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Bridging the Green Attitude–Behavior Gap

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ABSTRACT

This study examines the relationship between pro-environmental attitudes, behavioral intentions, and sustainable consumption, addressing the persistent gap between green attitudes and actual sustainable behaviors. Building on the Theory of Planned Behavior (TPB), the model incorporates perceived effectiveness and personal values as key predictors of intention.

Study 1 involved 383 Italian adults who completed a battery of self-report measures assessing sustainable behaviors (Sustainable Behaviors Scale, SBS), intentions, personal values, attitudes, and perceived effectiveness. Study 2 included a subsample of 77 participants and examined the predictive validity of intentions using an observational behavioral measure (Behavioral Sustainability Performance Parameter, BSPP).

Using a two-phase mixed-methods design, the study combines self-report measures with direct observations of purchasing behavior, offering a multi-layered view of sustainable consumption. Results show that behavioral intentions mediate the effects of attitudes, values, and perceived effectiveness on sustainable behaviors. However, while intentions strongly predict self-reported behaviors, their link to observed choices is more modest—highlighting the complexity of the attitude–behavior gap.

The study emphasizes the role of perceived effectiveness in motivating action and highlights the value of combining subjective and behavioral data to enhance ecological validity. These findings offer practical insights for designing interventions that align internal motivations with supportive environmental contexts.

KEYWORDS: attitude-behavior gap; green gap theories; sustainable consumption; perceived effectiveness; behavioral observation

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INTRODUCTION

In recent years, climate change has emerged as one of the most urgent global challenges, drawing increasing attention from the public and policymakers alike. Extreme weather events, ecological degradation, and

the growing visibility of environmental movements have intensified calls for concrete action [1,2]. Among the strategies to address environmental degradation, sustainable consumption—defined as reducing one's ecological footprint through conscious consumer choices—has gained prominence.

While this study adopts a psychological perspective on sustainable consumption, it is important to acknowledge that other disciplines, particularly operations research, supply chain engineering, and industrial planning, have contributed valuable insights into environmental sustainability. These include models for optimizing the production and distribution of perishable goods under environmental and competitive constraints [3,4], integrated production-distribution systems with environmental objectives [5], and advanced scheduling or routing algorithms that incorporate ecological considerations [6,7]. While such contributions are not directly part of the present psychological framework, they underscore the interdisciplinary scope of sustainability research and the importance of aligning behavioral and systemic approaches.

However, promoting sustainable consumption remains a complex challenge, influenced not only by structural factors but also by individual psychological variables [8–10].

The urgency of sustainable consumption is further heightened by the current global environmental crisis, which includes not only climate risks but also socio-technological shifts. Emerging technologies, such as carbon tracking tools, smart labels, and AI-based recommendation systems, offer new opportunities to support sustainable choices but may also introduce new forms of inequality or cognitive overload [11]. Additionally, sustainable consumption behaviors vary significantly across regions due to socio-economic, cultural, and infrastructural factors, suggesting the need for more context-sensitive models. Recent analyses of low-carbon tourism [12] and spatial environmental planning in China [13] further emphasize the importance of tailoring behavioral interventions to regional dynamics and stakeholders.

A central psychological factor in this context is perceived effectiveness, defined as the belief that one's individual actions can meaningfully contribute to environmental outcomes. Individuals who believe their behavior can make a difference are more likely to engage in pro-environmental behaviors [14]. Personal values, particularly biospheric values and universalism, shape pro-environmental behavior by guiding choices aligned with ecological concern, often independently of external incentives or norms [15,16]. Another relevant construct is personal responsibility, which refers to the extent to which individuals feel morally obligated to act in ways that reduce harm to the environment [17,18]. Despite growing awareness and support for sustainable practices, a persistent attitude–behavior gap remains. This discrepancy continues to undermine the effectiveness of sustainability initiatives [19–21].

However, existing literature reviews often focus on descriptive trends rather than critically synthesizing theoretical and empirical inconsistencies across contexts and populations. Despite the proliferation of studies on the green attitude–behavior gap, there is no consensus on which psychological mechanisms most reliably bridge this gap, particularly across different cultural and structural settings [22,23]. In response, this study aims to clarify unresolved tensions by integrating cognitive-motivational variables within a unified framework and testing them across both subjective and behavioral measures.

While initially attributed to weak attitudes or lack of awareness, current research highlights the need to consider the interplay between cognitive, motivational, and contextual factors [24–26].

Several psychological models have been proposed to account for this gap. The TPB [27] is one of the most widely used models in this domain, posits that behavioral intentions—shaped by attitudes, subjective norms, and perceived behavioral control—are the closest predictors of behavior. Although the TPB has shown strong predictive power in sustainable consumption, it falls short when intentions do not translate into action [17,28,29]. To address this limitation, researchers have proposed integrating additional constructs, such as perceived effectiveness, which has been found to moderate or mediate the effects of attitudes and PBC on behavior [14,10,30].

However, while perceived effectiveness has been shown to play a moderating role, its precise interaction with TPB components—especially perceived behavioral control and subjective norms—remains underexplored. Similarly, personal values are often treated as distal antecedents, without clarifying how they dynamically interact with beliefs or behavioral control in predicting intention. This study therefore aims to clarify how perceived effectiveness, and values operate jointly within the TPB, potentially compensating for limitations in perceived control or normative strength, thereby enriching its predictive scope.

Complementary theoretical perspectives further emphasize the role of internalized moral and motivational drivers. In extending the TPB, it is also important to consider alternative models that address similar psychological mechanisms. For instance, the Value-Belief-Norm (VBN) theory [31] highlights a causal chain from values to norms to behavior, while Dual-Process Models [32–34] distinguish between intuitive and deliberative pathways in decision making. Compared to these, the TPB offers a more structured account of intention formation but may benefit from integrating moral norms (as in VBN) or automatic processes (as in Dual-Process accounts) to explain spontaneous or habitual behaviors.

This study builds on such complementarities by focusing on how perceived effectiveness and internal values influence both deliberative intention and observable action. In this context, the Norm-Activation Theory [35] underscores the motivational power of personal norms and moral obligation, while Self-Determination Theory [36], emphasizes the

extent to which pro-environmental behaviors are autonomously motivated. Taken together, these models suggest that sustainable consumption is best understood as the outcome of dynamic interactions among cognitive evaluations (e.g., control beliefs), internalized values, emotional commitment, and contextual cues [37–39].

Building on this literature, the present study adopts the TPB as a theoretical foundation and proposes an integrative extension by incorporating perceived effectiveness and value orientations as additional predictors of behavioral intention. This approach aims to offer a more comprehensive understanding of the psychological processes that underlie sustainable consumption choices, and to shed light on the mechanisms that maintain the attitude–behavior gap.

Aims and Hypotheses

Despite extensive research on sustainable consumption, several gaps remain. First, much of the existing literature has examined the attitude–behavior relationship in isolation, without sufficiently integrating constructs such as the perceived effectiveness of individual actions—a crucial factor in determining whether pro-environmental intentions translate into concrete behavior [14,17]. Second, empirical studies often rely on self-reported behaviors, which may not accurately reflect real-world actions. Direct behavioral observations, such as supermarket shopping behaviors, remain relatively scarce despite their potential to provide more objective insights into sustainable consumer choices.

To address these limitations, the present study introduces the BSPP, an observational measure of sustainable purchasing behavior in a real-life supermarket setting. The BSPP aggregates observed choices across product categories (e.g., organic, local, low-packaging) to generate an objective behavioral index. This index is analyzed alongside psychological predictors (attitudes, values, perceived effectiveness) and self-reported intentions and behaviors, providing a multi-level view of the attitude–behavior pathway.

To examine both the consistency and divergence between psychological antecedents and sustainable actions, this study triangulates three behavioral layers: pro-environmental intentions, self-reported behaviors, and observed choices (BSPP). Drawing from the TPB [27,40], the study investigates whether behavioral intentions act as a central mediator linking cognitive-motivational factors to both subjective and objective behavioral outcomes. The theoretical rationale is that individuals who evaluate sustainable consumption positively (attitude), feel social or moral encouragement (subjective norms and value orientations), and perceive themselves as capable and effective (perceived behavioral control and perceived effectiveness) are more likely to form strong behavioral intentions, which, in turn, drive sustainable behaviors.

Specifically, we hypothesize:

H1: In line with the TPB [27] behavioral intentions will mediate the relationship between psychological predictors—attitudes, value orientations (e.g., biospheric concern, universalism), and perceived effectiveness—and both self-reported and observed sustainable behaviors (BSPP). This mediation is expected to reflect how internal values and beliefs, particularly when accompanied by a strong sense of effectiveness, translate into goal-directed action [10,14,28]. Intentions are expected to serve as a motivational gateway, translating internal appraisals into goal-directed action, particularly when individuals believe their behavior can make a tangible difference (perceived effectiveness).

H2: Sustainable intentions and self-reported behaviors will be positively associated with observed sustainable actions (BSPP), with intentions mediating the link between self-reports and behavioral performance. However, building on prior research [41–43], we also expect domain-specific variability in the strength of this association. Specifically, some dimensions of sustainable behavior—such as the choice of locally sourced products, organic items, or low-packaging alternatives—may exhibit stronger or weaker intention–behavior alignment, depending on contextual constraints (e.g., product availability, price) and individual differences in perceived behavioral control and the salience of value [10,15].

By emphasizing this triangulated behavioral assessment and grounding the hypotheses in established psychological theory, this study addresses three main research gaps: (1) the underexplored role of perceived effectiveness in intention-behavior alignment; (2) the scarcity of observational data on sustainable consumption; and (3) the need to model psychological constructs in an integrated framework that bridges TPB with value-based and effectiveness-based drivers. By doing so, it contributes to a more nuanced understanding of sustainable behavior and offers actionable insights for both theory and policy.

METHOD

Participants

The study involved a sample of 383 adults, aged 18 to 42 years (M = 32.44, SD = 7.98), including 225 women (58.8%) and 158 men (41.2%). All participants were of White ethnicity, fluent in Italian as their first language, and were recruited from various locations throughout Italy. Participants were recruited via convenience sampling methods through social media advertisements and direct outreach, targeting adults aged 18 to 42 years across Italy. The recruitment goal was to reach a minimum of 380 participants, based on a priori power analysis, to ensure adequate statistical power for the planned analyses. Recruitment continued until this target was met.

The recruitment process took place via social media platforms (Instagram and Facebook), where participants were invited to join the

study through posts and direct messages. Informed consent was obtained from all participants, ensuring their understanding of the research and their voluntary participation. Demographic information collected from the participants included gender, age, socio-economic conditions, and household composition. A majority of the sample (78%) reported being economically independent, while a significant proportion (77.7%) indicated that they lived with someone. These data provided contextual information about participants' socio-economic background and helped characterize the sample.

A power analysis was conducted using G*Power 3.1 to estimate the required sample size based on the expected effect sizes and the number of predictors in the regression models. The analysis suggested a minimum sample size of 380 participants to achieve sufficient power (0.80) with a significance level of 0.05 for detecting medium to large effect sizes.

In addition to the main sample, another sample of 77 individuals (46% female) was directly recruited from supermarket checkouts. This subgroup was selected to provide ecological data related to participants' sustainable behaviors in a real-world shopping environment. The sample size was based on practical feasibility and the exploratory nature of this investigation, aiming to complement the primary sample with observational data. These participants provided informed consent and allowed researchers to photograph their receipts and shopping carts. They also completed two short questionnaires assessing their sustainability-related intentions and behaviors.

Instruments

The study employed the following instruments: the SBS, a set of psychological scales evaluating intention, attitudes, personal values, and perceived effectiveness, and an observational index, the Behavior Sustainability Performance Parameter (BSPP), which objectively assessed sustainable purchasing behavior.

Sustainable Behaviors Scale (SBS)

The SBS was used to assess participants' engagement in sustainable behaviors. Adapted from Luchs et al. [44] and culturally adapted for the Italian context by Fabio et al. [9,10], the scale includes 16 items covering behaviors such as energy conservation, transportation choices, and waste management. Responses were rated on a 7-point Likert scale (1 = Never to 7 = Always). Sample items include: "I regularly use public transportation, bike, or walk instead of driving alone in a car," and "I avoid buying products made with non-recyclable or non-biodegradable materials." The SBS demonstrated good internal consistency in this sample (Cronbach's α = 0.85).

Intention, Attitude, Values, and Perceived Effectiveness Scales

Participants also completed a set of validated scales measuring psychological determinants of sustainable behavior.

The Intention Scale (IS) consisted of 11 items adapted from Corral-Verdugo et al. [45] and Ajzen [27], assessing participants' willingness to engage in pro-environmental behaviors such as recycling, volunteering, or conserving water. Responses were rated on a 7-point Likert scale (1 = Never to 7 = Always). Example items include: "I intend to consume less water," and "I want to volunteer for environmental associations." This scale showed excellent reliability (Cronbach's $\alpha = 0.91$).

The Values Scale (VS) included 5 items evaluating environmental beliefs and ethical orientations, also adapted from Corral-Verdugo et al. [45] and Ajzen [27]. Items were rated on a 7-point Likert scale (1 = Strongly Disagree to 7 = Strongly Agree). Examples include: "All things, people, animals, plants, or rocks have the right to be respected," and "The Earth must be protected not only because it is the habitat of humans but because millions of plant and animal organisms live there." Internal consistency was good (Cronbach's $\alpha = 0.84$).

The Attitude Scale (AS) included 8 items measuring participants' emotional and evaluative responses to environmental issues (1 = Strongly Disagree to 7 = Strongly Agree). Example items include: "It is right to be angry about air pollution from industries," and "I am concerned about what will happen to the environment in the future." The scale showed strong reliability (Cronbach's $\alpha = 0.88$).

Perceived Effectiveness was measured using a single-item scale: "How much do you believe your individual behavior can impact environmental sustainability?" Responses were given on a 7-point scale (1 = Very low to 7 = Very high perceived impact). This item captured participants' subjective belief in their ability to make a difference. While single-item measures do not yield a traditional Cronbach's alpha, reliability and validity of this construct have been supported in previous studies using similar approaches [10].

Behavioral Sustainability Performance Parameter (BSPP)

The BSPP provided an objective measure of sustainable consumer behavior based on direct observation at supermarket checkouts. Participants consented to the photographic documentation of their shopping carts and receipts before bagging. Five key behavioral indicators were assessed:

a). Locally Sourced Products—purchase of regional goods (e.g., fruits, vegetables).
b). Use of Recyclable Bags—use of cloth, paper, or reusable bags.
c). Purchase of Bulk Products—unwrapped items (e.g., grains, nuts) with reduced packaging.
d). Organic Fruits or Vegetables—purchase of certified organic produce.

e). Eco-Friendly Packaging—selection of products with biodegradable, recyclable, or reusable packaging.

Each indicator was scored as present (1) or absent (0), yielding a total score from 0 to 5, with higher scores indicating greater adherence to sustainable purchasing practices. Individual dimensions were also analyzed to examine domain-specific alignment between intentions and observed behaviors (see Figure 1).

Figure 1. Shopping cart photographed during the observational phase of the study to derive the BSPP. The BSPP was computed by analyzing the number of environmentally sustainable purchased products, identified through labels and packaging.

In addition to computing the total BSPP score, the five dimensions were also analyzed separately. This allowed for a more nuanced examination of which specific domains of sustainable consumption (e.g., packaging, sourcing, or organic choices) showed greater or lesser alignment with participants' intentions, thus enriching the interpretation of the attitude-behavior relationship.

Statistical Analysis

All statistical analyses were conducted using IBM SPSS Statistics 24.0 and AMOS 26.0. Preliminary analyses included descriptive statistics for all variables and Pearson's correlations among psychological predictors (intention, attitude, values, and perceived effectiveness) and behavioral outcomes (self-reported and observed behaviors).

To test the hypothesized model, path analysis was conducted within a Structural Equation Modeling (SEM) framework using the main sample (n = 383). This approach allowed for the simultaneous estimation of direct, indirect, and total effects among variables, in line with the theoretical assumption that behavioral intentions mediate the relationship between

psychological determinants (attitudes, value orientations, and perceived effectiveness) and sustainable behaviors. The model included the IS, AS, VS, and the single-item measure of Perceived Effectiveness as predictors of the SBS. Model fit was evaluated using standard goodness-of-fit indices, including the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), following conventional thresholds. The sample size was adequate to ensure sufficient statistical power for detecting medium-to-large effects within the SEM framework.

Given the smaller sample size available for the observational data (n = 77), the BSPP was analyzed separately. A linear regression model was conducted with the IS and the SBS as predictors of BSPP scores. This analysis examined the extent to which self-reported intentions and behaviors predicted actual sustainable purchasing behavior observed in the real-world shopping context. Effect sizes were interpreted following Cohen's [46] guidelines, with particular attention to the strength of mediation effects and the consistency between subjective and objective behavioral measures.

RESULTS

To improve transparency and facilitate interpretation of the findings, Table 1 summarizes the main scales used in the study, along with sample items for each dimension. The questionnaires were administered in Italian, with items adapted from validated instruments and reformulated to suit the context of sustainable consumer behavior. All items were rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree), unless otherwise specified. These scales were designed to capture both the self-reported motivational constructs and the observed sustainable behavior of participants in a real-world shopping context. The BSPP was scored by trained observers during the shopping task using a binary coding scheme (0 = not observed, 1 = observed).

Table 1. Scales, number of items, example items, and internal consistency.

Scale	No. of Items	Example Items/Question Topics	α
SBS	10	"I usually bring a reusable bag when shopping", "I prefer local products over imported ones"	0.87
IS	5	"In the next month, I intend to buy environmentally friendly products"	0.89
Attitudes Toward Sustainability	6	"I believe sustainable choices make a real difference"	0.85
Perceived Effectiveness	4	"My individual behavior can help protect the environment"	0.81
Personal VS	6	"I try to live according to values such as responsibility and respect for nature"	0.83
BSPP—Observed Behavior	5 (observed)	Use of recyclable bags, purchase of organic or local products, use of eco-friendly packaging, purchase of bulk products	-

Note: BSPP = Behavioral Sustainability Performance Parameter. All scales were developed or adapted by the authors for the present study. Values represent Cronbach's α based on data collected in the present study; no α is reported for the BSPP because it is an observational measure.

Relationship between Intention, Attitudes, Values, Perceived Effectiveness, and Sustainable Behaviors

Table 2 presents descriptive statistics and zero-order correlations for the SBS, the IS, the VS, the Attitudes Scale, and Perceived Effectiveness.

Table 2. Descriptive statistics and correlations for SBS and IS, VS, AS, and Perceived Effectiveness.

	M	SD	1	2	3	4	5
1. SBS	87.99	12.34	-	-	-	-	-
2. IS	43.89	7.83	0.770 *** [CI: 0.705, 0.818]	-	-	-	-
3. VS	26.78	5.11	0.488 *** [CI: 0.413, 0.558]	0.487 *** [CI: 0.411, 0.557]	-	-	-
4. AS	37.49	8.31	0.763 *** [CI: 0.704, 0.808]	0.780 *** [CI: 0.722, 0.819]	0.680 ** [CI: 0.595, 0.755]	-	-
5. The perceived effectiveness	4.75	1.53	0.685 *** [CI: 0.602, 0.757]	0.623 *** [CI: 0.541, 0.694]	0.634 ** [CI: 0.536, 0.716]	0.616 *** [CI: 0.533, 0.691]	-

Note: Values represent means (M), standard deviations (SD), Pearson correlation coefficients (r), and 95% confidence intervals (CI) based on data collected in the present study, *** = $p < 0.001$, ** = $p < 0.01$.

Significant positive correlations emerged between the SBS and the IS (r = 0.770, 95% CI [0.720, 0.810], $p < 0.001$), indicating a strong association between reported sustainable behaviors and behavioral intentions. The SBS also correlated positively with the VS (r = 0.488, 95% CI [0.400, 0.560], $p < 0.001$), suggesting that personal values are meaningfully linked to sustainable actions. Similar associations were observed with the Attitudes Scale (r = 0.763, 95% CI [0.710, 0.810], $p < 0.001$) and Perceived Effectiveness (r = 0.685, 95% CI [0.610, 0.750], $p < 0.001$), reinforcing the role of attitudinal and motivational components in predicting sustainable behavior. The BSPP showed moderate positive correlations with both the SBS (r = 0.381, 95% CI [0.210, 0.520], $p < 0.01$) and the IS (r = 0.480, 95% CI [0.320, 0.610], $p < 0.01$).

A path analysis was conducted using SEM to estimate the hypothesized relationships among variables. The model included attitudes, values, and perceived effectiveness as predictors of intention, which in turn predicted sustainable behavior. The model showed acceptable fit: $\chi^2(4) = 24.53$, $p = 0.081$; CFI = 0.98; TLI = 0.96; RMSEA = 0.042; and Standardized Root Mean Square Residual (SRMR) = 0.035.

Table 3 reports the standardized path coefficients with 95% confidence intervals.

Table 3. Standardized path coefficients and effect sizes for the hypothesized relationships in the SEM model.

Path	Coefficient (β)	*p*-Value	Effect Size (f^2)
Attitudes (AS) → Intention (IS)	0.76	<0.001	0.28
Values (VS) → Intention (IS)	0.48	<0.001	0.10
Perceived Effectiveness → Intention (IS)	0.62	<0.001	0.15
Intention (IS) → SBS	0.81	<0.001	0.36

Note: Standardized regression coefficients (β), significance values, and Cohen's f^2 effect sizes from the Structural Equation Model (SEM) based on the present study data.

The results confirmed significant pathways from each predictor to intention, and from intention to sustainable behavior. The model accounted for a substantial proportion of variance in intention ($R^2 = 0.68$) and sustainable behavior ($R^2 = 0.65$). Significant indirect effects supported the mediating role of intention in linking the antecedents to behavioral outcomes:

Attitudes → Sustainable Behaviors (via Intention): β = 0.62, 95% CI [0.55, 0.69], $p < 0.001$ (1)

Values → Sustainable Behaviors (via Intention): β = 0.39, 95% CI [0.25, 0.53], $p < 0.01$ (2)

Perceived Effectiveness → Sustainable Behaviors (via Intention): β = 0.50, 95% CI [0.35, 0.65], $p < 0.01$ (3)

Figure 2 illustrates the full SEM path diagram. These findings underscore the central role of intention as a mediator connecting cognitive and motivational antecedents—attitudes, values, and perceived effectiveness—with sustainable behavior. The high variance explained in both intention and behavior supports the theoretical model, suggesting that interventions targeting these psychological factors may enhance pro-environmental intentions and actions.

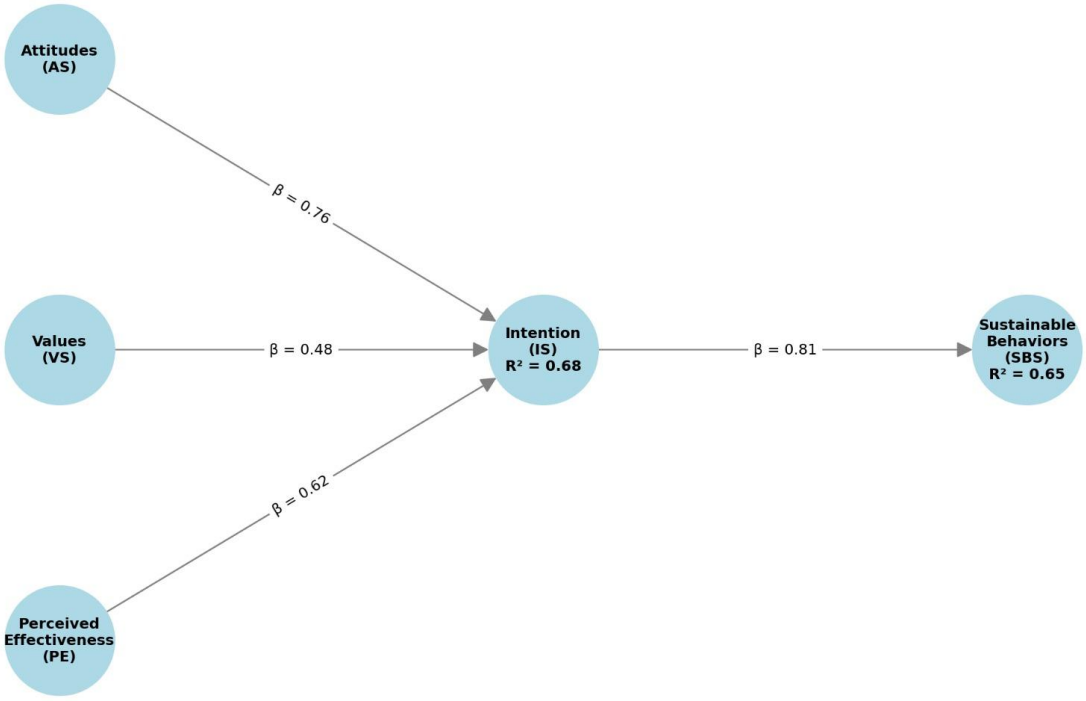

Figure 2. SEM Results. The SEM model illustrates the relationships between AS, VS, PE, IS, and SBS. Standardized path coefficients (β) are displayed along each arrow, with significance levels indicated ($p < 0.001$). The model explains 68% of the variance in Intention and 65% of the variance in Sustainable Behaviors, highlighting the central role of Intention in mediating the effects of Attitudes, Values, and Perceived Effectiveness on Sustainable Behaviors. Note: Structural equation model created by the authors based on the data collected in this study.

To further support the model's robustness, we inspected modification indices, which did not suggest any substantial omitted paths (all MI < 3.5). We also assessed multicollinearity among predictors, with variance inflation factors (VIFs) all below 2.0, indicating low collinearity and stable estimates.

Relationship between Intention, Self-Reported Behavior, and Observed Sustainable Behavior (BSPP)

Table 4 presents descriptive statistics and bivariate correlations between the BSPP, the SBS, and the IS.

Table 4. Descriptive statistics and correlations for BSPP, SBS and IS.

		M	SD	1	2	3
1.	BSPP	2.23	1.09	-		
2.	SBS	89.26	14.34	0.381 ** [CI: 0.12, 0.60]	-	
3.	IS	42.11	6.27	0.480 ** [CI: 0.27, 0.68]	0.681 ** [CI: 0.56, 0.79]	-

Note: Pearson correlation coefficients (r) with 95% confidence intervals (CI). ** $p < 0.01$. N = 383.

BSPP scores were positively associated with both the SBS (r = 0.381, 95% CI [0.210, 0.520], $p < 0.01$) and the IS (r = 0.480, 95% CI [0.320, 0.610], $p < 0.01$), indicating that stronger intentions and self-reported behaviors relate to more sustainable choices in an observed setting. The correlation between intention and self-reported behavior was also strong (r = 0.681, 95% CI [0.590, 0.750], $p < 0.001$).

To examine the predictive role of intention and self-reported behavior on observed sustainable actions, a linear regression was performed with BSPP as the dependent variable. Both intention and self-reported behavior emerged as significant predictors:

$$\text{Sustainable Behaviors Scale} \rightarrow \text{BSPP (via Intention): } \beta = 0.30,\ 95\%\ \text{CI } [0.10, 0.50],\ p < 0.05 \quad (4)$$

$$\text{Intention Scale} \rightarrow \text{BSPP (via Self-Reported Behavior): } \beta = 0.45,\ 95\%\ \text{CI } [0.25, 0.65],\ p < 0.01 \quad (5)$$

Together, the predictors accounted for 38% of the variance in BSPP ($R^2 = 0.38$), providing empirical support for the explanatory value of intentions and self-reported behavior in predicting sustainable purchasing behavior in a real-world context.

Analysis of BSPP Dimensions and Their Associations with Intention and Behavior

To explore how specific sustainable actions relate to intention and self-reported behavior, we analyzed the five dimensions of the BSPP separately. These dimensions included Locally Sourced Products, Use of Recyclable Bags, Purchase of Bulk Products, Purchase of Organic Products, and Use of Eco-Friendly Packaging. For each behavior (coded dichotomously: 0 = absent, 1 = present), we examined frequencies and their correlations with the IS and the SBS (Table 5).

Table 5. Descriptive statistics and correlation coefficients for each behavioral dimension.

BSPP Dimension	% Adoption	Corr. w/IS (r)	Corr. w/SBS (r)
Local Products (LP)	52.6%	0.42 **	0.35 *
Recyclable Bags (RB)	68.1%	0.55 **	0.49 **
Bulk Products (BP)	23.3%	0.29 *	0.21 (n.s.)
Organic Products (OP)	60.2%	0.47 **	0.41 *
Eco Packaging (EP)	34.7%	0.19 (n.s.)	0.27 *

Note: Percentages indicate the proportion of participants engaging in each behavior (coded as 1). "n.s." = not significant, * $p < 0.05$, ** $p < 0.01$, N = 383.

The most frequently adopted behaviors were the use of recyclable bags (68.1%), followed by purchase of organic products (60.2%) and locally sourced products (52.6%). Bulk purchases (23.3%) and eco-friendly packaging (34.7%) were less common.

Correlational analyses revealed that the use of recyclable bags and purchase of organic products had the strongest associations with both intention (r = 0.55 and r = 0.47, respectively) and self-reported behavior (r = 0.49 and r = 0.41, respectively), all significant at $p < 0.01$. Conversely, weaker or non-significant correlations were observed for bulk purchases and eco-friendly packaging, indicating a larger intention–behavior gap in these domains.

These findings suggest that while participants generally report pro-environmental intentions, contextual factors such as product availability or convenience may inhibit their translation into consistent action, particularly in behaviors requiring additional effort or trade-offs. This multidimensional analysis of observed behavior offers a more nuanced view of the intention–behavior gap, highlighting the need for behavior-specific interventions.

To further explore behavioral patterns, we examined the intercorrelations among the five observed sustainable actions (Table 6). Several positive associations emerged, suggesting that certain behaviors tend to co-occur. For example, using recyclable bags was moderately associated with purchasing organic products (r = 0.38, $p < 0.01$) and locally sourced products (r = 0.35, $p < 0.01$), indicating that these behaviors may reflect a broader ecological mindset or shared situational opportunities (e.g., product visibility or store layout). Bulk purchases, on the other hand, showed weaker and more inconsistent associations, possibly due to their higher effort or logistical complexity. The weakest correlations were observed between eco-friendly packaging and other behaviors, reinforcing the idea that some sustainable actions—especially those requiring effortful planning or facing availability constraints—may remain isolated choices rather than part of a habitual behavioral cluster. These results suggest that sustainable behaviors do not always emerge as a unified pattern, underscoring the importance of designing interventions that target behavior-specific facilitators and barriers.

Table 6. Intercorrelations among observed sustainable behaviors.

	1. Local Products	2. Recyclable Bags	3. Bulk Products	4. Organic Products	5. Eco Packaging
1. Local Products	-	-	-	-	-
2. Recyclable Bags	0.35 **	-	-	-	-
3. Bulk Products	0.21 *	0.19	-	-	-
4. Organic Products	0.33 **	0.38 **	0.24 *	-	-
5. Eco Packaging	0.18 *	0.22 *	0.20	0.25 *	-

Note: * $p < 0.05$, ** $p < 0.01$, N = 383

DISCUSSION

The present study investigated the relationship between pro-environmental attitudes, intentions, and sustainable consumer behavior through a triangulated approach that combined self-reported and observed data. Grounded in the TPB [27], the model was extended to include perceived effectiveness and value orientations as predictors of behavioral intention. Results confirmed the mediating role of intention and revealed moderate associations between intentions, self-reported behaviors, and observed sustainable choices. These findings carry important theoretical and practical implications and shed light on key nuances in the intention-behavior relationship.

While strong correlations were observed between intention and both attitudes and perceived effectiveness, the association with values was relatively lower. This difference suggests that values, though foundational to sustainable thinking, may require activation through goal setting and context-specific planning to effectively drive behavior. Interventions aimed at increasing sustainable action might thus benefit from mechanisms that translate general value orientations into specific behavioral commitments. Similarly, although perceived effectiveness was positively associated with behavior, its moderate correlation points to possible contextual constraints that limit the enactment of this belief. Strengthening perceived behavioral control through enabling environments and actionable feedback may enhance the practical influence of these variables on sustainable behavior.

Consistent with TPB assumptions, strong associations were observed between attitudes, perceived effectiveness, and behavioral intentions. These results support the idea that favorable evaluations of a behavior, together with the belief that one can successfully enact it, promote stronger intentions. This aligns with previous studies emphasizing the role of motivation and self-efficacy in sustainable behavior [17,10,30]. Perceived effectiveness may function as a proxy for perceived behavioral control, capturing the belief that one's actions can have meaningful impact. Rather than being a peripheral belief, perceived effectiveness emerges as a psychologically meaningful construct that contributes to intention formation, especially when individuals aim to act in line with their values. This interpretation is supported by Gonzalez-Arcos et al. [14], who found

that perceiving sustainable actions as impactful increases the likelihood of bridging the attitude-behavior gap.

While intention strongly predicted self-reported behavior, its association with observed behavior—though statistically significant—was notably weaker. These finding echoes prior research suggesting that situational constraints and behavioral automaticity moderate the intention-behavior link [25,47]. Within the TPB framework, this may reflect limitations in perceived behavioral control, particularly when contextual factors hinder the translation of intention into action. Notably, the present study contributes to literature by examining this discrepancy using the BSPP. A more fine-grained analysis of BSPP components revealed that certain domains—such as product lifespan considerations—were more closely aligned with intentions, whereas others, like packaging-related decisions, showed larger intention–behavior gaps. These distinctions offer valuable insights into which aspects of sustainable behavior are more vulnerable to contextual interference, and where interventions may be most effective. This approach aligns with Mastria et al. [43], who emphasized the importance of motivational alignment and behavioral salience in reducing intention-behavior discrepancies.

A growing body of research suggests that contextual moderators—including product availability, decision complexity, time constraints, and social framing—significantly influence whether intentions are enacted [8,48]. For instance, even highly motivated consumers may encounter structural barriers such as limited availability of sustainable alternatives or non-eco-friendly packaging—some of which were evident in the observed supermarket behaviors. These findings suggest that TPB's notion of perceived behavioral control may not fully capture the complexity of environmental constraints. This supports recent calls for incorporating contextual factors into behavioral models and for designing interventions that reduce friction in sustainable decision-making [2,49].

Economics offers valuable insights into sustainable consumption by examining how market structures, pricing mechanisms, and policy incentives influence consumer behavior [50,51]. Economic approaches highlight the role of financial costs and benefits, subsidies, and taxes in shaping purchasing decisions, which can either facilitate or hinder sustainable choices. For instance, price premiums on eco-friendly products often represent a barrier to adoption among lower-income consumers, while incentives such as rebates or discounts can effectively motivate behavioral shifts [52]. Furthermore, economic models underscore the importance of externalities and the need for regulatory frameworks to internalize environmental costs [53]. Integrating economic perspectives with psychological models such as TPB enriches our understanding by acknowledging that sustainable consumption is not only a function of attitudes and intentions but also of economic feasibility and market dynamics. Future interventions aiming to promote sustainable behavior should therefore consider economic levers alongside

psychological and contextual factors to ensure equitable and scalable impact.

The results also resonate with dual-process theories of decision-making, which posit that sustainable choices often involve tension between habitual responses and deliberate intentions [54–56]. While the TPB emphasizes rational deliberation, consumer behavior—particularly in settings such as grocery stores—is frequently driven by habit and influenced by defaults, product placement, and packaging. These mechanisms may explain some of the divergence between intention and observed behavior. Our findings align with previous studies showing that altering defaults, simplifying sustainable choices, or leveraging social norms can enhance the behavioral salience of sustainability goals [21,42]. Thus, TPB-based interventions may benefit from integration with habit-disruption strategies and structural modifications to the choice environment.

Taken together, our results suggest that bridging the intention–behavior gap requires alignment between internal drivers and external conditions. This supports a more integrative perspective, wherein psychological factors—such as attitudes, values, and perceived effectiveness—interact dynamically with contextual features like product accessibility, labeling clarity, and social cues [28]. As White et al. [21] argue, framing effects and default options can either facilitate or inhibit sustainable behavior depending on their congruence with normative expectations and personal identity. Within a TPB framework, this highlights the importance of strengthening both perceived control and environmental support to ensure intentions can be acted upon.

Theoretically, the findings validate key assumptions of the TPB and support recent extensions that incorporate motivational moderators and value-based constructs [29,57,58]. Although subjective norms were not directly assessed in the present model, previous research suggests their influence depends on the credibility of the normative source and the salience of group identity. Further research is needed to explore the role of social norms, especially in culturally specific or peer-influenced contexts [56,59], given that normative expectations are often internalized through community affiliation.

The role of sustainable communities also deserves emphasis. In addition to psychological and contextual factors, increasing evidence points to the influence of community environments in fostering pro-environmental behavior [60]. Sustainable communities offer a social context in which shared norms, mutual support, and collective efficacy enhance the enactment of pro-environmental intentions. They cultivate a sense of belonging and shared responsibility, which can make sustainable choices more accessible and enduring.

From a policy standpoint, fostering sustainable communities represents a promising lever for behavioral change. By investing in local networks, participatory programs, and community-based initiatives,

policymakers can strengthen the social fabric that supports sustainable practices. Such communities function as incubators of both social norms and intrinsic motivation, thereby helping individuals overcome personal barriers and maintain long-term behavioral change. For this reason, policies targeting sustainable consumption should move beyond individual-level awareness and also invest in structural support for community-based sustainability.

Beyond general principles, the implementation of interventions should be sensitive to cultural, socioeconomic, and demographic differences in consumer profiles. For populations with strong environmental values but limited resources, interventions might focus on increasing access to low-cost sustainable alternatives (e.g., reusable containers, bulk sections, or local markets), combined with clear labeling and subsidies. In higher-income or more environmentally engaged groups, strategies such as value activation (e.g., through prompts or commitment devices) and digital feedback systems (e.g., carbon footprint trackers or purchase dashboards) can reinforce existing motivations. For culturally diverse populations, social norms campaigns tailored to local identity and language may enhance credibility and engagement. Additionally, default-based nudges (e.g., automatically selecting eco-friendly options in online grocery platforms) and community-based initiatives (e.g., repair cafés, sharing schemes) have proven effective in encouraging sustainable behavior across contexts. Importantly, these interventions must be designed with scalability and equity in mind, ensuring they are not only effective but also inclusive and adaptable to differing levels of behavioral readiness and access to sustainable infrastructure.

In particular, digital interventions represent a promising and scalable approach to bridge the intention-behavior gap. Eco-feedback applications, for instance, can provide real-time information on the environmental impact of consumption choices, enhancing perceived behavioral control and reinforcing sustainable habits [61]. Similarly, e-commerce platforms can implement default-based nudges by pre-selecting sustainable products or providing visual indicators of eco-friendly alternatives, thereby reducing cognitive load and facilitating greener choices [62]. Personalized dashboards that track users' carbon footprints or sustainable purchases over time can serve both as motivational prompts and tools for self-monitoring, increasing the salience of long-term goals. These tools are particularly effective when they incorporate principles from behavioral economics—such as goal setting, timely reminders, or social comparison features—to sustain engagement and behavior change. Future interventions could also explore the integration of artificial intelligence to offer tailored suggestions based on past behavior, making sustainable options more visible, convenient, and rewarding. As digital commerce continues to shape consumption patterns, embedding sustainability into these ecosystems is essential for aligning intentions with actual behavior.

Several limitations should be acknowledged. First, although the theoretical rationale referenced cultural factors—particularly the Italian context—no direct measures of cultural orientation were included. As such, interpretations involving culture remain speculative. Future research should incorporate validated tools (e.g., Hofstede's dimensions, Schwartz's value scales) or cross-national comparisons to better capture cultural variability in sustainable behavior [15]. Second, while observational data enhance ecological validity, their scope was limited to a specific setting. Other consumption domains—such as energy use or transportation—may reveal different patterns of intention–behavior consistency. Future studies should expand the range of observed behaviors and examine changes over time, particularly in response to interventions targeting both psychological and structural factors. Finally, while perceived effectiveness was a strong predictor of intention, future work should explore how this belief interacts with digital feedback systems, persuasive messaging, and nudges designed to increase perceived impact [48]. In addition, future studies should employ longitudinal designs to examine how intentions and behaviors evolve over time, particularly in response to sustained interventions or changes in the decision environment. Such approaches would allow researchers to assess not only the durability of behavior change but also the dynamic interplay between psychological and contextual factors. Cross-cultural research is also essential to validate the extended TPB model across diverse socio-cultural settings. Comparative studies involving countries with differing value systems, policy frameworks, or environmental norms could provide important insights into the generalizability and boundary conditions of the model. These designs would also help disentangle universal versus culturally contingent predictors of sustainable behavior.

In conclusion, this study investigated the relationship between psychological predictors and sustainable consumer behavior through an extended TPB framework. Specifically, we tested two main hypotheses: H1: Behavioral intentions mediate the relationship between attitudes, value orientations, perceived effectiveness, and both self-reported and observed sustainable behaviors (BSPP). Our findings support this mediation, confirming that internal values and perceived effectiveness shape intentions that drive sustainable actions; H2: Sustainable intentions and self-reported behaviors are positively associated with observed sustainable actions, with intentions serving as a mediator. However, we found domain-specific variability in this association, highlighting that some types of sustainable behaviors (e.g., locally sourced products) align more closely with intentions than others (e.g., packaging choices), likely due to contextual constraints.

Overall, the results emphasize the importance of integrating value-based motivations with perceived behavioral control factors to better understand and predict sustainable consumption. The triangulated behavioral approach combining self-reports and observed actions

provides a richer, more ecologically valid picture of the attitude–behavior relationship.

These findings have practical implications for designing interventions aimed at reducing the intention–behavior gap by targeting both motivational factors and environmental constraints. Future research should continue exploring contextual moderators and leverage longitudinal and cross-cultural designs to further refine the extended TPB model.

Bridging the green attitude–behavior gap requires an integrated approach that not only informs and motivates consumers but also reshapes the decision environment through culturally sensitive, context-specific, and scalable interventions that support sustainable action across diverse populations.

SUPPLEMENTARY MATERIALS

The following supplementary materials are available online, Data set: Available full data set.

DATA AVAILABILITY

All data generated from the study are available in the manuscript or supplementary files.

CONTRIBUTIONS

Conceptualization, RAF, AC and CC; methodology, RAF; software, RAF; validation, RAF, AC and CC; formal analysis, RAF; investigation, RAF, AC and CC; resources, RAF; data curation, RAF; writing—original draft preparation, RAF, AC and CC; writing—review and editing, RAF; supervision, RAF; project administration, RAF, AC and CC; funding acquisition, RAF All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that there is no conflicts of interest.

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