



Review

Psychological correlates of e-waste recycling intentions and behaviors: A meta-analysis

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ABSTRACT

E-waste recycling is important for environmental sustainability. Despite the well-established infrastructure in place, only a small portion of users recycle e-waste. The present meta-analysis aimed to investigate the strength of key theory-based correlates of e-waste recycling intentions and behavior. We focused on hypothesized relationships between constructs from four relevant theories (i.e., extended theory of planned behavior, value-belief-norm theory, habit theories, and behavioral reasoning theory). A total of 36 studies were included in the final selection. Studies were coded for four moderators of model effects: age, gender, region of data collection, and study quality. Effect sizes from 37 samples ($N = 18,410$) were analyzed through bare-bones and psychometric meta-analysis. Consistently with the assumptions of the theory of planned behavior, the relationship between e-waste recycling intentions and actual behavioral outcomes had a very large effect size. Attitudes, policy effectiveness, and convenience were shown to be related to e-waste recycling intentions with very large effect sizes. Studies included presented high heterogeneity. In the final part of the manuscript, we explore methods for pinpointing potential intervention strategies aimed at facilitating e-waste recycling.

1. Introduction

The exponential growth of the technology industry and the promotion of digitalization led to unparalleled levels of electronic equipment consumption (e.g., telephones, laptops, TV screens, and fridges; Forti et al., 2018). Once electronic equipment becomes obsolete, it becomes waste from electrical and electronic equipment (WEEE or e-waste; Islam et al., 2021). E-waste poses a severe challenge to sustainability owing to the numerous toxic substances it contains and its massive waste stream (Parajuly et al., 2020). Qalati and colleagues (2021), recently reported that annual estimates for dumped e-waste by developed countries ranges from over 50,000 tons to 95,400 tons (Fan et al., 2021). In addition, e-waste generation skyrocketed after digital acceleration owing to the COVID-19 pandemic (Echegaray et al., 2021). If not properly disposed of, e-waste represents a source of pollution that can contaminate waters with toxic materials (Kumar et al., 2017) and emit greenhouse gases, exacerbating global warming (Xia et al., 2023). Proper e-waste management is crucial for achieving both resource efficiency and environmental sustainability (Dhir et al., 2021a); this practice allows the disposal of e-waste without harming the environment (Islam et al., 2021) and the recovery of raw materials contained in e-waste (Shumon

et al., 2014).

Consumers are the crucial starting point for successful e-waste management, as they are the ones to dispose of e-waste and determine its destination (Islam et al., 2021). It is, thus, paramount to identify the psychological correlates of consumers' e-waste recycling intentions and behaviors to trigger a change in users' choices regarding recycling, ultimately developing management practices that reduce the environmental impact of e-waste (Saphores et al., 2012).

Since the 2000s, many studies have investigated the psychological correlates of e-waste recycling intentions and behaviors (Parajuly et al., 2020). While these studies have hugely expanded knowledge on this topic, the high number of studies led to fragmentation of the literature. Parajuly and colleagues (2020) reviewed more than 80 theories adopted in the field of behavioral change and found no consensus on the strength of each variable when influencing intentions and behaviors. Researchers across different academic fields have identified many entry points for interventions (Islam et al., 2021); however, there is currently no meta-analytical review of the most important factors that may influence consumers' decisions.

To bridge these gaps, this study aims to conduct a global meta-analysis to determine the strength of the relationships between key

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theory-based psychological factors and people's e-waste recycling intentions and behaviors. To justify the analysis of each hypothesized relationship, we will review the most established theories in the literature on antecedents of intentions and behaviors: the theory of planned behavior (Ajzen, 1991), the value-belief-norm theory (Stern, 2000), habit theories (Verplanken and Aarts, 1999), and behavioral reasoning theory (Westaby, 2005). While we do not aim to compare them nor to test a general model, we argue that these theories are potentially complementary - in the sense that they can enrich and benefit from one another. This transtheoretical view will help define future research and practice, as we will identify the most critical psychological correlates of intentions and behaviors across different theories. Our meta-analytic study will inform researchers about the key research questions for future research. Moreover, our findings will be useful for practitioners and policymakers, as we will identify the most important psychological factors they may consider when strategically developing effective e-waste management practices.

2. Theoretical background

2.1. The theory of planned behavior

One of the most widely used psychological theories for investigating recycling intentions and behaviors is the theory of planned behavior (Parajuly et al., 2020). The theory of planned behavior posits that planning and forming an intention to act are related to performing the related behavior. Intentions are, in turn, influenced by three factors (Ajzen, 1991). Attitudes refer to how positively or negatively a person evaluates the behavior. Subjective norms are perceived social pressures to perform or avoid the behavior. Finally, perceived behavioral control refers to how easy or difficult the behavioral performance is perceived to be. Therefore, we hypothesize as follows:

- H1.** *Intentions to recycle e-waste will positively correlate with behaviors.*
- H2.** *Attitudes will positively correlate with intentions to recycle e-waste.*
- H3.** *Subjective norms will positively correlate with intentions to recycle e-waste.*
- H4.** *Perceived behavioral control will positively correlate with intentions to recycle e-waste.*

The theory of planned behavior has been extensively adopted to frame e-waste recycling studies, including other relevant psychological variables (Parajuly et al., 2020) such as environmental knowledge. Hines and colleagues (1987) define environmental knowledge as those cognitive factors pertaining to knowledge of an environmental issue (i. e., the consequences of an environmental problem or how to act on a specific challenge). Based on their results, the authors argue that intentions are the consequence of cognitive-related variables. Before an individual can intentionally act on a particular environmental problem, that individual must know of the existence of the problem. Knowledge appears to be a prerequisite for intentions to act; consequently, some extended versions of the theory of planned behavior also include knowledge as an antecedent of intentions (Kochan et al., 2016; Kumar, 2019). Recent research found that knowledge of e-waste recycling and its consequences is significantly related to intentions (Koshta et al., 2022; Najmi et al., 2021). Thus, we hypothesize as follows:

- H5.** *Environmental knowledge will positively correlate with intentions to recycle e-waste.*

Ajzen (1991) also suggests that behaviors may depend on situational or external factors in terms of time, money availability, storage space, or access to recycling schemes (Kuhl and Beckmann, 2012). Convenience is a construct that reflects an individual's perceived time availability and ease in managing e-waste (Tonglet et al., 2004) and has been found to

positively influence intentions (Kochan et al., 2016). Convenience was significantly associated with perceived behavioral control, as time availability and ease of performing e-waste recycling may shape the perception of the difficulty of the same task (Cheng et al., 2020; Mahmud et al., 2020). A recent cross-sectional study examining intentions and behaviors in a sample of 110 people in Malaysia revealed a significant relationship between convenience and e-waste recycling intentions (Shaharudin et al., 2020). We hypothesize that:

- H6.** *Convenience will positively correlate with intentions to recycle e-waste.*

Policy effectiveness (i.e., the government's perceived capability to satisfactorily implement e-waste recycling policies) is another important situational factor affecting e-waste recycling intentions (Wan et al., 2014). Prior studies have focused on delineating the policy implications for promoting recycling behavior. Steg and Vlek (2009) underscored policy strategies for altering attitudes, addressing social norms, and facilitating pro-environmental behavior. Another stream of research investigated how perceptions of policy effectiveness motivate people to perform recycling behaviors. Wan and Shen (2013) posited that if a government-initiated motivational policy is perceived as more effective, it is likely to increase the intention to act. In line with this argument, Shaharudin and colleagues (2020) found that policy effectiveness was positively related to intentions to recycle e-waste. Therefore, we hypothesize that:

- H7.** *Policy effectiveness will positively correlate with intentions to recycle e-waste.*

Relevant external variables include economic benefits and costs associated with recycling activities (Wang et al., 2019). Lan and Zhu (2009) explored how economic incentives encourage users to dispose of household appliances. They found that the transparent pricing of online recycling platforms could significantly impact residents' inclination to recycle. Moreover, Wang and colleagues (2011) examined residents in Beijing and established that as economic costs increase, the intention to recycle e-waste weakens. More recently, in two studies conducted in China, Wang and colleagues (2016, 2019) hypothesized that intentions might be shaped by the economic benefits and costs of e-waste recycling. Their findings provide partial support to their hypothesis, showing that economic costs were negatively related to intentions (Wang et al., 2016). Intentions were found to be positively associated with economic benefits as well (Wang et al., 2019). We therefore hypothesize that:

- H8.** *Economic benefits will positively correlate with intentions to recycle e-waste.*
- H9.** *Economic costs will negatively correlate with intentions to recycle e-waste.*

2.2. Value-belief-norm theory

One of the theories used to frame intentions and behaviors is the norm-activation theory (Schwartz and Howard, 1981). One assumption of the norm-activation theory is that people help each other if they feel morally obliged to do so by a personal norm. Stern (2000) organized the identified variables in causal order, giving birth to the value-belief-norm theory. Stern assumes that individuals' behaviors are directly determined by their personal norms, which are activated by the ascription of responsibility (i.e., the degree to which individuals accept responsibility for their actions) and, in turn, by awareness of consequences (i.e., the degree to which individuals understand the consequences of their behavior). Empirical evidence supports the application of value-belief-norm theory in the environmental domain (e.g., De Groot and Steg, 2007; Hansla et al., 2008). However, the number and scope of examples from the e-waste domain are limited (e.g., Parajuly et al., 2020; Saphores et al., 2012). Therefore, we hypothesize that:

- H10.** *Personal norms will positively correlate with intentions to recycle e-*

waste.

2.3. Habit theories

Habits are automatic responses to specific stable situations that are functional in achieving goals. They develop both by frequently repeating the same behavior in the same situation and by being rewarded for achieving the desired goals (Verplanken and Aarts, 1999). The more frequently a behavior is performed, the more established the habit becomes. A habit can be related to the degree of automaticity a behavior has in a given situation (Klöckner, 2013). Both Triandis (1980) and Ajzen (1991) argue that, once a habit is established, the corresponding behavior occurs to some extent independently of the influence of attitudes, subjective norms, perceived behavioral control, and intentions.

While the importance of routine actions calls for fundamentally different psychological models that consider the transition toward the circular economy (Parajuly et al., 2020), habits are usually included as a determinant of pro-environmental intentions. Klöckner (2013) conducted a meta-analysis of 53 studies investigating several types of pro-environmental intentions (i.e., car use, waste behavior, energy behavior, and food-related behavior). Their results show that habits play an important role in predicting behavior. Regarding the specific case of e-waste, Wang and colleagues (2011) define recycling habits as one of the most important factors pushing people to use appropriate recovery channels for e-waste. Habits have also been included in many reviews (Dhir et al., 2021b; Islam et al., 2021; Parajuly et al., 2020) as some of the most influential factors on intentions. Therefore, we hypothesize that:

H11. *Habits will positively correlate with intentions to recycle e-waste.*

2.4. Behavioral reasoning theory

The behavioral reasoning theory is a theoretical framework that assesses the relative influence of both the perceived benefits (“reasons for”) and the perceived risks (“reasons against”) in the relationship between the environmental values held by individuals, their attitudes, and their intentions (Westaby, 2005; Sahu et al., 2020). On one hand, perceived benefits (“reasons for”) are reflected by personal and environmental benefits that individuals can obtain when recycling e-waste (Botelho et al., 2016). Personal benefits refer to non-economic gains accrued to consumers if they recycle e-waste, such as the reduced health hazard that consumers may experience (Dhir et al., 2021a), while environmental benefits refer to the improvement of energy conservation, reduction in pollution, and the extended life of the product (Baxter et al., 2016).

On the other hand, perceived risks (“reasons against”) are resistors that can cause negative perceptions of performing a specific behavior (Sahu et al., 2020). “Reasons against” are operationalized as being made of four different types of barriers to engagement in a task (e.g., Dhir et al., 2021a; Nyeko et al., 2022). Risk barriers reflect the different risks perceived by the consumer in a particular activity (Kaur et al., 2020). Value barriers are mostly associated with the perceived monetary value gained — or lost — by the consumer (Talwar et al., 2020), usage barriers are defined as the inconvenience of practicing or adopting innovation (Lian and Yen, 2014), while image barriers arise when consumers possess negative perceptions about a product (Kaur et al., 2020; Lian and Yen, 2014; Talwar et al., 2020).

Recently, researchers have conducted studies on benefits and risks of e-waste recycling intentions. Dhir and colleagues (2021a) explored how “reasons against” (i.e., perceived risks) and “reasons for” (i.e., perceived benefits) influence intentions. Their results highlighted the impact of both benefits and risks on e-waste recycling intentions. Nyeko and colleagues (2022) hypothesized that perceived benefits and risks influence e-waste disposal intentions. Their results show how perceived benefits positively influence intentions, while perceived risks negatively affect

them. We thus hypothesize that:

H12. *Perceived benefits will positively correlate with intentions to recycle e-waste;*

H13. *Perceived risks will negatively correlate with intentions to recycle e-waste.*

2.5. The present study

The aim of the present study was to determine the strength of the relationships between key theory-based psychological factors and e-waste recycling intentions and behaviors. Drawing from the background provided above, we have identified theoretical support for each hypothesized correlational relationship. Specifically, the purpose of the present research is to synthesize quantitative research that applies the extended theory of planned behavior, value-belief-norm theory, habit theories, and behavioral reasoning theory. While we did not aim to compare these theories or to test a general model, we strongly believe that understanding the strength of every relationship across studies framed within different theories will contribute to an improvement of future research and practices. Although these theories do not make strong predictions about moderators of the hypothesized relationships between model constructs, we also aimed to investigate the potential effects of four moderators (i.e., age, gender, region of data collection, and study quality) on the relationships between the considered variables.

3. Materials and methods

3.1. Identification of relevant research studies

We based this meta-analytic work on three search criteria:

- (1) The study should aim to investigate a relationship between at least one psychological variable and e-waste recycling intentions and/or behaviors.
- (2) The study should use operationalizations in line with standardized measures or indications by the authors.
- (3) The study should report the correlation coefficients or other statistics that could be converted to effect size r (e.g., effect size d , beta path coefficients) and the number of participants.

The literature search strategies were developed using text words related to the literature on intentions and behaviors. To maximize the validity of the meta-analysis and diminish the effect of publication bias, both published and unpublished studies (e.g., grey literature) were searched. The observational study quality evaluation (Drukker et al., 2021) was used as a quality assessment tool. The search was conducted in three databases (Scopus, Web of Science, and Google Scholar) and included studies in the English language. The search strategies, search terms, and criteria used are provided in Annexes A, B, and C for Scopus, Google Scholar, and Web of Science respectively. The two authors independently screened titles, authors, year of publication, and abstracts to decide which study to include. The resulting estimate of inter-rater reliability using Cohen’s kappa was 0.71 (95 % CI [.64, 0.78]). According to the guidelines provided by Landis and Koch (1977), this value indicates substantial agreement. Full-text articles were obtained for all included titles and abstracts ($n = 104$). We screened articles for eligibility in accordance with the inclusion criteria.

3.2. Data extraction

For the included longitudinal studies (Liu et al., 2019; Kumar, 2019), we only reported cross-sectional data stemming from the latest data collection time point. Standardized beta path coefficients stemming

from structural equation modeling or hierarchical regression analyses were converted into Pearson's r according to Peterson and Brown (2005). As this formula can be used for beta coefficients included between -0.05 and 0.05 , we excluded coefficients that did not fall within this range.

The authors acknowledge the difficulty of including every extracted variable in the data analysis given the considerable number of constructs measured in the 38 studies. To facilitate the data analysis phase, the authors retained constructs that were investigated in at least three studies. The final number of studies included was 36. As a taxonomy of psychological antecedents of e-waste recycling intentions and behaviors is currently missing, the authors checked the definitions and scale items of every retained variable and decided on a common label to assign them. More information on the labeling process can be found in Supplemental Materials. Fig. 1 provides an overview of the screening process, while Table 1 lists the included studies and corresponding retained variables.

3.3. Analyses

Prior to analysis, we converted all effect size information to Pearson's r employing standard formulas. Analyses were conducted using the metafor (Viechtbauer, 2010) and psychmeta (Dahlke and Wiernik, 2019) R packages. We calculated meta-analytic estimates using Schmidt and Hunter's (2015) approach. Using Schmidt and Hunter's (2015) approach, the analysis produced the mean and corrected effect size, the

standard deviation for both, 95 % confidence intervals (95 %-CIs) and 80 % credibility intervals (80 %-CVs). A random-effect model was adopted. The 95 %-CIs surrounding the effect size were used to determine the statistical significance of such effect. The presence of outliers and influential cases was examined by computing different outlier and influential case diagnostics (Viechtbauer and Cheung, 2010). We also computed corrected correlations for scale reliability estimates reported in each study. When reliability estimates were not reported, we imputed reliability based on the artifact distribution for that variable using the bootstrap method. In addition to the 80 % credibility intervals, we computed the Q and I^2 statistics to examine the heterogeneity between the studies. When sufficient primary studies were retained ($k > 15$), and in case of a significant Q statistic and an I^2 of 75 % or more, moderation hypotheses were tested (i.e., meta-regression procedure).

R_s in the ranges of 0.10, 0.20, 0.30, and 0.40 were considered small, medium, large, and very large (Gignac and Szodorai, 2016; Funder and Ozer, 2019). Considering that the research integrates findings from more than 18,000 participants, we considered very large effect sizes in the range of 0.40 as being sufficiently reliable (Valentine et al., 2019). Moreover, a meta-analysis conducted on 250 meta-analyses found that the mean differences between uncorrected r and corrected ρ are around 0.05 (Paterson et al., 2016). We thus interpreted as overestimation the effect sizes whose difference between r and ρ is higher than 0.10. Meta-regression was performed using observational study quality evaluation, age, gender, and region of data collection. In terms of region of data collection, we adopted the distinction into developed and

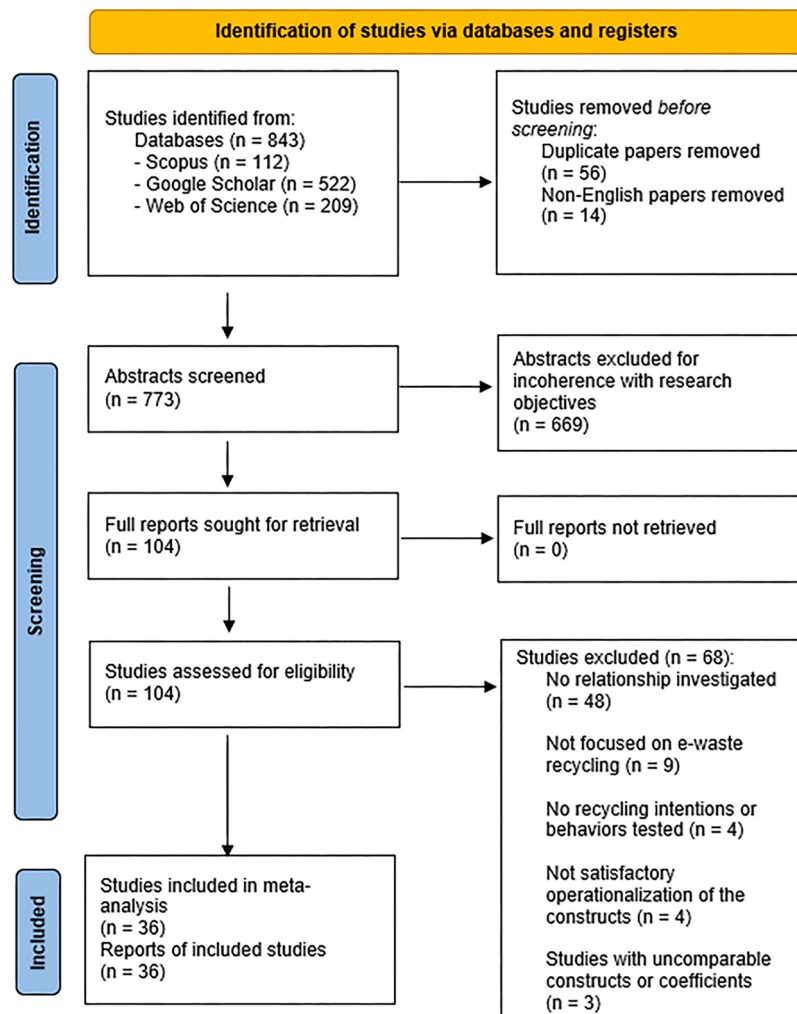


Fig. 1. The screening process.

Table 1
List of included studies and corresponding retained variables.

Study	INT	BEH	ATT	SN	PBC	PN	CONV	EK	PB	PR	EB	EC	PE	HAB
Aboelmaged et al., 2021	✓		✓	✓	✓									✓
Ardi et al., 2020	✓		✓	✓	✓									
Cheng et al., 2020	✓		✓	✓	✓		✓		✓		✓			
Delcea et al., 2020	✓	✓	✓	✓	✓		✓	✓					✓	
Dhir et al., 2021a			✓						✓	✓				
Dhir et al., 2021b	✓								✓	✓				
Dixit and Badgaiyan, 2016	✓	✓	✓	✓	✓	✓								
Kochan et al., 2016	✓	✓		✓			✓	✓						
Gu, 2017	✓	✓		✓					✓					
Jabbar, 2018	✓		✓											
Kianpour et al., 2017	✓		✓	✓	✓				✓	✓	✓			
Koshita et al., 2022	✓		✓	✓	✓			✓						
Kumar, 2017	✓		✓	✓	✓				✓					
Kumar, 2019	✓		✓	✓	✓	✓	✓	✓						
Le et al., 2012	✓		✓	✓	✓	✓	✓	✓			✓			✓
Liu et al., 2019	✓		✓	✓	✓	✓	✓	✓						
Mahmud et al., 2020	✓		✓	✓	✓	✓	✓	✓						
Mouton, 2020	✓		✓	✓	✓	✓	✓	✓				✓		
Najmi et al., 2021	✓	✓	✓	✓	✓	✓	✓	✓						
Nduneseokwu et al., 2017	✓		✓	✓	✓			✓						
Nguyen et al., 2018	✓		✓	✓			✓					✓	✓	
Nyeko et al., 2022	✓								✓	✓				
Papaoikonomou et al., 2020	✓		✓	✓	✓	✓								
Peng et al., 2018	✓										✓			
Ran and Zhang, 2022	✓	✓												
Sarathchandra and Hettiarachchib, 2020	✓		✓	✓			✓	✓						
Sari et al., 2021	✓		✓	✓	✓						✓		✓	
Shaharudin et al., 2020	✓	✓	✓	✓			✓		✓				✓	
Sharif and Keat, 2017		✓	✓	✓			✓	✓						
Simamora et al., 2021	✓				✓		✓							
Siringo et al., 2020	✓				✓			✓					✓	
Wang et al., 2016	✓		✓									✓		
Wang et al., 2018	✓		✓	✓	✓	✓		✓						
Wang et al., 2019	✓		✓	✓	✓						✓			
Xu et al., 2014	✓		✓	✓	✓									
Zhang et al., 2019	✓		✓	✓	✓		✓					✓		✓

Note: INT = Intentions to recycle e-waste; BEH = E-waste recycling behaviors; ATT = Attitudes; SN = Subjective Norms; PBC = perceived behavioral control; PN = Personal norms; CONV = Convenience; EK = Environmental Knowledge; PB = Perceived Benefits; PR = Perceived Risks; EB = Economic Benefits; EC = Economic Costs; PE = Policy Effectiveness; HAB = Habits.

developing countries presented by the World Economic Situation and Prospects 2023 Report of the United Nations.

4. Results

We extracted 171 effect sizes from 37 samples found in 36 studies. There were 18,410 participants with an average of 498 respondents per sample. The 89 % of the sample represented participants from developing countries, with only 11 % of the sample being composed of participants from developed countries. The samples were on average composed of 45 % women, for the 16 studies where gender was reported, while on average participants were 31 years old. The samples were drawn from common citizens. Our findings revealed that the most investigated predictors of intentions were attitudes ($k = 25$), subjective norms ($k = 25$), perceived behavioral control ($k = 21$), knowledge ($k = 14$), and convenience ($k = 12$).

Table 2 presents results for the meta-analysis of bivariate correlations. The results of our study align with the theoretical underpinnings of the theory of planned behavior. Consistent with expectations, behaviors demonstrated a substantial and positive correlation with intentions ($\rho = 0.42$; 95 % CI [0.29, 0.56]). Furthermore, intentions exhibited significant positive associations with attitudes ($\rho = 0.42$; 95 % CI [0.35, 0.50]), subjective norms ($\rho = 0.35$; 95 % CI [0.26, 0.43]), and perceived behavioral control ($\rho = 0.35$; 95 % CI [0.27, 0.43]). Consequently, H1, H2, H3, and H4 were supported.

Expanding our investigation to include extended versions of the theory of planned behavior, our results revealed significant correlations between intentions and knowledge ($\rho = 0.33$; 95 % CI [0.22, 0.44]),

convenience ($\rho = 0.49$; 95 % CI [0.33, 0.64]), policy effectiveness ($\rho = 0.48$; 95 % CI [0.16, 0.80]), and economic benefits ($\rho = 0.34$; 95 % CI [0.19, 0.48]). This provides support for H5, H6, H7, and H8. Intriguingly, intentions were not significantly associated with economic costs ($\rho = -0.22$; 95 % CI [-0.76, 0.33]), leading to the rejection of H9.

Moving on to other theories, the analysis of personal norms revealed a positive and significant association with intentions ($\rho = 0.36$; 95 % CI [0.12, 0.60]), offering strong support for this moral variable as posited in H10. Nevertheless, our study yielded unexpected results in relation to habits. The relationship between habits and intentions was found to be non-significant ($\rho = 0.25$; 95 % CI [-0.59, 1.08]), resulting in the rejection of H11. Additionally, our data provided ambivalent support for psychological variables taken from behavioral reasoning theory. While perceived benefits displayed a positive relationship with intentions ($\rho = 0.53$; 95 % CI [0.44, 0.62]), risks did not exhibit a significant correlation with intentions ($\rho = 0.25$; 95 % CI [-0.63, 1.13]). As a result, H12 was supported, but H13 was rejected.

4.1. Heterogeneity of data and meta-regression results

Table 2 shows 80 % CR, Cochran’s Q, and the I² statistic. The results show a high degree of heterogeneity, suggesting the existence of potential moderators. In response to this, a meta-regression analysis was conducted for outcomes characterized by a minimum of 15 effect size estimates. This analysis specifically addressed the relationships between (1) attitudes and intentions; (2) subjective norms and intentions; and (3) perceived behavioral control and intentions. Table 3 presents the outcomes of the meta-regression analysis examining relationships within

Table 2
Results of meta-analyses.

Independent Variable	Dependent Variable	<i>k</i>	<i>N</i>	\bar{r}	<i>SD_r</i>	<i>SD_{res}</i>	$\bar{\rho}$	<i>SD_{r_c}</i>	<i>SD_ρ</i>	95 % CI	80 % CR	<i>Q</i>	<i>I</i> ²
Intentions	Behaviors	6	2 881	.33	.12	.11	.42	.13	.12	[0.29, 0.56]	[0.25, 0.60]	30.71***	83.7 %
Attitudes	Intentions	25	13 417	.35	.13	.13	.42	.17	.17	[0.35, 0.50]	[0.20, 0.64]	330.87***	92.8 %
Subjective Norms	Intentions	25	13 208	.29	.16	.16	.35	.20	.20	[0.26, 0.43]	[0.08, 0.61]	422.94***	94.3 %
PBC	Intentions	21	10 831	.28	.15	.14	.35	.18	.18	[0.27, 0.43]	[0.11, 0.58]	267.48***	92.5 %
Knowledge	Intentions	14	6 367	.28	.15	.14	.33	.19	.18	[0.22, 0.44]	[0.08, 0.57]	167.89***	92.3 %
Convenience	Intentions	12	3 895	.38	.19	.18	.49	.25	.24	[0.33, 0.64]	[0.15, 0.82]	180.87***	93.9 %
Policy Effectiveness	Intentions	6	2 078	.41	0.25	0.25	.48	.31	.30	[0.16, 0.80]	[0.03, 0.93]	169.92***	97.1 %
Economic Benefits	Intentions	7	5 253	.27	.11	.10	.34	.15	.15	[0.19, 0.48]	[0.12, 0.55]	75.53***	92.1 %
Economic Costs	Intentions	4	2 462	-.18	.25	.24	-.22	.34	.34	[-0.76, 0.33]	[-0.77, 0.34]	25.93***	84.6 %
Personal Norms	Intentions	7	2 601	.29	.21	.20	.36	.26	.25	[0.12, 0.60]	[-0.01, 0.72]	117.94***	94.9 %
Habits	Intentions	3	3 080	.18	.28	.28	.25	.34	.33	[-0.59, 1.08]	[-0.38, 0.88]	152.01***	98.7 %
Perceived Benefits	Intentions	7	3 040	.41	.08	.06	.53	.10	.08	[0.44, 0.62]	[0.41, 0.65]	22.26**	73.0 %
Perceived Risks	Intentions	5	2 617	.20	.57	.57	.25	.71	.70	[-0.63, 1.13]	[-0.83, 1.33]	734.08***	99.5 %

Note: PBC = perceived behavioral control; *k* = number of studies contributing to meta-analysis; *N* = total sample size; \bar{r} = mean observed correlation; *SD_r* = observed standard deviation of *r*; *SD_{res}* = residual standard deviation of *r*; $\bar{\rho}$ = mean true-score correlation; *SD_{r_c}* = observed standard deviation of corrected correlations (*r_c*); *SD_ρ* = residual standard deviation of ρ ; CI = confidence interval around $\bar{\rho}$; CR = credibility interval around $\bar{\rho}$; *Q* = *Q* statistic; *I*² = *I*² statistic. Correlations corrected individually.

* *p* < .05; ** *p* < .01; *** *p* < .001.

Table 3
Meta-regression results.

Variables	<i>k</i>	Coefficient	S.E.	<i>z</i>	95 % CI
Attitudes - Intentions	25				
OSQE	25	0.06	0.07	0.88	-0.08, 0.20
Age	18	0.02**	0.01	3.17	0.01, 0.03
Gender	19	-0.08	0.25	-0.32	-0.57, 0.41
WESP	25	0.12	0.10	1.13	-0.08, 0.31
Subjective Norms - Intentions	25				
OSQE	25	0.26**	0.10	2.67	0.07, 0.45
Age	18	0.02	0.01	1.91	-0.01, 0.03
Gender	20	-0.38	0.34	-1.10	-1.05, 0.30
WESP	25	0.12	0.13	0.88	-0.15, 0.38
Perceived Behavioral Control - Intentions	21				
OSQE	21	0.18*	0.08	2.33	0.03, 0.33
Age	16	0.01	0.01	0.58	-0.01, 0.02
Gender	17	-0.09	0.27	-0.32	-0.61, 0.44
WESP	21	0.14	0.11	1.30	-0.07, 0.35

Note: *k* = number of studies contributing to meta-analysis; S.E. = standard error; *z* = standardized coefficient; CI = Confidence Interval; OSQE = Observational Study Quality Evaluation; WESP = World Economic Situation and Prospects. * = *p* < .05.

** = *p* < .01 *** = *p* < .001.

studies with a minimum of 15 effect sizes. The analysis incorporated factors such as observational study quality evaluation, age, gender, and World Economic Situation and Prospects classification. Regarding the relationship between attitudes and intentions to recycle, we observed a positive correlation with age (*r* = 0.02, *p* < .01), indicating that the effect size increased with advancing age. Despite the attempt to mitigate heterogeneity through meta-regression, the residual heterogeneity remained substantial (*Q* = 91.86, *df* = 11, *p* < .001; *I*² = 75.91 %). In the context of the relationship between subjective norms and intentions, the meta-regression analysis revealed a moderating effect of the observational study quality evaluation score (*r* = 0.26, *p* < .01). However, even with this moderating correlation, the residual heterogeneity persisted at a high level (*Q* = 115.57, *df* = 12, *p* < .001; *I*² = 89.74 %). Lastly, the meta-regression analysis for the relationship between perceived behavioral control and intentions demonstrated that the observational study quality evaluation score had a moderating effect (*r* = 0.18, *p* < .05). Significant residual heterogeneity persisted (*Q* = 95.42, *df* = 10, *p* < .001; *I*² = 82.30 %) despite this moderation.

5. Discussion

The current meta-analytic study aimed to determine the strength of the relationships between key theory-based psychological factors and people’s e-waste recycling intentions and behaviors. First, as expected, the intentions-behaviors relationship displayed a very large effect size. We found very large effect sizes also for intentions’ relationship with attitudes, convenience, and policy effectiveness, respectively. Additionally, the association between intentions and subjective norms, perceived behavioral control, economic benefits, environmental knowledge, and perceived benefits resulted significant and showed positive effect sizes. Personal norms showed a large positive correlation with intentions; while habits, perceived risks, and economic costs were not significantly related to intentions to recycle e-waste. Table 4 shows the hypotheses we developed and whether our findings support or reject them.

Table 4
Hypotheses and results summary.

Hypothesis	Relationship	Supported/Rejected	Effect size interpretation (Funder and Ozer, 2019)
H1	Intentions → Behaviors	Supported	Very large
H2	Attitudes → Intentions	Supported	Very large
H3	Subjective Norms → Intentions	Supported	Large
H4	Perceived Behavioral Control → Intentions	Supported	Large
H5	Environmental Knowledge → Intentions	Supported	Large
H6	Convenience → Intentions	Supported	Very large
H7	Policy Effectiveness → Intentions	Supported	Very large
H8	Economic Benefits → Intentions	Supported	Large
H9	Economic Costs → Intentions	Rejected	Non-significant
H10	Personal Norms → Intentions	Supported	Large
H11	Habits → Intentions	Rejected	Non-significant
H12	Perceived Benefits → Intentions	Supported	Large
H13	Perceived Risks → Intentions	Rejected	Non-significant

5.1. Attitudes, subjective norms, and perceived behavioral control

In line with the established body of literature, our results fully support the theory of planned behavior (Ajzen, 1991). We found that attitudes, subjective norms, and perceived behavioral control significantly correlate with intentions, the latter being significantly and positively associated with behaviors. Our findings support the idea that the qualitative evaluation of e-waste recycling, whether positive or negative, has a larger effect on intentions than the perceived social pressure or the degree of difficulty of the behavior. This is partially in line with results from previous research studies: a meta-analysis by Klöckner (2013) found a large effect size for both attitudes and perceived behavioral control in their relationships with intentions to recycle diverse types of waste, while subjective norms displayed a medium effect size. The literature has provided substantial evidence on the importance of attitudes in shaping intentions (Parajuly et al., 2020); our results add up to this, as they suggest that attitudes have the largest effect size out of the three variables. Differently from what was argued by past cross-sectional studies (Kumar, 2017), subjective norms do not have a lesser role than perceived behavioral control when affecting intentions.

5.2. Environmental knowledge

We also found that knowledge shows a large and positive correlation with intentions. This finding supports the idea that intentions are shaped based on cognition: before individuals can intentionally act on e-waste recycling issues, they must know the existence of these e-waste-related problems (Hines et al., 1987). Our findings align with previous reviews of the literature: Parajuly and colleagues (2020) state that behaviors are related to knowledge and beliefs about environmental impacts (Saphores et al., 2012). In a more recent review, Islam and Colleagues (2021) highlight that a lack of information related to e-waste is one of the critical aspects shaping intentions. It seems likely that e-waste recycling is misunderstood as being too complicated. Therefore, we argue that knowledge of basic e-waste issues — such as the consequences of not recycling e-waste — is an important cognitive variable that correlates with e-waste recycling intentions.

5.3. Convenience

Based on the findings of our meta-analysis, we argue that situational or external factors play a role in e-waste recycling intentions. Reliability and accessibility of e-waste management services (e.g., the number of collection points available in a territory) are crucial situational factors that build perceived convenience, which in turn fosters intentions (Islam et al., 2021). Our findings support this idea, as convenience was strongly found to positively correlate with intentions. Past survey investigations report convenience as one of the main reasons for planning to recycle e-waste (Kurusu et al., 2020; Zhang et al., 2019). We argue that this is

because recycling e-waste is not as easy and convenient as recycling other types of waste. Recycling e-waste is not immediate, and requires planning, time, and prospective thinking to be effectively performed (Wagner, 2013). People consider convenience when they plan how to recycle e-waste and, thus, when they form the intention to perform this behavior. Summing up, recycling e-waste is a time-consuming activity, and intentions thus must be formed before the corresponding behavior can be executed. Our findings suggest that convenience (e.g., reliability and accessibility of collection points) helps to flexibly arrange and plan how people intend to recycle e-waste.

5.4. Policy effectiveness

Moreover, our results showed that policy effectiveness is related to intentions, displaying a very large effect size. Our finding is in line with what reported by Wan and Shen (2013): if a policy is perceived as efficient and useful, people are more motivated to act accordingly. Our results are consistent with previous research reporting that governments implementing e-waste recycling policies have influenced users' intentions to recycle (Wan et al., 2014; Shaharudin et al., 2020). It is important to highlight that these studies were conducted in countries whose governments simultaneously disseminate guidelines on how to dispose of e-waste and show a lack of structured management systems (Rasheed et al., 2022). Commenting on this ambivalence, our results point to the idea that sharing accurate information on e-waste disposal may be sufficient to ignite perceptions of policy effectiveness and, thus, enhance e-waste recycling intentions (Shaharudin et al., 2020).

5.5. Economic benefits and cost

Our study shows that the associations linking economic benefits and intentions yielded a significantly large effect size, while the relationship between economic costs and intentions was non-significant. Our finding is in contrast with the literature (Wang et al., 2011; 2016; 2019), as it suggests that overall benefits correlate with intentions to recycle e-waste while costs may not be as relevant. In other words, the costs associated with recycling e-waste are currently negligible and do not affect intentions. Therefore, citizens develop intentions to properly recycle e-waste based on the economic benefits provided by their government or administration's policies.

5.6. Personal norms

Our findings confirm the key role that morality plays when it comes to environmental sustainability, as personal norms largely and positively correlate with intentions. This insight suggests that individuals' values and moral system compels them to behave accordingly, thus forming their intentions to act (Shwartz and Howard, 1981). Our findings add to the existing literature on personal norms and e-waste

recycling intentions, highlighting how these behavioral intentions can be associated with moral drivers.

5.7. Habits

According to Wang and colleagues (2011), habits are one of the most paramount factors in determining e-waste recycling intentions. Moreover, a previous meta-analysis showed that habits are a powerful cause of pro-environmental behavior (Klöckner, 2013). Our study is in clear contrast with these findings, as we did not find any significant correlation between habits and intentions. This surprising result can be explained examining the theoretical foundation of our work; habits play a prominent influence on repetitive behaviors. Given that the frequency of a behavior is related to habit strength (Klöckner, 2013), habits display a weak association with behaviors that are performed more rarely (Triandis, 1980). This is confirmed by another meta-analytic study, which found that habits have a weak influence on behaviors that are performed only annually or biannually (Ouellette and Wood, 1998). Our results confirm that e-waste recycling is not performed as frequently as it would be necessary for a habit to be established. This could be because electronic products degrade more slowly than other types of waste (Ongondo et al., 2015). Moreover, disposal infrastructures do not entail a frequent collection of e-waste from consumers (Wagner, 2013; Islam et al., 2021). Summing up, our results suggest that people recycle e-waste so rarely that they hardly establish the corresponding habit. Therefore, in the specific case of e-waste, habits may not relate to intentions.

5.8. Perceived benefits and risks

Similar to the case of economic benefits and costs, we found that perceived benefits have a large positive correlation with intentions, while risks display a non-significant one. These results suggest that people mostly consider personal and environmental benefits when they form intentions, and they neglect the barriers associated with this behavior. This is in contrast with previous research that found significant effects of both benefits and risks on e-waste recycling intentions (Dhir et al., 2021b; Kumar, 2017; Shaharudin et al., 2020; Nyeko et al., 2022). It appears that e-waste is perceived differently than other types of waste, as users evaluate recycling risks and costs as not important when deciding whether to recycle. On the other hand, people seem to heavily rely on the environmental, personal, and economic benefits of recycling to form their e-waste disposal intentions.

5.9. Moderation effects: age, gender, study quality

Stemming from our meta-regression analysis, we found that elders display a stronger correlation between attitudes and intentions than younger participants. One explanation for this finding is that younger individuals are more likely to believe that future technological advancements will solve environmental issues, thus making it unnecessary for them to limit their consumption (Benn, 2004). Similarly, research conducted among university students has shown that while they hold strong environmental attitudes, they are unwilling to make significant changes to their behavior (Kagawa, 2007). As a result, they do not feel the same urgency to engage in pro-environmental behavior, despite holding stronger attitudes than older individuals. Similar findings can be found in studies focusing on e-waste as well: Nduneseokwu and colleagues (2017) found an effect of age on e-waste recycling intentions and a difference among consumers of different age groups with respect to their intentions. Our results thus add to the existing literature on e-waste, as elders display a stronger correlation between attitudes and intentions.

Surprisingly, we could not find any significant moderation for gender. Our findings are in contrast with previous literature: according to Gender Schema Theory (Bem, 1983), women perceive the usefulness

of brand-new electronic technology less than men (Taherdoost, 2019). As a follow-up to these findings, Fan and colleagues (2021) investigated the moderating role of gender between distinct types of motivation and e-waste recycling intentions. They found that men are more intrinsically motivated to dispose of e-waste, while women feel more the impact of external motivation to enact this behavior. Our results add up to this statement: their motivations might be different, but men's and women's attitudes, subjective norms, and perceived behavioral control correlate to the same degree with intentions. Connecting this finding with previous literature (Taherdoost, 2019), women could find it more difficult than men to turn their e-waste recycling intentions into behaviors because they do not receive sufficient external motivation to do so (Fan et al., 2021). Finally, we found that, among studies of high quality, subjective norms and perceived behavioral control were more strongly related to intentions. This finding advocates for undertaking higher-quality research able to understand subjective norms and perceived behavioral control effects on intentions more correctly.

5.10. Limitations of the present study

This work suffers from several limitations, notably related to the high heterogeneity of construct operationalization in the included studies. As encouraged by Fishbein and Ajzen (2010), the theory of planned behavior does not envisage a standard questionnaire to measure the main constructs, and researchers are required to develop study-specific (e.g., for the specific population and behavior) questionnaires. For each article, we have looked up as much as possible information on the definition, scale, and items used to operationalize these constructs. While we believe to have successfully managed to solve this issue for the present study, future research should take into consideration the possibility of developing common and validated scales for e-waste recycling antecedents, as well as its corresponding advantages.

This research faces a methodological limitation due to a lack of available samples for some variables (e.g., habits, perceived convenience). This shortage determines less robust estimates, making it necessary to conduct further studies to examine the explanatory power of these variables in predicting intentions and behaviors. It is crucial to exercise caution when interpreting estimates based on a relatively small number of samples. Similarly, the literature does not offer a sufficient number of studies framed within the value-belief-norm, habit, or behavioral reasoning theories, making it currently impossible to compare them with the theory of planned behavior or to test a general model. Future research designs should aim to be framed within two or more theories, contributing to closing this gap and comparing them in future reviews or meta-analyses. Moreover, 13 studies only included beta coefficients from structural equation modeling analyses, so we had to convert them by using the Peterson and Brown (2015) formula. A best practice for future research could be to provide correlation coefficients for the relationships between every possible pair of the study's variables.

The methodological adequacy of the research base is another important limitation of this meta-analysis. The studies investigating the key theory-based correlates of e-waste recycling intentions and behaviors are entirely cross-sectional in nature. Future prospective, longitudinal, and experimental research is needed to better understand the causal mechanisms. Moreover, few studies have investigated the predictors of e-waste recycling behavior. This is an important limitation of the literature, as most studies used intentions as the main outcome. Although it is clear in the experimental research literature that a change in intention leads to a modification in behavior (Webb and Sheeran, 2006), the investigation of the proximal predictors of e-waste recycling behavior is crucial. Future research should consider more situational and external variables specific to e-waste recycling management that might affect how intentions turn into behaviors. Considering our meta-regression results, it would also be interesting to investigate the role of gender in affecting how intentions shape behaviors.

5.11. Implications for research and practice

5.11.1. Directions for future research

Our meta-analysis entails different implications for researchers. First, future research should exercise caution when interpreting the role of habits in influencing e-waste recycling intentions. People do not frequently need to dispose of e-waste because it degrades at a slower rate than other typologies. We argue that habits to recycle e-waste can be hardly established, as current collection policies require people to rarely perform this behavior. Moreover, our meta-analysis seems to suggest that the adverse consequences of e-waste recycling (i.e., perceived risks and economic costs) do not affect people's decisions to dispose of e-waste. On the other hand, economic benefits and perceived benefits are crucial factors that correlate with e-waste recycling intentions. Future research could delve more into this aspect, identifying which benefits are more important in making people recycle e-waste.

Our results also suggest that researchers should delve more into how situational factors might affect intentions. While the role of psychological variables is of paramount importance, it is still unclear how citizens evaluate different situational facilitators and barriers to e-waste recycling. Our meta-analysis points out that convenience is an important situational factor in relation to intentions. Investigating which aspects of convenience (e.g., proximity, opening hours, accessibility, and user experience of the collection center; Wagner, 2013) exert a more influential role remains an open research question.

Finally, the examined body of literature mostly relied on self-report measures of e-waste recycling behavior. Future research should investigate whether other measures of e-waste recycling behavior (e.g., data from e-waste collection points) are differentially predicted by the hypothesized determinants. Moreover, broader research on potential moderators between antecedents, intentions, and behavior is needed. In a literature review, Knussen and Yule (2008) report that the absence of a recycling habit moderates the relationship between attitude and intention, suggesting that individuals without such a habit may have treated recyclables as regular garbage in the past. Future research could investigate whether habits play a moderating role between attitudes and intentions to recycle e-waste. Moreover, whether the nature of the recycled e-waste affects e-waste recycling behaviors is an open research question. In 2022, the recycling rate for televisions in Japan was 72 % (Statista, 2022a), while washing machines were recycled at a 92 % rate in the same year (Statista, 2022b). Additionally, future longitudinal research is needed to better understand the temporal relations between the variables (Velicer and Fava, 2003).

5.11.2. Approaches to design intervention strategies

Our findings pinpoint potential targets for intervention to enhance e-waste recycling intentions and behaviors. The Behavior Change Wheel (Michie et al., 2011) serves as a valuable methodology for identifying various intervention areas and connecting them to potential policies that can drive behavioral change. Aligning our results with this methodological framework, we contend that practitioners and policymakers should focus on implementing interventions targeting diverse areas. Specifically, we emphasize the critical role of education in improving people's knowledge, which can deepen their understanding of the environmental benefits and risks of e-waste recycling and raise awareness on this issue. Additionally, interventions centered on persuasion may prove effective by using mass communication to foster positive attitudes toward e-waste recycling and influence intentions. Exploring incentivization is also recommended, along with the implementation of rewards in the recycling process (e.g., economic incentives, benefits). Furthermore, enabling e-waste recycling by increasing means or reducing barriers could positively affect convenience, facilitating planning for recycling. Conversely, areas of restriction and coercion may not strategically enhance e-waste recycling, as economic costs and risks have a minimal impact on intentions. A recent meta-analysis by Allison and colleagues (2022) partially supports this perspective, highlighting

persuasion and enablement as key areas associated with significant behavioral changes.

The Behavior Change Wheel links these intervention areas to potential policies for action, including communication marketing, guidelines, fiscal regulation, and legislation (Michie et al., 2011). Given the array of intervention options, practitioners and policymakers may find the use of intervention mapping (Bartholomew et al., 1998) beneficial in identifying strategies capable of influencing these policies. Intervention mapping expands the traditional three major intervention program activities (i.e., needs assessment, program development, and evaluation). The authors recommend designing interventions through five consecutive steps: (1) creating a matrix of proximal program objectives, (2) selecting theory-based intervention methods and practical strategies, (3) designing and organizing a program, (4) specifying adoption and implementation plans, and (5) generating program evaluation plans.

6. Conclusion

E-waste is a peculiar type of waste, as it degrades much slower than other types of waste (Ongondo et al., 2015) and is seldom recycled by people (Baldé et al., 2017). Incentivizing people to properly dispose of e-waste is crucial to reducing global warming and recovering raw materials, ultimately contributing to ameliorate the e-waste crisis. This meta-analysis aimed to determine the strength of the relationship between key theory-based psychological factors and people's e-waste recycling intentions and behaviors. While many well-established effects were confirmed, our results highlighted how attitudes, convenience, and policy effectiveness are the most important correlates to e-waste recycling intentions. It is crucial to undertake user-centered interventions to enhance e-waste collection, as general population is the one that decides whether and how to dispose of e-waste (Borthakur and Govind, 2018). We recommend the use of intervention mapping (Bartholomew et al., 1998) as a strategic tool to identify intervention strategies. This may influence policies associated with "persuasion" and "enabling" intervention areas, as outlined by Michie et al. (2011) and supported by recent studies (Allison et al., 2022). This approach aims to streamline the process of facilitating e-waste recycling intentions and behaviors, thereby enhancing the overall effectiveness of interventions in these targeted domains.

Spotlights

- People rarely recycle e-waste - despite it being crucial for environmental sustainability.
- Improving people's feelings and e-waste service convenience will likely drive people to recycle e-waste more.
- E-waste recycling is currently not a widespread behavior and may not yet be firmly established as a common habit.
- Designing appropriate interventions to motivate e-waste collection will contribute to a cleaner environment.
- Motivators are important, but the influence that context (i.e., distance) has on e-waste recycling is still neglected.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Chat GPT to rephrase sentences aiming to improve readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

CRediT authorship contribution statement

Gabriele Puzzo: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Data curation,

Conceptualization. **Gabriele Prati:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Supplementary materials

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References

- Aboelmaged, M.G., 2021. E-waste recycling behaviour: an integration of recycling habits into the theory of planned behaviour. *J. Clean. Prod.* 278, 124182 <https://doi.org/10.1016/j.jclepro.2020.124182>.
- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50 (2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-t](https://doi.org/10.1016/0749-5978(91)90020-t).
- Allison, A.L., Baird, H.M., Lorencatto, F., Webb, T.L., Michie, S., 2022. Reducing plastic waste: a meta-analysis of influences on behaviour and interventions. *J. Clean. Prod.* 380, 134860 <https://doi.org/10.1016/j.jclepro.2022.134860>.
- Ardi, R., Iqbal, B.M., Sesarea, S., Komarudin, K., 2020. What drives individuals to dispose of waste mobile phones? A case study in Indonesia. *Int. J. Technol.* <https://doi.org/10.14716/ijtech.v1i1i3.3855>.
- Baldé, C.P., Forti V., Gray, V., Kuehr, R., & Stegmann, P. (2017). *The Global E-waste Monitor –2017, United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna.* https://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017_electronic_single_pages.pdf.
- Bartholomew, L.K., Parcel, G.S., Kok, G., 1998. Intervention mapping: a process for developing Theory and Evidence-Based health education programs. *Health Educ. Behav.* 25 (5), 545–563. <https://doi.org/10.1177/109019819802500502>.
- Baxter, J., Lyng, K., Askham, C., Hanssen, O.J., 2016. High-quality collection and disposal of WEEE: environmental impacts and resultant issues. *Waste Manag.* 57, 17–26. <https://doi.org/10.1016/j.wasman.2016.02.005>.
- Bem, S.L., 1983. Gender schema theory and its implications for child development: raising gender-aschematic children in a gender-schematic society. *Signs* 8 (4), 598–616. <https://doi.org/10.1086/493998>.
- Benn, J., 2004. Consumer education between “consumership” and citizenship: experiences from studies of young people. *Int. J. Consum. Stud.* 28 (2), 108–116. <https://doi.org/10.1111/j.1470-6431.2003.00364.x>.
- Borthakur, A., Govind, M., 2018. Public understandings of E-waste and its disposal in urban India: from a review towards a conceptual framework. *J. Clean. Prod.* 172, 1053–1066. <https://doi.org/10.1016/j.jclepro.2017.10.218>.
- Botelho, A., Amorim, M., Ferreira, C., Pinto, L., 2016. The market of electrical and electronic equipment waste in Portugal: analysis of take-back consumers’ decisions. *Waste Manag. Res.* 34 (10), 1074–1080. <https://doi.org/10.1177/0734242x16658546>.
- Cheng, M., Hung, S., Tsai, H., Chou, Y., 2020. Fostering environmentally responsible consumer behavior: a hierarchical approach toward smartphone recycling. *IEEE Trans. Eng. Manag.* 69 (5), 2326–2336. <https://doi.org/10.1109/tem.2020.3007605>.
- Dahlke, J.A., Wiernik, B.M., 2019. Psychmeta: an R package for psychometric meta-analysis. *Appl. Psychol. Meas.* 43 (5), 415–416. <https://doi.org/10.1177/0146621618795933>.
- De Groot, J.I.M., Steg, L., 2007. General beliefs and the theory of planned behavior: the role of environmental concerns in the TPB. *J. Appl. Soc. Psychol.* 37 (8), 1817–1836. <https://doi.org/10.1111/j.1559-1816.2007.00239.x>.
- Delcea, C., Craciun, L., Ioanăș, C., Ferruzzi, G., Cofas, L., 2020. Determinants of individuals’ E-waste recycling decision: a case study from Romania. *Sustainability* 12 (7), 2753. <https://doi.org/10.3390/su12072753>.
- Dhir, A., Koshta, N., Goyal, R.K., Sakashita, M., Almotairi, M., 2021a. Behavioral reasoning theory (BRT) perspectives on E-waste recycling and management. *J. Clean. Prod.* 280, 124269 <https://doi.org/10.1016/j.jclepro.2020.124269>.
- Dhir, A., Malodia, S., Awan, U., Sakashita, M., Kaur, P., 2021b. Extended valence theory perspective on consumers’ e-waste recycling intentions in Japan. *J. Clean. Prod.* 312, 127443 <https://doi.org/10.1016/j.jclepro.2021.127443>.
- Dixit, S., Badgaiyan, A.J., 2016. Towards improved understanding of reverse logistics—examining mediating role of return intention. *Resour. Conserv. Recycl.* 107, 115–128. <https://doi.org/10.1016/j.resconrec.2015.11.021>.
- Drukker, M., Weltens, I., Van Hooijdonk, C.F.M., Vandenberk, E., Bak, M., 2021. Development of a methodological quality criteria list for observational studies: the observational study quality evaluation. *Front. Res. Metr. Anal.* 6 <https://doi.org/10.3389/frma.2021.675071>.
- Echegaray, F., Brachya, V., Vergragt, P.J., Zhang, L., 2021. Sustainable Lifestyles After Covid-19. Routledge eBooks. <https://doi.org/10.4324/9781003162391>.
- Fan, M., Khalique, A., Qalati, S.A., Gillal, F.G., Gillal, R.G., 2021. Antecedents of sustainable e-waste disposal behavior: the moderating role of gender. *Environ. Sci. Pollut. Res.* 29 (14), 20878–20891. <https://doi.org/10.1007/s11356-021-17275-y>.
- Fishbein, M., Ajzen, I., 2010. *Predicting and Changing Behavior: The Reasoned Action Approach.* Psychology Press, New York.
- Forti, V., Balde, K., Kuehr, R. (2018). E-waste statistics: guidelines on classifications, reporting and indicators. Retrieved from: http://collections.unu.edu/eserv/UNU:6477/RZ.EWaste_Guidelines_LoRes.pdf.
- Funder, D.C., Ozer, D.J., 2019. Evaluating effect size in psychological research: sense and nonsense. *Adv. Methods Pract. Psychol. Sci.* 2 (2), 156–168.
- Gignac, G.E., Szodorai, E.T., 2016. Effect size guidelines for individual differences researchers. *Personal. Individ. Differ.* 102, 74–78.
- Gu, M. (2017) Research on user behavior of online e-waste recycling platform (April 16, 2017). Available at SSRN: <https://ssrn.com/abstract=2953590> or [10.2139/ssrn.2953590](https://doi.org/10.2139/ssrn.2953590).
- Hansla, A., Gamble, A., Juliusson, A., Gärling, T., 2008. Psychological determinants of attitude towards and willingness to pay for green electricity. *Energy Policy* 36 (2), 768–774. <https://doi.org/10.1016/j.enpol.2007.10.027>.
- Hines, J.M., Hungerford, H.R., Tomera, A.N., 1987. Analysis and synthesis of research on responsible environmental behavior: a meta-analysis. *J. Environ. Educ.* 18 (2), 1–8. <https://doi.org/10.1080/00958964.1987.9943482>.
- Islam, T., Mahmud, M.A.P., Baumber, A., Shumon, M.R.H., Zaman, A., Ali, F., Hossain, R., Sahajwalla, V., 2021. A global review of consumer behavior towards e-waste and implications for the circular economy. *J. Clean. Prod.* 316, 128297 <https://doi.org/10.1016/j.jclepro.2021.128297>.
- Jabbar, A.A.D. (2018). Studying the effect of institutional pressures on intention the managers of small enterprise at Thi-Qar province to adopt environmental disposal of electronic waste. Retrieved from: https://www.researchgate.net/publication/323992888_Studying_the_effect_of_institutional_pressures_on_intention_the_managers_of_small_enterprise_at_Thi-Qar_province_to_adopt_environmental_disposal_of_electronic_waste.
- Kagawa, F., 2007. Dissonance in students’ perceptions of sustainable development and sustainability: implications for curriculum change. *Int. J. Sustain. High. Educ.* 8 (3), 317–338.
- Kaur, P., Dhir, A., Singh, N., Sahu, G.P., Almotairi, M., 2020. An innovation resistance theory perspective on mobile payment solutions. *J. Retail. Consum. Serv.* 55, 102059 <https://doi.org/10.1016/j.jretconser.2020.102059>.
- Kianpour, K., Jusoh, A., Mardani, A., Streimikienė, D., Cavallaro, F., Nor, K.M., Zavadskas, E.K., 2017. Factors influencing consumers’ intention to return the end-of-life electronic products through reverse supply chain management for reuse, repair and recycling. *Sustainability* 9 (9), 1657. <https://doi.org/10.3390/su9091657>.
- Klöckner, C.A., 2013. A comprehensive model of the psychology of environmental behaviour—a meta-analysis. *Glob. Environ. Chang. Hum. Policy Dimens.* 23 (5), 1028–1038. <https://doi.org/10.1016/j.gloenvcha.2013.05.014>.
- Krussens, C., Yule, F., 2008. I’m not in the habit of recycling. *Environ. Behav.* 40, 683–702. <https://doi.org/10.1177/0013916507307527>.
- Kochan, C.G., Pourreza, S., Tran, H., Prybutok, V.R., 2016. Determinants and logistics of e-waste recycling. *Int. J. Logist. Manag.* 27 (1), 52–70. <https://doi.org/10.1108/ijlm-02-2014-0021>.
- Koshta, N., Patra, S., Singh, S., 2022. Sharing economic responsibility: assessing end user’s willingness to support E-waste reverse logistics for circular economy. *J. Clean. Prod.* 332, 130057 <https://doi.org/10.1016/j.jclepro.2021.130057>.
- Kuhl, J., Beckmann, J., 2012. *Action Control: From Cognition to Behavior.* Springer Science & Business Media.
- Kumar, A., Holuszko, M.E., Espinosa, D.C.R., 2017. E-waste: an overview on generation, collection, legislation and recycling practices. *Resour. Conserv. Recycl.* 122, 32–42. <https://doi.org/10.1016/j.resconrec.2017.01.018>.
- Kumar, A., 2017. Extended TPB model to understand consumer behaviour: implications for reverse supply chain design of mobile phones. *Asia Pac. Jour. Mark. Log.* 29 (4), 721–742.
- Kumar, A., 2019. Exploring young adults’ e-waste recycling behaviour using an extended theory of planned behaviour model: a cross-cultural study. *Resour. Conserv. Recycl.* 141, 378–389. <https://doi.org/10.1016/j.resconrec.2018.10.013>.
- Kurusu, K., Miura, J., Nakatani, J., Moriguchi, Y., 2020. Hibernating behavior for household personal computers. *Resour. Conserv. Recycl.* 162, 105015 <https://doi.org/10.1016/j.resconrec.2020.105015>.
- Lan, Y., Zhu, Q., 2009. Analysis and empirical research on the influencing factors of users’ dispositional behavior of used appliances. *Prediction* 1, 65–70.
- Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. *Biometrics* 33 (1), 159–174. <https://doi.org/10.2307/2529310>.

- Le, H., Yamasue, E., Okumura, H., Ishihara, K.N., 2012. Analysis of intentions to recycle electronic waste (e-waste) using the theory of planned behavior: a case study in urban areas of Vietnam. *Green Energy and Technology*. Springer. https://doi.org/10.1007/978-4-431-54264-3_7.
- Lian, J., Yen, D.C., 2014. Online shopping drivers and barriers for older adults: age and gender differences. *Comput. Hum. Behav.* 37, 133–143. <https://doi.org/10.1016/j.chb.2014.04.028>.
- Liu, J., Bai, H., Zhang, Q., Jing, Q., He, X., 2019. Why are obsolete mobile phones difficult to recycle in China? *Resour. Conserv. Recycl.* 141, 200–210. <https://doi.org/10.1016/j.resconrec.2018.10.030>.
- Mahmud, I., Sultana, S., Rahman, A., Ramayah, T., Ling, T.C., 2020. E-waste recycling intention paradigm of small and medium electronics store managers in Bangladesh: an S–O–R perspective. *Waste Manag. Res.* 38 (12), 1438–1449. <https://doi.org/10.1177/0734242x20914753>.
- Michie, S., Van Stralen, M.M., West, R., 2011. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement. Sci.* 6 (1) <https://doi.org/10.1186/1748-5908-6-42>.
- Mouton, A.J.J. (2020). A framework for the re-use, recycling and disposal of waste electrical and electronic equipment: the South African case. Retrieved from: <https://repository.nwu.ac.za/handle/10394/36262>.
- Najmi, A., Kanapathy, K., Aziz, A.A., 2021. Understanding consumer participation in managing ICT waste: findings from two-staged structural equation modeling–artificial neural network approach. *Environ. Sci. Pollut. Res.* 28 (12), 14782–14796. <https://doi.org/10.1007/s11356-020-11675-2>.
- Nduneseokwu, C.K., Qu, Y., Appolloni, A., 2017. Factors influencing consumers' intentions to participate in a formal E-Waste collection system: a case study of Onitsha, Nigeria. *Sustainability* 9 (6), 881. <https://doi.org/10.3390/su9060881>.
- Nguyen, H.T.T., Hung, R., Lee, C., Nguyen, H.T.T., 2018. Determinants of residents' e-waste recycling behavioral intention: a case study from Vietnam. *Sustainability* 11 (1), 164. <https://doi.org/10.3390/su11010164>.
- Nyeko, S., Mlay, S., Amerit, B. (2022). Drivers and inhibitors of sustainable electronic waste collection and disposal behavioural intentions in a developing country. Retrieved from: https://www.researchgate.net/publication/362105203_Drivers_and_Inhibitors_of_Sustainable_Electronic_Waste_Collection_and_Disposal_Behavioural_Intentions_in_a_Developing_Country.
- Ongondo, F., Williams, L.H., Whitlock, G., 2015. Distinct urban mines: exploiting secondary resources in unique anthropogenic spaces. *Waste Manag.* 45, 4–9. <https://doi.org/10.1016/j.wasman.2015.05.026>.
- Ouellette, J.A., Wood, W., 1998. Habit and intention in everyday life: the multiple processes by which past behaviour predicts future behaviour. *Psychol. Bull.* 124, 54–75.
- Papaioanomou, K., Latinopoulos, D., Emmanouil, C., Kungolos, A., 2020. A survey on factors influencing recycling behavior for waste of electrical and electronic equipment in the municipality of Volos, Greece. In: *Environ. Process.*, 7, pp. 321–339. <https://doi.org/10.1007/s40710-019-00399-2>.
- Parajuly, K., Fitzpatrick, C., Muldoon, O.T., Kuehr, R., 2020. Behavioral change for the circular economy: a review with focus on electronic waste management in the EU. *Resour. Conserv. Recycl.* X 6, 100035. <https://doi.org/10.1016/j.rcrx.2020.100035>.
- Paterson, T.A., Harms, P.D., Steel, P., Credé, M., 2016. An assessment of the magnitude of effect sizes. *J. Leadersh. Organ. Stud.* 23 (1), 66–81. <https://doi.org/10.1177/1548051815614321>.
- Peng, B., Tu, Y., Wei, G., 2018. Governance of electronic waste recycling based on social capital embeddedness theory. *J. Clean. Prod.* 187, 29–36. <https://doi.org/10.1016/j.jclepro.2018.02.265>.
- Peterson, R.A., Brown, S.S., 2005. On the use of beta coefficients in meta-analysis. *J. Appl. Psychol.* 90 (1), 175–181. <https://doi.org/10.1037/0021-9010.90.1.175>.
- Qalati, S.A., Vela, E.G., Li, W., Dakhani, S.A., Thuy, T.T.H., Merani, S.H., 2021. Effects of perceived service quality, website quality, and reputation on purchase intention: the mediating and moderating roles of trust and perceived risk in online shopping. In: *Cogent Bus. Manag.*, 8 <https://doi.org/10.1080/23311975.2020.1869363>.
- Ran, W., Zhang, L., 2022. Bridging the intention-behavior gap in mobile phone recycling in China: the effect of consumers' price sensitivity and proactive personality. *Environ. Dev. Sustain.* 25 (1), 938–959. <https://doi.org/10.1007/s10668-021-02085-6>.
- Rasheed, R., Rizwan, A., Javed, H., Sharif, F., Yasar, A., Tabinda, A.B., Mahfooz, Y., Ahmed, S., Su, Y., 2022. Analysis of environmental sustainability of e-waste in developing countries—a case study from Pakistan. *Environ. Sci. Pollut. Res.* 29 (24), 36721–36739. <https://doi.org/10.1007/s11356-022-18691-4>.
- Sahu, A.K., Padhy, R., Dhir, A., 2020. Envisioning the future of behavioral decision-making: a systematic literature review of behavioral reasoning theory. *Australas. Mark. J.* 28 (4), 145–159. <https://doi.org/10.1016/j.ausmj.2020.05.001> (Amj).
- Saphores, J., Ogunseitan, O.A., Shapiro, A.A., 2012. Willingness to engage in a pro-environmental behavior: an analysis of e-waste recycling based on a national survey of U.S. households. *Resour. Conserv. Recycl.* 60, 49–63. <https://doi.org/10.1016/j.resconrec.2011.12.003>.
- Sarathchandra, K., Hettiarachchi, H., 2020. Factors affecting for e-waste recycling in Sri Lanka. *Int. J. Sci. Res. Publ.* <https://doi.org/10.29322/ijsrp.10.01.2020.p9715>.
- Sari, D.P., Masruroh, N.A., Asih, A.M.S., 2021. Consumer Intention to Participate in E-Waste Collection Programs: A Study of Smartphone Waste in Indonesia. *Sustainability* 13, 2759.
- Schmidt, F.L., Hunter, J.E., 2015. *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings*, 3rd ed. Sage. <https://doi.org/10.4135/9781483398105>.
- Schwartz, S.H., Howard, J.A., 1981. A normative decision-making model of altruism. In: Rushton, J.P., Sorrentino, R.M. (Eds.), *Altruism and Helping Behavior*. Lawrence Erlbaum, Hillsdale, NJ, pp. 89–211.
- Shaharudin, M.R., Said, R., Hotrawaisaya, C., Rashid, N.R.N.A., Perwira, N.D.Y., 2020. Linking determinants of the youth's intentions to dispose of portable e-waste with the proper disposal behavior in Malaysia. *Soc. Sci. J.* 1–15. <https://doi.org/10.1080/03623319.2020.1753157>.
- Sharif, K.I.B.M., & Keat, S.B. (2017). Factors influence consumer's behaviour toward logistics e-waste recycling in Malaysia. Retrieved from: <https://repo.uum.edu.my/i/eprint/22638/>.
- Shumon, M.R.H., Ahmed, S., Islam, T., 2014. Electronic waste: present status and future perspectives of sustainable management practices in Malaysia. *Environ. Earth Sci.* 72 (7), 2239–2249. <https://doi.org/10.1007/s12665-014-3129-5>.
- Simamora, E.R., Farida, N., Indriani, F., Aryanto, V.D.W., 2021. Determinants of intention of electronic waste recycling: application of theory of planned behavior. *J. Asian Financ. Econ. Bus.* 8 (3), 1095–1100. <https://doi.org/10.13106/jafeb.2021.vol8.no3.1095>.
- Siringo, R., Herdiansyah, H., Kusumastuti, R.D., 2020. Underlying factors behind the low participation rate in electronic waste recycling. *Glob. J. Environ. Sci. Manag.* 6 (2), 203–214. <https://doi.org/10.22034/gjesm.2020.02.06>.
- Statista (2022). Resource regeneration rate of cathode-ray tube (CRT) televisions in Japan from fiscal year 2013 to 2022. *Statista*. Retrieved January 12, 2024, from <https://www.statista.com/statistics/1198533/japan-crt-television-recycling-rate/>.
- Statista (2022). Resource regeneration rate of washing machines and dryers in Japan from fiscal year 2013 to 2022. *Statista*. Retrieved January 12, 2024, from <https://www.statista.com/statistics/1198522/japan-washing-machine-dryer-recycling-rate/>.
- Steg, L., Vlek, C., 2009. Encouraging pro-environmental behaviour: an integrative review and research agenda. *J. Environ. Psychol.* 29 (3), 309–317. <https://doi.org/10.1016/j.jenvp.2008.10.004>.
- Stern, P.C., 2000. New environmental theories: toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* 56 (3), 407–424. <https://doi.org/10.1111/0022-4537.00175>.
- Taherdoost, H., 2019. Importance of technology acceptance assessment for successful implementation and development of new technologies. *Glob. J. Eng. Sci.* 1 (3) <https://doi.org/10.33552/gjes.2019.01.000511>.
- Talwar, S., Dhir, A., Kaur, P., Mäntymäki, M., 2020. Barriers toward purchasing from online travel agencies. *Int. J. Hosp. Manag.* 89, 102593 <https://doi.org/10.1016/j.ijhm.2020.102593>.
- Tonglet, M., Phillips, P.S., Read, A.D., 2004. Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. *Resour. Conserv. Recycl.* 41 (3), 191–214. <https://doi.org/10.1016/j.resconrec.2003.11.001>.
- Triandis, H.C., 1980. Values, attitudes, and interpersonal behavior. In: Howe, H., Page, M. (Eds.), *Proceedings of the Nebraska Symposium on Motivation 1979*. University of Nebraska Press, Lincoln, pp. 195–260.
- Valentine, J.C., Aloe, A.M., Wilson, S.J., 2019. Interpreting effect sizes. In: Cooper, H., Hedges, L.V., Valentine, J.C. (Eds.), *The Handbook of Research Synthesis and Meta-Analysis*, 3rd ed. Russell Sage Foundation, New York, NY, pp. 433–452.
- Velicer, W.F., Fava, J.L., 2003. Time series analysis. In: Schinka, J., Velicer, W.F. (Eds.), *Handbook of Psychology Volume 2: Research Methods in Psychology*. John Wiley & Sons, New York.
- Verplanken, B., Aarts, H.H., 1999. Habit, attitude, and planned behaviour: is habit an empty construct or an interesting case of goal-directed automaticity? *Eur. Rev. Soc. Psychol.* 10 (1), 101–134. <https://doi.org/10.1080/14792779943000035>.
- Viechtbauer, W., 2010. Conducting meta-analyses in R with the metafor package. *J. Stat. Softw.* 36 (3), 1–48. <https://doi.org/10.18637/jss.v036.i03>.
- Viechtbauer, W., Cheung, M.W.L., 2010. Outlier and influence diagnostics for meta-analysis. *Res. Synth. Methods* 1 (2), 112–125. <https://doi.org/10.1002/jrsm.11>.
- Wagner, T.P., 2013. Examining the concept of convenient collection: an application to extended producer responsibility and product stewardship frameworks. *Waste Manag.* 33 (3), 499–507. <https://doi.org/10.1016/j.wasman.2012.06.015>.
- Wan, C., Shen, G.Q., 2013. Perceived policy effectiveness and recycling behaviour: the missing link. *Waste Manag.* 33 (4), 783–784. <https://doi.org/10.1016/j.wasman.2013.02.001>.
- Wan, C., Shen, G.Q., Yu, A.T., 2014. The role of perceived effectiveness of policy measures in predicting recycling behaviour in Hong Kong. *Resour. Conserv. Recycl.* 83, 141–151. <https://doi.org/10.1016/j.resconrec.2013.12.009>.
- Wang, Z., Zhang, B., Yin, J., Xiang, Z., 2011. Willingness and behavior towards e-waste recycling for residents in Beijing city, China. *J. Clean. Prod.* 19 (9–10), 977–984. <https://doi.org/10.1016/j.jclepro.2010.09.016>.
- Wang, Z., Guo, D., Wang, X., 2016. Determinants of residents' e-waste recycling behaviour intentions: evidence from China. *J. Clean. Prod.* 137, 850–860. <https://doi.org/10.1016/j.jclepro.2016.07.155>.
- Wang, Z., Guo, D., Wang, X., Zhang, B., Wang, B., 2018. How does information publicity influence residents' behaviour intentions around e-waste recycling? *Resour. Conserv. Recycl.* 133, 1–9. <https://doi.org/10.1016/j.resconrec.2018.01.014>.
- Wang, B., Ren, C., Dong, X., Zhang, B., Wang, Z., 2019. Determinants shaping willingness towards on-line recycling behaviour: an empirical study of household e-waste recycling in China. *Resour. Conserv. Recycl.* 143, 218–225. <https://doi.org/10.1016/j.resconrec.2019.01.005>.
- Webb, T.L., Sheeran, P., 2006. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol. Bull.* 132 (2), 249–268. <https://doi.org/10.1037/0033-2909.132.2.249>.
- Westaby, J.D., 2005. Behavioral reasoning theory: identifying new linkages underlying intentions and behavior. *Organ. Behav. Hum. Decis. Process.* 98 (2), 97–120. <https://doi.org/10.1016/j.obhdp.2005.07.003>.
- Xia, Z., Gu, Y., Li, J., Xie, J., Liu, F., Wen, X., Tian, X., Zhang, C., 2023. Do behavioural interventions enhance waste recycling practices? Evidence from an extended meta-

- analysis. *J. Clean. Prod.* 385, 135695 <https://doi.org/10.1016/j.jclepro.2022.135695>.
- Xu, F., Wang, X., Sun, X., Abdullah, A.T.M., 2014. Influencing factors and moderating factors of consumers' intentions to participate in e-waste recycling. In: Proceedings of the IEEE International Conference on Services Systems and Services Management, ICSSSM. <https://doi.org/10.1109/icsssm.2014.6874096>.
- Zhang, L., Qu, J., Sheng, H., Yang, J., Wu, H., Yuan, Z., 2019. Urban mining potentials of university: in-use and hibernating stocks of personal electronics and students' disposal behaviors. *Resour. Conserv. Recycl.* 143, 210–217. <https://doi.org/10.1016/j.resconrec.2019.01.007>.