

When Sustainability Signals Build Hotel Brand Equity: The Moderating Roles of Brand Familiarity and Practice Awareness

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Abstract

Drawing on receiver-side signaling theory, this study examines how guests' perceived sustainability (PS) shapes hotel brand awareness (BAW) and brand equity (BEQ), and whether brand familiarity (BFAM) and practice awareness (PRAW) condition those relationships. Survey data from 1,029 U.S. guests of five major hotel chains (Hilton, Hyatt, Marriott, MGM, and Wyndham) were analyzed in Mplus 8.4 using a three-factor confirmatory factor analysis and latent moderated structural equations (LMS). The indirect effect was verified with 5,000 bias-corrected bootstrap draws. Perceived sustainability raises both BAW and BEQ, with BAW partially mediating the PS-BEQ relationship. Brand familiarity strengthens PS-to-BAW but weakens PS-to-BEQ, a dual-sign moderation pattern. Practice awareness strengthens PS-to-BEQ without affecting PS-to-BAW. The pattern holds across measurement invariance checks, an education control, and an unmeasured latent method construct, though PS-to-BAW magnitudes shift enough to warrant caution about effect-size precision. From a managerial perspective, hotels should tailor sustainability communication by audience: less-familiar brands gain more equity from sustainability perceptions, whereas familiar brands retain awareness gains but show smaller direct equity updates. Communication should pair visible credibility cues with concrete evidence of practice, and practice noticing should be instrumented on the guest-feedback side. The paper extends receiver-side signaling theory to hospitality sustainability branding and shows that moderation in a mediation chain can change the sign across paths.

Keywords

Operations Management, ESG, Sustainability, Sustainable Consumer Behavior, Service.

1. Introduction

Sustainability in hotels is fundamentally an operations-management decision domain, spanning energy and water systems, waste handling, supplier and procurement choices, service-delivery protocols, and capital investment in green retrofits. The brand-equity return on those operational decisions, however, depends on whether guests notice and credit the practices that result, making the consumer-side translation of operational sustainability a central question in service operations strategy rather than a peripheral marketing concern. Hotels increasingly present sustainability as a customer-facing brand attribute rather than a purely back-of-house operating choice. Major chains publicize carbon

commitments, display certifications, embed eco-filters in booking interfaces, and describe operational practices across the guest journey. Because those disclosures are now widespread rather than exceptional, guests encounter competing sustainability claims from multiple brands, and the critical question is no longer whether hotels communicate sustainability but whose sustainability perceptions convert into brand value. The hospitality branding literature offers mixed evidence on this conversion. Some studies find positive downstream effects through trust, value, or intention, whereas others highlight skepticism and greenwashing concerns that interrupt the path from practice to reputation. What remains underdeveloped is a model that specifies the signal, identifies the receiver-side conditions that change how the signal is interpreted, and connects those conditions to brand equity in one structural framework.

Signaling theory provides a useful lens because it centers the information gap between firm and consumer. In the classical formulation, insiders hold private information about quality and send observable signals that would be costly for lower-quality actors to mimic (Spence 1973). Recent work argues that the signal alone is not enough, because receivers differ in attention, prior schema, and decoding capacity, and those differences shape what the signal can accomplish (Connelly et al. 2025). A hospitality account of sustainability signaling therefore has to explain not only what hotels communicate, but also how different guests receive, interpret, and integrate that information into brand judgments.

This study applies that receiver-side logic to hotel branding. Perceived sustainability (PS) is the signal as interpreted by the guest, brand awareness (BAW) is the proximal cognitive outcome, and brand equity (BEQ) is the broader evaluative outcome. Brand familiarity (BFAM) represents prior schema, and practice awareness (PRAW) captures whether guests noticed concrete sustainability practices on-site. Six hypotheses are tested with survey responses from 1,029 U.S. hotel guests across five major brands. The base mediation was estimated with robust maximum likelihood (MLR), the indirect effect was re-estimated with 5,000 bias-corrected bootstrap draws under maximum likelihood, and the moderated paths were estimated with LMS on a matched sample of 1,018.

1.1 Objectives

The paper makes three contributions. First, it brings signaling theory into hospitality sustainability branding in a way that keeps the receiver, not only the signal, at the center of the explanation (Spence 1973; Connelly et al. 2025). Second, it documents a dual-sign familiarity pattern in which the same sustainability perception strengthens awareness formation but weakens direct equity updating among more familiar consumers. Third, it shows that practice awareness operates differently from familiarity: it does not change the salience stage, but it does strengthen the conversion of sustainability perceptions into brand equity. Together, these findings show why moderators in a mediation chain should be theorized path by path rather than treated as uniform amplifiers.

The remainder of the paper is organized as follows. Section 2 develops the theoretical background and situates the constructs within receiver-side signaling theory. Section 3 develops the hypotheses. Section 4 describes the data, measures, and analytical approach. Section 5 reports the retained measurement model, mediation results, moderation tests, and robustness checks. Sections 6 through 9 discuss the findings, derive implications, and outline limitations, future research, and conclusions.

2. Literature Review

2.1 Signaling Theory and the Receiver's Role

Signaling theory begins with an asymmetric-information problem. An organization holds private information about its own quality. A consumer cannot observe that quality directly. The organization communicates quality by taking a costly action that a lower-quality organization would not rationally mimic. If the signal is detected and decoded, the information gap closes and the consumer updates beliefs (Spence 1973). The framework was imported from labor economics into marketing and management in the late 1980s and has since accumulated applications in corporate governance, entrepreneurship, consumer perception, and, more recently, sustainability communication.

Connelly et al. (2025) organize modern signaling research around four parts: signaler, signal, receiver, and context. Their review argues that early applications in business research privileged the signaler and the signal while treating receivers as a homogeneous population. Connelly and colleagues argue that receiver heterogeneity is not a nuisance factor but a first-order theoretical variable, and that receivers vary in attention, decoding capability, and prior schema. The empirical model in this study operationalizes two of those receiver-side conditions directly: brand familiarity captures prior schema, because guests who already know a brand hold a denser stock of stored information against

which new sustainability cues are judged, and practice awareness captures the extent to which guests noticed concrete sustainability practices on-site. The same sustainability signal can therefore produce different downstream effects depending on what the guest already knows and what the guest actually recognized during the stay.

2.2 Sustainability as a Signal, and the Credibility Boundary

Perceived sustainability, as operationalized here, is the guest's evaluative belief that the hotel genuinely engages in environmental and social responsibility practices. The hotel's certifications, carbon commitments, and practice disclosures are inputs into the signal; whether the guest processes those inputs, and with what credibility, is the output. In Spence's (1973) terms, sustainability investment is informationally costly precisely because the fixed and variable costs of genuine environmental retrofits exceed the costs of surface claims, which is what makes sustainability a candidate separating signal rather than a low-cost shared claim.

Credibility is the first boundary condition. Environmental sincerity can convert green claims into favorable responses, but skepticism and suspected greenwash can also block persuasion (Grimmer and Woolley 2014; Schmuck et al. 2018; Khan et al. 2022; Waris and Suki 2025). In signaling terms, skepticism raises the credibility threshold. The present study assumes that threshold is met often enough for the average main effects to emerge, while recognizing that the strength of the equity response should depend on whether guests notice concrete practices that make the signal more tangible.

Recent hospitality research provides useful empirical anchors for this argument. Nimri et al. (2022) show that green-hotel message framing alters travelers' behavioral intentions. Nosrati et al. (2025) show that environmentally friendly hotels generate value perceptions that carry forward into downstream responses. Esawe et al. (2024) show that sustainable innovation practices reduce consumer resistance when they are tied to co-created value. Raza et al. (2023) likewise connect hotels' sustainability initiatives to green consumer responses. Taken together, this literature suggests that visible and interpretable practices matter because they make sustainability claims easier to process and harder to dismiss.

2.3 Brand Awareness as the Proximal Cognitive Destination

Brand awareness is the first cognitive destination of a detected signal. Keller (1993, 2013) places awareness at the base of customer-based brand equity because later associations and evaluations cannot develop without prior recognition. In online hotel search, sustainability badges and green filters can increase exposure by making eligible hotels more visible in the choice set (Xiang et al. 2015). Eye-tracking evidence also shows that distinctive visual cues attract attention even when travelers are simultaneously processing price and quality information (Espigares-Jurado et al. 2020). Sustainability cues should therefore raise awareness through both cognitive distinctiveness and platform visibility.

2.4 Brand Equity as the Terminal Outcome

Customer-based brand equity is defined as the differential effect of brand knowledge on consumer response to the marketing of the brand (Keller 1993, p. 8). In Keller's framework, brand knowledge has two components: brand awareness, which concerns whether the brand comes to mind in relevant choice situations, and brand image, which is the constellation of associations linked to the brand in memory. Brand equity in this study therefore refers to the broader evaluative component, holding awareness separate so that it can be modeled as a distinct antecedent and mediator rather than as an intermixed part of the outcome.

Building on Yoo et al. (2000), Pappu et al. (2005), and Buil et al. (2013), the retained BEQ factor aggregates eighteen indicators drawn from favorable associations, perceived quality, loyalty intention, and brand imagery. A broader reflective operationalization is appropriate because a credible sustainability signal should update more than recognition alone: it can also shape quality judgments, affective attachment, and loyalty-relevant beliefs that are central to hotel brand equity (Nam et al. 2011; El-Adly et al. 2024; Tran et al. 2024). Consistent with customer-based brand equity theory, these facets function as correlated indicators of a superordinate evaluative factor rather than as independent outcomes, so modeling them as a single reflective latent preserves the construct's intended breadth while supporting parsimony in the structural model. Discriminant validity with BAW is assessed empirically through heterotrait-monotrait (*HTMT*) ratios and reported in the results.

2.5 Brand Familiarity and Practice Awareness as Receiver Moderators

Brand familiarity affects both stages of the signaling process, but not in the same way. Familiarity provides retrieval cues that help a new signal connect to an already established brand node, which should strengthen the movement from PS to awareness (Campbell and Keller 2003). At the same time, familiar brands are evaluated against a denser stock of stored beliefs, so the marginal informational contribution of any new sustainability cue to broader equity updating is smaller. This asymmetry leads to the prediction that familiarity strengthens PS to BAW while weakening PS to BEQ. A competing prediction, grounded in brand-congruity logic, is that familiarity should amplify rather than attenuate the equity update because a new attribute finds a well-organized associative network into which to integrate (Keller 1993). The present study treats the receiver-side prediction as the focal hypothesis and evaluates the competing prediction against the observed pattern in the discussion. Wang et al. (2024) offer empirical support for the receiver-side view by showing that green-hotel intention can be stronger when brands feel newer or less familiar to young adults.

Practice awareness is treated more narrowly than an abstract literacy construct. In the analytical model it is captured by a count of concrete on-site sustainability practices that the respondent reported noticing (for example, visible recycling provision, linen or towel reuse programs, and in-room energy or water conservation cues). Guests who notice more practices should be better able to translate a general sustainability perception into a substantive brand judgment because the signal is supported by visible evidence. That logic implies a stronger PS-to-BEQ path for practice-aware guests, whereas no comparable moderation is expected on the awareness path because simple salience does not require the same level of interpretive support.

3. Hypothesis Development

The hypotheses assume the sustainability signal is credible on average in the present sample. Where skepticism overwhelms the signal, the chain breaks at the first stage and the hypotheses do not apply. The credibility assumption is tested indirectly by the PRAW moderation and examined again in the discussion.

3.1 Perceived Sustainability and Brand Awareness

Distinctiveness theory predicts that attributes that depart from expectation receive disproportionate cognitive allocation and are encoded more readily (Brewer 1991; Markus 1977). Sustainability has become a common feature of hotel marketing rather than an atypical one, so the distinctiveness argument is not that sustainability itself is rare but that credible and concrete sustainability cues still stand apart from the routine information set of location, amenities, and price. Online search environments can amplify that residual distinctiveness by ranking eco-certified properties more visibly in filtered results (Xiang et al. 2015), and eye-tracking and message-framing evidence suggests that environmental cues can attract attention and reshape downstream response patterns (Espigares-Jurado et al. 2020; Nimri et al. 2022). Accordingly, H1 predicts that perceived sustainability is positively related to brand awareness.

H1. Perceived sustainability is positively related to brand awareness.

3.2 Perceived Sustainability and Brand Equity

A credible sustainability signal should also affect brand equity directly. One mechanism is value congruence, because guests may perceive a closer fit between the brand and their own priorities when hotel practices align with environmental or social concerns (Bhattacharya and Sen 2003; Dang-Van et al. 2024). A second mechanism is experiential reinforcement, because sustainability cues are encountered across multiple touchpoints rather than through a single isolated claim (Schmitt 1999). Those mechanisms imply an equity effect over and above any awareness-mediated path.

H2. Perceived sustainability is positively related to brand equity.

3.3 Brand Awareness and Brand Equity

Brand awareness should contribute to brand equity because awareness lowers the activation threshold for favorable associations and increases the likelihood that positive meanings will be retrieved in later choice situations (Keller 1993). Recent hospitality and adjacent branding studies also document awareness-to-equity transmission in settings where brand meaning is built cumulatively rather than instantaneously (Tran et al. 2024; Ranjbaran et al. 2022).

H3. Brand awareness is positively related to brand equity.

3.4 Mediation

Taken together, H1 through H3 imply that the effect of perceived sustainability on brand equity should operate both directly and indirectly through brand awareness. The indirect path is theoretically informative because it indicates whether sustainability works partly by improving salience before it shapes broader evaluation.

H4. Brand awareness positively mediates the relationship between perceived sustainability and brand equity.

3.5 Moderation by Brand Familiarity

Brand familiarity should produce opposite signs across the two structural paths because it helps a signal attach to an existing brand node while simultaneously reducing the marginal informational value of that same signal for broader brand evaluation. On the awareness side, familiarity supplies retrieval cues that allow a new sustainability perception to activate an already established brand node more efficiently (Campbell and Keller 2003). On the equity side, three considerations converge on attenuation rather than amplification. First, anchoring-and-adjustment logic implies that familiar brands are evaluated against a well-entrenched prior, so new attribute information produces smaller updates than it does for less-entrenched priors (Chaiken and Maheswaran 1994). Second, expectancy-congruity research suggests that attributes that simply confirm what guests already expect of a brand contribute less to evaluative updating than attributes that resolve ambiguity (Heckler and Childers 1992). Third, the received signal's marginal informational content is lower when receivers already hold a dense stock of prior beliefs, consistent with the receiver-side refinement of signaling theory (Connelly et al. 2025). Together, these arguments imply that familiarity asymmetrically helps the awareness path while weakening the direct equity path, and this path-specific prediction is offered in preference to a pure congruity account, which would imply uniform amplification across paths rather than the staged structure of customer-based brand equity.

H5a. Brand familiarity strengthens the positive relationship between perceived sustainability and brand awareness.

H5b. Brand familiarity weakens the positive relationship between perceived sustainability and brand equity.

3.6 Moderation by Practice Awareness

Practice awareness should matter at the stage where sustainability perceptions are converted into evaluative meaning rather than at the stage where the signal is merely noticed. Elaboration Likelihood Model logic is useful here: salience is largely driven by peripheral-route cues that do not require evidence to become memorable, whereas broader brand judgments draw on central-route processing that is more responsive to specific, disconfirmable substantiation (Petty and Cacioppo 1986). Guests who recognize more concrete practices therefore have tangible evidence that supports positive brand judgments, but that recognition need not change whether the brand enters awareness in the first place.

H6. Practice awareness strengthens the positive relationship between perceived sustainability and brand equity (Figure 1).

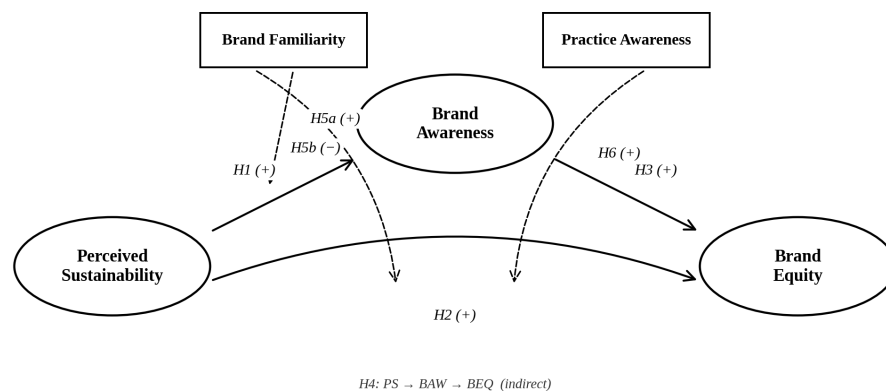


Figure 1. Conceptual moderated-mediation model

Figure 1. Conceptual moderated-mediation model. Ovals represent latent constructs. Rectangles represent observed moderators. Solid arrows represent direct structural paths (H1–H3). Dashed arrows represent moderating paths (H5a, H5b, H6). H4 is the indirect effect of PS on BEQ through BAW.

4. Methods

4.1 Research Design and Sample

Data were collected through an online survey of U.S. adult consumers who had stayed with one of five major hotel brands, Hilton, Hyatt, Marriott, MGM, and Wyndham, within the prior twelve months. The initial raw sample contained 1,149 responses recruited through Amazon Mechanical Turk. Because MTurk samples are known to warrant stringent quality controls, the following procedures were applied in sequence: (a) an eligibility screener that required verified recent stay at one of the five focal brands, (b) three embedded attention checks distributed across the instrument, with failure on any check triggering removal, (c) a speeder threshold based on completion time below one-third of the median, (d) within-respondent response-variability screening that removed patterns suggestive of straight-lining, and (e) IP-address filtering that limited responses to U.S.-based IPs and removed duplicates (Hauser et al. 2019). After these screens, the retained analytical sample for the measurement model and base mediation was $N = 1,029$ (an exclusion rate of 10.4 percent from the raw sample). The moderation and robustness models were estimated on a rebuilt matched file used for the latent-interaction specifications; eleven further cases with non-usable responses on the BFAM and PRAW measures were excluded from this file, yielding $N = 1,018$ for those models. Table 1 reports the respondent profile.

The five brands span upper-midscale to luxury segments and include a casino-resort operator (MGM) whose brand architecture differs from the three large full-service chains (Hilton, Hyatt, Marriott) and the upper-midscale franchise operator (Wyndham). Pooling is appropriate for the focal research questions because the constructs of interest are receiver-side belief structures (PS, BFAM, PRAW) rather than brand-specific attribute scores, and because the study aims to document a structural pattern that generalizes across major U.S. chain-scale brands rather than to compare brands against one another. Brand heterogeneity is nevertheless acknowledged as a scope condition, and implications are framed at the level of brand-familiarity segments rather than specific brands.

Table 1. Respondent demographic profile ($N = 1,029$)

Characteristic	Category	n	%
Gender	Male	595	57.8
	Female	434	42.2
Age	18–29	179	17.4
	30–39	456	44.3
	40–49	257	25.0
	50–59	93	9.0
	60 and above	44	4.3
Ethnicity	White / Caucasian	899	87.4
	Asian	58	5.6
	African American / Black	46	4.5
	Hispanic / Latino	18	1.7
	Other	8	0.8
Education	High school or less	34	3.3
	Some college	143	13.9
	Bachelor's degree	614	59.7
	Master's degree	210	20.4
	Doctoral / Professional	28	2.7
Annual income (USD)	Under 25,000	55	5.3
	25,000–49,999	349	33.9

	50,000–74,999	423	41.1
	75,000–99,999	137	13.3
	100,000 and above	65	6.3
Employment	Employed full-time or part-time	998	97.0
	Not employed	31	3.0
Marital status	Married	832	80.8
	Not married	197	19.2

Notes. Percentages are computed on the analytic sample (N = 1,029). Rounding may produce totals that differ from 100% by 0.1 percentage point.

4.2 Measures

All focal constructs were measured with seven-point Likert-type items, except the practice-awareness count used in the moderation model. Perceived sustainability (PS) was originally measured with seven items adapted from Chung (2020) and Hartmann and Apaolaza-Ibanez (2012); the first item (PS1) was retained during exploratory analysis but dropped during CFA refinement because it weakened construct coherence, showing the weakest inter-item associations in the PS battery. The retained six-item scale (PS2 through PS7) preserves the intended content breadth across environmental footprint, resource use, transparent communication, local initiatives, long-term commitment, and ethical conduct.

Brand awareness (BAW) was represented by five anchor indicators retained from the broader customer-based brand equity battery: BA1 (recognition), PQ1 (perceived quality anchor), HBA1 (hotel brand association anchor), BL1 (loyalty anchor), and BI1 (brand imagery anchor). This composition reflects a deliberate conceptual choice: BAW is treated as a cognitively accessible, evaluation-ready stance toward the brand rather than as pure unaided recall. The underlying rationale follows Keller's (1993, 2013) observation that awareness in a mature consumer market is not purely episodic: repeated exposure establishes a readiness-to-evaluate that includes thin affective and quality-adjacent content. The construct can therefore be read as brand salience anchored by recognition rather than as unaided recall in the narrowest sense. Discriminant validity from the BEQ factor is supported by the heterotrait-monotrait (*HTMT*) ratios reported below.

Brand equity (BEQ) was modeled as an 18-indicator reflective latent construct spanning favorable associations, perceived quality, loyalty intention, and brand imagery. The reflective specification follows the customer-based brand equity tradition (Yoo et al. 2000; Pappu et al. 2005; Buil et al. 2013), in which these facets behave as correlated manifestations of a superordinate evaluative stance toward the brand. A higher-order specification was also estimated for comparison during refinement; the single first-order factor was retained because it achieved comparable fit with fewer parameters and preserved the intended theoretical breadth of the construct.

Brand familiarity (BFAM) was used as the prior-schema moderator in the LMS models. BFAM was measured by a three-item reflective scale adapted from Campbell and Keller (2003) and Nam et al. (2011), capturing the respondent's subjective prior familiarity with the focal brand. BFAM was treated as a latent moderator in the XWITH specifications and grand-mean centered for coefficient interpretation.

Practice awareness (PRAW) was operationalized as a count of three observable on-site sustainability practices that guests could report noticing during their stay: (a) in-room energy or water conservation cues, (b) linen or towel reuse programs communicated through room signage, and (c) visible recycling provision in guest-accessible areas. Each item was coded 1 if noticed and 0 otherwise, and the three items were summed to form an index ranging from 0 to 3 ($M = 1.84$, $SD = 0.98$). The index was grand-mean centered for the moderation analysis. A count measure was used because the construct is defined as the recognition of concrete practices rather than an abstract knowledge-of-sustainability scale.

For robustness, education was entered as the only usable demographic control covariate because the retained analytical file did not preserve meaningful variance for the other screened demographic variables. Internal consistency was acceptable for PS ($\alpha = .90$), BAW ($\alpha = .83$), and BEQ ($\alpha = .95$), and convergent and discriminant validity were evaluated from the retained CFA reported below. Table 2 presents the measurement items and psychometric properties.

Table 2. Measurement items and psychometric properties (N = 1,029)

Construct / Item code	Item wording (abridged)	λ	Mean	SD
<i>Perceived Sustainability (PS); $\alpha = 0.90$</i>				
PS2	The hotel makes genuine efforts to reduce its environmental footprint.	0.696	5.12	1.33
PS3	The hotel uses resources (water, energy) responsibly.	0.757	5.08	1.29
PS4	The hotel communicates its sustainability practices clearly.	0.798	4.97	1.35
PS5	The hotel supports local environmental and social initiatives.	0.832	4.95	1.32
PS6	The hotel is committed to long-term sustainability.	0.841	5.03	1.31
PS7	The hotel behaves ethically toward the environment and community.	0.784	5.10	1.28
<i>Brand Awareness (BAW); $\alpha = 0.83$</i>				
BA1	I can recognize this hotel brand among competing brands.	0.747	5.67	1.12
PQ1	This hotel brand offers high-quality service.	0.811	5.54	1.08
HBA1	Characteristics of this brand come to mind quickly.	0.714	5.38	1.17
BL1	I would visit this hotel brand again.	0.682	5.45	1.24
BI1	This hotel brand has a clear, distinctive image.	0.631	5.27	1.18
<i>Brand Equity (BEQ); $\alpha = 0.95$</i>				
BA3	This brand offers memorable experiences.	0.670	5.29	1.16
BA5	This brand has positive associations in my mind.	0.722	5.35	1.12
BA6	I think favorably of this brand overall.	0.689	5.32	1.15
BA7	I can easily associate this brand with quality.	0.735	5.30	1.14
PQ3	The quality of this brand is consistent.	0.730	5.41	1.09
PQ4	This brand is reliable.	0.759	5.44	1.10
PQ5	This brand offers good value for money.	0.804	5.26	1.19
PQ6	This brand has excellent service standards.	0.818	5.37	1.13
PQ7	This brand is a top performer in its segment.	0.822	5.25	1.17
HBA3	This brand stands for something meaningful.	0.780	5.20	1.20
HBA4	This brand has a clear brand personality.	0.823	5.18	1.19
HBA6	This brand differentiates itself from others.	0.771	5.14	1.22
HBA7	This brand conveys positive brand imagery.	0.728	5.22	1.18
BL3	I intend to stay with this brand again.	0.757	5.31	1.21
BL4	I would recommend this brand to others.	0.688	5.28	1.23
BL5	I would choose this brand over alternatives.	0.750	5.19	1.26
BL6	I am loyal to this brand.	0.800	5.12	1.29
BL7	I consider this brand my preferred choice.	0.803	5.15	1.27

Notes. λ = standardized factor loading from three-factor CFA (STDYX). Item codes correspond to survey labels. Cronbach's α reported for each construct. Measurement items are seven-point Likert scales (1 = strongly disagree; 7 = strongly agree).

4.3 Analytical Strategy

The analysis proceeded in five stages. First, a three-factor CFA identified the retained measurement model, estimated under robust maximum likelihood (MLR) because Likert-type items can exhibit non-normality that MLR is designed to accommodate (Muthén and Muthén 2017). Second, a structural equation model (SEM) estimated the base mediation PS to BAW to BEQ with MLR. Third, the indirect effect was re-estimated under maximum likelihood (ML) with 5,000 bias-corrected bootstrap draws, because bootstrap standard errors are not available under MLR in Mplus; the estimator was therefore switched solely for the indirect-effect inference rather than for the substantive path estimates, which

remain from the *MLR* solution. Fourth, separate LMS models tested the BFAM and PRAW moderation hypotheses using Monte Carlo numerical integration with 1,000 integration points, following the latent-interaction approach of Klein and Moosbrugger (2000). Fifth, robustness checks examined common method variance through Harman's test and an unmeasured latent method construct (*ULMC*), measurement invariance across familiarity groups, and an education-control specification.

All models were estimated in Mplus 8.4. Missing data were handled with full-information maximum likelihood under the estimator used in each model. The retained CFA is a refined three-factor solution with ten theoretically motivated within-battery residual covariances that absorb method-linked shared variance among items drawn from the same legacy scale. Because Mplus does not provide standardized coefficients for XWITH interactions, the moderation results are reported in the unstandardized metric with standard errors, *z* statistics, and information-criterion comparisons against matched null models, following standard SEM guidance for integrated moderation and mediation assessment (Sardeshmukh and Vandenberg 2017).

5. Results and Discussion

5.1 Measurement Model

The retained measurement model is a refined three-factor CFA. It fits the data at an acceptable level, $\chi^2(362) = 1880.65$, $p < .001$, comparative fit index (*CFI*) = .906, Tucker-Lewis index (*TLI*) = .894, root mean square error of approximation (*RMSEA*) = .064 with a 90% confidence interval of [.061, .067], and standardized root mean square residual (*SRMR*) = .048. The model retains ten within-battery residual covariances identified during refinement, so its fit should be interpreted as the fit of the retained specification rather than an unrestricted item structure. Standardized loadings range from .696 to .841 for PS, from .631 to .811 for BAW, and from .669 to .823 for BEQ; the lowest loading (BI1 at .631) is retained because it is theoretically anchored in the imagery facet of awareness and because its removal did not materially change structural estimates. Standardized latent correlations are .565 between PS and BAW, .799 between PS and BEQ, and .708 between BAW and BEQ. Composite reliability and average variance extracted are acceptable, and the *HTMT* ratios support discriminant validity across the construct pairs. Table 3 to Table 5 report the validity diagnostics, and Table 6 reports model-fit indices.

Table 3. Convergent and discriminant validity, with latent correlation matrix

Construct	CR	AVE	MSV	MaxR(H)	PS	BAW	BEQ
PS	0.906	0.617	0.638	0.910	0.785		
BAW	0.836	0.506	0.502	0.842	0.565	0.711	
BEQ	0.955	0.579	0.638	0.956	0.799	0.708	0.761

Notes. CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; MaxR(H) = maximum reliability. Diagonal values (bold) are the square root of AVE. Off-diagonal values are standardized latent correlations. All correlations $p < 0.001$.

Table 4. Bootstrap 95% confidence intervals for CR and AVE

Construct	CR (95% CI)	AVE (95% CI)
PS	0.906 [0.894, 0.918]	0.617 [0.584, 0.650]
BAW	0.836 [0.816, 0.856]	0.506 [0.472, 0.540]
BEQ	0.955 [0.949, 0.961]	0.579 [0.553, 0.605]

Notes. Bias-corrected bootstrap confidence intervals based on 5,000 draws. CR values comfortably exceed the 0.70 threshold. AVE values exceed the 0.50 convergent-validity threshold (Fornell and Larcker 1981).

Table 5. Heterotrait-monotrait (HTMT) ratios of correlations with 95% CI

	PS	BAW	BEQ
PS	—		
BAW	0.601 [0.552, 0.651]	—	
BEQ	0.784 [0.754, 0.814]	0.745 [0.706, 0.784]	—

Notes. Bootstrap 95% confidence intervals based on 5,000 draws. All HTMT values are below the 0.85 conservative threshold recommended by Henseler et al. (2015) except the PS-BEQ pair, which is below the 0.90 threshold. Discriminant validity is supported.

Table 6. Model-fit indices for the three-factor measurement model (N = 1,029)

Index	Obtained value	Threshold	Interpretation
χ^2 / df (CMIN/DF)	1,880.65 / 362 = 5.20	< 3 (good); < 5 (acceptable)	Acceptable given model complexity and sample size
CFI	0.906	> 0.90	Acceptable
TLI	0.894	> 0.90	Marginal; within tolerance for large models
RMSEA	0.064 [0.061, 0.067]	< 0.08 (acceptable)	Acceptable
SRMR	0.048	< 0.08 (good)	Good
PClose	0.000	not significant	RMSEA distinguishable from 0.05, expected for N $\approx$ 1,000

Notes. Thresholds follow Hu and Bentler (1999) and Kline (2023). Indices are from the three-factor CFA (PS, BAW, BEQ) estimated in Mplus 8.4 with MLR estimator. The structural model (base mediation) yields essentially identical fit: CFI = 0.906, TLI = 0.895, RMSEA = 0.064, SRMR = 0.048.

5.2 Base Mediation

The base mediation model supports all four core hypotheses. In the standardized solution, PS predicts BAW ($\beta = .565$, $SE = .042$, $p < .001$), PS predicts BEQ ($\beta = .587$, $SE = .055$, $p < .001$), and BAW predicts BEQ ($\beta = .376$, $SE = .057$, $p < .001$). The latent R^2 values are .319 for BAW and .734 for BEQ. In the bootstrap re-estimation under maximum likelihood, the unstandardized indirect effect is .189 with a 95% bias-corrected confidence interval of [.138, .254], the direct effect is .523 with a 95% CI of [.386, .667], and the total effect is .712 with a 95% CI of [.601, .832]. These estimates indicate partial mediation, with just over a quarter of the total PS effect on BEQ flowing through BAW and the remainder operating directly.

5.3 Moderation by Brand Familiarity

Brand familiarity moderation was evaluated with a simplified latent-interaction specification that retained the PS-by-BFAM term on both BAW and BEQ (the less theoretically central BAW-by-BFAM term was dropped to reduce the integration dimension), and a matched main-effects baseline, both estimated on the $N = 1,018$ subsample. The baseline yields an Akaike information criterion (AIC) value of 79,407.36 and the interaction model yields $AIC = 79,097.92$, a ΔAIC improvement of 309.44 in favor of the interaction model. Under an information-criterion comparison, this constitutes strong evidence for the better-fitting moderated specification (Burnham and Anderson 2004). PS on BAW remains positive ($b = .495$, $SE = .067$, $p < .001$), BFAM predicts BAW directly ($b = .209$, $SE = .033$, $p < .001$), and the PS-by-BFAM interaction on BAW is positive ($b = .181$, $SE = .051$, $z = 3.56$, $p < .001$). On the equity side, PS remains positive ($b = .327$, $SE = .040$, $p < .001$), BAW remains positive ($b = .376$, $SE = .045$, $p < .001$), BFAM has a positive main effect ($b = .120$, $SE = .020$, $p < .001$), and the PS-by-BFAM interaction is negative ($b = -.205$, $SE = .024$, $z = -8.70$, $p < .001$). H5a and H5b are therefore supported, and the moderation model shows the expected dual-sign pattern.

For interpretability, the conditional PS slopes were evaluated at one standard deviation above and below the BFAM mean. On the awareness path, the PS slope is stronger for more-familiar guests than for less-familiar guests, consistent with familiarity aiding the attachment of a new signal to an established brand node. On the equity path, the pattern reverses: the PS slope is weaker for more-familiar guests than for less-familiar guests, consistent with anchoring-and-

adjustment logic in which new attribute information produces smaller updates against a well-entrenched prior. The dual-sign pattern is therefore not a statistical artifact of scale but a substantive asymmetry that differs in direction across the two structural paths.

5.4 Moderation by Practice Awareness

Practice awareness moderation was evaluated with a simplified latent-interaction specification retaining the PS-by-PRAW term on both BAW and BEQ, against a matched main-effects baseline on the same $N = 1,018$ subsample. The baseline yields $AIC = 78,936.65$ and the interaction model yields $AIC = 78,889.12$, which favors the interaction model by 47.53 AIC points. The PS-by-PRAW interaction is not significant on BAW ($b = -.121$, $SE = .079$, $p = .125$), but it is positive and significant on BEQ ($b = .161$, $SE = .049$, $z = 3.26$, $p = .001$). The main effect of PRAW on BEQ is negative ($b = -.061$, $p = .005$), which is best interpreted cautiously because it is estimated in the presence of the interaction term and conditional on centered PS. H6 is therefore supported on the equity path only, consistent with the argument that noticed practices matter more for evaluative translation than for basic salience.

5.5 Validation and Robustness

Before the main robustness checks, a Harman's single-factor test provided a first pass on common method variance. A one-factor unrestricted model accounted for less than half of the total item variance, which is consistent with method variance not being the dominant explanation for the observed relationships (Podsakoff et al. 2003). Because Harman's test is known to be an insensitive diagnostic, the more stringent *ULMC* specification reported below is treated as the primary common-method check.

Three robustness checks support the interpretation while also imposing appropriate limits on it. First, the multi-group invariance model across high- and low-familiarity groups yields CFI values of .872 for the configural model, .867 for the metric model, and .862 for the scalar model, so the change in CFI at each step is .005 and satisfies the $\Delta CFI \leq .010$ criterion (Cheung and Rensvold 2002). The configural CFI , however, is below the conventional .90 heuristic, so the invariance conclusion should be read as no differential deterioration across increasingly constrained models within an already marginally fitting configural baseline rather than as a strong claim of full invariance. Second, the *ULMC* specification improves overall fit, $CFI = .946$, $TLI = .934$, $RMSEA = .059$, $SRMR = .036$, and the three substantive structural paths remain positive and significant. The magnitudes do shift, however: PS to BAW moves from .565 to .483 (a reduction of roughly 14.5%), PS to BEQ from .587 to .580, and BAW to BEQ from .376 to .334. The pattern is consistent with some shared method variance on the awareness path in particular, so the conservative conclusion is that signs and significance are stable but effect-size precision on PS to BAW is method-sensitive and should not be over-read (Podsakoff et al. 2003). Third, adding education as a control leaves the substantive mediation pattern intact, with unstandardized paths of .577 for PS to BAW, .519 for PS to BEQ, and .331 for BAW to BEQ. Taken together, the three checks support the sign and significance of the substantive story while flagging method-variance magnitude on the PS-to-BAW path as a quantitative caveat.

5.6 Discussion and Hypothesis Summary

The hypothesis tests converge on a clear pattern: H1 through H4 are supported in the base mediation model, H5a and H5b are supported in the BFAM moderation model, and H6 is supported only on the PS-to-BEQ path in the PRAW moderation model. The central empirical contribution is the dual-sign moderation by brand familiarity: the same sustainability perception strengthens the path to awareness while weakening the path to broader equity. A receiver-side signaling account holds that familiar brands offer denser retrieval cues (helping the signal attach to awareness) and a denser stock of prior beliefs (lowering the marginal informational content of any new sustainability cue for broader equity updating). The competing brand-congruity account, which predicts uniform amplification (Keller 1993), is inconsistent with the observed equity-side pattern. The mediation results show that awareness does not carry the entire sustainability effect: roughly a quarter of the total effect is indirect through BAW, whereas the larger share is direct to BEQ, so sustainability perceptions shape quality judgments, associations, loyalty-relevant beliefs, and imagery in ways that do not require awareness to be the sole carrier (El-Adly et al. 2024). The practice-awareness result is narrower but informative: noticed practices provide tangible, disconfirmable support for translating a broad sustainability perception into a substantive brand judgment (Schmuck et al. 2018; Connelly et al. 2025), complementing adjacent hospitality frameworks (Nimri et al. 2022; Nosrati et al. 2025; Esawe et al. 2024).

6. Conclusion

Three theoretical implications follow. First, receiver-side heterogeneity should be modeled explicitly in hospitality sustainability branding rather than treated as background noise (Connelly et al. 2025). Second, the BFAM results refine signaling logic by showing that prior schema can help one stage of the process while constraining another. Third, the PRAW result indicates that tangible cue recognition and prior schema should not be collapsed into a single moderator construct. Managerially, credibility remains the entry condition: hotels need visible sustainability cues across the guest journey. Less-familiar brands gain more direct equity from sustainability perceptions, whereas more-familiar brands retain awareness gains but show smaller direct equity updates. Communication should include concrete, observable practice evidence rather than generic claims alone.

Several limitations bound the claims. The cross-sectional design cannot be read as definitive temporal causation, and reverse causation is a live alternative. *ULMC* results showed effect-size precision on the PS-to-BAW path is method-sensitive even though signs and significance hold. MTurk-based sampling may overrepresent certain demographic segments and differ from paying travelers on hospitality-specific dispositions. The PRAW measure is a count of three observed practices rather than a richer literacy scale, and the five focal brands pool different architectures; the study is U.S.-based. Future research should prioritize experimental or longitudinal designs, multi-source or time-separated data, brand-stratified replications, richer practice-literacy scales, and cross-market tests of whether the path-specific moderation pattern is stable across baseline familiarity distributions.

In sum, the same sustainability perception can do different work at different stages of the same brand-equity chain. Brand familiarity strengthens the awareness path while weakening the direct equity path, a dual-sign pattern inconsistent with uniform amplifier accounts of moderation and consistent with a receiver-side reading of signaling theory. Practice awareness strengthens only the equity path. For research, sustainability signals should be theorized as receiver-dependent and moderators in a mediation chain should be reasoned about path by path. For practice, less-familiar brands can move equity more directly through sustainability claims, whereas more familiar brands need concrete practice evidence; all brands benefit from pairing visible credibility cues with tangible, noticeable practices.

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