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ORIGINAL PAPER

How Do Consumers Engage With Circularity? Differences Across Six Circular Economy Behaviours

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Abstract
The transition to a circular economy (CE) requires not only supply-side innovation but also a fundamental shift in consumer behaviour. However, existing research and policy frameworks often treat circular behaviour as a uniform construct, overlooking its inherent heterogeneity. This study addresses this gap by examining how determinants of circular behaviour vary across different practices and how these differences can inform more effective policy design. Using original survey data from residents of the South Tyrol (Northern Italy), we analyse six behavioural domains spanning the product lifecycle: consumption reduction, second-hand purchasing, repair, sharing, donation, and upcycling. Empirically, we employ survey-weighted ordinal logistic regression models for each behaviour, complemented by robustness checks using binary and continuous circularity indices. The analysis integrates consumer characteristics, normative factors, and product-related perceptions, alongside targeted models of behavioural barriers and enablers. While normative orientations and sustainability perceptions influence some practices, structural and practical barriers consistently exert the largest effects, reducing the likelihood of engagement by up to 88% (Odd ratio = 0.12). Repair behaviour is primarily driven by durability perceptions and age, second-hand consumption is shaped by household composition and lifestyle norms, and reduction reflects minimalist values. In contrast, upcycling and donation show weaker associations with attitudinal factors, suggesting stronger dependence on contextual conditions. From a policy perspective, the findings underscore three key insights: (i) barrier removal is more effective than awareness-raising, (ii) circular behaviours require behaviour-specific interventions, and (iii) demographic segmentation improves policy targeting.

Keywords Circular Economy · Product Characteristics · CE drivers · CE Behaviour

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Introduction

Within the European Union (EU), the CE paradigm has been explicitly codified as a foundational pillar for meeting long-term climate-neutrality ambitions [1]. Central to this legislative agenda is the New Circular Economy Action Plan (CEAP), a core building block of the European Green Deal that mandates systemic interventions spanning the entire product lifecycle, stretching from upstream design and production to downstream consumption and end-of-life management [1].

Operationalizing the CE paradigm shift requires robust public policy instruments designed to also actively engage consumers and residents within their specific characteristics and local contexts. However, while the demand side is widely acknowledged as a critical, non-negotiable component of a functioning circular economy [2], the majority of academic contributions to date have favoured supply-side explorations, such as corporate business cases, novel production technologies, and reverse logistics optimization [3, 4].

This persistent asymmetry exposes a fundamental diagnostic failure in current environmental policy design targeted at consumers: how do we change what we cannot describe? Macklin and Kaufman, [3]. Consumer behaviour in relation to the CE encompasses a wide range of real-world consumer practices or behaviours (during this article, both terms are used interchangeable), that stretch from low-effort "reduce–reuse–recycle" activities to highly disruptive, transformative consumption modes such as product self-repair, sharing schemes, collaborative consumption, and access-based product-as-a-service models. Consequently, "circular behaviour" cannot be evaluated as a single, monolithic action. It is more accurately described as a heterogeneous portfolio of diverse behaviours that vary in relation to the consumers or users, the product or service and the context in which this occurs [5, 6].

To design local policies capable of overcoming these barriers, regulators require a diagnostic approach that moves away from flat behavioural assumptions. Instead, effective policy must be contextualized using an integrated perspective that borrows from both product-centric dimensions (the technical capacity, lifecycle degradation, and macro infrastructure of the asset) and consumer-centric dimensions (the sociodemographic, psychological readiness, and micro situational affordances of the individual) [5–7].

Circular behaviours differ precisely because they sit at different intersections of these dimensions: some are restricted by contextual dimensions such as physical access to specialized infrastructure (e.g., repair cafes or sharing platforms), some depend heavily on characteristic dimensions such as sociodemographic or market trust in secondary goods, and others are driven by household routines and personal choices such as household size or living in a rural or urban setting. A comparative approach that analyses multiple behaviours side-by-side across these shifting dimensions can therefore provide far more actionable insights for demand-side policy than traditional analyses limited to a single behavioural outcome [4, 8].

In response to this knowledge gap, the overarching aim of this study is to support policy makers by providing empirical evidence about the characteristics of Circular Economy behaviours and their associated barriers and drivers. This paper contributes directly to demand-side CE scholarship by offering a rigorous comparative behavioural perspective across different circular economy behaviours. Using a constant empirical base model, CE behaviours are analysed and compared to identify behaviour-specific determinants and common, cross-cutting drivers and barriers. More specifically this study answers the following

research questions: **(RQ1) How is the frequency of circular engagement associated with individual characteristics?** and **(RQ2) Which characteristics distinguish respondents who actively engage in a circular practice from those who do not engage at a meaningful level?**

The present study examines multiple self-reported circular economy behaviours among residents of the South Tyrol (Autonomous Province of Bolzano in Northern Italy), drawing on a dedicated, large-scale consumer survey developed in collaboration with the Provincial Statistical Office (ASTAT). This design is explicitly consistent with the CEAP's emphasis on enabling circular choices throughout the entire product lifecycle and tailoring public interventions to specific value chains and real-world consumption contexts.

Moreover, South Tyrol represents a particularly valuable empirical setting for this study. Although the analysis is conducted at the provincial level and concerns a population of approximately 550,000 residents, the region's institutional autonomy and dedicated resources for collecting and maintaining detailed information on its population provide an unusually precise representation of local socio-demographic characteristics and contextual conditions. This makes South Tyrol more than a geographically bounded case: it offers a well-defined and empirically rich setting of a medium scale region with clear sustainable goals, in which local patterns and differences can be identified with considerable precision.

This feature is particularly relevant when examining the transition towards more circular and just economies. The availability of detailed, representative local information enables authorities to monitor changes in circular economy practices and to identify differences across population groups and local contexts. Such evidence can support the design and evaluation of local policies that are responsive to the specific characteristics of the population, while allowing progress towards circularity and social inclusiveness to be tracked over time. In this sense, the provincial focus should not be interpreted as a limitation of the study, but rather as a strength: South Tyrol provides an opportunity to generate context-sensitive evidence at the level at which many policy interventions are designed and implemented.

Theoretical Underpinnings

Circular Economy and Consumer Behaviour

Kirchherr et al. [9] defines the CE as a regenerative economic system that necessitates a paradigm shift to replace the 'end of life' concept by reducing, alternatively reusing, recycling, and recovering materials throughout the supply chain, with the aim of promoting value maintenance and sustainable development; creating environmental quality, economic development, and social equity; and benefiting current and future generations. It is enabled by an alliance of stakeholders (industry, consumers, policymakers, academia) and their technological innovations and capabilities.

Although the role of consumers in enabling circular economy is increasingly acknowledged [10], the empirical literature examining how individuals engage with circular practices remains fragmented and uneven [2]. Existing contributions have largely focused on identifying isolated determinants of specific behaviours [11], generating valuable but dispersed insights across the different product life phases that span from before purchasing, purchase, use, maintenance and post use activities [12, 13].

Accordingly, circular consumer behaviour is better understood as a portfolio of actions that intervene at different product life-cycle stages, such as reduce, purchase, use, lifetime extension, and recirculation, rather than as a single homogeneous construct. For example Selvefors et al. [14], explicitly propose a used-centre view of product circularity in which products move through "use-to-use" exchanges, while Vidal-Ayuso et al. [2] show that the literature connects consumers to several distinct areas, including sustainable consumption (sustainability-oriented perception), reparability (durability-oriented perception), upcycling, and post purchase practices, the latter being among the least explored.

A more explicit relationship with product lifecycle mapping is provided by placing the consumer at the centre of the issue and conceptualizing their contribution to circularity as follows: the consumer as a customer who acquires products, as a user who retains value through careful use and maintenance, and as an end-of-life holder who decides whether a product is reused, repaired, recycled, or discarded [6]. This framing is important because it shifts away from previous product- or business-centric views and shows that circular practices are distributed across different decision points; therefore, individuals should not be expected to respond to identical drivers or barriers. Using a similar perspective, Anderluh et al. [5] reinforce this point empirically by showing that consumer affinity for circularity varies depending on the combination of R-strategy, product group, and socioeconomic milieu rather than reflecting one uniform pro-circular disposition. Empirical literature further demonstrates this heterogeneity.

Heterogeneity in Circular Consumer Behaviour

The determinants of circular purchase behavior vary across circularity practices. In the context of reused and remanufactured electronic products, Hunka et al. [15], using choice-based conjoint experiments, show that consumers may prefer partly circulated products to either fully circulated or entirely new alternatives. This suggests that circular demand depends not only on general pro-environmental orientations but also on how value retention is configured within specific product categories. In circular fashion, Cascavilla et al. [16] provide experimental evidence that prosocial and pro-environmental preferences, together with perceptions of quality and production costs, increase both purchase intention and willingness to pay for products with higher levels of circularity. Similarly, awareness of circular fashion principles and perceived environmental benefits positively affect willingness to purchase recycled and sustainably sourced cotton products [17], while environmental concern has been identified as an important determinant of circular purchasing behavior [18].

The determinants also vary across practices beyond purchasing. For repair, Korsunova et al. [19] show that decisions are shaped by previous repair experience, the cultural meanings attached to repair, and institutional structures within education, business, and service provision. At the product level, furniture repair is influenced by financial considerations, product attachment, and perceived repairability, whereas assisted bicycle repair highlights the importance of repair experience, competence, and supportive repair spaces spaces [20, 21].

Similar heterogeneity is observed in sharing, donation, and waste-related practices. Jiménez Encarnación et al. [22] show that participation in sharing varies across household product groups and according to gender, education, age, income, and family composition, with men being less likely than women to reduce consumption through sharing and more educated respondents being more engaged in such practices. Waste prevention and sorting

behaviors are likewise influenced by demographic and contextual factors. Kurisu and Bortoleto, [23] report that gender and age shape waste prevention behaviors, while Siminelli [24] shows that age, gender, and environmental-label knowledge matter across several sectors, although not always for the propensity to purchase circular products. Pan and Liu, [25] further demonstrate that determinants of waste separation differ between children and adults, reinforcing the importance of age and behavioral context.

Overall, the literature suggests that consumers cannot simply be characterized as either "circular" or "non-circular". Rather, individuals engage in multiple circular practices, and the factors that encourage or constrain one behavior may not operate in the same way for another. Circular consumer behavior should therefore be approached as a heterogeneous set of practices shaped by the interaction of individual characteristics, behavioral motivations, social influences, and contextual conditions.

Determinants of Circular Consumer Behaviour

A growing body of research has examined the internal and external factors that shape circular consumer behaviour. Across the literature, determinants can broadly be understood in terms of motivations and values, social influences, perceptions of capability and control, and practical or institutional barriers.

For second-hand clothing consumption, for example, economic, hedonic, ecological, and social values are important determinants, alongside perceived risks related to quality, cleanliness, style, and social image [26]. For repair and maintenance, research points to a combination of environmental and economic motives, past behaviour, ability to repair, and access to services, while actual repair may be constrained by cost, infrastructure, spare parts, and access to technical information [27–29].

For sharing tools and other peer-to-peer or access-based models, financial benefits, trust, effort expectancy, and ecological sustainability are important drivers, while broader uptake also depends on user experience, perceived fairness, and institutional support [30, 31].

Similar patterns emerge for other circular practices. For second-hand clothing donations, attitudes towards sustainable consumption, problem awareness, ascription of responsibility, sense of community, and perceived hedonic benefits have been identified as relevant determinants [32]. For remanufacturing, Ozden, [33], focusing on smartphones, finds that environmental friendliness positively influences circular consumption intentions, although its effects are largely mediated through social norms and product perceptions rather than operating independently. In waste sorting, perceived behavioural control has consistently emerged as an important predictor, while situational and institutional conditions, including bin distance and facility quality [34], environmental regulation, knowledge, moral responsibility, and personal involvement [35] and community factors can strengthen or weaken intentions [36].

Taken together, these studies indicate that positive environmental attitudes or awareness alone are unlikely to provide a complete explanation of circular behaviour. Consumers may value sustainability while facing barriers related to effort, time, cost, availability, trust, safety, competence, or infrastructure. Conversely, accessible services, supportive institutions, and favourable social conditions may facilitate circular practices even when environmental motivations are relatively weak. This distinction between motivation and feasibility

is particularly important when considering the relationship between behavioural intentions and actual engagement.

Analytical Frameworks for Circular Consumer Behaviour

While research has identified a wide range of determinants across different circular practices, analytical frameworks provide a basis for understanding how these factors interact and influence circular consumer behavior.

The Theory of Planned Behavior (TPB) provides one of the principal theoretical frameworks for analyzing the psychological determinants of individual behavior [37–39]. The framework proposes that behavioral intentions are shaped by three core constructs: attitudes towards the behavior, subjective norms, and perceived behavioral control. The TPB is particularly relevant to circular consumption because many circular practices require consumers to evaluate their desirability, consider social expectations, and assess whether they have sufficient capability and control to perform them.

Applications of the TPB to circular behavior, however, suggest that its core constructs often need to be complemented by behavior-specific factors. For second-hand clothing consumption, for example, the determinants identified in the literature extend beyond the conventional TPB dimensions to include economic, hedonic, ecological, and social values, as well as perceived risks concerning quality, cleanliness, style, and social image [26].

The integration of behavioral determinants with intervention mechanisms is also reflected in the Pro-Circular Change Model (P-CCM) proposed by Muranko et al. [40] which combines the TPB with values and interventions. The model is relevant because it conceptualizes circular behavior not simply as an outcome to be explained but as behavior that can be actively shaped through interventions. This perspective draws attention to the distinction between interventions aimed at changing internal states, such as knowledge, values, and motivations, and those aimed at reducing practical barriers that constrain behavior.

More broadly, Camacho-Otero et al. [8] argue that the circular economy depends on a bundle of consumer behaviors rather than isolated purchasing decisions. This broader perspective is consistent with [41], who show that research remains fragmented across individual circular behaviors and that comparative, multi-behavior approaches remain relatively uncommon. To our knowledge, only a limited number of studies have examined multiple circular strategies within the same framework. Gonella et al. [42], for example, examine awareness across five CE strategies and show that psychological barriers, including sunk-cost perceptions and limited cognition, can reduce awareness, while social influence can increase it.

Despite the growing literature, relatively few studies compare multiple circular behaviors within the same population and analytical framework. As a result, it remains unclear whether variables such as individual characteristics, norms, perceived behavioral control, motivations, and barriers operate as general determinants of circular engagement or whether their importance depends on the specific behavior under consideration.

Research Gap and Study Contribution

Three gaps emerge from literature. First, circular consumer behavior continues to be examined predominantly through individual practices, limiting understanding of whether deter-

minants are common across behaviors or specific to circular strategies. Second, although literature identifies a wide range of psychological, sociodemographic, motivational, and contextual determinants, these factors are rarely examined simultaneously within a common empirical framework. This makes it difficult to distinguish general drivers of circular engagement from behavior-specific determinants. Third, the existing evidence provides limited comparative information that can support demand-side policy interventions tailored to specific behaviors and population characteristics.

This study addresses these gaps by analyzing multiple circular economy behaviors within the same population and using a common empirical framework. Specifically, it compares second-hand purchasing, repair, and upcycling while considering individual characteristics alongside normative influences, perceived behavioral control, behavioral motivations, and perceived barriers. This comparative approach makes it possible to identify both cross-cutting determinants and behavior-specific patterns of circular engagement. The study therefore contributes to the demand-side CE literature by moving beyond the analysis of isolated circular practices and providing a comparative assessment of the characteristics, drivers, and barriers associated with different forms of consumer engagement.

Materials and Methods

Survey Design and Data Collection

The data were collected through a dedicated survey administered to residents of South Tyrol (Northern Italy) in collaboration with the Provincial Statistical Institute (ASTAT). The survey was designed to measure self-reported circular economy practices, product-related preferences, perceived behavioural control, normative influences, and household characteristics.

The survey comprised 7 sections: (a) sociodemographic characteristics, (b) perceived knowledge of the circular economy, (c) circular economy behaviours, (d) attitudes and perceptions, (e) policy preferences, (f) needs related to public libraries (not considered in the present study), and (g) household and socioeconomic vulnerabilities.

Sociodemographic information included sex, age, place of residence, mother tongue, and employment status. Although some variables were originally collected at a finer level (e.g., exact age and municipality of residence), the dataset made available for analysis contained aggregated categories (e.g., age groups and residents within or outside the city of Bolzano) in accordance with national regulations governing official statistics and data protection. This approach reduced the level of granularity available for the analysis.

Most survey items were measured using four-point Likert-type scales. The four-point Likert scale was adopted to reduce respondents' cognitive burden and facilitate rapid and intuitive responses. This forced-choice format, which does not include a neutral midpoint, was considered appropriate for the exploratory nature of the study, as it encouraged respondents to express a directional opinion while providing sufficient response options to capture different levels of agreement. Examples include questions on the frequency of engaging in circular behaviours (e.g., purchasing second-hand products) and the importance assigned to different product characteristics when making purchasing decisions. Additional information was collected through multiple-choice questions, for instance, regarding local services and

incentives that could facilitate the adoption of circular economy behaviours (Supplementary Material 1).

The survey was conducted in two languages (German and Italian, i.e., the two official mother tongues of the province) between September and October 2025 using a mixed-mode approach combining online and telephone interviews. According to the multiannual experience of ASTAT (the Provincial Statistical Office), the CAWI mode tends to reduce social desirability bias because, unlike CATI, it does not involve the presence of an interviewer. The data collected were embedded within 'South Tyrol in Figures' ('Così pensa l'Alto Adige'), ASTAT's probability-based population panel established in 2022, to provide timely, reliable, and impartial information on a broad range of policy-relevant topics. The panel supports three survey waves annually, each focusing on different themes[1].

Panel participants were selected through a stratified probability sampling design based on sex, geographical area, and age group. Importantly, respondents agreed to participate in the panel before being informed about the specific survey topic, thereby reducing the risk of topic-related self-selection bias. The target population consisted of residents of South Tyrol aged 18–80 years.

The survey wave analysed in this study included 994 respondents and achieved a response rate of 83%. To ensure the representativeness of the provincial population, ASTAT perfumed the calibrated and calculated survey weights using sex, age, geographical area, and educational attainment. For more information on the unweighted statistics, please refer to supplementary material 2 (Table 1).

Table 1 Weighted sample participating in the panel 'Così pensa l'Alto Adige'

Variable		Weighted sample	
		N	%
Gender			
	Male	204,152	50.0
	Female	204,372	50.0
Age			
	18–39	136,013	33.3
	40–59	153,682	37.6
	60–80	118,829	29.1
Residence			
	Rural	327,433	80.2
	Urban	81,091	19.8
Highest Education			
	Compulsory education	137,092	33.6
	Secondary education	182,203	44.6
	Tertiary education	89,229	21.8
Employment status			
	Full-time	226,747	55.5
	Part-time	67,188	16.4
	Unemployed	114,590	28.0
Children under 13 in household			
	Yes	84,345	20.6
	No	324,179	79.4

[1] https://sostenibilita.provincia.bz.it/it/panel-probabilistico-astat-cosi-pensa-l-alto-adige.

Circular Behaviours

The study examined six dimensions of circular economy (CE) engagement reflecting different stages of the product lifecycle: reduction in consumption (CE1), second-hand purchasing (CE2), repair and maintenance (CE3), sharing and collaborative consumption (CE4), donation (CE5), and upcycling (CE6). Each behaviour was measured using a self-reported survey item capturing the frequency with which respondents engaged in the respective practice.

All behavioural items were measured using a four-category ordinal frequency scale: (0) never, (1) rarely, (2) sometimes, and (3) often. The four categories were selected to provide a parsimonious and consistently interpretable measure of behavioural frequency across the six practices while preserving their ordinal structure. This approach distinguishes between non-participation, occasional participation, and more frequent engagement without introducing response categories that may imply a level of precision that respondents cannot reliably provide across behaviours that differ substantially in their frequency and context. Research on response-category design further indicates that intermediate response categories may be interpreted heterogeneously by respondents, potentially reflecting uncertainty or lack of a substantive position rather than a clearly defined behavioural state [43].

The four response categories were therefore treated as ordered categories rather than equally spaced numerical values. The primary analysis retained the original four-category measures and estimated ordinal logistic regression models, thereby preserving the information contained in the distinction between never, rarely, sometimes, and often.

To address the second research question, a complementary binary measure of active engagement was constructed. Respondents reporting “often” were coded as 1, while those reporting “never”, “rarely”, or “sometimes” were coded as 0. This threshold was defined substantively rather than as a statistical convenience: frequent engagement was interpreted as evidence that the circular practice represents a meaningful component of the respondent’s consumption behaviour, whereas occasional participation does not necessarily indicate an established behavioural pattern. The binary specification therefore identifies characteristics associated with active engagement in a circular practice and provides a common outcome definition across the six behaviours.

The binary specification necessarily involves some loss of information relative to the ordinal measure. It was therefore not used to replace the ordinal models, but to address a distinct analytical question. In particular, the ordinal models address how individual characteristics are associated with the frequency of circular engagement, whereas the binary models address which characteristics distinguish respondents who actively engage in a circular practice from those who do not engage at a meaningful level. The latter specification also provides the basis for the subsequent analysis of barriers and enablers for selected behaviours.

Because “often” represents a relatively high frequency threshold, the resulting binary outcomes can be sparse for less prevalent circular practices. Such sparsity was explicitly assessed in the binary models, and estimates showing evidence of separation or substantial instability were subjected to additional sensitivity with Firth regressions analysis (Table 7 in annex).

Product Preference Measures

In addition to behaviour measurement, the survey assessed the perceived characteristics of products and the behavioural context through two summary constructs. Factor analysis (FA) was used to determine the loading of these constructs, and Table 3 in the appendix contains the results of two constructs: (i) Durability perception: A three-item scale (0 = never to 3 = often) assessed preferences about how often consumers consider product longevity and repairability: (i) "Ease of maintenance", (ii) "Repairability (the item can be repaired)" and (iii) "Durability (an item that lasts a long time without breaking easily)". The scores were averaged to create a unidimensional durability perception scale (Cronbach's $\alpha \approx 0.71$).

(ii) Environmental perceptions: A three-item scale was used to assess the perceived environmental and social benefits of circular practices: (i) "Recyclability (the item is made with recyclable components and materials)", (ii) "Made with recycled materials" and (iii) "Sustainable packaging". The items were averaged to create a sustainability perception scale (Cronbach's $\alpha \approx 0.68$).

The resulting continuous preference measures were rescaled to a 0–100 range to facilitate comparison across constructs. For analyses requiring categorical measures, respondents were classified into three groups using population-weighted terciles. Specifically, the first and second tercile cut points were calculated using the survey weights, corresponding to the weighted 33rd and 67th percentiles of each distribution. This procedure ensures that the classification reflects the distribution of preferences in the target population rather than the unweighted sample.

For the subsequent analysis of consumer preference profiles, only the lower and upper terciles were retained, representing respondents with relatively low and high levels of durability and environmental preferences, respectively. The resulting low/high classifications were then combined to construct a 2×2 matrix distinguishing four preference profiles according to the joint distribution of durability and environmental perceptions. Respondents in the middle tercile were excluded from this specific profiling exercise because the objective was to identify comparatively distinct low- and high-preference groups rather than to classify intermediate levels of preference. A descriptive matrix, with averages was constructed to characterize the preferences of the respondents. Figure 5 does not present statistically significant results and it only use is purely descriptive.

Estimation Methods

All analyses used survey-weighted maximum likelihood estimation to account for complex survey results. Models were estimated using the R package *survey* with Wald F-statistics for global model fit. Robust standard errors were computed to account for survey weights.

The core individual and household covariates included sex, age, education, urban residence, and the presence of children younger than 13 years in the household. Sex was coded with males as the reference category. Age was grouped into 18–39 years (reference), 40–59 years, and 60–80 years. Education was grouped into lower education (reference) and higher education. Urban residence and the presence of children younger than 13 were represented as binary indicators.

The regression models included three measures capturing normative orientations relevant to circular consumption: waste-related norms, lifestyle norms, and minimalist norms. These

measures were included to capture differences in respondents' broader orientations towards consumption, waste, and lifestyle choices that may be associated with circular engagement.

The same set of core characteristics was retained across the behavioural models to provide a consistent empirical base for comparing determinants across circular practices. This common specification allows the analysis to distinguish behaviour-specific associations from factors that operate across several forms of circular engagement.

Primary Specification: Logistic Models to Estimate Frequency of Circular Behaviours

To address RQ1(How is the frequency of circular engagement associated with individual characteristics?) six separate ordinal logistic regression models were estimated, one for each circular behaviour (CE1–CE6). The original four-category behavioural outcomes were retained in their ordered form: never, rarely, sometimes, and often.

The ordinal specification preserves the full information contained in the behavioural frequency measures and estimates the association between the explanatory variables and the likelihood of reporting a higher level of engagement. Odds ratios greater than one therefore indicate higher odds of being in a higher behavioural frequency category, conditional on the other variables in the model.

The proportional-odds assumption was assessed using Brant tests, and all six models satisfied this assumption (all $p > 0.05$). Multicollinearity was assessed using variance inflation factors (VIFs), which ranged from 1.2 to 2.1 across the models, indicating minimal multicollinearity.

The core predictor set was held constant across all six models to provide a consistent basis for identifying both behavior-specific and cross-cutting determinants.

As a final robust check, binary logistic regression models were estimated for each behaviour, recoding ordinal outcomes as never, rarely and sometimes (0) vs. often (1). Coefficient signs, magnitudes, and significance patterns were compared to ordinal specifications to confirm robustness across outcome transformations (see Supplementary Materials II).

Secondary Specification: Binary Models to Explore Barriers and Motivators of Active Engagement

To address RQ2 (*Which characteristics distinguish respondents who actively engage in a circular practice from those who do not engage at a meaningful level?*) binary logistic regression models were estimated using the same binary definition described above: never, rarely, and sometimes = 0, and often = 1.

The "often" category was used to identify active engagement because frequent participation indicates that the circular practice represents a meaningful component of an individual's consumption behaviour, whereas occasional participation does not necessarily indicate an established behavioural pattern. The binary specification therefore serves a distinct purpose from the primary ordinal models: while the latter examine variation in the frequency of engagement, the former identify characteristics associated with active engagement in the respective circular practice.

For three behaviours (second-hand purchasing, repair, and upcycling) it was possible to investigate RQ2, since the survey only collected information about specific barriers and enablers for these CE behaviours.

For each behavior, alternative model specifications were evaluated, and the final reported models included the corresponding behavior-specific barriers and motivators while retaining the same core covariates used in the primary specification. This approach allows the analysis to identify behavior-specific factors associated with active engagement while controlling for the common individual, household, normative, and product-preference characteristics included in the main models.

For each model, various specifications were evaluated, and the final reported models included the corresponding barriers and motivators. All the models were tested with the same core covariates used in the previous model plus the barrier/motivator-specific questions from the survey. All barrier and enabler items used four-point Likert scales (1 = Strongly disagree to 4 = Strongly agree) and were averaged to create scale scores or used individually where single items were employed.

Because the binary outcome defines active engagement using the relatively high frequency "often" category, some behaviours may contain relatively few positive observations. Binary models were therefore examined for sparse cells and potential estimation instability. Where unusually large coefficients or standard errors indicated potential (quasi-)complete separation, Firth penalized logistic regression was used as a sensitivity analysis. These sensitivity estimates were used to assess the robustness of the binary results and were not treated as replacements for the survey-weighted models. Detailed results from Firth regression are found in Table 6 in annex.

Results

Characteristics of Circular Economy Behaviours

Engagement in circular economy behaviours varies across the six typologies of behaviours investigated, as presented in Fig. 1. Reducing consumption emerges as the most common behaviour, with over four-fifths of respondents reporting that they do so often (76.2%). Repairing products are also widespread, with 54.8% reporting doing so 'often' and a further 35.8% 'sometimes'. Sharing and donating are practiced less frequently but remain relatively common, with approximately four-fifths of respondents reporting engaging in these activities at least sometimes. In contrast, purchasing second-hand products and upcycling exhibit lower levels of regular engagement. For both practices, fewer than 10% of respondents reported engaging often, while a substantial share reported doing so rarely or never. Approximately 22% reported never purchasing second-hand products, and 24% reported never upcycling.

Contribution to environmental sustainability emerges as the most important motivation across all three circular economy behaviours, namely, second-hand purchases, repairs, and upcycling. Economic considerations also play a prominent role, particularly for second-hand purchasing and repair. Social motivations appear to play a relatively minor role. Only a small proportion of respondents reported being motivated by opportunities for socializing (2.3–4.5%), while peer-to-peer influence was reported by between 10.0% and 17.8% of respondents. Overall, the findings suggest that environmental and economic considerations are the primary drivers of circular behaviours, whereas social motivations and peer influence are considerably less important. See Fig. 2a.

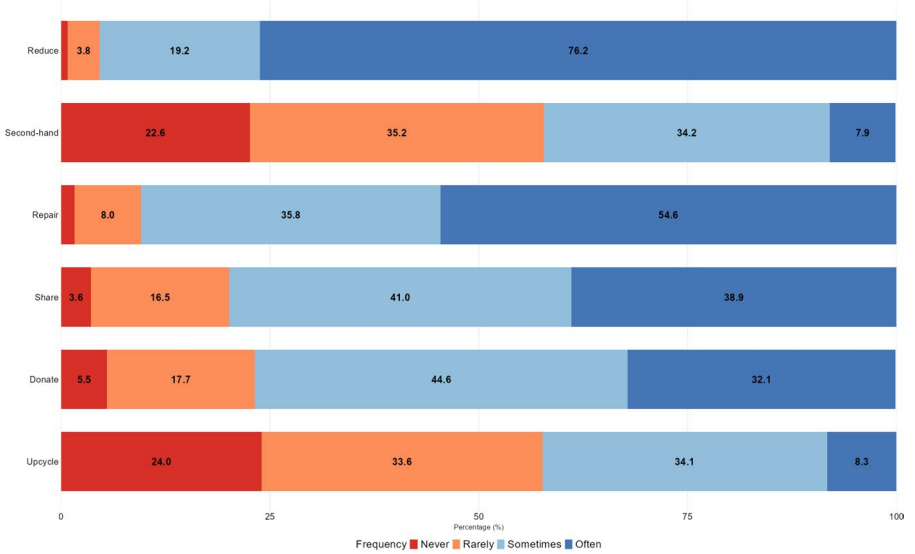


Fig. 1 Distribution of CE behaviours among households in South Tyrol. $N=994$

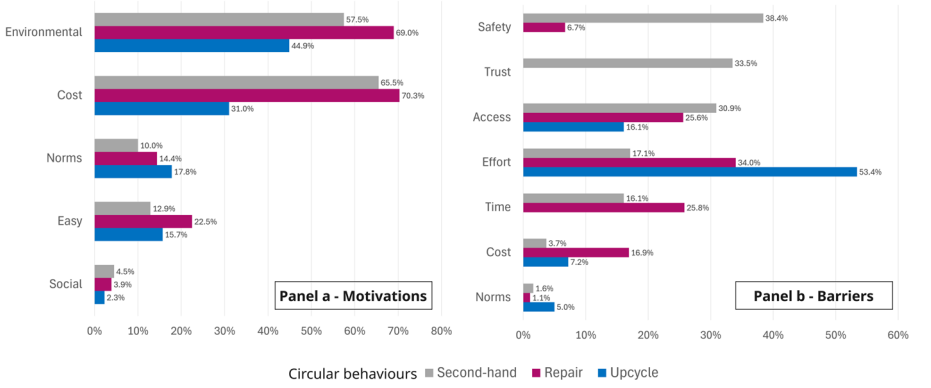


Fig. 2 Percentage of respondents selecting (**a**) motivations and (**b**) barriers for engaging in CE. $N=994$

Perceived barriers differ substantially between behaviours. For second-hand purchasing, concerns about safety (38.4%) and lack of trust in product quality and durability (33.5%) emerged as the most frequently reported barriers, followed by the lack of nearby services or opportunities to purchase second-hand (30.9%). For repair activities, the most important barrier was the lack of required skills (34%), while limited availability of services (25%) and costs (16.9%) were reported less frequently. Upcycling was primarily reported as constrained by the lack of needed skills (53.4%), making it the single most frequently cited barrier across all behaviours, followed by lack of time (25.8%). Economic barriers were rel-

atively uncommon overall, particularly for second-hand purchasing (3.7%) and upcycling (7.2%). Social factors, such as the absence of peer-to-peer influence, were rarely identified as obstacles to any of the three behaviours. These findings suggest that trust in product quality and safety considerations is particularly relevant for second-hand consumption, whereas skills and time-related constraints play a more important role in limiting engagement in repair and upcycling behaviours (Fig. 2a, b).

Respondents' perceptions of product sustainability and product durability were measured through composite scales capturing preferences for environmental product attributes and product longevity, respectively. Both constructs exhibit similar distributions, with median values close to the sample mean and comparable interquartile ranges, suggesting that respondents place a relatively balanced emphasis on sustainability and durability when evaluating products. Perceptions of sustainability show a slightly wider spread, whereas durability perceptions display a small number of lower-end outliers, indicating that a minority of respondents report particularly low concern for product longevity and repairability. Overall, the results suggest that environmental and durability considerations are both salient dimensions in consumers' product evaluations.

Primary Specification: Determinants of CE Behaviours

The results from the first set of ordered logistic regressions aimed at extracting the core factors that explain the reported behaviour for the six circular economy behaviours (reduce, reuse, repair, sharing, delay and upcycle) are presented in Fig. 3 as odds ratios (for model results in coefficients, see Supplementary Material).

All ordinal logistic regression models demonstrated significant global fit (Wald $F \approx 9.13$–15.01, $df \approx 11{,}993$, all $p < 0.001$), indicating that the set of predictors collectively explained substantially more variance than did the intercept-only baseline models. The pseudo-R^2 val-

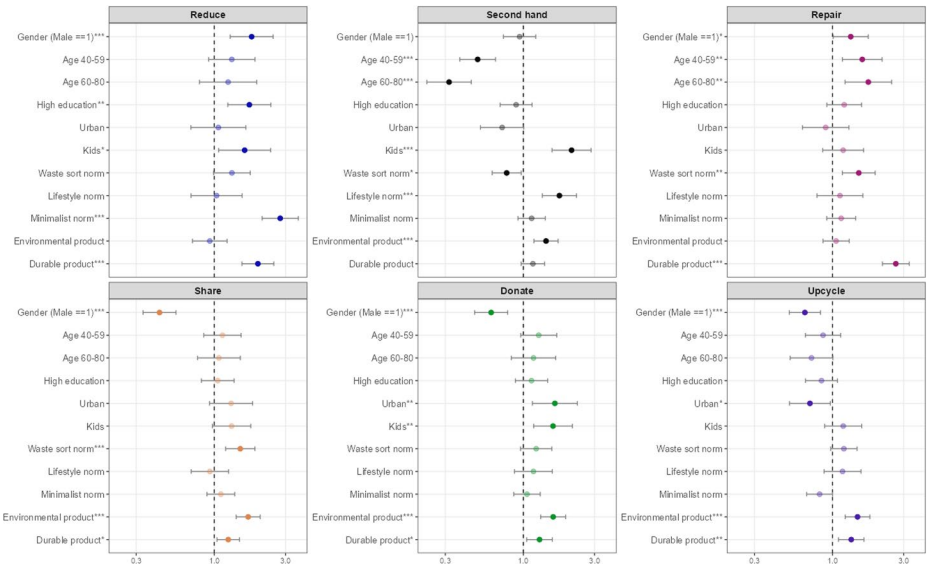


Fig. 3 Ordered logit results. Odd ratios and statistical significance per variable. Statistical significance: * (5%), ** (1%), *** (0.1%). Regression results in detail in Appendix Table 4

ues for the ordinal models ranged from 0.044 (upcycling) to 0.109 (reducing), falling within the typical ranges for cross-sectional behavioural research (McFadden 0.04–0.11 often considered acceptable). Overall, the findings indicate that CE behaviours are not driven by a common set of determinants but instead reflect behaviour-specific mechanisms involving normative orientations, product-related perceptions, and sociodemographic characteristics.

As a robustness check, the binary logistic regression models (recoding ordinal outcomes: Never/Rarely = 0; Sometimes/Often = 1) showed consistent coefficient signs and similar magnitude patterns to ordinal specifications, with pseudo-$R^2 \approx 0.091$–0.326. The consistency of findings across ordinal and binary specifications (in terms of magnitude and significance) provides evidence that results are not artifacts of the chosen outcome transformation or model specification. The results of these estimations can be found in Supplementary Material 2.

A reduction in consumption emerges as the behaviour most strongly associated with normative orientation. The self-reported value of having more objects or products is not an important variable and has a large and highly significant effect ($OR \approx 2.77$, $p < 0.001$), indicating that individuals who endorse minimalist values are nearly three times more likely to reduce consumption. Durability perceptions of products ($OR \approx 1.96$, $p < 0.001$), male sex ($OR \approx 1.78$, $p < 0.001$), and higher education ($OR \approx 1.72$, $p < 0.01$) were also positively associated with reduction. In contrast, sustainability perceptions of products and broader normative constructs do not have significant effects, suggesting that reduction behaviour is driven primarily by value-based and product-oriented considerations rather than by general environmental concern.

Second-hand purchasing displays a distinct pattern characterized by strong household composition. The presence of children under 13 years of age significantly increased engagement ($OR \approx 2.10$, $p < 0.001$), while lifestyle norms ($OR \approx 1.74$, $p < 0.001$) and preference for sustainable products ($OR \approx 1.42$, $p < 0.001$) also played important roles. A pronounced negative age gradient was observed, with older individuals (60–80) being significantly less likely to participate ($OR \approx 0.318$, $p < 0.001$). Unlike reduction, minimalist norms and education are not significant predictors, suggesting that second-hand behaviour is more closely linked to practical household needs and lifestyle identity than to ideological commitments.

Repair and maintenance behaviour is strongly influenced byproduct-related perceptions, particularly durability ($OR \approx 2.66$, $p < 0.001$), which represents one of the largest effects observed across all the models. Age was also a key determinant, with middle-aged ($OR \approx 1.58$, $p < 0.01$) and older individuals ($OR \approx 1.74$, $p < 0.01$) being significantly more likely to engage in repair activities. Waste-related norms ($OR \approx 1.50$, $p < 0.01$) contribute positively, while sustainability perceptions and other normative constructs do not exhibit significant effects. These findings suggest that repair behaviour is primarily grounded in functional and experiential considerations rather than abstract environmental motivations.

Sharing behaviour is predominantly shaped by sustainability-related perceptions and social norms. Perceived behavioural control for sustainability ($OR \approx 1.69$, $p < 0.001$) and waste norms ($OR \approx 1.49$, $p < 0.001$) both significantly increase the likelihood of participation. A strong gender effect was observed, with men being significantly less likely to engage ($OR \approx 0.43$, $p < 0.001$). The other variables, including age, education, and durability perceptions, are not significant. This finding indicates that sharing practices are primarily socially oriented and value-driven rather than linked to product characteristics.

Donation behaviour exhibits relatively modest explanatory power and fewer significant predictors. The presence of children under 13 years of age (OR ≈ 1.58, $p < 0.01$) and sustainability-related product preferences (OR ≈ 1.58, $p < 0.001$) are positively associated with engagement, while men are significantly less likely to donate (OR ≈ 0.61, $p < 0.001$). For this behaviour, urban setting seems to be positively associated. Notably, none of the normative variables show significant effects, suggesting that donation is less driven by identity or normative frameworks and may instead reflect routine or situational practices.

Upcycling was the least well-explained behaviour in the analysis. Although sustainability (OR ≈ 1.47, $p < 0.001$) and durability perception of goods (OR ≈ 1.34, $p < 0.01$) exhibited positive associations, the overall model fit remained low (pseudo-$R^2 \approx 0.044$), and no normative variables were significant. Gender differences persist, with women being more likely to engage than men. These findings point to the limited role of attitudinal and normative factors in explaining upcycling behaviour, suggesting the importance of external or structural constraints. Additionally, for this behaviour, rural setting seems to be positively associated.

Based on the findings of each of these six models, Table 2 gathers the main factors and articulates them in the form of a profile.

The same model specifications were estimated with binary outcomes to evaluate the robustness of the models, which showed consistent patterns (Spearman ρ for coefficient rankings > 0.92 across ordinal and binary specifications).

Secondary Specification: Barriers and Motivators

Binary logit models indicate that the adoption of circular behaviours is shaped by perceived barriers and motivations. In sum, barriers exhibit uniformly negative associations and are often substantial in magnitude, indicating that practical and psychological constraints play a central role in limiting engagement. This suggests that reducing frictions, such as effort, time, availability, and trust, is likely to be critical for facilitating wider adoption of circular practices. All the models presented relatively moderate pseudo-R^2 values, further indicating that while motivations and barriers are important, circular behaviours are only partially explained by the included variables. Moreover, global Wald tests for all three models confirm that the sets of predictors are jointly significant across all the models ($p < 0.001$). These results are presented in tables and images and in the appendix as the full model.

Motivational factors, particularly those related to social influence and environmental concern, show strong positive associations. These effects are especially pronounced for second-hand and upcycling behaviours. Normative influences, however, are more behaviour specific: lifestyle-related norms strongly predict second-hand consumption but are less influential for repair and upcycling activities, indicating that norms may operate differently depending on the behavioural context.

Perceptions of product durability also play an important role, particularly in shaping repair and upcycle-related behaviours, where they emerge as strong positive predictors. In contrast, durability appears less relevant for second-hand consumption, highlighting differences in how product attributes influence distinct circular practices. Sociodemographic characteristics further vary across behaviours, suggesting that different circular activities resonate with different segments of the population (Fig. 4).

Table 2 Main factors per CE behaviour

CE behaviour	Main factors	Profile
Reduce	1. Minimalist norm 2.Durability 3. Male	Values-driven and product-focused; associated with minimalism and durability perceptions. More prevalent among men and higher-educated individuals; broadly consistent across age groups.
Second-hand	1. Children 2. Lifestyle norm 3. Sustainability	Household situation- and lifestyle-driven; more common among younger households with children. Reflects identity and practical needs rather than ideological commitment. Strong negative association with older age.
Repair	1. Durability 2. Age 60–80 3. Age 40–59	Product-quality-oriented and age-stratified; strongly associated with durability perceptions and older age groups. Moderately influenced by waste norms; more prevalent among men.
Sharing	1. Sustainability 2. Waste norm 3. Female	Social and value-driven; shaped by pro environmental perceptions and waste norms. Strongly female-dominated; not linked to product durability considerations. Cross-generational pattern.
Donate	1. Children 2. Sustainability 3. Female	Weakly structured behaviours; influenced by household composition and pro environmental perceptions. Female-dominated. Likely habitual or routine rather than norm-driven or identity-based. Urban based.
Upcycle	1. Sustainability 2. Durability 3. Female	Least explained behaviours; weakly associated with attitudinal variables. Female-dominated. Suggests strong dependence on structural and logistical conditions rather than motivations. Rural based

Second-Hand Purchases

Second-hand purchasing is primarily driven by normative orientation and perceived convenience but is strongly constrained by multiple barriers. Lifestyle norms had the largest positive association (OR≈10.3), indicating that individuals who are aligned with resource-conscious lifestyles have substantially greater odds of engaging in second-hand consumption. Motivational factors further reinforce this pattern, with perceived ease (OR≈3.2) and social motivation (OR≈2.6) emerging as important positive contributors.

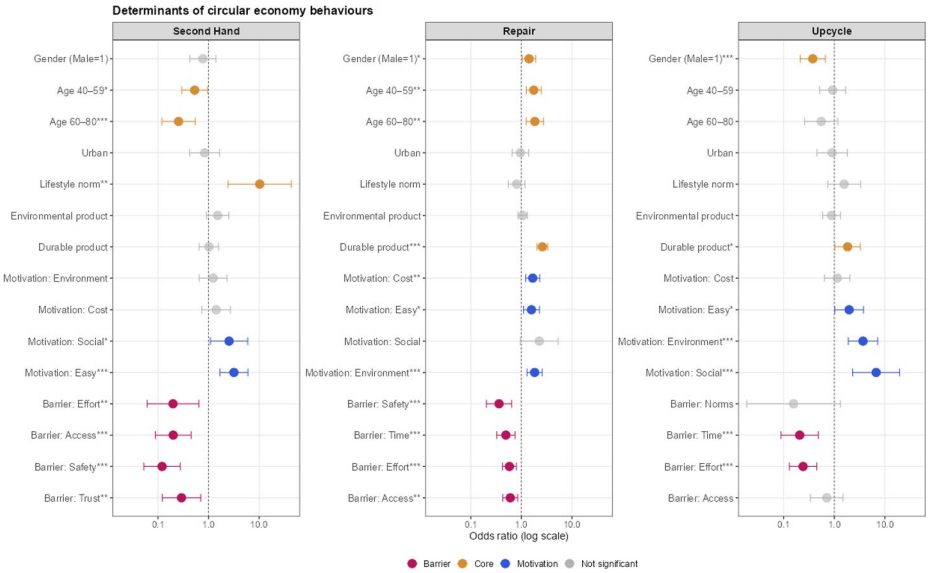


Fig. 4 Ordered logit results for main CE behaviours. Odd ratios and statistical significance per variable. Statistical significance: * (5%), ** (1%), *** (0.1%). Regression results in detail in Appendix Table 5

The large estimate for lifestyle norms warrants cautious interpretation. Formal separation diagnostics found no evidence of complete or quasi-complete separation in the model[2], and no individual term was flagged. However, inspection of the underlying contingency table revealed substantial sparsity (see Table A5). The original lifestyle-norm measure comprised four response categories, but no respondent selected "Totally agree." Among the three observed categories, second-hand purchasing was reported by 0 of 25 respondents in the "Totally disagree" category, 2 of 226 respondents in the "Disagree" category, and 83 of 743 respondents in the "Agree" category. The same pattern was observed in the survey-weighted frequencies. Thus, although formal separation was not detected, the large OR should be interpreted considering the sparse distribution of this predictor.

As a sensitivity analysis, we estimated an unweighted Firth bias-reduced logistic regression using the same model specification. The association between lifestyle norms and second-hand purchasing was attenuated from OR≈10.29 (95% CI: 2.45–43.26) in the primary survey-weighted model to OR≈6.57 (95% CI: 2.07–33.31) in the Firth model. The direction and substantive interpretation of the association were unchanged, although the reduction in magnitude indicates some sensitivity of the estimate to the estimation procedure. The survey-weighted model is therefore retained as the primary specification, while the magnitude of the lifestyle-norm association is interpreted cautiously. Full Firth sensitivity results are reported in Table 6 in Appendix.

In contrast, barriers exert strong and consistent negative effects. Perceived lack of security stands out as the most substantial constraint (OR≈0.12), followed by limited availability (OR≈0.20), effort (OR≈0.20), and low trust (OR≈0.29). These effects indicate that second-hand behaviour is highly sensitive to both practical frictions and perceived risks, with barriers substantially reducing the likelihood of participation.

[2] Using brglm2::detect_separation() function in r.

Sociodemographic effects are comparatively modest but consistent: older individuals and men have lower odds of engaging in second-hand purchasing, and urban residence shows a small negative association. Perceived control plays a limited role, with only sustainability-related control showing a slight positive effect (OR ≈ 1.5).

Repair

Repair behaviour is most strongly associated with product-related perceptions, particularly durability. Perceived durability emerges as the dominant positive predictor (OR ≈ 2.6), indicating that individuals who value longer product lifespans have substantially greater odds of engaging in repair. Motivational factors, including social (OR ≈ 1.9) and environmental considerations (OR ≈ 1.7), also contributed positively, although to a lesser extent.

Barriers again display a consistent negative pattern, with lack of trust representing the strongest constraint (OR ≈ 0.34). This was followed by availability (OR ≈ 0.49), peer-related barriers (OR ≈ 0.59), and perceived effort (OR ≈ 0.62), highlighting that both access- and confidence-related issues reduce the likelihood of repair behaviour.

Unlike second-hand consumption, repair behaviour is positively associated with age and male sex, indicating a distinct sociodemographic profile with greater engagement among older individuals and men. Normative factors and sustainability-related controls have comparatively weak effects (ORs close to 1), suggesting that they play a limited role in this domain. For sensitivity analysis, see Table 7, with Firth regressions.

Upcycle

Upcycling behaviour is driven primarily by strong motivational factors but is heavily constrained by perceived effort and time costs. Social (OR ≈ 5.0) and environmental (OR ≈ 4.0) motivations are the dominant positive predictors, indicating that these behaviours are strongly linked to value-based and socially reinforced drivers.

Moreover, barriers related to time (OR ≈ 0.22) and effort (OR ≈ 0.23) had large negative effects, suggesting that perceived inconvenience substantially reduces engagement. Compared to the other behaviours, this domain appears to be particularly sensitive to the burden of action.

Sociodemographic patterns differed from those of repair: men (OR ≈ 0.39) and older individuals (OR ≈ 0.46) had lower odds of engaging in upcycling-related behaviours. Perceived product durability remains positively associated (OR ≈ 2.0), while sustainability-related control has no clear effect (OR ≈ 0.86), indicating that general perceptions of control are less influential than specific motivations and constraints. For sensitivity analysis, see Table 7, with Firth regressions.

Discussion

Consumer Preferences for Product Durability Vs. Sustainability

Consumer behaviour has become an increasingly important area of research within circular economy (CE) research, as the success of circular strategies ultimately depends on

consumer participation. As described in Chap. 2, there are two streams of related research. The first section examines sustainability-oriented drivers of circular consumption, including environmental concern, pro-environmental values, and environmental attitudes. The second focuses on product-related characteristics that facilitate circularity, such as durability, repairability, longevity, and product lifetime extension [2, 44].

Recent studies have advanced the understanding of sustainability-related motivations in CE contexts. For example, [33] demonstrates the continuing emphasis within CE behaviour research on environmental values and sustainability-related constructs as key drivers of consumer decision-making. A substantial body of literature has examined durability-related factors such as product longevity, repairability, and product life extension. These studies suggest that consumers often value durable products because they provide functional, economic, and quality-related benefits, including reduced replacement costs, increased reliability, and greater value for money [45]. Similarly, Jacobs, [46] found that preferences for long-lasting products are frequently driven more strongly by personal benefits than by environmental concerns, highlighting the importance of distinguishing between durability-related and sustainability-related motivations.

Although both environmentally oriented and durability-oriented drivers of consumption have been studied independently, limited research has directly compared their relative explanatory power in predicting circular economy behaviours. According to our analysis, only a preference for durable products is associated with more repair and upcycling, but further analysis is needed to contextualize these findings in terms of products and sociodemographic. As a result, it remains unclear whether consumers engage in circular behaviours primarily because they value the functional and economic benefits associated with durable products or because they seek to achieve broader environmental sustainability outcomes. As explained in Section "Materials and Methods", the sample was divided into four groups based on the responses obtained for the preferences for durable and sustainable products. Figure 5 presents 2×2 matrices with socioeconomic profiles, barriers and motivations as well as products purchased on the second hand, repaired and upcycled. Figure 5 is purely descriptive, without statistical significance and it helps to characterize how residents engage in the various CE behaviours. The Figure repeats its structure for each of these previously mentioned behaviours. This framework allows us to identify which products are most relevant for each behaviour and provides the basis for analysing the motivators and barriers discussed in the following section.

Across the matrix, the overall level of circularity increases consistently with preferences for sustainability and durability. Starting in the low–low quadrant (low preference for environmental and durable products), the average level of circular behaviour is 58.9, and it progressively increases toward the high–high quadrant, where it reaches 77.27. Sociodemographic patterns also emerge along this gradient. The low–low segment tends to include younger respondents, with a greater proportion of males and households with children. Within the group with a low-low level of attention given to the product's environmental sustainability, increasing durability preferences are associated with an even greater share of male respondents, suggesting that practical constraints and budget considerations may play an important role in shaping durability-oriented attitudes. Education, however, does not show a consistent pattern across the matrix. Finally, higher preferences for sustainability and durability are associated with fewer overall purchases, indicating a tendency toward reduced consumption intensity (Fig. 5).



Fig. 5 Matrix of CE behaviours. Socioeconomic characteristics, main products and barriers and motivations. Figure (**a**) for second-hand purchases, (**b**) for repairing and (**c**) for upcycling

For second-hand purchases, the results reveal a nonlinear pattern across the environmentally durable product preference matrix. At low levels of environmental product preferences, second-hand engagement remains relatively stable across durability levels, with mean values ranging from 1.09 to 1.15. With respect to high environmental preferences, engagement remains elevated, ranging from 1.36 to 1.50. At the product level, clothing shows the strongest variation across groups, increasing from 24% in the low–low quadrant to 37% at high sustainability levels. Furniture and electronics remain relatively stable across conditions, while sport-related items remain consistently lower (approximately 16% to 27%). These patterns indicate that second-hand consumption is particularly responsive in identity-relevant categories such as clothing, where perceptions of durability reinforce the motivations for performing the behaviour.

About repair, there is a clear and consistent pattern across the environmental–durability matrix, characterized by a steady increase from the low–low to the high–high quadrant. In the low–low condition, respondents reported repairing items at a level corresponding to "sometimes" (mean≈2.08), while in the high–high condition, this item increased to levels approaching "always" (mean≈2.83). Both the environment and durability are positively associated with repair behaviour, but durability plays a more dominant role. Across all levels of environmental preferences, increasing durability leads to increases in repair frequency, for example, from 2.08 to 2.67 at low sustainability and from 2.25 to 2.83 at high sustainability. In contrast, increases in the area along the sustainability axis are more modest. At the product level, electronics showed the highest repair rates, followed by clothing and furniture. Sport-related items remain comparatively low, ranging from approximately 22% to 38%. As durability increases, all categories exhibit higher repair rates, whereas preferences for environmental characteristics have a more limited influence on category distribution. This suggests that repair is primarily driven by functional and practical considerations, with environmental considerations playing a secondary, reinforcing role.

For upcycling, the pattern differs by combining elements of both sustainability-driven and durability-driven behaviour. Starting from the low–low quadrant, upcycling engagement is relatively low (mean≈0.98) but increases substantially when moving either along the durability axis or the sustainability axis. At low sustainability, increasing durability leads to a large increase (0.98 to 1.50), while at low durability, increasing sustainability also produces a strong increase (0.98 to 1.41). In the high–high quadrant, the value reaches 1.58, although differences across durability levels decrease with increasing environmental preference (1.41, 1.54, 1.58). This indicates a compensatory relationship where either environmental or durability can independently drive upcycling behaviour and where the marginal effect of one decrease as the other becomes stronger. At the category level, upcycling is strongly concentrated in clothing and furniture. Clothing increases from 31% in the low–low quadrant to 55% in the high–high quadrant, while furniture consumption remains consistently high, reaching up to 50%. In contrast, electronics remain very low across all groups (approximately 3% to 0.16%), and sport-related items are also minimal. These results suggest that upcycling is closely linked to the physical and creative transformability of products, favouring categories such as clothing and furniture. Durability appears to support more functional forms of upcycling, particularly for furniture, while environmental characteristics are more associated with creative and identity-driven upcycling of clothing.

Barriers

In our study, barriers to circular behaviours differed across second-hand purchasing, repair, and upcycling, revealing three distinct constraint structures linked to perception, feasibility, and capability.

For second-hand purchasing, the dominant barriers are perceptual, particularly safety/hygiene and trust concerns. This finding is in line with similar studies in the literature that consistently identify perceived risk as a key obstacle, including concerns regarding product quality, hygiene, reliability, and uncertainty about previous ownership [47]. Early work by Guiot and Roux [48] demonstrated that consumers frequently experience barriers related to contamination concerns, social perceptions, and a preference for new products. Similarly, [49] found that trust and perceived product quality strongly influence consumers' willingness to purchase second-hand goods. By further distinguishing between levels of environmentally oriented and durability-oriented behaviours, several additional characteristics arise. In the low–low quadrant, safety concerns (47%) and trust (44%) are the most salient, while access remains secondary (28%). As sustainability increases, trust decreases substantially (from 44% to 14%), and effort also declines (21% to 5%), indicating that more environmentally oriented individuals perceive fewer psychological barriers. However, safety/hygiene concerns remain consistently high even at high environmental levels (34%–48%), suggesting the presence of a persistent structural barrier. With increasing durability, the relative importance of access increases (up to 45% under low environmental–high durability), indicating a shift from perceptual barriers toward availability constraints. Cost and social factors remain negligible across all segments.

Repair behaviours are primarily constrained by feasibility-related barriers, particularly skills, effort, and access, which again mirror what has been identified in the literature, where the main barriers are related to reduced feasibility of extending product lifetimes. These specific barriers include cost comparisons to replacement, limited access to spare parts, lack of repair information and tools, and lack of repair services [50]. Other studies have also highlighted the importance of consumer capabilities and product design. For example, Ackermann et al. [51] reported that a lack of repair skills, low confidence in repair outcomes, and poor perceptions of inconvenience significantly reduce consumers' willingness to repair products. Moreover, design-related barriers, such as products being difficult to disassemble or requiring specialized tools, further discourage repair activities [52]. When further detail was introduced from our study in the low–low quadrant, lack of skills was the most significant barrier (49%), followed by effort (29%) and access (26%), highlighting the importance of perceived difficulty. As durability increases, both skill and effort barriers decrease substantially (skills: 49% to 17%; effort: 29% to 17%) under low sustainability. Along the sustainability axis, effort and cost decline moderately (effort from 29% to 8%; cost from 22% to 10%), but skill remains relatively persistent even in high-sustainability segments (22%–34%).

For upcycling, the most dominant barrier is skill, again appearing in the literature as one of the most significant barriers, together with the knowledge, time, and resources necessary to transform discarded products into items of equal or greater value. Additional studies have shown that uncertainty regarding the aesthetic quality, functionality, and durability of upcycled products can further reduce consumer engagement [53]. In our study, skill barriers remained consistently high across all segments (42%–61%), making them the most

constrained behaviours in terms of capability. Even in the high–high quadrant, skill barriers remain substantial (43%), indicating that upcycling is perceived as requiring specialized or creative abilities that are not easily overcome by sustainability preferences. Effort represents the second most important barrier (11%–38%), and like repair, effort decreases with durability, reflecting improved feasibility. However, unlike repair barriers, skill barriers do not decline systematically with either sustainability or durability, reinforcing the idea that they are more deeply embedded. Costs remain negligible (0%–12%), and access is relatively low and inconsistent (0%–21%), suggesting that barriers are not primarily structural but competence-driven. Social factors remain marginal throughout.

These results indicate that second-hand purchasing is constrained mainly by trust and risk perceptions, repair by practical feasibility and general skills, and upcycling by high and persistent capability requirements. While higher sustainability preferences reduce some barriers, particularly trust and effort, they do not fully overcome the core constraints specific to each behaviour, highlighting the need for differentiated strategies to support circular practices.

Motivations

When looking at the motivations, a similar pattern to barriers in the literature can be observed, which means that there are different types of motivations for different circular consumption behaviours. While second-hand purchasing is motivated primarily by economic value, environmental concerns, and the pursuit of unique products [48, 54], repair is driven by cost savings, product attachment, and the desire to extend product lifetimes [51, 55]. In contrast, upcycling is particularly associated with creativity, self-expression, skill development, and environmental stewardship [53, 56].

In our study, cost and environmental concerns consistently emerge as the primary drivers, while all the other motivations remain secondary. For second-hand purchasing, a clear transition is observed along the environmental preference axis. In low environmental segments, behaviours are predominantly driven by cost (69%–74%), with environmental motivations playing a secondary role (37%–40%). As environmental preference increases, environmental motivation rises substantially (up to 78%), becoming the dominant driver, while cost remains relevant but declines in relative importance (50%–58%). This indicates a shift from economically driven participation to value-driven engagement, although the highest engagement occurs when both motivations are simultaneously high. Convenience, social, and normative motivations remain low across all segments.

In relation to these barriers, there is a clear gap between motivations and barriers: while motivations shift toward environmental concerns, persistent issues related to trust and hygiene continue to limit engagement. This suggests that stronger motivation does not necessarily translate into action due to enduring perception-based barriers.

Repair behaviours are characterized by a stable dual-motivation structure, where both cost and environmental concerns are consistently important across all groups. Costs remain high throughout, indicating a persistent economic rationale, while environmental motivations increase steadily with a preference for sustainability, reaching very high levels (85%–89%) in high environmental preference segments. Unlike second-hand motivations, there is no clear substitution between motivations; instead, cost and environmental concerns reinforce each other. Durability amplifies both motivations, particularly environmental ones,

suggesting that repair is driven by a combination of economic benefit and functional justification and strengthened by sustainability values.

In relation to the barriers, repair shows a strong alignment between motivations and barriers. Economic and environmental motivations are consistently present, while barriers related to effort and feasibility decrease as conditions become more favourable. This creates a context where higher motivation can more easily translate into actual behaviours.

In upcycling, motivations are more balanced and generally lower in magnitude, reflecting a more diffuse structure. In low environmental segments, neither cost (27%–36%) nor environmental concerns (29%–39%) clearly dominate, indicating weaker and less defined drivers. As preference for environmental products increases, environmental motivations become more prominent (up to 66%), but cost remains relevant across all conditions, without the clear transition observed in second-hand or the strong reinforcement seen in repair. Notably, normative motivations are somewhat more visible in upcycling (up to 28%) than in other behaviours, suggesting a slightly stronger influence of perceived norms, although still secondary overall. Convenience remains low and stable, and social motivations are minimal.

Finally, in upcycling, there is a mismatch between motivation and capability. Although both economic and environmental motivations are present, they are weaker and less clearly defined, while skill-related barriers remain consistently high. As a result, even motivated individuals may be unable to act, indicating that capability constraints play a central limiting role.

Policy Implications

The findings of this study contribute to a more nuanced understanding of circular consumer behaviour, moving beyond the traditional assumption that circular behaviours can be treated as a homogeneous and unified category of behaviours and are driven by a common set of determinants. Our results showed that different circular behaviours, particularly second-hand purchasing, repairing, and upcycling, are associated with distinct combinations of motivations, barriers, and sociodemographic characteristics. This suggests that circular behaviour should not be treated as a homogeneous category when designing policy interventions.

A first implication is that policies aimed at promoting circular consumption should be behaviour specific rather than adopting a one-size-fits-all approach. Interventions designed to reduce barriers, strengthen motivations, and engage specific consumer groups are likely to be more effective when tailored to the characteristics and determinants of individual circular behaviours. The observed heterogeneity across second-hand purchasing, repairing, and upcycling indicates that policy measures targeting one behaviour cannot be assumed to generate similar effects for others.

A second implication concerns the integration of two strands of literature that have often developed separately: one emphasizing environmental sustainability concerns as drivers of circular behaviour and another focusing on product-related attributes such as durability. By jointly considering these dimensions, our study highlights the importance of developing differentiated policy pathways for consumer segments characterized by distinct combinations of sustainability orientation and product durability preferences. The diverse combinations can be reported to diverse consumer profiles: one profile strictly related to environmental

sustainability and the other more related to practical characteristics of the products and their functionality according to individual and household needs.

For example, consumers displaying low engagement in second-hand purchasing may benefit from interventions that simultaneously improve trust in product quality and strengthen practical competences related to second-hand transactions. Policies supporting quality assurance mechanisms, information provision, and consumer guidance could help increase participation among less active users. Notably, this group is characterized by the highest average number of children, suggesting that targeted initiatives could be particularly effective in product categories associated with rapidly changing household needs, such as children's clothing, toys, and equipment.

The findings related to upcycling further suggest that increasing motivations alone may be insufficient to stimulate behavioural change. Although both economic and environmental motivations are present, capability-related barriers remain consistently high across consumer groups. This indicates that policies should place greater emphasis on skill development, practical training, and access to resources that enable consumers to engage in upcycling activities. Addressing capability constraints may therefore represent a more effective strategy than focusing exclusively on awareness-raising campaigns. Furthermore, by addressing the barriers of first access and cost, consumers could enter upcycling activities and – by practicing – reduce their main barrier.

An additional policy-relevant finding concerns household composition. Across the three circular behaviours examined, lower levels of engagement are more frequently observed among respondents with children. This suggests that family-related constraints may limit participation in all three circular practices mentioned above. Consequently, policies aimed at fostering circular consumption could benefit from extending their focus beyond individual consumers to include households and families as units of intervention. Family-oriented measures, such as support schemes, dedicated services, or targeted information campaigns addressing the specific needs of households with children, may contribute to reducing barriers and increasing the adoption of circular behaviours. Given the central role of families in shaping consumption patterns, integrating a household perspective into circular economy policies could generate substantial gains in the diffusion of second-hand purchasing, repair, and upcycling behaviours.

Overall, the principal policy recommendation emerging from this study is the need for circular economy policies that explicitly recognize the diversity of circular behaviours and the diversity of consumer profiles associated with them. Effective policy design should move beyond generic approaches and instead account for the specific combinations of motivations, barriers, sociodemographic characteristics, and product-related preferences that shape different forms of circular consumption. Furthermore, integrating policy domains that are often treated separately, such as the circular economy, consumers, products/production, family, and household policies, may enhance the effectiveness of interventions aimed at promoting circular consumption behaviours.

Limitations

While this study offers a comprehensive, comparative mapping of the circular economy behavioural portfolio among the residents of Alto Adige, several structural and methodological limitations must be acknowledged when interpreting the results.

Due to strict resource constraints and the operational necessity of minimizing respondent fatigue within the ASTAT provincial framework, the survey instrument could not be extended to capture the full spectrum of circular economy behaviours. Concurrently, the evaluated behaviours were measured using generalized, product-agnostic items. Circular practices are highly sensitive to the specific material and technical characteristics of the product in question. A consumer's drivers and barriers regarding second-hand acquisition or repair of consumer electronics differ radically from their choices regarding textiles or household furniture. Future research should deploy more granular, sector-specific instruments to evaluate whether the behavioural determinants identified here remain stable across distinct product categories.

While this failure to construct uniform psychometric constructs presented an analytical challenge, it serves as a valuable empirical finding. This finding directly validates our core thesis regarding the profound heterogeneity of circular behaviours. This finding demonstrates that the cognitive, normative, and efficacy structures driving a routine action such as upcycling cannot be mathematically compressed into the same predictive scale as disruptive actions such as collaborative sharing or consumption reduction. Future structural equation modelling (SEM) approaches should treat these psychological determinants as highly localized, behaviour-specific latent variables rather than attempting to enforce broad, cross-cutting psychological constructs.

The survey collected information about self-reported behavioural data only from the residents of South Tyrol. Consequently, the dataset is susceptible to traditional survey limitations, including recall inaccuracies and social desirability bias, where respondents may overreport virtuous environmental behaviours due to perceived societal expectations. Validation through objective, real-world behavioural metrics (e.g., physical municipal waste weights, localized repair shop transaction records, or verified sharing platform user logs). This approach leaves the classic "attitude-behaviour" or "intention–behaviour" gap unmeasured. Future longitudinal or experimental research designs integrating observational data, digital tracking, or field experiments within the municipality would be highly valuable to cross-examine and validate the self-reported dynamics identified in this study.

Moreover, for the CE index, the models show moderate explanatory power, which underscores the importance of unobserved factors not captured in the analysis. Infrastructure availability, time constraints, market conditions, and access to circular services are likely to play a significant role in shaping behaviour but are not directly measured here. The continuous specification therefore confirms that while attitudes and perceptions are important, they operate alongside a broader set of structural determinants that remain critical for understanding circular engagement.

Finally, the findings are context specific and may not be generalizable across different institutional, cultural, or economic settings. The drivers of circular behaviours are likely to vary depending on local infrastructure, social norms, and policy frameworks. Caution is therefore warranted in extrapolating the results beyond the study context without further comparative analysis.

Conclusion

This study examined the determinants of multiple circular economy behaviours among residents of South Tyrol, revealing three critical insights for policy and practice.

First, barriers appear to play a more substantial role than awareness in shaping circular engagement. Structural obstacles, such as safety and trust concerns in the second-hand market, effort and time requirements in upcycling, and availability and trust constraints in repair, were associated with substantial reductions in the odds of engaging in specific circular behaviours. Across statistically significant barrier effects, the estimated reductions in odds ranged from approximately 51% to 88%, corresponding to odds ratios between 0.49 and 0.12, respectively (Appendix Table 5). For example, perceived safety barriers in second-hand purchasing were associated with an 88% reduction in the odds of engagement ($OR \approx 0.12$), while perceived availability barriers in repair were associated with an approximately 51% reduction ($OR \approx 0.49$). Similarly, perceived time and effort barriers for upcycling corresponded to reductions of approximately 78% and 77% in the odds of engagement ($OR \approx 0.22$ and 0.23, respectively). In contrast, the generic awareness variables examined in the models were not significantly associated with the tested behaviours. These findings suggest that information provision alone may be insufficient to change circular behaviour and that interventions addressing practical and perceived barriers may be more consequential.

Second, circular behaviours are heterogeneous and require behaviour-specific rather than generic policy responses. Second-hand purchasing is primarily driven by household composition, lifestyle identity norms, and younger age cohorts; reduction is uniquely driven by minimalist value; repair is concentrated among older adults and strongly responds to durability perception; and sharing shows a pronounced gender effect. These heterogeneous patterns suggest that bundled, one-size-fits-all interventions will miss critical leverage points. Instead, policy must be tailored to the specific (i) consumer perspective, such as the motivational and structural profile of each behaviour and household segment, and (ii) product perspective, such as the life cycle, product typology and context, such as policies or infrastructure.

Third, household composition and demographic context substantially condition behavioural intention, pointing to targeted segmentation as a cost-effective implementation strategy. The presence of children under 13 years of age increases the odds of second-hand purchasing, reducing consumption, and donating by 1.6 to 2.1 times; gender differences reverse across behaviours (men reduce more; women share and donate more); and age strongly predicts repair adoption but inversely predicts second-hand consumption. These patterns indicate that policies aligned with household types have greater chances of achieving higher adoption rates than broad, universal campaigns.

Taken together, these insights support a barrier-first, behaviour specific, and segment-targeted implementation framework for future policy strategies to foster the transition toward the CE.

Appendix

Table 3 Factor loading for index creation

Construct diagnostics for product-characteristics				
Construct	**Item**	**Loading**	**h2**	**Value**
Environemtnal	Recyclability	0.86	0.74	
	Made with recycled materials	0.93	0.86	
	Sustainable packaging	0.81	0.65	
	Alpha (standardized)			0.85
	Average inter-item r			0.66
	SS loadings			2.25
	Proportion variance explained			0.75
Durability	Durability	0.8	0.65	
	Ease of maintenance	0.72	0.53	
	Repairability	0.59	0.35	
	Alpha (standardized)			0.64
	Average inter-item r			0.37
	SS loadings			1.52
	Proportion variance explained			0.51
Items are ordinal (0–3). Loadings and communalities (h^2) are from 1-factor EFA				
For 3-item one-factor models, global fit indices (e.g., RMSEA/TLI) are not				

Table 4 Odd-ratios estimation for CE practices

Coefficient	Ordered logit (odds ratios)					
(95% CI)	**Reduce**	**Secondhand**	**Repair**	**Share**	**Donate**	**Upcycle**
Gender (Male=1)	**1.781*** **	0.944	**1.325***	**0.430*** **	**0.609*** **	**0.653*** **
	(1.278, 2.482)	(0.735, 1.212)	**(1.011, 1.736)**	**(0.333, 0.554)**	**(0.472, 0.785)**	**(0.514, 0.831)**
Age 40 & 59	1.311	**0.494*** **	**1.583** **	1.135	1.268	0.865
	(0.916, 1.876)	**(0.375, 0.651)**	**(1.165, 2.151)**	(0.851, 1.514)	(0.960, 1.674)	(0.659, 1.135)
Age 60 & 80	1.238	**0.318*** **	**1.738** **	1.075	1.169	0.723
	(0.795, 1.926)	**(0.226, 0.448)**	**(1.213, 2.490)**	(0.772, 1.496)	(0.830, 1.648)	(0.520, 1.006)
High-school or higher	**1.719** **	0.894	1.198	1.055	1.134	0.844
	(1.233, 2.396)	(0.699, 1.144)	(0.917, 1.566)	(0.819, 1.359)	(0.884, 1.455)	(0.660, 1.081)
Urban (Urban =1)	1.065	0.721	0.9	1.297	**1.626** **	**0.706***
	(0.697, 1.629)	(0.516, 1.007)	(0.629, 1.288)	(0.930, 1.808)	**(1.150, 2.300)**	**(0.515, 0.968)**
With children <13	**1.598***	**2.104*** **	1.179	1.307	**1.580** **	1.18
	(1.070, 2.389)	**(1.556, 2.844)**	(0.860, 1.616)	(0.971, 1.758)	**(1.172, 2.129)**	(0.887, 1.570)
Norm waste	1.313	**0.773***	**1.500** **	**1.494*** **	1.219	1.192
	(0.989, 1.744)	**(0.618, 0.968)**	**(1.164, 1.932)**	**(1.192, 1.873)**	(0.957, 1.552)	(0.973, 1.462)
Norm lifestyle	1.036	**1.744*** **	1.122	0.934	1.168	1.168
	(0.698, 1.537)	**(1.340, 2.272)**	(0.787, 1.598)	(0.700, 1.247)	(0.873, 1.563)	(0.878, 1.553)
Norm minimalistic	**2.767*** **	1.137	1.144	1.107	1.058	0.82
	(2.092, 3.660)	(0.921, 1.403)	(0.916, 1.430)	(0.893, 1.373)	(0.863, 1.297)	(0.671, 1.001)
Environmental product	0.933	**1.419*** **	1.058	**1.688*** **	**1.584*** **	**1.471*** **
	(0.714, 1.220)	**(1.177, 1.710)**	(0.864, 1.294)	**(1.403, 2.030)**	**(1.306, 1.920)**	**(1.216, 1.781)**
Durable product	**1.961*** **	1.158	**2.656*** **	**1.241***	**1.283***	**1.335** **
	(1.532, 2.509)	(0.966, 1.389)	**(2.160, 3.266)**	**(1.043, 1.476)**	**(1.053, 1.564)**	**(1.097, 1.626)**
Global F (Wald)	12.16	14.12	15.01	14.18	12.47	9.13
Global df	11, 993	11, 993	11, 993	11, 993	11, 993	11, 993
Global p-value	<2e-16	<2e-16	<2e-16	<2e-16	<2e-16	0
Pseudo R^2	0.109	0.061	0.102	0.078	0.063	0.044

Survey-weighted linear models (svyglm, Gaussian).

OR with 95% CI

GOF: Wald-type global F computed from coef/vcov; Σw is sum of survey weights; R^2 is weighted.

Table 5 Odd-ratios estimation of binary CE practices with barriers and motivation

Coefficent	Binary logit model comparison (odds ratios)		
(95 CI)	**Secondhand**	**Repair**	**Upcycle**
Gender (Male=1)	0.771	**1.417***	**0.376*****
	(0.426, 1.395)	**(1.047, 1.917)**	**(0.212, 0.666)**
Age 40–59	**0.532***	**1.756****	0.927
	(0.297, 0.953)	**(1.253, 2.460)**	(0.515, 1.668)
Age 60–80	**0.255*****	**1.842****	0.552
	(0.119, 0.547)	**(1.245, 2.726)**	(0.259, 1.180)
Urban	0.837	0.954	0.906
	(0.424, 1.653)	(0.655, 1.391)	(0.454, 1.808)
Lifestyle norm	**10.286****	0.806	1.568
	(2.442, 43.334)	(0.551, 1.178)	(0.743, 3.307)
Environmental product	1.513	1.057	0.884
	(0.912, 2.509)	(0.853, 1.310)	(0.589, 1.326)
Durable product	1.013	**2.600*****	**1.834***
	(0.651, 1.577)	**(2.037, 3.318)**	**(1.027, 3.273)**
Barrier: Effort	**0.199****	**0.579*****	**0.242*****
	(0.061, 0.646)	**(0.422, 0.796)**	**(0.130, 0.451)**
Barrier: Access	**0.200*****	**0.602****	0.709
	(0.088, 0.453)	**(0.429, 0.846)**	(0.337, 1.493)
Barrier: Safety	**0.120*****	**0.361*****	
	(0.052, 0.276)	**(0.203, 0.642)**	
Barrier: Trust	**0.292****		
	(0.122, 0.700)		
Barrier: Time		**0.493*****	**0.207*****
		(0.325, 0.748)	**(0.088, 0.484)**
Barrier: Norms			0.157
			(0.019, 1.321)
Motivation: Cost	1.415	**1.675****	1.143
	(0.737, 2.715)	**(1.219, 2.300)**	(0.641, 2.039)
Motivation: Easy	**3.178*****	**1.583***	**1.967***
	(1.681, 6.008)	**(1.101, 2.276)**	**(1.024, 3.778)**
Motivation: Environment	1.23	**1.827*****	**3.696*****
	(0.655, 2.311)	**(1.290, 2.587)**	**(1.895, 7.209)**
Motivation: Social	**2.548***	2.253	**6.725*****
	(1.087, 5.970)	(0.949, 5.353)	**(2.308, 19.597)**
N (sample)	994	994	994
N (weighted, Σw)	408524	408524	408524
Global F (Wald)	8.47	11.39	7.98
Global df	15, 993	15, 993	15, 993
Global p-value	<1e-16	<1e-16	<1e-16
Pseudo R^2 (deviance)	0.329	0.181	0.267

Survey-weighted binary logit models (svyglm, quasibinomial).

OR with 95% CI

GOF: Wald-type global F from coef/vcov; Σw is sum of survey weights; Pseudo R^2 is deviance-

Odds ratios reported (exp(coef)). OR>1 increases odds of Y=1; OR<1 decreases odds.

Table 6 Firth penalized regression for robust check under quasi-separation

Coefficent	Firth bias-reduced logistic regression					
	Secondhand		Repair		Upcycle	
	OR (CI 95%)	p-value *, **, ***	OR (CI 95%)	p-value *, **, ***	OR (CI 95%)	p-value *, **, ***
Gender (Male=1)	0.79 (0.45, 1.37)	0.401	1.42 (1.06, 1.91)	0.018 *	0.42 (0.23, 0.72)	0.002 **
Age 40–59	0.51 (0.28, 0.90)	0.02 *	1.75 (1.26, 2.43)	<0.001 ***	0.83 (0.47, 1.49)	0.535
Age 60–80	0.25 (0.11, 0.54)	<0.001 ***	1.86 (1.26, 2.76)	0.002 **	0.54 (0.25, 1.12)	0.096
Urban	0.94 (0.47, 1.79)	0.851	0.95 (0.66, 1.36)	0.761	0.92 (0.45, 1.77)	0.81
Lifestyle norm	6.57 (2.07, 33.31)	<0.001 ***	0.84 (0.60, 1.17)	0.303	1.54 (0.78, 3.31)	0.22
Environmental product	1.48 (0.97, 2.31)	0.072	1.06 (0.86, 1.30)	0.607	0.9 (0.62, 1.31)	0.574
Durable product	0.93 (0.62, 1.41)	0.726	2.53 (2.02, 3.19)	<0.001 ***	1.69 (1.10, 2.70)	
Barrier: Effort	0.19 (0.06, 0.49)	<0.001 ***	0.59 (0.44, 0.81)	<0.001 ***	0.24 (0.13, 0.41)	<0.001 ***
Barrier: Access	0.21 (0.10, 0.41)	<0.001 ***	0.51 (0.34, 0.75)	<0.001 ***	0.75 (0.35, 1.49)	0.429
Barrier: Safety	0.15 (0.07, 0.31)	<0.001 ***				
Barrier: Trust	0.29 (0.13, 0.61)	<0.001 ***	0.39 (0.22, 0.70)	0.002 **	0.2 (0.02, 0.83)	0.023 *
Barrier: Time					0.23 (0.09, 0.48)	<0.001 ***
Barrier: Norms			0.62 (0.45, 0.86)	0.004 **		
Motivation: Cost	1.32 (0.70, 2.57)	0.397	1.62 (1.19, 2.22)	0.002 **	1.06 (0.63, 1.79)	0.816
Motivation: Easy	3.01 (1.63, 5.53)	<0.001 ***	1.58 (1.12, 2.24)	0.008 **	1.91 (1.03, 3.45)	0.04 *
Motivation: Environment	1.28 (0.68, 2.45)	0.448	1.84 (1.32, 2.57)	<0.001 ***	3.54 (1.97, 6.67)	<0.001 ***
Motivation: Social	2.69 (1.03, 6.51)	0.043 *	2.34 (1.02, 5.66)	0.044 *	7.13 (2.34, 21.12)	<0.001 ***
Goodness-of-fit diagnostics						
n_obs	994		994		994	
n_events	85		538		84	
logLik	-267.57		-654.61		-266.29	
null_logLik	-290.28		-685.60		-287.90	
AIC	567.15		1341.23		564.57	
BIC	645.58		1419.65		643.00	
McFadden_R2	0.078		0.0452		0.0751	
AUC	0.887		0.7757		0.8605	
Brier	0.056		0.1923		0.0617	

n_obs = number of observations; n_events = number of Y = 1 events; logLik = model log-likelihood; AIC = Akaike information criterion; BIC = Bayesian information criterion; McFadden_R2 = McFadden pseudo-R^2; AUC = area under the ROC curve; Brier = Brier score.

Table 7 Distribution of second-hand behaviour and "Buying sustainable and recyclable products is an important part of my lifestyle"

Lifestyle norm	No secondhand (Never = 0, 1, Sometimes = 2)	Secondhand (Often = 3)	Total
Strongly disagree	25 (11,014)	0 (0.0)	25 (11,014)
Disagree	224 (90,939)	2 (604.9)	226 (91,544)
Agree	660 (274,147)	83 (31,817)	743 (305,965)
Strongly agree	0 (0)	0 (0)	0 (0)
Total	909 (376,101)	85 (32,422)	994 (408,524)

Weighted sample between parentheses

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Declarations

Ethics Approval and Consent to Participate This study did not involve any experiments with humans or animals that required formal ethical approval. However, all survey participants gave their informed consent, and their participation was voluntary, anonymous, and confidential. The research followed standard ethical guidelines and an internal self-assessment guideline is included as Supplementary Material 3.

Consent for Publication Not applicable. This manuscript does not contain any individual person's data in any form (including any individual details, images, or videos) that would require consent for publication.

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