to memorable experiences. Journal of Destination Marketing & Management, 9, 36–43.

Kahneman, D. (2011). Thinking, fast and slow. Farrar, Straus and Giroux.

Krosnick, J. A. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys. Applied Cognitive Psychology, 5(3), 213–236.

Kuru, O., & Pasek, J. (2016). Improving social media measurement in surveys: Avoiding acquiescence bias in Facebook research. Computers in Human Behaviour, 57, 82–92.

Mariani, M., & Borghi, M. (2020). Environmental discourse in hotel online reviews: A big data analysis. Journal of Sustainable Tourism, 29(5), 829–848.

Mariani, M., & Borghi, M. (2021). Are environmental-related online reviews more helpful? A big data analytics approach. International Journal of Contemporary Hospitality Management, 33(6), 2065–2090.

Nederhof, A. J. (1985). Methods of coping with social desirability bias: A review. European Journal of Social Psychology, 15(3), 263–280.

Nicolau, J. L., Mellinas, J. P., & Martín-Fuentes, E. (2020). The halo effect: A longitudinal approach. Annals of Tourism Research, 83, 102938.

Pacheco, L., Ramazanova, M., Carvalho, J. M. S., Nogueira, S., & Durão, M. (2024). How do guests evaluate eco-certified hotels? An analysis of guests' reviews of Portuguese hotels. Tourism and Hospitality Research.

Smironva, E., Kiatkawsin, K., Lee, S. K., Kim, J., & Lee, C.-H. (2020). Self-selection and non-response biases in customers' hotel ratings – a comparison of online and offline ratings. Current Issues in Tourism, 23(10), 1191–1204.

Yi, S., Li, X., & Jai, T. M. (2018). Hotel guests' perception of best green practices: A content analysis of online reviews. Tourism and Hospitality Research, 18(2), 191–202.

Yu, Y., Li, X., & Jai, T. M. (2017). The impact of green experience on customer satisfaction: Evidence from TripAdvisor. International Journal of Contemporary Hospitality Management, 29(5), 1340–1361.