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Unraveling the influence of convenience situational factors on e-waste recycling behaviors: A goal-framing theory approach

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Abstract

The surge in e-waste production highlights the need to investigate what influences recycling behaviors, ultimately to enhance sustainable management practices. Previous research has explored its psychological antecedents, but there has been limited study on how situational factors of collection centers affect e-waste recycling behavior. This research investigates how convenience of collection centers (i.e., proximity, availability, and user experience) influences e-waste recycling behaviors. A survey administered to 700 citizens explores the relationship between convenience and goal-framing theory components, namely gain, normative, and hedonic goals. Structural equation modeling is employed for analysis. Results reveal that convenience significantly affects e-waste recycling behaviors through gain ($\beta = -.304$, $p < .001$) and normative goals ($\beta = .154$, $p < .05$), while hedonic goals show no significant association ($\beta = -.064$, $p > .05$). Furthermore, convenience exhibits a direct impact on e-waste recycling behaviors ($\beta = .166$, $p < .05$). Implications for research and practical strategies for recycling initiatives are discussed. This study adds valuable insights to the existing literature and informs targeted interventions for sustainable e-waste management.

KEYWORDS
e-waste, e-waste management, goal-framing theory, recycling, sustainability, WEEE

1 | INTRODUCTION

The surge in waste from electrical or electronic equipment (WEEE or e-waste) production on a global scale is a formidable environmental challenge, prompting heightened attention from researchers and policymakers alike (Parajuly et al., 2020). In fact, e-waste collection rates are globally low despite the growing awareness of its importance: Asia displays the lowest collection rate (15%), followed by the Americas (17%) and Europe (35%; Baldé et al., 2017). This tendency poses substantial risks to ecosystems and human health, as improper e-waste disposal releases hazardous substances into water, soil, and air, contaminating the food chain and water supply (He et al., 2024).

Amidst the multifaceted strategies available for mitigating the massive production of e-waste, recycling stands out as a particularly promising avenue (Islam et al., 2021). Recycling mitigates the release of toxic substances into the environment, thereby preventing soil and water contamination; moreover, it facilitates the recovery of valuable resources, reducing the need for extracting new raw materials (Thi et al., 2022). To face this environmental challenge, it is crucial to understand why there is a lack of citizens' e-waste recycling worldwide (Dhir et al., 2021).

Most studies are framed within theories that explore psychological antecedents of e-waste recycling (Islam et al., 2021). Nevertheless, this proclivity fails to consider that individuals occasionally exhibit

behaviors that are incongruent with their motivations due to situational factors (Verplanken & Holland, 2002). In a meta-analytical study, Puzzo and Prati (2024) report a lack of research samples that investigate convenience, advocating for more studies that assess how situational factors affect e-waste recycling behaviors. Framing studies within the goal-framing theory is an innovative approach that helps to bridge this gap, as it considers how situational factors can influence e-waste recycling behaviors by directing people's attention toward multiple goals (Canto et al., 2022).

The goal framing theory posits that different environmental values and situational factors affect three types of goals (i.e., hedonic, gain, and normative; Lindenberg & Steg, 2007). In turn, these goals clash with each other to shape an overarching objective, subsequently influencing pro-environmental behavior. Framed within this theory, the present study aims to investigate the role of convenience situational factor (i.e., proximity, availability, and user experience of the collection center) in affecting e-waste recycling behaviors—both directly and via gain, normative, and hedonic goals—in a European sample (e.g., Italian citizens).

This study bridges an important gap in the literature on psychological antecedents of e-waste recycling. In fact, to the extent of the authors' knowledge, this is the first research that applies goal framing theory to investigate e-waste recycling behaviors. Arguably, this is an innovative approach because it considers the unique interaction between situational factors and people's motivations, as the former might foster decisions on e-waste recycling that contradict people's goals. For example, Steg et al. (2014) elucidate in a review how individuals are less inclined to adhere to normative goals (NG) when the associated behavior involves relatively high costs or efforts, such as choosing cycling over driving a car.

This study will contribute to conduct more relevant research studies and to implement more efficient practices regarding e-waste proper disposal. On one hand, this study may show the adequacy of goal framing theory to encompass the complex interaction between situational factors and people's behavioral goals, thus opening a new venue for research. On the other hand, understanding which goals are more relevant when planning to recycle e-waste may lead the way to design communication campaigns or e-waste management practices that may effectively enhance citizens' e-waste recycling behaviors.

2 | THEORETICAL BACKGROUND

According to goal framing theory (Lindenberg & Steg, 2007), environmental behavior is driven by three types of goals: gain (i.e., monitoring personal resources), normative (i.e., meeting obligations and promoting appropriate conduct), and hedonic (i.e., seeking pleasure and avoiding effort). The dominant goal, or "goal-frame," shapes attention, perception, and behavior (Steg et al., 2016). Background goals can strengthen or weaken the focal goal, often subconsciously influenced by individual traits and environmental cues (Steg et al., 2014). Research in environmental psychology shows how NG are less predictive of behavior when the latter is more effortful, costly, time-consuming, or uncomfortable, as they clash with the achievement of gain and hedonic goals (Steg et al., 2011).

Bamberg and Schmidt (2003) disseminated a survey among 608 university students to predict which psychological variables influenced car use and found that factors related to gain goals (GG) (i.e., reduced effort or cost) were more influential than ones related to NG (i.e., personal norms). In an experimental study, Dogan et al. (2011) showed that people were less successful in reducing fuel consumption when they simultaneously had a gain goal conflicting with environmental norms (i.e., needing to be on time for an appointment). Keizer (2014) replicated this finding with a larger sample of 15,000 people spread across 7 European countries, showing that normative considerations predicted short-distance car trips (since it is perceived as easier to avoid), but not overall car use (due to a perceived lack of feasible alternatives). Considering these findings, arguably NG clash with hedonic and GG when people choose to recycle e-waste, since recycling in collection centers is often less convenient and more effortful than improper disposal (Islam et al., 2021).

H1. *Gain Goals will be negatively related to e-waste recycling behaviors.*

H2. *Normative Goals will be positively related to e-waste recycling behaviors.*

H3. *Hedonic Goals will be negatively related to e-waste recycling behaviors.*

Values play a crucial role in determining the prominence of hedonic, gain, and NG, thus influencing the likelihood of a particular goal becoming focal. While goals, as discussed earlier, represent the motivations that drive individuals within a given context, values represent the overarching priorities individuals hold in life in general. Steg et al. (2014) identified three distinct types of values, namely hedonic, egoistic, and biospheric. Hedonic values are centered around improving one's feelings and reducing effort, while egoistic values revolve around the protection or increase of personal resources. On the other hand, biospheric values are concerned with nature and the environment for their intrinsic worth.

When individuals make personal choices, they tend to favor options that align with their core values (Verplanken & Holland, 2002). These values hold such significance that they dictate which goals are deemed most crucial to individuals (Steg et al., 2016). By influencing the prominence and accessibility of goals, values play a pivotal role in determining the probability of a specific goal becoming prominent in a given situation. Steg et al. (2012) examined relationships between values and environmental behaviors between 468 people from the Netherlands. Participants with strong biospheric values valued the biospheric aspects of the restaurants (i.e., presence of organic food), while those with strong hedonic values reported to mostly seek pleasure (i.e., tastiness of food served). This study thus adheres to the hypotheses of previous studies in the field (e.g., Steg et al., 2016).

H4. *Egoistic values positively relate to gain goals.*

H5. *Biospheric values positively relate to normative goals.*

H6. *Hedonic values positively relate to hedonic goals.*

It is worth noting that individuals may exhibit behaviors that contradict their core values due to the influence of situational factors on choices' perceptions (Verplanken & Holland, 2002). In fact, goal framing theory posits that situational factors operate in many ways, as they affect the predominance of hedonic, gain, and normative goal-frames in shaping behavior (Steg et al., 2014). Focusing on e-waste, convenience is a particularly important situational factor that affects the predominance of hedonic, gain, and normative goal-frames, since citizens have to diligently plan how, when, and where to dispose of it to successfully do so (Borthakur & Govind, 2018).

Wagner (2013) points out that convenience, defined as the ease and accessibility of e-waste recycling services (Mohamad et al., 2022), is defined by different categories: proximity to the collection center (i.e., distance and time to reach a collection site), availability (i.e., opportunities to recycle e-waste through more flexible opening hours) and user experience (i.e., the smoothness and easiness of the disposal process).

To the extent of the authors' knowledge, no study has ever investigated how situational factors affect gain, normative, and hedonic goals within the setting of e-waste recycling behaviors. Nevertheless, reviews of the literature suggest that this relationship is theoretically possible, as they highlight how situational factors in different contexts (i.e., tempting chocolates, money-related signs, or organic labels) may prime gain, normative, and hedonic goals (Steg et al., 2016) and, thus, steer people's pro-environmental behaviors accordingly (Canto et al., 2022). In an experimental study, Hahnel et al. (2014) investigated how normative symbols (i.e., environmental pictures) influenced evaluations of electric vehicles. Their results showed that people evaluated electric vehicles more positively when their normative goal was activated through environmental pictures. Considering these theoretical foundations and findings, this study hypothesizes the following:

H7. *Convenience of the collection center positively relates to gain goals.*

H8. *Convenience of the collection center positively relates to normative goals.*

H9. *Convenience of the collection center positively relates to hedonic goals.*

Goal framing theory posits that situational factors (i.e., convenience) can also affect behavior directly (Steg & Vlek, 2009). In an experiment by Fujii and Kitamura (2004), 23 drivers received a one-month free bus ticket, while 20 drivers did not. Findings showed that there was an upsurge in bus ridership for people

TABLE 1 Summary of most recent research on goal framing theory and pro-environmental behaviors.

Relationship tested	Description	Field	Reference	Hypotheses
Goals → Behaviors	When people had a conflicting gain goal (i.e., needing to be on time for an appointment), they reduced fuel consumption behavior.	Car usage	(Dogan et al., 2011)	H1, H2, H3
	Normative goals predict short-distance car trips, as they are easier to avoid, but not overall car use, as there is a lack of feasible alternatives.	Car usage	(Keizer, 2014)	H1, H2, H3
Gain Goals → Behaviors	Gain goal frames are negatively associated with sustainable food consumption.	Eating habits	(Onwezen, 2023)	H1
Normative Goals → Behaviors	University students' pro-environmental behaviors were stronger for those who possessed strong normative goals to benefit the environment.	Recycling	(Chakraborty et al., 2017)	H2
Hedonic Goals → Behaviors	Strong hedonic goals enhanced the adoption of electric cars.	Car usage	(Rezvani et al., 2018)	H3
Values → Goals	Biospheric values influenced people to focus on organic food options while choosing restaurants, while people with hedonic ones mostly sought tasty food.	Eating habits	(Steg et al., 2012)	H4, H5, H6
Convenience → Goals	Experimental investigation on how situational factors affected goals. Showing environmental pictures activates normative goals, as people evaluated electric vehicles more positively in this case.	Car usage	(Hahnel et al., 2014)	H7, H8, H9
Convenience → Gain Goals	Time-consuming situations reduce willpower to use energy responsibly.	Responsible Energy Usage	(Abrahamse & Steg, 2009)	H7
Convenience → Behaviors	Survey among 900 people, revealing that convenience is positively related with e-waste recycling behavior.	E-waste recycling	(Zhang et al., 2019)	H10
	Survey disseminated among 7500 people, who reported that proximity of the collection center was the main factor affecting their decisions in recycling e-waste.	E-waste recycling	(Arain et al., 2020)	H10

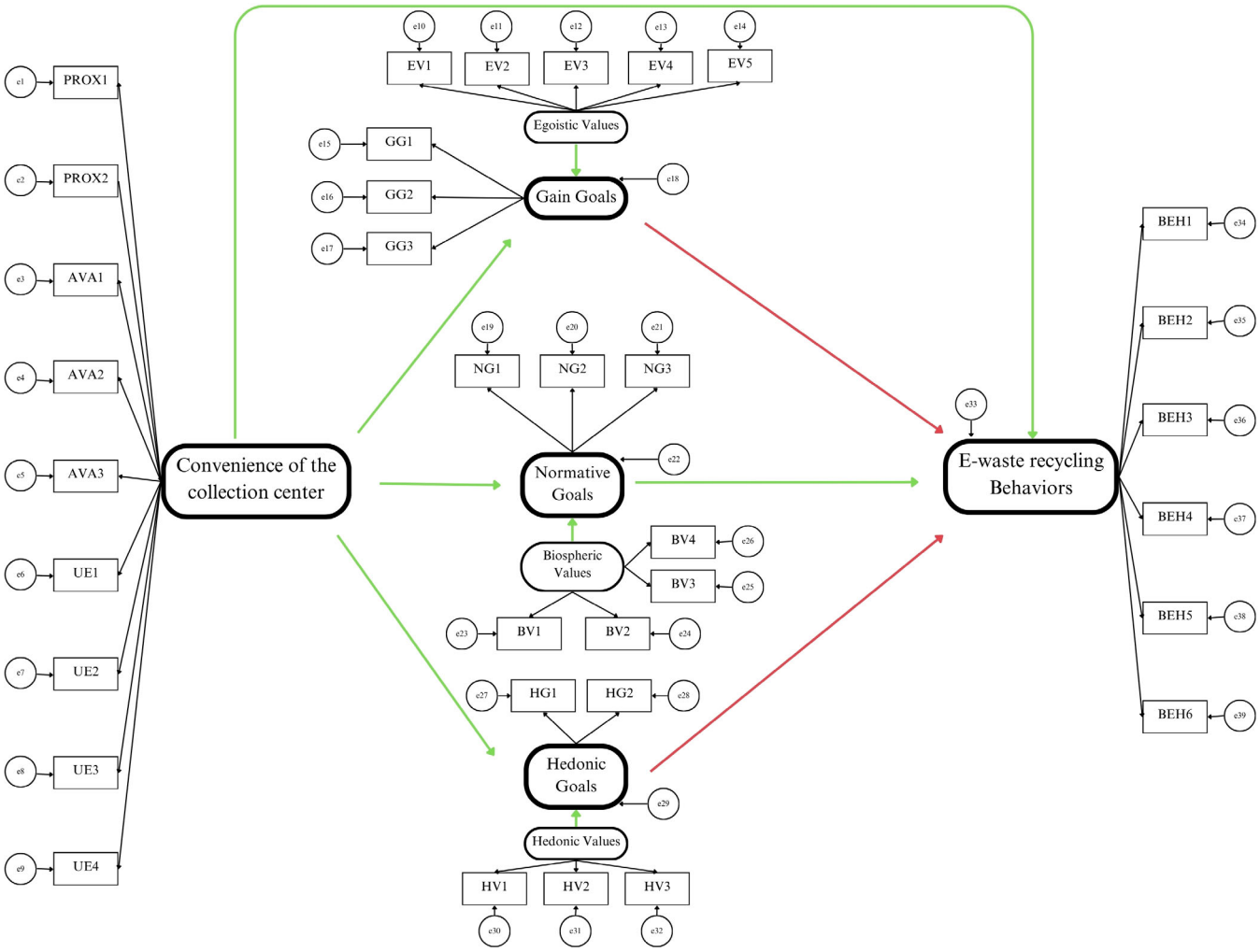

FIGURE 1 Graphical representation of the tested model. Green arrows represent positive relationships, red arrows represent negative ones. AVA, availability of the collection center; BEH, e-waste recycling behaviors; BV = biospheric values; EV, egoistic values; GG, gain goals; HV, hedonic values; NG, normative goals; PROX, proximity to the collection center; UE, user experience of the collection center.

that received the free bus ticket. Focusing on e-waste, Bouvier and Wagner (2011) studied how availability of collection centers impacted the household collection rate of e-waste in Maine, USA. They found a positive correlation between the per capita e-waste collection rate and the number of days facilities were open.

Another study by Ongondo and Williams (2011) surveyed 79,000 university students in the UK and discovered that user experience was a key factor in choosing cell phone recycling programs. More recently, a survey on e-waste recycling practices among nearly 900 people revealed that convenience was positively associated with e-waste recycling behaviors (Zhang et al., 2019). Arain et al. (2020) surveyed 7500 people to assess e-waste recycling behaviors and found that proximity was one of the most significant factors influencing e-waste recycling decisions. Table 1 summarizes recent research in the field and how each study contributes to formulate the corresponding hypothesis. Figure 1 shows a graphical representation of every hypothesis of the present study, with the latter being:

H10. *Convenience of the collection center positively relates to e-waste recycling behaviors.*

3 | MATERIALS AND METHODS

3.1 | Sample and data collection

The participants in the study were 750 adult citizens (476 women, 274 men; mean age 61 years old) living in the Ferrara and Bologna urban areas of the Emilia Romagna region, Italy. Participants completed a questionnaire-based survey that included different scales between October and November 2023. The survey dissemination process was outsourced to one of the biggest statistical market analysis companies in Italy, which recruited participants through their database and administered the survey via phone. Phone administration was chosen to ensure that participants completed the whole questionnaire and to minimize partial responses.

TABLE 2 Demographic data and descriptive statistics of the participant sample.

Demographic factor	Descriptive statistics
Gender	Men: 274 (36.4%) Women: 478 (64.6%)
Age	19–34 years old: 41 (5.5%) 35–54 years old: 218 (29.0%) 55–74 years old: 302 (40.2%) 75–92 years old: 189 (25.1%)
Education	Elementary school: 47 (6.3%) Middle school: 140 (18.6%) High school: 293 (39.0%) Bachelor's degree: 36 (4.8%) Master's degree or higher: 142 (18.8%) Missing data: 91 (12.1%)
Occupation	Full-time student: 28 (3.7%) Full-time occupation: 211 (28.1%) Part-time occupation: 51 (6.8%) Homely work: 29 (3.9%) Unemployed: 14 (1.9%) Retired: 352 (46.8%) Missing data: 67 (8.9%)
Income level	Very good: 30 (4.0%) Adequate: 491 (65.3%) Scarce: 99 (13.2%) Insufficient: 9 (1.2%) Missing data: 123 (16.4%)

Sampling and survey administration was completely conducted by the outsourced company, which ensured to have a homogenous geographical and socio-demographic distribution of the participants to minimize potential biases. Participants were considered eligible if they were older than 18 years old. The company contacted participants one by one via phone and, before starting the administration, clarified participants' rights (e.g., voluntary and confidential participation) and the study procedures, ultimately asking to provide their informed consent. The multiservice company contacted more than 1000 people, with 750 of them giving their consent. Detailed socio-demographic data are shown in Table 2.

3.2 | Measures

Along with single questions that collected demographic information, the questionnaire contained various measures. Six items were developed to assess e-waste recycling behaviors. Participants were asked to rate on a 5-point Likert scale (1 = never; 5 = very often) their frequency of e-waste recycling in the collection center. Each item corresponded to a different category of e-waste (example items: "fridges, air-conditioners, refrigerators" and "laptops, electronic equipment, and smartphones"; $\alpha = .85$).

Nine items were developed for convenience to encompass three situational factors (e.g., proximity, availability, and user experience; Wagner, 2013). Participants were asked to provide their degree of agreement with each statement on a 5-point scale (1 = completely disagree; 5 = completely agree). Proximity to the collection center was measured with two items (example item: "you need a lot of time to reach a collection center") to encompass the space and time dimensions of this variable ($r = .60$). Availability was measured by three items (example item: "opening days of the collection center allow you to flexibly reach it"; $\alpha = .86$). Finally, user experience was measured by four items (example item: "The service offered by the collection center is efficient"; $\alpha = .87$). These three subscales converged into one convenience scale, which displayed a strong reliability score ($\alpha = .89$).

Items for gain, normative, and hedonic goals were adapted from previous literature (e.g., Tang et al., 2020) to fit the context of e-waste recycling. Participants were asked to provide their degree of agreement with each statement on a 5-point scale (1 = completely disagree; 5 = completely agree). GG were measured with three items (example item: "Taking WEEE to the collection center is a waste of time"; $\alpha = .61$). Hedonic goals were measured using two items (example item: "Taking WEEE to collection centers is a satisfying activity"; $r = .87$). Finally, NG were measured by three items (example item: "Taking WEEE to the collection center is the right thing to do"; $\alpha = .74$).

Measures for hedonic, egoistic, and biospheric values were adapted from Steg et al. (2012). Participants were asked to rate the importance of 12 values "as guiding principles in their lives" on an 8-point scale (0 = not important, 7 = extremely important). Hedonic values included three items (i.e., pleasure, enjoying life, gratification for oneself; $\alpha = .79$), egoistic values included five items (i.e., social power, wealth, authority, being influential, being ambitious; $\alpha = .83$), while biospheric values included four items (i.e., respecting the earth, being one with nature, protecting the environment, preventing pollution; $\alpha = .89$). A description of the corresponding value was provided for each item. A sample of the questionnaire used is available in Appendix A.

4 | RESULTS

4.1 | Preliminary analyses

Before fitting the structural equation model, an examination of both the measurement model and structural model was performed. In this step, the external model of the framework was assessed, evaluating measurement items that collectively constitute a latent variable. The examination of the measurement model entails the assessment of both convergent and discriminant validity.

Convergent validity is defined as the degree to which measuring items associated with a construct demonstrate interrelatedness among themselves (Carlson & Herdman, 2012). In the current investigation, this construct is evaluated through different indicators: factor loadings and composite reliability (CR). Cronbach's alpha was considered for scales that have more than three items, while Spearman-Brown for two-item scales (Eisinga et al., 2012). A summary of every scale and corresponding indicators is provided in Table 3.

TABLE 3 Convergent validity of the study variables, including scale factor loadings, Chronbach's alpha, and composite reliability.

Constructs	Items	Factor loadings	Chronbach's alpha[1]	Composite reliability
Proximity	PROX1	0.811	0.60	0.62
	PROX2	0.520		
Availability	AVA1	0.950	0.86	0.88
	AVA2	0.956		
	AVA3	0.587		
User experience	UE1	0.757	0.87	0.88
	UE2	0.899		
	UE3	0.896		
	UE4	0.662		
Convenience of the collection center	PROX	0.818	0.89	0.83
	AVA	0.714		
	UE	0.837		
Gain goals	GG1	0.745	0.61	0.60
	GG2	0.659		
	GG3	0.557		
Normative goals	NG1	0.787	0.74	0.76
	NG2	0.849		
	NG3	0.486		
Hedonic goals	HG1	0.856	0.87	0.87
	HG2	0.900		
Egoistic values	EV1	0.730	0.83	0.82
	EV2	0.562		
	EV3	0.865		
	EV4	0.752		
	EV5	0.512		
Biospheric values	BV1	0.882	0.89	0.88
	BV2	0.895		
	BV3	0.857		
	BV4	0.841		
Hedonic values	HV1	0.769	0.79	0.78
	HV2	0.726		
	HV3	0.733		
E-waste recycling behaviors	BEH1	0.742	0.85	0.84
	BEH2	0.792		
	BEH3	0.832		
	BEH4	0.767		
	BEH5	0.504		
	BEH6	0.454		

Note: Spearman-Brown coefficients are displayed for 2-item scales.
Abbreviations: AVA, availability of the collection center; BEH, e-waste recycling behaviors; BV, biospheric values; EV, egoistic values; GG, gain goals; HG, hedonic goals; HV, hedonic values; NG, normative goals; PROX, proximity to the collection center; UE, user experience of the collection center.

To obtain factor loadings of the different items, a confirmatory factor analysis was conducted. While Comrey and Lee (1992) highlighted how factor loading should be interpreted without fixing a rigid cut-off, they also provided a minimum range of loadings for an item to be considered part of the corresponding scale. Following the authors' instructions, factor loadings that respect the following criterion "λ >45" were included. As shown in Table 3, every item surpasses this threshold.

In interpreting the CR, the guidelines established by Heir Jr et al. (2013) were followed, that set a criterion of 0.60 < CR <0.90. As

TABLE 4 Discriminant validity (CI_{CFA}sys) of the study variables.

	PROX	AVA	UE	CONV	GG	NG	HG	HV	EV	BV	BEH
PROX	1										
AVA	0.699	1									
UE	0.778	0.677	1								
CONV	0.645	0.613	0.714	1							
GG	0.432	0.273	0.378	0.345	1						
NG	0.572	0.466	0.594	0.553	0.424	1					
HG	0.390	0.374	0.503	0.487	0.314	0.755	1				
HV	0.338	0.230	0.299	0.282	0.054	0.348	0.341	1			
EV	0.308	0.112	0.159	0.198	0.278	0.157	0.051	0.426	1		
BV	0.324	0.265	0.310	0.378	0.339	0.478	0.379	0.454	0.073	1	
BEH	0.515	0.399	0.340	0.467	0.348	0.428	0.306	0.137	0.215	0.216	1

Note: Coefficients represent confidence intervals' upper limits per each pair of variables.
Abbreviations: AVA, availability of the collection center; BEH, e-waste recycling behaviors; BV, biospheric values; CONV, convenience of the collection center; EV, egoistic values; GG, gain goals; HG, hedonic goals; HV, hedonic values; NG, Normative Goals; PROX, proximity to the collection center; UE, user experience of the collection center.

TABLE 5 Bivariate correlations between study variables.

	CONV	GG	NG	HG	HV	EV	BV	BEH
CONV	1							
GG	−.61**	1						
NG	.59**	−.28***	1					
HG	.43**	−.27***	.57***	1				
HV	.26**	−.01	.18***	.26***	1			
EV	.09*	.12**	−.01	.08*	.32***	1		
BV	.27**	−.20***	.31***	.28***	.32***	.04	1	
BEH	.42**	.30***	.26***	.20***	.03	−.08*	.10**	1

Abbreviations: BEH, e-waste recycling behaviors; BV, biospheric values; CONV, convenience of the collection center; EV, egoistic values; GG, gain goals; HG, hedonic goals; HV, hedonic values; NG, normative goals.
*$p < .05$.**$p < .01$.***$p < .001$.

depicted in Table 3, the CR for each scale falls within this specified range. Proximity ($r = .60$) and the GG ($\alpha = .61$) scales exhibit relatively low reliability scores. On one hand, as pointed out by Eisinga et al. (2012), it is common that two-item scales display low reliability scores, which could explain the reason behind the proximity score. On the other hand, although the GG scale has been utilized in diverse contexts (Tang et al., 2020), its application in an e-waste recycling research setting is novel. This may offer insights into why a suboptimal score was obtained. Given these considerations and the fact that some scholars set the reliability threshold at 0.60 (Shi et al., 2012), the reliability score was deemed acceptable.

Discriminant validity is the extent to which items pertaining to a given construct demonstrate a lack of association with the measuring items of other constructs (Bagozzi et al., 1979). In the present study, discriminant validity was assessed by using the CI_{CFA}(sys) technique, which is based on calculating the confidence intervals (CIs) in confirmatory factor analysis. The upper limits of CI were calculated by using Formula (1) (Rönkkö & Cho, 2020). According to the authors, reasonably there is no discriminant validity problem if the CI_{UL} (upper limit of the confidence interval) < 0.8. As shown in Table 4, data display an acceptable discriminant validity. Table 5 displays the correlations between the study's variables.

$$CI = x + 1.96 \times se, \quad (1)$$

where x = covariance between two constructs, and se = standard error.

4.2 | Model fit and hypotheses testing

Structural equation model fitting was conducted using Mplus. A Bayesian estimator was used. Missing data was handled by using full-information maximum likelihood estimation. First, model fit was assessed by interpreting CFI (comparative fit index) and RMSEA (root mean square error of approximation) indicators.

TABLE 6 Summary of the results and corresponding hypothesis testing.

No.	Hypothesis	Path coefficient (β)	Previous research	Previous research fields	Remarks
H1	GG → BEH	−.304***	(Dogan et al., 2011; Keizer, 2014; Onwezen, 2023)	Car usage; eating habits	Supported
H2	NG → BEH	.154*	(Dogan et al., 2011; Keizer, 2014; Chakraborty et al., 2017)	Car usage; recycling	Supported
H3	HG → BEH	−0.064	(Dogan et al., 2011; Keizer, 2014; Rezvani et al., 2018)	Car usage	Not supported
H4	EV → GG	.231***	(Steg et al., 2012)	Eating habits	Supported
H5	BV → NG	.190***	(Steg et al., 2012)	Eating habits	Supported
H6	HV → HG	.146***	(Steg et al., 2012)	Eating habits	Supported
H7	CONV → GG	−.602***	(Abrahamse & Steg, 2009; Hahnel et al., 2014)	Responsible energy usage; car usage	Not supported
H8	CONV → NG	.565***	Hahnel et al., 2014	Car usage	Supported
H9	CONV → HG	.432***	(Hahnel et al., 2014)	Car usage	Supported
H10	CONV → BEH	.166*	(Zhang et al., 2019; Arain et al., 2020)	E-waste recycling	Supported

Abbreviations: BEH, e-waste recycling behaviors; BV, biospheric values; CONV, convenience of the collection center; EV, egoistic values; GG, gain goals; HG, hedonic goals; HV, hedonic values; NG, normative goals.
*p < .05.**p < .01.***p < .001.

Hu and Bentler (1999) recommend using cut-off values close to .95 and .05 for CFI and RMSEA respectively, as they result in the least sum of type I and type II error rates. The model shows that CFI = .933 while RMSEA = .044. The model thus shows a generally acceptable model fit rate.

Second, the hypotheses were tested. Findings align partially with the first three hypotheses, demonstrating that e-waste recycling behaviors are influenced by gain ($\beta = -.304$, $p < .001$) and NG ($\beta = .154$, $p < .05$), while hedonic goals show no significant impact ($\beta = -0.064$, $p > .05$). Therefore, H1 and H2 find support, whereas H3 is rejected. Consistent with expectations, egoistic values positively correlate with GG ($\beta = .231$, $p < .001$), biospheric values significantly impact NG ($\beta = .190$, $p < .001$), and hedonic values exhibit a positive association with hedonic goals ($\beta = .146$, $p < .001$), supporting H4, H5, and H6.

In accordance with goal framing theory, the study reveals that convenience to collection centers is a situational factor directly influencing e-waste recycling behaviors ($\beta = .166$, $p < .05$), normative ($\beta = .565$, $p < .001$), and hedonic goals ($\beta = .432$, $p < .001$). Thus, H8, H9, and H10 are confirmed. Contrary to the hypotheses, a negative directionality of convenience toward GG was observed ($\beta = -.602$, $p < .001$), rejecting H7. The detailed path coefficients are summarized and compared with previous research in Table 6 and Figure 2.

4.3 | Uncertainty and sensitivity analyses

According to Goffart et al. (2017), uncertainty analysis was performed to assign confidence bounds to the model predictions. Specifically, the 95% credible/CI of the parameter estimates was computed and reported in Table 6. In addition, uncertainty and sensitivity analysis was performed by comparing the parameters estimates of the tested model to (1) the parameter estimates of a model using the Metropolis-Hastings algorithm (instead of the Gibbs sampler algorithm); (2) the parameter estimates of a model using a higher quality of precision with which the estimates are approximated (Zitzmann & Hecht, 2019); specifically, an effective sample size (ESS) of 400 samples implies a potential scale reduction (PSR) value of 1.002 was used; (3) a model using robust maximum likelihood parameter estimates (MLR); (4) a model using a MLR estimator and multiple imputation approach ($N = 10$) to handle missing data (instead of a full information approach). When using the Metropolis-Hastings algorithm, a higher quality of precision with which the estimates are approximated, a MLR estimator, and a MLR estimator and multiple imputation (Table 7), the analyses revealed similar parameters estimates.

5 | DISCUSSION

The aim of this study was to investigate the role of situational factors in affecting e-waste recycling behaviors within a goal-framing theory perspective (Lindenberg & Steg, 2007). Specifically, the objective was to analyze the influence of collection centers' convenience (i.e., proximity, availability, and user experience) on e-waste recycling behaviors, both directly and via gain, normative, and hedonic goals. The hypotheses envisioned that convenience related to proximity, availability, and user experience would significantly relate to each goal which, in turn, would affect e-waste recycling behaviors. Convenience would also directly affect behaviors, and egoistic, biospheric, and

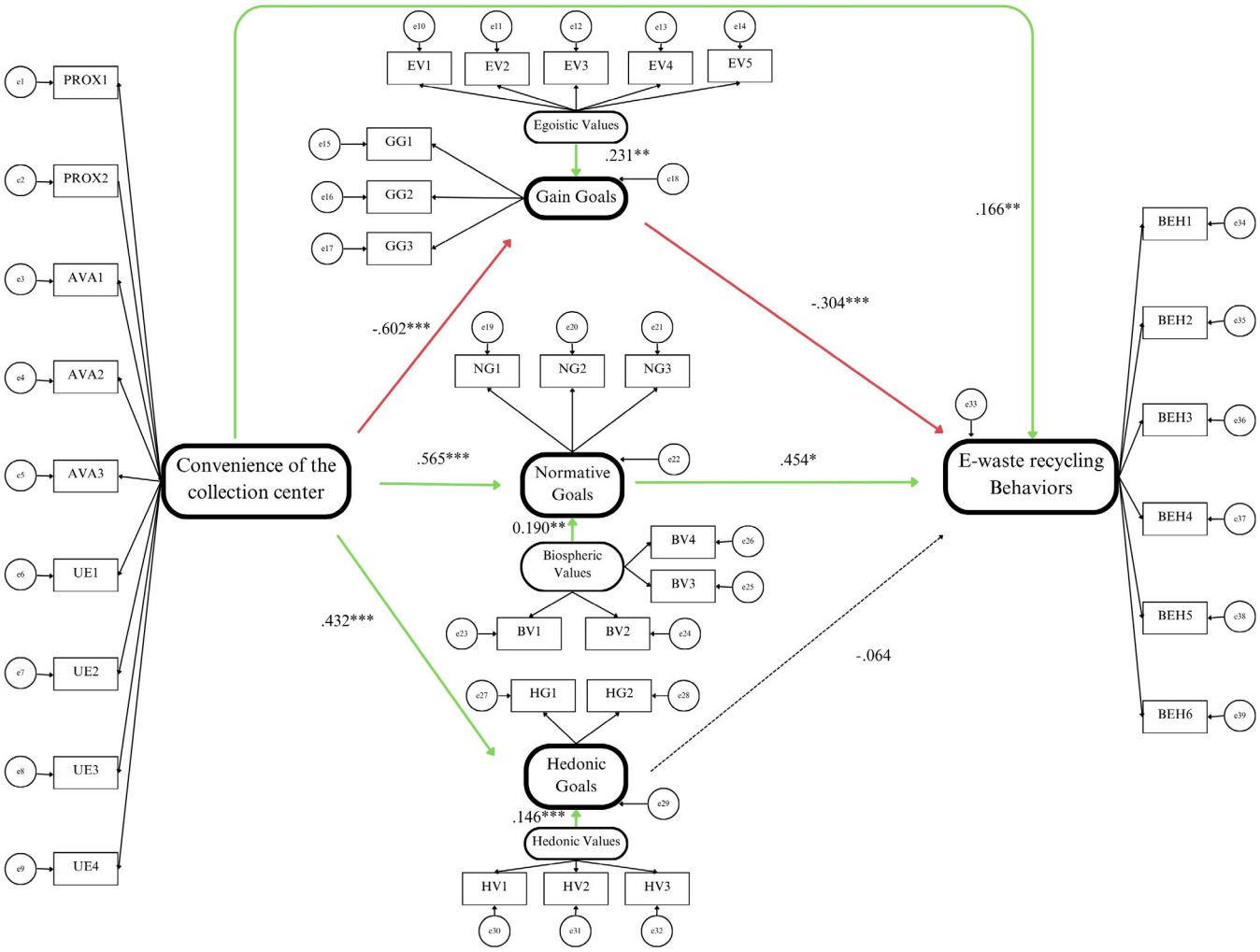

FIGURE 2 Graphical representation of path coefficients (β) results. AVA, availability of the collection center; BEH, e-waste recycling behaviors; BV, biospheric values; EV, egoistic values; GG, gain goals; HV, hedonic values; NG, normative goals; PROX, proximity to the collection center; UE, user experience of the collection center. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

hedonic values would relate with gain, normative, and hedonic goals, respectively.

Transporting WEEE to the nearest collection center frequently turns out to be less financially rewarding, more demanding in terms of effort, time-consuming, or labor-intensive than other pro-environmental behaviors (Islam et al., 2021). The results corroborate this statement, revealing that GG exhibit a negative influence on the inclination to recycle e-waste (H1 was confirmed).

This finding is in line with recent research on the influence of goal frames on pro-environmental behavior. Onwezen (2023) conducted two cross-sectional studies on a sample of 1100 people and found that gain goal frames were negatively associated with sustainable food consumption, while they promoted price-comparison behaviors when choosing food. Corroborating this study with the findings, arguably recycling e-waste at collection centers is an activity that entails resource depletion, thus resulting in a negative relationship between e-waste recycling behaviors and GG. Opting to retain electronic waste at home, selling it to acquaintances, or disposing of it improperly are likely to be more convenient choices, requiring less effort when compared with investing time and incurring transportation costs to reach the nearest disposal service point.

This observation may also account for the unexpected finding of a negative relationship between the convenience of collection centers and GG (H7 was rejected). The convenience, proximity, and accessibility of such services make e-waste recycling a more viable option, conflicting with behaviors associated with maximizing resource goal-frames—such as selling, storing e-waste at home, or saving gas costs and time to bring e-waste to collection centers. Abrahamse and Steg (2009) assessed households' responsible energy use on a sample of 180,000 people and found that time-consuming behaviors reduce individuals' willpower to perform pro-environmental behaviors (i.e., using energy responsibly).

In line with the hypotheses, convenience situational factors affected e-waste recycling behaviors via NG (H2 and H9 were confirmed). Past research established this relationship on different pro-environmental behavior: in a cross-sectional study conducted in the education context, Chakraborty et al. (2017) showed that strong NG positively shaped university students' pro-environmental behavior.

TABLE 7 Results of uncertainty and sensitivity analyses.

Hypothesis	Tested model		Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
H1: GG → BEH	−.304	−.43, −.18	−.294	−.43, −.17	−.304	−.44, −.17	−.305	−.42, −.19	−.313	−.43, −.20
H2: NG → BEH	.154	.00, .30	.153	.02, .30	.155	.00, .31	.155	.02, .29	.155	.02, .29
H3: HG → BEH	−.064	−.18, .06	−.058	−.18, .06	−.064	−.19, .06	−.064	−.19, .06	−.066	−.19, .06
H4: EV → GG	.231	.14, .32	.235	.14, .32	.232	.14, .32	.234	.13, .34	.234	.13, .34
H5: BV → NG	.190	.12, .26	.184	.12, .25	.189	.12, .26	.190	.09, .29	.191	.09, .29
H6: HV → HG	.146	.07, .22	.144	.07, .22	.144	.07, .22	.144	.06, .23	.142	.06, .22
H7: CONV → GG	−.621	−.70, −.54	−.618	−.69, −.53	−.623	−.71, −.54	−.623	−.73, −.51	−.601	−.71, −.49
H8: CONV → NG	.565	.48, .64	.565	.48, .64	.562	.49, .63	.560	.47, .65	.568	.48, .66
H9: CONV → HG	.432	.35, .51	.433	.34, .50	.430	.35, .51	.430	.33, .53	.437	.34, .53
H10: CONV → BEH	.166	.02, .31	.167	.02, .33	.165	.02, .31	.166	.02, .31	.161	.02, .30

Note: β = path coefficients; standardized estimates are reported.
Abbreviations: BEH, e-waste recycling behaviors; BV, biospheric values; CI, credible/confidence interval; CONV, convenience of the collection center; EV, egoistic values; GG, gain goals; HG, hedonic goals; HV, hedonic values; NG, normative goals.
[a]Model using the Metropolis-Hastings algorithm Model.
[b]Model using a higher quality of precision with which the estimates are approximated.
[c]Model with robust maximum likelihood parameter estimates.
[d]Model with robust maximum likelihood parameter estimates and multiple imputation ($N = 10$).

Arguably, an easily reachable, fast, and efficient e-waste collection service display respect for order from an institution (i.e., the multi-service company responsible for designing recycling processes that benefit the environment), ultimately resulting in an increase of e-waste recycling behaviors. In fact, research shows that convenience of the collection center is positively related to NG because signs of respect for order norms determine goals that prioritize moral obligations (Keizer et al., 2013).

While in contrast with the hypotheses, the absence of a relationship between hedonic goals and e-waste recycling behaviors (H3 rejected) aligns with past research showing that hedonic goals are not always associated with pro-environmental behaviors (Lindenberg & Steg, 2007). This paper suggests that e-waste disposal is not an environmentally friendly behavior that promptly enhance individuals' enjoyment, as hedonic goals are not relevant in influencing people's e-waste recycling behaviors. On the contrary, they may be promoted by strengthening NG or by making gain and hedonic goals less incompatible with them. Unsurprisingly, the findings of the paper showed that convenience affected hedonic goals to a significant degree (thus confirming H10) since an efficient and fast experience fulfills individuals' needs to seek pleasure (Steg et al., 2016).

Ultimately, consistent with goal framing theory framework, the findings reveal a significant and positive association between hedonic, egoistic, and biospheric values with hedonic, gain, and NG, respectively (H4, H5, and H6 were confirmed). This is consistent with past research, as Steg et al. (2012) conducted four cross-sectional studies to demonstrate that values play a pivotal role in focusing individuals' attention on different goals, contributing to their prioritization. Moreover, as anticipated, this research suggests that convenience directly influences e-waste recycling behaviors (confirming H7), in line with previous studies showing the influence of convenience situational factors (Arain et al., 2020).

6 | CONCLUSIONS AND RECOMMENDATIONS

While psychological factors are undoubtedly important to assess e-waste recycling behaviors (Dhir et al., 2021), this study highlights the paramount importance of assessing situational factors as well, to better encompass behavioral complexity (Canto et al., 2022). Through the application of goal framing theory and the utilization of structural equation modeling in the analysis of survey data from 750 Italian citizens, these results highlighted that GG negatively affected e-waste recycling behaviors, while NG demonstrated a positive relationship with behaviors. Contrary to expectations, hedonic goals did not exhibit significant relevance in influencing behaviors. This innovative study also suggested that situational factors exert an influence on goals: convenience emerged as a positive factor affecting e-waste recycling behaviors, NG, and hedonic goals.

The present study does not come without its limitations. Firstly, the sample used in this research predominantly comprises older individuals (Mage = 61 years old), potentially limiting the generalizability of findings to a broader demographic. To address this, future research endeavors should purposefully include younger participants, as their distinct attitudes and behaviors toward e-waste recycling may differ significantly. Moreover, a meta-analysis showed that older adults might engage more frequently in pro-environmental behaviors (Wiernik et al., 2016). A new research direction is thus to investigate whether this finding applies for e-waste recycling behaviors as well,

thus assessing age differences for this specific pro-environmental behavior.

Secondly, the research design adopted for this study is cross-sectional, capturing a snapshot of participants' behaviors at a specific point in time. While cross-sectional designs provide valuable insights, they fall short of capturing the dynamic nature of behavior change. Future investigations should prioritize longitudinal studies to track e-waste recycling behaviors over an extended period. This is a new research direction for e-waste recycling literature, as it would allow for a more nuanced understanding of the factors influencing these behaviors over time, potentially revealing patterns and trends that are not evident in a single-time-point analysis. Furthermore, the findings of the current study may offer some basis for future intervention studies that should test whether an intervention aimed at increasing convenience have an effect on e-waste recycling behaviors.

Thirdly, the reliance on self-report scales to assess both e-waste recycling behaviors and situational factors introduces the potential for response bias and social desirability effects. To enhance methodological rigor, future research should incorporate different research designs, such as observational or experimental studies, to enable a more objective and controlled examination of the causal relationships between situational factors and e-waste recycling behaviors. This shift toward observational or experimental methodologies would not only strengthen the internal validity of findings, but also facilitate the identification of causal mechanisms that can inform targeted interventions and policy recommendations in the realm of e-waste recycling.

Despite its cross-sectional nature, this research provides new insights into the interplay between convenience and goal framing in the context of e-waste recycling, thus offering some practical implications for improving sustainable e-waste management practices. Firstly, policymakers should strategically plan the distribution of e-waste collection centers, ensuring a comprehensive and capillary network throughout territories. This spatial optimization aims to maximize gain goal-frames, making e-waste disposal more accessible and convenient for individuals, thereby fostering heightened engagement in recycling behaviors.

In addition to spatial optimization, the findings of the current study suggest that availability and user experience are important too. Opening hours of the collection center might be adapted based on citizens' needs as far as possible. In addition, the design of the collection center might be developed to meet the citizens' demands and expectations. Finally, companies that organize e-waste management might conduct on a regular basis user experience surveys to obtain feedback and to better identify needs and improve citizens' perceived convenience.

The findings of the present paper also suggest that e-waste recycling is still viewed as an inherently resource-depleting practice, as a negative association between convenience and GG was found. Policymakers may want to consider implementing more reward-based systems for citizens that properly dispose of their e-waste, as this might affect GG and motivate people to recycle their WEEE to get a reward for it. A progressive tax incentive pricing system based on the weight of waste has proven effective, even though it may result in illegal dumping by individuals who are reluctant to adhere to the policy (Kirakozian, 2016).

Shevchenko et al. (2019) introduced a recycling incentive mechanism utilizing an electronic bonus card system. The cost of these rewards is distributed among multiple stakeholders, and consumers can redeem the accumulated bonuses to buy remanufactured products. Even though incentive-based systems exist, they are still quite immature (Zhou et al., 2021). It is thus paramount to fine-tune and implement innovative reward-based systems, as this might enhance e-waste recycling behaviors by affecting gain goal frames.

For practitioners, particularly multi-service companies that organize e-waste management practices, there is a clear call to invest in enhancing the user experience of e-waste collection centers. This can be achieved through comprehensive training programs for employees to ensure a knowledgeable and customer-friendly approach. Furthermore, implementing user-friendly technologies and interfaces at the collection centers can facilitate smoother transactions. Additionally, streamlining disposal processes to be fast and efficient can contribute to a positive and hassle-free experience for individuals dropping off their e-waste. By addressing these areas, companies can significantly improve user experience at the collection center level, encouraging more frequent e-waste recycling behaviors.

Finally, practitioners should collaborate on the development and dissemination of robust communication plans emphasizing the environmental importance of e-waste disposal at collection centers. Such campaigns can help instill a collective sense of normative moral responsibility, showing the potential to reshape public perceptions and behaviors, as well as contribute to more sustainable e-waste management practices. Enhancing NG will prove useful to instill a collective sense that e-waste recycling is "the right thing to do" as it benefits the environment and human life. Overall, a collaborative effort between policymakers and practitioners is crucial to establishing an effective, convenient, and user-friendly e-waste recycling infrastructure that aligns with GG and societal norms.

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AUTHOR CONTRIBUTIONS

G. Pu: Conceptualization; data curation; investigation; project administration; resources; software; visualization; writing–original draft; writing–review and editing. **G. Pr**: Conceptualization, formal analysis; funding acquisition; investigation; methodology; resources; software; supervision; validation; writing–review and editing.

CONFLICT OF INTEREST STATEMENT

The authors have no competing interests to declare that are relevant to the content of this article.

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APPENDIX A: QUESTIONNAIRE

COMPORTAMENTO STAZIONE ECOLOGICA. Seppure sia un'azione poco frequente, la prego di indicarmi su una scala da 1 (= Mai) a 5 (= Molto spesso), quanto spesso ha portato alla stazione ecologica le apparecchiature delle seguenti categorie RAEE nel momento in cui non le ha più utilizzate. (*risposta multipla*).

		Da leggere solo se richiesto	1 = mai	2 = raramente	3 = qualche volta	4 = spesso	5 = Molto spesso
R1	Freddo e clima	*Frigoriferi, condizionatori, congelatori, ecc.*					
R2	Grandi Bianchi	*Lavatrici, asciugatrici, lavastoviglie, cappe, forni, ecc.*					
R3	Tv e Monitor	*Televisori e schermi a tubo catodico, lcd o plasma, ecc.*					
R4	Piccoli Elettrodomestici	*Phon, microonde, apparecchi di illuminazione, pannelli fotovoltaici, ecc.*					
	Pc e apparecchi informatici, telefonini						
R5	Sorgenti Luminose	*Lampadine a basso consumo, lampade e led, lampade a neon, lampade fluorescenti, ecc.*					

GOALS. Per le seguenti affermazioni, indichi il suo grado di accordo su una scala da 1 (= per nulla d'accordo) a 5 (= completamente d'accordo). (3 = né in accordo né in disaccordo). (*risposta multipla*).

Non leggere		1	2	3	4	5
Gain Goals	1. Portare i RAEE alla stazione ecologica è una perdita di tempo					
	2. Portare i RAEE alla stazione ecologica è stancante					
	3. Portare i RAEE alla stazione ecologica non porta benefici economici					
Hed. Goals	1. Portare un RAEE alla stazione ecologica, rende orgogliosi di se stessi					
	2. Portare i RAEE alla stazione ecologica dà soddisfazione					
Norm. Goals	4. Non portare i RAEE alla stazione ecologica può far sentire in colpa					
	5. Portare i RAEE alla stazione ecologica è motivato da un senso di responsabilità					
	6. Portare i RAEE alla stazione ecologica è la cosa giusta da fare					

PERCEIVED CONVENIENCE. Indichi per ogni affermazione il suo grado di accordo su una scala da 1 (= per nulla d'accordo) a 5 (= completamente d'accordo). (3 = né in accordo né in disaccordo). (*risposta multipla*).

Non leggere		1	2	3	4	5
Proximity	1. Le stazioni ecologiche sono vicine a dove vive					
	2. Ha bisogno di molto tempo per recarsi alla stazione ecologica					
Availability	3. I giorni di apertura delle stazioni ecologiche le permettono di andarci facilmente					
	4. Gli orari di apertura delle stazioni ecologiche sono comodi					
	5. È facile trovare la stazione ecologica dove recarsi					
Ease of the service (User Experience)	6. È stato facile accedere alla stazione ecologica					
	7. Il servizio offerto dalle stazioni ecologiche è veloce					
	8. Il servizio offerto dalle stazioni ecologiche è efficiente					
	9. E' semplice orientarsi all'interno della stazione ecologica					

VALORI. Indichi su una scala da 0 (= non importante) a 7 (= estremamente importante) il grado con cui valuta i seguenti valori come "principi guida della sua vita." (*risposta multipla*).

Non leggere		0 = non importante	1.	2.	3.	4.	5.	6.	7 = estremamente importante
Hedonic Values	1. Piacere (massimizzare il proprio piacere nel fare le cose)								
	2. Godersi la vita (ridurre al minimo le preoccupazioni)								
	3. Gratificazione personale (sentirsi soddisfatti e/o orgogliosi di ciò che si fa)								
Egoistic Values	4. Potere sociale (controllo sugli altri, dominanza)								
	5. Benessere materiale (possessioni materiali, soldi)								
	6. Autorità (avere la possibilità di comandare)								
	7. Influenza (avere un impatto sulle altre persone e sul corso degli eventi)								
	8. Ambizione (lavorare sodo, aspirare a ottenere meglio per sé)								
Altruistic Values	9. Uguaglianza (opportunità uguali per tutte le persone)								
	10. La pace nel mondo (desiderare un mondo libero da guerre e conflitti)								
	11. Giustizia sociale (affrontare le ingiustizie, avere cura delle persone più deboli)								
	12. Essere di aiuto (lavorare per migliorare il benessere altrui)								
Biospheric Values	13. Rispetto della terra (raggiungere un'armonia con le altre specie)								
	14. Unione con la natura (adattarsi alle esigenze della natura)								
	15. Protezione dell'ambiente (preservare la natura)								
	16. Prevenzione dell'inquinamento (proteggere le risorse naturali)								

GENERE. Qual è la sua identità di genere? (*risposta singola*)

1. Uomo
2. Donna
3. Altro: _____
4. Preferisce non rispondere

ETA'. Quanti anni ha? (*risposta singola*).

_____.

LAVORO. Attualmente lavora o studia? (*risposta singola*)

1. Studia a tempo pieno
2. Lavora a tempo pieno
3. Lavora part-time (incluso per gli studi)
4. Lavora come casalingo/a
5. È disoccupato/a
6. È pensionato/a

STUDI. Qual è il titolo di studio piu' elevato che ha conseguito? (*risposta singola*)

1. Scuola elementare
2. Scuola media
3. Scuola superiore
4. Laurea triennale
5. Laurea magistrale
6. Master post-laurea
7. Dottorato
8. Altro: _____

REDDITO. Negli ultimi 12 mesi le risorse economiche complessive del suo nucleo familiare sono state…
(*risposta singola*)

1. Ottime	1. Adeguate	2. Scarse	4. Insufficienti

E-WASTE RECYCLING BEHAVIORS. While this is an infrequent action, please indicate on a scale of 1 (= Never) to 5 (= Very often), how often did you take equipment in the following WEEE categories to the collection center when you no longer used them. (multiple answer).

		Examples	1 = never	2 = rarely	3 = sometimes	4 = often	5 = very often
R1	Climate	*Fridges*, *air conditioners*, *refrigerators*, etc.					
R2	"Big Whites"	*Dishwashers*, *washers*, *ovens*, etc.					
R3	TVs and Monitors	*Televisions and monitors*, etc.					
R4	Small household appliances	*Air dryers*, *microwaves*, etc.					
	Computers and informatics	*Laptops*, *electronic equipment*, *smartphones*, etc.					
R5	Light sources	*Light bulbs*, *led bulbs*, *neon bulbs*, etc.					

GOALS. For the following statements, indicate your degree of agreement on a scale of 1 (= not at all agree) to 5 (= completely agree). (3 = neither agree nor disagree). (multiple response).

		1	2	3	4	5
Gain Goals	Taking WEEE to the collection center is a waste of time					
	Taking WEEE to the collection center is tiring					
	Taking WEEE to the collection center does not bring economic benefits					
Hed. Goals	Taking WEEE to the collection center makes one proud of oneself					
	Taking WEEE to the collection center is a satisfying activity					
Norm. Goals	Not taking WEEE to the collection center makes one feel guilty					
	Taking WEEE to the collection center gives one a sense of responsibility					
	Taking WEEE to the collection center is the right thing to do					

PERCEIVED CONVENIENCE. For the following statements, indicate your degree of agreement on a scale of 1 (= not at all agree) to 5 (= completely agree). (3 = neither agree nor disagree). (multiple response) (*multiple response*).

		1	2	3	4	5
Proximity	Collection centers are close by to where you live					
	You need a lot of time to reach a collection center					
Availability	Opening days of collection centers allow you to flexibly reach it					
	Opening hours of collection centers allow you to flexibly reach it					
	It's easy to get to a collection center close by					
Ease of the service (User Experience)	It's easy to access a collection center					
	The service offered by the collection center is fast					
	The service offered by the collection center is efficient					
	It's easy to navigate a recycling area					

VALORI. For the following values, indicate your degree of importance on a scale of 0 (= not at all important) to 7 (= extremely important) as "guiding life principles" of your life. (*multiple response*).

		0	1.	2.	3.	4.	5.	6.	7
Hedonic Values	Pleasure								
	Enjoying life								
	Gratification for oneself								
Egoistic Values	Social power								
	Wealth								
	Authority								
	Being influential								
	Being ambitious								
Biospheric Values	Respecting the earth								
	Being one with nature								
	Protecting the environment								
	Preventing pollution								

GENDER. What is your gender identity?

1. Man.
2. Woman.
3. Other: _____.
4. Prefers not to answer.

AGE. How old are you? (single answer).

_____.

WORK. Are you currently working or studying? (single answer).

1. Student.
2. Employed full-time.
3. Employed part-time (including for studies).
4. Homemaker.
5. Unemployed.
6. Retired.

STUDIES. What is the highest degree or level of school you have completed? (single answer).

1. Elementary school or lower.
2. Middle school.
3. High school.
4. Bachelor's degree.
5. Master's degree.
6. Postgraduate master's degree.
7. Doctorate.
8. Other: _____.

INCOME. In the past 12 months, the total economic resources of your household were…
(single answer).

1. Excellent 2. Adequate 3. Poor 4. Insufficient.