



Extended valence theory perspective on consumers' e-waste recycling intentions in Japan

Amandeep Dhir^{a,b,c,*}, Suresh Malodia^d, Usama Awan^e, Mototaka Sakashita^f, Puneet Kaur^{g,c}

^a Department of Management, School of Business & Law, University of Agder, Norway

^b Norwegian School of Hotel Management, University of Stavanger, Stavanger, Norway

^c Optentia Research Focus Area, North-West University, Vanderbijlpark, South Africa

^d Strategic Marketing Area, MICA, Ahmedabad, 380058, India

^e Industrial Engineering and Management, Lappeenranta-Lahti University of Technology, Lappeenranta, Finland

^f Graduate School of Business Administration, Keio University, Japan

^g Department of Psychosocial Science, University of Bergen, Norway

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ABSTRACT

The gravity of the electronic waste (e-waste) crisis can be attributed to consumers' low participation in ensuring the proper disposal of such materials. Motivating consumers to recycle e-waste requires a deeper understanding of the dimensions that underlie behavioral intentions. Accordingly, the present study uses the novel framework of Valence Theory (VT) to examine how consumers evaluate their decision to recycle e-waste. The authors propose an extended VT model incorporating consumer values (value compatibility, openness to change, and environmental concerns), which is validated using cross-sectional survey data from 774 Japanese consumers. We also examine the role of different moderators resembling consumers' e-waste recycling behavior. The findings support the moderation hypotheses and suggest that intentions to recycle e-waste are affected by value compatibility, environmental concerns, and the perceived benefits of engaging in this behavior. Thus, the study has important implications for decision-makers, policymakers, and researchers interested in gaining deeper insights into issues surrounding consumers' e-waste recycling intentions.

1. Introduction

The electronics and electrical industries have witnessed a marked increase with the rise in urbanization (Borthakur and Govind, 2018). The paradox of such exponential growth, however, is the ongoing global electronic waste (e-waste) crisis. As greater numbers of electronic equipment become obsolete and no longer provide value to their owners, consumers must make decisions concerning how or even whether to dispose of such devices (Dhir et al., 2021). Approximately 53.3 million tons of waste from electrical and electronic equipment (WEEE) were produced worldwide in 2019 alone, a figure that is projected to grow to 74.7 million tons by 2030 (Forti et al., 2020). This staggering amount of e-waste generation has created a waste management crisis that threatens the environment and poses substantial health-related complications for human beings.

Notably, the e-waste crisis afflicts both developed and developing

countries alike, with the public and private sectors struggling to mitigate its effects. Governments worldwide, for instance, have invested in creating the necessary infrastructure to process e-waste and ensure proper waste management. Despite these efforts, only 20% of WEEE is treated formally, while the rest is either stored at home, dumped with household waste, or sold to second-hand peddlers and informal recyclers (Dixit and Badgaiyan, 2016; Zhang et al., 2019), who offer consumers the convenience and economic incentives that make them a more attractive disposal alternative (Kumar, 2019). These third parties, however, inappropriately dispose of the e-waste after recovering precious metals like palladium, silver, gold, and copper from it (Dias et al., 2018). Although e-waste does contain valuable metals, it also has several toxic substances that can inflict significant environmental damage if disposed of irresponsibly (Brannon et al., 2014). The polychlorinated naphthalene present in electronic products, for example, is dangerous to aquatic and wildlife (Kumar et al., 2017). Furthermore,

* Corresponding author. Department of Management, School of Business & Law, University of Agder, Norway.

E-mail addresses: amandee.dhir@uia.no (A. Dhir), suresh.malodia@micamail.in (S. Malodia), Usama.Awan@lut.fi (U. Awan), m_sakash@kbs.keio.ac.jp (M. Sakashita), puneet.kaur@uib.no (P. Kaur).

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e-waste is carcinogenic, posing severe health hazards to the respiratory system, nervous system, kidney, and liver (Kumar et al., 2017). In spite of these adverse effects, only a small portion of electronics users engages in e-waste recycling, while the academic literature exploring users' perceptions of waste management, environmental degradation, and their intentions to participate in recycling e-waste is similarly sparse.

Our review of the prior extended literature suggests four main research gaps. First, the understanding of the behavioral dimensions associated with e-waste recycling intentions remains fragmented and disjointed. Specifically, the past studies have been selective in discussing the determinants of e-waste recycling intentions and have only considered variables, such as convenience (Liu et al., 2019; Zhang et al., 2019), economic benefits (Mishima and Nishimura, 2016), and awareness (Wang et al., 2018). Second, the extant literature has predominantly adopted the Theory of Planned Behavior (TPB) as its main conceptual framework (Dixit and Badgaiyan, 2016; Kumar, 2019). However, TPB fails to capture how consumers make trade-offs in their decisions based on the perceived risks and benefits involved (Peter and Tarpey, 1975). Third, these benefits (Wang et al., 2019) and perceived risks (Nguyen et al., 2018) have only been examined separately in the context of recycling e-waste. There is thus a need to investigate these trade-offs in a single research model. Lastly, the findings from the current literature remain equivocal. Kumar (2019), for example, reported that consequence awareness (perceived risk) does not have a significant impact on consumer's e-waste recycling intentions, while Zhang et al. (2020) found that individuals who perceive a high risk of having their personal information stolen from their devices are less likely to recycle their smartphones when they become obsolete.

The current study attempts to bridge these gaps by developing a research model based on Valence Theory (VT) to encapsulate how consumers establish a net valence when evaluating the perceived benefits and risks of e-waste recycling. Our extended model consists of five independent variables (perceived benefits, perceived risks, value compatibility, openness to change, and environmental concerns), with the dependent variable being intentions to recycle e-waste. This study not only enhances our understanding of the dimensions underlying consumers' e-waste recycling intentions but also broadens our comprehension of how subjective values, especially the guiding principles of Japanese culture, shape consumer values and influence behavioral intentions, in turn. Our findings also benefit policymakers engaged in e-waste management by helping them design interventions that will deliver a net positive valence to consumers. We test our research model using cross-sectional data from 774 Japanese consumers and examine the moderating role of contemporary behavioral issues on the studied associations, including whether a consumer has (a) contacted an e-waste recycler in the recent past, (b) contacted their local government office to seek help regarding e-waste recycling, or (c) sold an obsolete electronic product in the gray, or second-hand, market.

The rest of the study is structured as follows. The background literature is presented in Section 2, while the theoretical framework and hypotheses development are given in Section 3. We then discuss the research method in Section 4 and report the results in Section 5. Section 6 presents the discussion on the obtained results as well as their practical and theoretical implications. Finally, we discuss the study's limitations and future research directions in Section 7.

2. E-waste recycling and management

In the past decade, scholars have paid increasing attention to the behavioral issues pertaining to e-waste recycling. As a result, the extant literature has investigated various challenges associated with e-waste recycling intentions and behavior, with a particular focus on identifying the psychological determinants behind them. The two most studied factors positively affecting users' formal e-waste recycling intentions have been the convenience of recycling (Liu et al., 2019) and the economic benefits associated with it (Zhang et al., 2019). If consumers

believe that engaging in e-waste recycling is economically beneficial, then their intentions to perform this behavior is likely to increase as a result (Liu et al., 2019). Similarly, if the convenience of e-waste recycling increases, the likelihood of consumers engaging in informal recycling does as well (Liu et al., 2019). However, Kumar (2019) found no significant association between convenience and e-waste recycling intentions among young adults in India and China, although this may be because proper recycling channels are non-existent in both countries (Kumar, 2019). It would thus be difficult for these respondents to judge whether e-waste recycling is convenient or not.

The prior literature has looked into several other variables that could influence consumers' intentions toward e-waste recycling. For example, Nguyen et al. (2018) studied the influence of recycling habits and recycling experience on users' e-waste recycling intentions and reported that the latter had a positive indirect association. Wang et al. (2018) similarly reported a positive indirect influence of information publicity on recycling intention. Moreover, demographic variables may also have an influence, with Echegaray and Hansstein (2017) finding that female and low-income middle-aged individuals held a positive attitude regarding e-waste recycling in Brazil, while people with high incomes were likely to already be practicing this behavior. Liu et al. (2019), meanwhile, performed a longitudinal study on Chinese consumers' recycling of obsolete cell phones. They found that cell phone life has declined from 2.9 years in 2011 to 2.21 years in 2018 and noted that consumers did not have any preference for collection mode, i.e., online or offline e-waste recycling channels. However, the convenience of the recycling method did influence their behavior. Liu et al. (2019) further argued that environmental education must be promoted to raise consumer awareness of e-waste recycling. In the context of Malaysia, Jayaraman et al. (2019) found that 'awareness of laptop disposal' and 'laptop usage' positively influenced laptop disposal practices, while computer literacy positively moderated the link between social consequences to beliefs and understanding of laptop disposal practices.

The predictors of recycling intentions have primarily been examined using the Theory of Planned Behavior (TPB). This theoretical framework states that attitude, subjective norms (SN), and perceived behavioral control (PBC) significantly predict intentions to engage in an act or behavior (Kumar, 2019). The results of these studies, however, are fragmented, with some studies suggesting that attitude positively influences e-waste recycling intentions (Nguyen et al., 2018) and others finding an insignificant association between the two (Dixit and Badgaiyan, 2016). In the case of SN, Dixit and Badgaiyan (2016) and Kumar (2019) supported a positive association with e-waste recycling intentions, which Kianpour et al. (2017) did not find. Similarly, for PBC, Dixit and Badgaiyan (2016) found a positive association with recycling intentions in the context of e-waste. However, only a few articles have examined the influence of perceived benefits and risks on consumers' recycling intention. Notably, Dhir et al. (2021) found that the personal and environmental benefits of e-waste recycling positively influenced consumer intentions. Wang et al. (2019) similarly reported that the economic benefit associated with e-waste recycling positively influenced consumers' intentions. Conversely, Kianpour et al. (2017) found no significant association between financial incentive and recycling intention. Kumar (2019), too, showed that perceived risk, measured as consequence awareness, did not share any association with recycling intention as well. In their study on smartphone recycling intentions, Zhang et al. (2020) reported that consumers were less likely to recycle their obsolete smartphones if they perceived a high risk of their personal information being stolen from them.

There are some noteworthy differences to mention between the objectives of the current study and the findings of the past literature. First, the current study employs the novel theoretical framework of VT to examine the determinants of e-waste recycling intentions. VT suggests that measuring the perceived risks and benefits of e-waste recycling should help us understand consumers' net perceived utility for this behavior. This, in turn, will improve our overall understanding of e-

waste recycling intentions. Second, the present study examines the role of different consumer values (such as value compatibility, openness to change, and environmental concerns) in predicting the intentions to recycle e-waste. The inclusion of values in the proposed model will provide insight into the guiding principles of Japanese consumers and whether these principles promote recycling behavior, in turn. Third, the prior literature has largely focused on China (Liu et al., 2019), India (Borthakur and Govind, 2018), Brazil (Echegaray and Hansstein, 2017), Malaysia (Kianpour et al., 2017), Pakistan (Gilal et al., 2019), and Vietnam (Nguyen et al., 2018), with only a few studies reporting insights from developed countries, such as Australia (Dias et al., 2018), the United States of America (Milovantseva and Saphores, 2013), and Japan (Mishima and Nishimura, 2016). Fourth, Mishima and Nishimura (2016) utilized the analysis of means (ANOM) to study consumer preferences of services promoting recycling behavior. The current study instead uses a different set of research questions and objectives. Thus, by providing insights from Japan, this study contributes to the e-waste management literature from a developed country perspective.

3. Theory and hypotheses development

3.1. Valence theory (VT)

Valence Theory (VT), proposed by Peter and Tarpey (1975), originated from the fields of psychology and economics. It explores the role of valence in understanding consumers' willingness to engage in a product, service, or behavior (Bilkey, 1953) and posits that consumers consider the associated benefits and risks holistically to achieve a net valence. Compared with the standalone perceived risk and perceived benefit models, which argue that consumers intend to maximize the perceived positive utility of a behavior or action, Peter and Tarpey's (1975) net valence model assumes that consumers seek to minimize its perceived negative utility as well. Peter and Tarpey (1975) thus suggested that VT could explain more variance in consumer intentions than the other two models, thereby proving the superiority of their framework.

VT postulates that this perceived net valence takes center stage when consumers are making a decision. VT differs from other behavioral theories as it considers both perceived benefit and perceived risk, meaning that it better evaluates an individual's intentions to engage in a behavior (Peter and Tarpey, 1975). VT considers perceived benefit to be composed of two major components: convenience and utilitarian value (Ozturk et al., 2017). Convenience is described as the consumer's perception of the time and effort required to perform a behavior, while the utilitarian value refers to their assessment of the functional attributes of the action (Han et al., 2017). Therefore, a consumer may be willing to recycle e-waste because it is easy, less time-consuming, and has environmental and health benefits. Conversely, perceived risk is defined as the consumers' perception of the uncertainty and negative effects of engaging in a behavior (Ozturk et al., 2017), which include the high cost of recycling, the threat of private information being stolen from mobile phones and laptops, and the misuse of disposed electronic devices.

Although VT is suitable for studying behavioral issues, it does not consider the consumer's subjective psychological perceptions, as captured through consumer values (He et al., 2018). Perceived values form the core of a consumer's thought processes and are considered the guiding principles in human life (Verma et al., 2019). Compared with other factors, values can help characterize the differences and similarities between individuals and groups (Schwartz, 2012) based on the extent that such values are deemed important. Thus, values can regulate people's intentions to engage in a behavior or act (Verma et al., 2019). Scholars have also highlighted that consumers' values are an important predictor of their willingness to participate in sustainable behaviors, such as visiting green hotels (Verma et al., 2019) and adopting electric vehicles (Han et al., 2017; He et al., 2018). Moreover, values are considered a critical central component of a consumer's self and

personality as well as an important motivator of their behavior (Schwartz, 2012). Previous studies have suggested that values influence consumers' intentions both directly and indirectly, as individuals are more likely to decide to engage in acts that meet their requirements (Han et al., 2017). As such, the present study extends the VT-based framework by adding different perceived values, such as value compatibility, openness to change, and environmental concerns, to the original model. Value compatibility refers to the adequacy of the innovation or service in meeting the user's values and norms (Bunker et al., 2007). Openness to change, meanwhile, is the user's autonomy in thinking and acting and their willingness to change to adopt the behavior (Barbarossa et al., 2017). In comparison, environmental concerns refer to the user's evaluation of their own and others' attitudes toward actions or behaviors related to the environment (Nnorom et al., 2009). Fig. 1 presents the combined view of valence and values, while Fig. 2 presents the research model tested in this study.

3.2. Hypothesis development

3.2.1. Perceived benefit and intentions

Perceived benefits can create a positive consumer perception of a particular behavior or action (Peter and Tarpey, 1975). The dumping of e-waste with household waste or the selling of WEEE to second-hand peddlers results in various negative externalities, including threats to human health and environmental hazards (Dias et al., 2018). Thus, saving the environment and reducing the health issues arising from informal e-waste dumping can potentially act as a benefit that motivates consumers to engage in e-waste recycling. Scholars have previously reported that perceived benefit positively influenced consumer intentions to engage in a behavior, act, or task. For example, Wang and Hazen (2016) identified a positive association between perceived benefits and intentions to purchase a remanufactured product. As such, people may prefer e-waste recycling over open dumping and informal disposal. This is also reflected by Kumar (2019), who reported that environmentally-conscious consumers had a positive intention toward e-waste recycling because they were aware of the adverse effects of e-waste if not disposed of through formal channels. Gilal et al. (2019) likewise suggested that individuals' self-determined needs, satisfaction, and intrinsic motivation to perform e-waste recycling are positive predictors of their intentions to engage in e-waste recycling, implying that perceived benefit is influential in understanding e-waste recycling intentions.

H1. Perceived benefit shares a positive association with the intention to recycle e-waste.

3.2.2. Perceived risk and intentions

Perceived risk refers to the probability of experiencing a loss and the possible negative consequences resulting from a behavior (Ozturk et al., 2017). Given that consumers typically seek to minimize the undesirable and uncertain consequences of their day-to-day decision-making processes, individuals with a higher risk perception are less likely to perform an act, while those with lower risk perceptions have increased behavioral intentions as a result (Wang and Hazen, 2016). Scholars across various domains have demonstrated the significance of perceived risk in the study of consumer behavior. He et al. (2018), for example, highlighted that perceived risk negatively influenced purchase intentions for electric vehicles, while Kaur et al. (2020) found that perceived risk was an obstacle to accepting mobile payment solutions. Li et al. (2018) further showed that perceived risk shared a negative relationship with users who intend to share health information. Wang and Hazen (2016) also reported a negative association between perceived risk and intentions to purchase remanufactured products. In the context of e-waste recycling, consumers similarly perceive risks with e-waste disposals, such as the threat of private data being stolen, loss of effort and time, and monetary loss. In particular, Zhang et al. (2019)

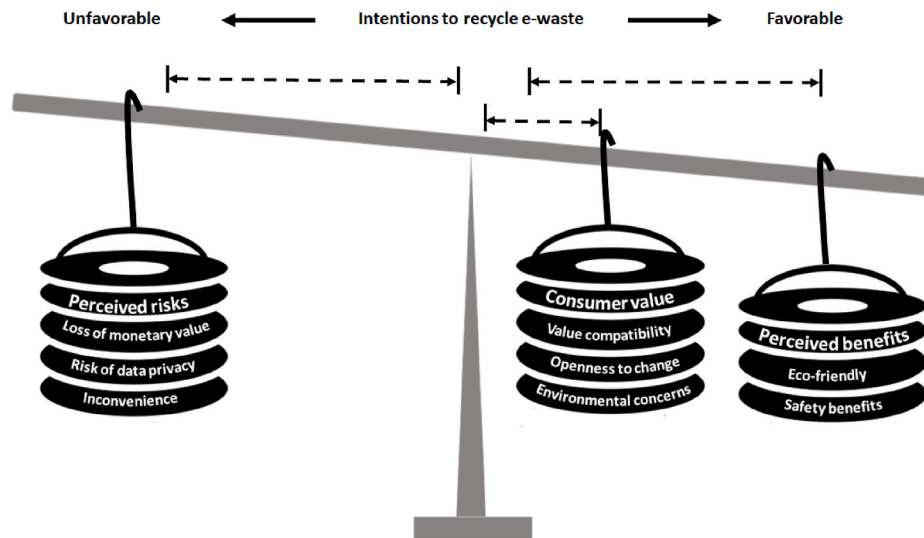


Fig. 1. Combined view of valence and values.

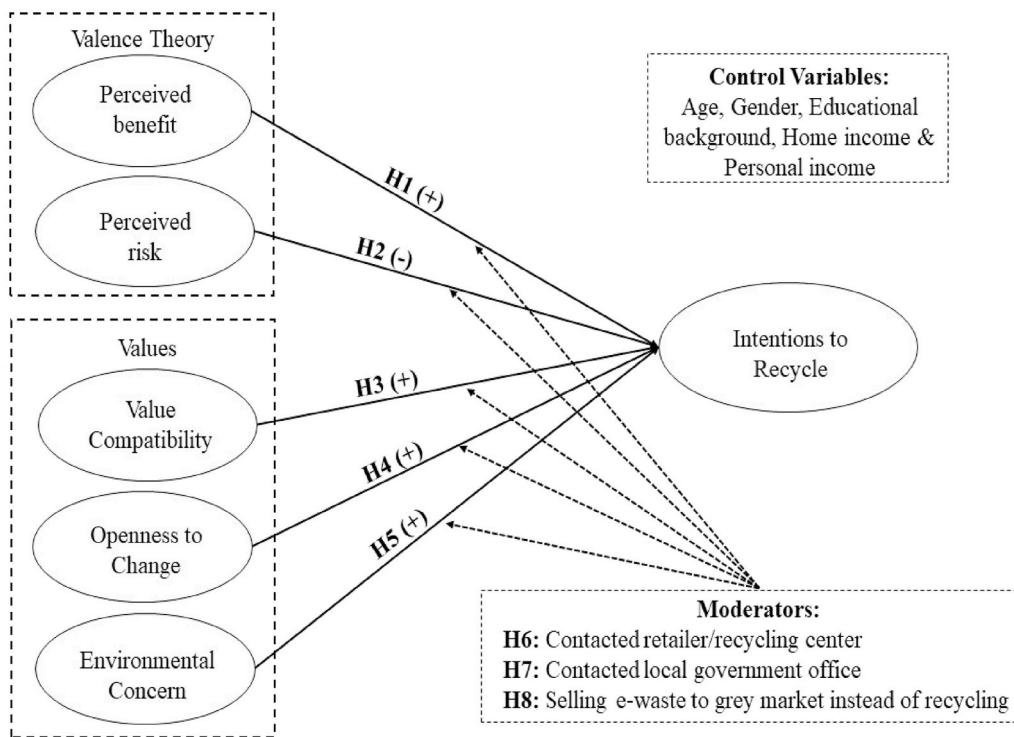


Fig. 2. Our research model.

highlighted that a perceived economic disadvantage negatively influenced intentions to recycle e-waste using e-commerce platforms. They also noted that as the convenience of recycling increased, so did the intentions to recycle e-waste. In other words, if inconvenience is high, people may be less willing to perform e-waste recycling through e-commerce channels. Finally, [Nguyen et al. \(2018\)](#) found a negative association between the inconvenience of recycling and intentions to recycle e-waste.

H2. Perceived risk shares a negative association with the intention to recycle e-waste.

3.2.3. Value and intentions

Value compatibility is defined as the adequacy of an innovation in

meeting a consumer’s values and norms ([Bunker et al., 2007](#)). It has been extensively used by information technology scholars to investigate consumers’ adoption intentions. For example, [Kang et al. \(2015\)](#) reported that value compatibility positively influenced intentions to use mobile learning (m-learning), while, in a pro-environmental behavior context, [Ting et al. \(2019\)](#) highlighted that value compatibility was a major predictor of whether consumers would dispose of their mobile phones or continue using them. Their findings suggest that if a consumer sees value compatibility in owning the mobile phone rather than disposing of it, they will tend to keep the product until they find a new mobile phone with better compatibility or feel obliged to discard the product. Consumers may perceive e-waste recycling as being more compatible with their values if it aligns with their previous experience,

current beliefs, and established needs (Saphores et al., 2012). Value compatibility can thus reinforce the intention to engage in e-waste recycling.

H3. Value compatibility shares a positive association with the intention to recycle e-waste.

Openness to change integrates the hedonic, self-direction, and stimulation dimensions of values (Barbarossa et al., 2017), where hedonic values refer to self-pleasure and satisfaction, self-direction emphasizes autonomy in thinking and action, and stimulation indicates novelty, excitement, and willingness to change (Barbarossa et al., 2017). Piscicelli et al. (2015) reported that consumers with higher openness to change values were also likely to engage in collaborative consumption behavior, a socio-economic paradigm that supports sharing, borrowing, exchanging, gifting, and renting. These behaviors, in turn, are considered to be more sustainable ways of consumption (Piscicelli et al., 2015). Ramasamy et al. (2020) also observed that consumers' openness to change values positively influenced their perceptions of firms' corporate social responsibility (CSR) initiatives. Similarly, Hansen et al. (2018) found that openness to change resulted in higher intentions to purchase or consume organic food. We argue here that consumers who find satisfaction, self-pleasure, excitement, novelty, and autonomy in engaging in sustainable behavior are thus more likely to act sustainably. Hence, individuals with higher openness to change values are more likely to indulge in e-waste recycling than those with lower such values.

H4. Openness to change shares a positive association with the intention to recycle e-waste.

Environmental concerns are the extent to which consumers are aware of environmental degradation and recognize that actions are required to protect this from happening further (Nnorom et al., 2009). This value dimension is associated with the feeling of guilt that consumers experience if they fail to protect the environment. Environmental concern is a key measure that has gained substantial coverage in the literature regarding consumers' pro-environmental behavior. In the e-waste recycling context, Dwivedy and Mittal (2013) found that environmental concerns positively affected consumers' willingness to participate in e-waste recycling.

H5. Environmental concerns share a positive association with the intention to recycle e-waste.

3.2.4. Moderating variables

The present study considers the moderating effect of three variables on the associations between perceived benefits, perceived risks, values, and intentions to recycle e-waste. The moderating variables represent consumers' prior experience with e-waste recycling, including whether they had (a) contacted a retailer or recycling centers, (b) contacted local government officials in the recent past to enquire about recycling e-waste, and (c) sold e-waste in the gray market (e.g., second-hand electronic store) instead of recycling it.

These moderating variables represent contemporary behavior in the form of prior experience with e-waste recycling. These are especially relevant and timely for better understanding the behavioral issues pertaining to e-waste recycling. Individuals who have contacted a retailer/recycling center and local government office for e-waste recycling (represented by the first two moderating variables) or those who have never sold e-waste in the gray market should thus have a higher e-waste recycling intention than those who have never contacted a formal recycling body nor sold e-waste in the gray market. This observation is in line with the extant literature, such as the study by Wang et al. (2018), which highlighted that consumers who had experience with recycling were more likely to continue engaging in such behavior. Similarly, Nguyen et al. (2018) reported that experience with recycling was an indirect predictor of e-waste recycling intentions.

Despite the importance of recycling experience in predicting

behavioral intention, almost no prior study has yet investigated its influence on e-waste recycling intentions or behavior. It is likely that all three types of prior e-waste recycling experiences (i.e., contacting a retailer/recycling center or local government office or selling e-waste in the gray market) pose a significant moderating role. For example, contacting a retailer/recycling center and local government office is likely to positively moderate the relationship between perceived benefits, values, and intentions and negatively moderate the association between perceived risks and intentions to recycle e-waste. Furthermore, selling e-waste in the gray market is likely to negatively moderate the relationship between perceived benefits, values, and intentions and positively moderate the link between perceived risks and intentions to recycle e-waste.

H6. Contacted retailer/recycling center positively moderates the associations between perceived benefits, values, and intentions and negatively moderates the associations between perceived risks and intentions to recycle e-waste.

H7. Contacted local government office positively moderates the associations between perceived benefits, values, and intentions and negatively moderates the associations between perceived risks and intentions to recycle e-waste.

H8. Selling e-waste to the gray market instead of recycling it negatively moderates the associations between perceived benefits, values, and intentions and positively moderates the associations between perceived risks and intentions to recycle e-waste.

4. Method

4.1. Measures and questionnaire

An extensive literature review was performed to select the study measures and measurement items (see Table 1) before we adapted them to fit the study context. The three moderating variables were accessed using a dichotomous scale where Yes = 1 and No = 0. Three experts with experience in survey development, e-waste recycling, and the Japanese market and culture reviewed the developed survey instrument. Based on their feedback, the authors incorporated minor changes related to the language and wording. Next, two qualified translators converted the survey items from English to Japanese using the back-translation method. Two third-party research professionals then evaluated the final survey by checking the instrument multiple times to ensure consistency in translation. In the next stage, a pilot study was used to test the final survey instrument with ten consumers (five male and five female), asking them to evaluate the survey questions and highlight any confusing and unclear statements. The pilot study resulted in minor improvements relevant to the survey items' language.

4.2. Data collection and sample

Data collection was done by Macromill Inc., a leading survey marketing organization with over two million registered Japanese users (Kumagai and Nagasawa, 2019). Macromill is a popular company for collecting survey data for various industries, government bodies, and academicians (Kumagai and Nagasawa, 2019). Random sampling was employed to select participants until the respondents' demographic profile mirrored the population of Japan. This replication resulted in a proportionate representation of respondents from each demographic in the survey data. The survey was online, with all questions made compulsory to avoid incomplete responses and missing values. In addition, all of the ethical guidelines of the Japan Marketing Research Association (JMRA) were observed.

The survey returned 774 responses, of which 51.6% were female respondents, and the remaining 48.4% were male. A total of 138 respondents were aged below 35, while 276 were between 36 and 45 years

Table 1
Measurement and structural model.

Study measures (Reference)	Measurement items	CFA	SEM
Value Compatibility (VC) Karahanna et al. (2006)	VC1: Using e-waste recycling would be in line with my own personal values.	.71	.71
	VC2: Using e-waste recycling fits the way I view the world.	.76	.78
	VC3: Using e-waste recycling would be consistent with the way I think I should live my life.	.65	.65
Openness to Change (OTC) Claudy et al. (2015)	OTC1: I always look for new things and surprises in life.	.67	.64
	OTC2: I look for adventure and like to take risks.	.79	.83
Environmental Concerns (EC) Tarrant & Cordell (1997)	EC1: I have read newsletters, magazines, or other publications written by environmental groups.	.65	.65
	EC2: I have signed a petition in support of protecting the environment.	.82	.82
	EC3: I have given money to an environmental group.	.79	.79
	EC4: I have boycotted or avoided buying products from a company because I felt that company was harming the environment.	.67	.67
Perceived Benefit (PB) Wang et al. (2016)	PB1: Using e-waste recycling is environmentally friendly.	.72	.71
	PB2: Adopting e-waste recycling is better than storing the product at home.	.75	.75
	PB3: Using e-waste recycling is safer than reselling and storing the product.	.68	.68
Perceived Risk (PR) (Echegaray and Hansstein, 2017; H. T. T. Nguyen et al., 2018)	PR1: It is hard to find the e-waste collection center.	.81	.81
	PR2: E-waste recycling is inconvenient for me.	.93	.93
	PR3: E-waste recycling does not provide me with monetary benefits.	.60	.60
	PR4: Using e-waste recycling may lead to improper handling of the stored data.	.55	.55
Intentions to Recycle (ITR) Holland et al. (2006)	ITR1: I intend to put extra effort into recycling e-waste.	.66	.66
	ITR2: I am willing to speak to my friends about appropriate modes of disposing of electronic appliances.	.75	.75
	ITR3: I am willing to spend some time taking my old electronic appliances to be recycled.	.72	.73

of age, 268 were aged between 46 and 55, and the other 92 respondents were above the age of 56. In addition, 21.2% of respondents had a household income below 4 million yen, 20.5% had a household income between 4 and 6 million yen, and the rest had an income above 6 million yen. Regarding respondents' personal income, 52.1% of people had a personal income below 4 million yen, 15.4% had a personal income between 4 and 6 million yen, with the rest having a personal income above 6 million yen. Furthermore, Japan is the third-largest e-waste generating country in the world (Baldé et al., 2017), amassing approximately 2.2 million tons of e-waste in 2016 alone, of which only 26% was collected for recycling that year (more recent data than 2016 is currently unavailable). Japan's e-waste generated per capita also stood at 16.9 kg, far more than the Asian average of 4.2 kg per capita, and the global average of 6.3 kg per capita (Baldé et al., 2017). The management of this massive quantity of Japanese e-waste is further complicated by the presence of peddlers and the informal sector (Menikpura et al., 2014).

4.3. Control variables

The present study utilizes several demographic variables, namely, age, gender, education, and income, as the control variables. According to the prior literature, demographic variables have an influential role in predicting e-waste recycling intentions (Echegaray and Hansstein, 2017), particularly when it comes to age. Borthakur and Govind (2018) and Saphores et al. (2012) both reported that older individuals were less likely to recycle e-waste, while Zhang et al. (2019) suggested that younger people (below 30 years of age) were more active in e-waste recycling instead. In comparison, Nnorom et al. (2009) reported that older individuals were more willing to recycle e-waste than younger ones. Moreover, Echegaray and Hansstein (2017) similarly found that middle-aged individuals were more inclined to participate in e-waste recycling than their younger counterparts.

In the case of e-waste recycling, gender has also been shown to play an influential role. Milovantseva and Saphores (2013), for example, observed that women acted more sustainably than men and were more likely to recycle e-waste, a finding validated by Saphores et al. (2012) and Echegaray and Hansstein (2017) as well. Several studies, however, have suggested an absence of gender differences in this context (Borthakur and Govind, 2018; Wang et al., 2018).

Consumers with different education levels may further have differences in their recycling intentions as well. For example, Jena and Sar-mah (2015) reported that education level was positively associated with consumer's return intentions of used products. Similarly, Nguyen et al. (2018) highlighted that education level positively influenced consumers' e-waste recycling intentions, with higher education levels corresponding to a higher willingness to perform e-waste recycling. Conversely, Zhang et al. (2019) found that individuals who were more educated were more likely to perform e-waste recycling through e-commerce platforms. These studies clearly suggest that education level significantly affects recycling intentions.

The influential role of income on e-waste recycling intention has also been proposed in the prior literature. Milovantseva and Saphores (2013) reported that people with low-income levels were more likely to store their e-waste at home rather than recycling it. Conversely, both Echegaray and Hansstein (2017) and Wang et al. (2016) suggested that people with low-income levels were more likely to perform e-waste recycling, finding that as income increased, people's willingness to recycle e-waste decreased accordingly. However, a study by Wang et al. (2011) did not find a significant difference in recycling intentions based on income levels.

4.4. Data analysis

The dataset was subjected to normality tests prior to further analysis. The statistical tests for skewness and kurtosis confirmed the normal distribution of the data (Hair et al., 2010). Scholars have proposed that if the Z-score values exceed the prescribed value of 3.29, then outliers are present in the data (Tabachnick and Fidell, 2012). The dataset did not observe any outliers, so all 774 responses were considered for the analysis.

We conducted the data analysis in three phases. First, the reliability and validity of the theoretical constructs were assessed using confirmatory factor analysis (CFA). Second, the proposed hypotheses in the research framework were validated using structural equation modeling (SEM) to test the significance of the theoretical relationship, referred to as the structural paths between constructs. Finally, the authors tested the moderating effect of the proposed moderators in the research framework. SPSS 24.0 and AMOSS 24.0 were used for CFA and the structural model estimation (Anderson and Gerbing, 1988). The moderation analysis, i.e., the testing of H6, H7, and H8, was performed in the PROCESS macro of SPSS.

5. Results

5.1. Validity and reliability

The validity and reliability of the study measures were established using a battery of statistical tests, as recommended in the existing literature (Fornell and Larcker, 1981; Hair et al., 2010). First, the study measures were drawn from the existing literature on e-waste management and consumer behavior to establish the instrument's content validity. Second, the face validity of the instrument was confirmed using a pilot study and testing as well as an evaluation by expert panels. Third, the factor loadings, composite reliability (CR), and average variance extracted (AVE) were assessed to determine the convergent validity. The factor loadings of all items were above 0.50, the CR values for all study measures were above the threshold value of 0.70, and the AVE values of all measures exceeded the threshold value of 0.50 (Table 2). Fourth, the model was tested for discriminant validity based on Fornell and Larcker's (1981) criteria, which state that the correlation between the items of any two measures should be less than the square root of the AVE. Table 2 shows the inter-construct correlation and square root of AVE (Columns 6–10). As the inter-construct correlation values were less than the diagonal values, the study measures possessed sufficient discriminant validity. Finally, the reliability was evaluated by estimating the CR of the different study measures (Table 2). The CR values each exceeded the recommended threshold value of 0.70. Thus, all of the tests above provide proof for the validity and reliability of the survey instrument.

5.2. Measurement model

The measurement model was tested using various model fit indices. The χ^2/df value was below the threshold value of 3.0 (2.43) and thus supported a good model fit (Hair et al., 2010). The values of other important goodness of fit indicators were NFI = 0.94, CFI = 0.96, and TLI = 0.95, which were greater than the minimum threshold values suggested by the prior literature (Hair et al., 2010). Lastly, this study examined the root means square error of approximation (RMSEA) value. Lower values of RMSEA indicate a better model fit, while the maximum RMSEA value should not exceed 0.08. The RMSEA value was 0.04, suggesting that the study possessed a good model fit.

5.3. Common method bias

Scholars have highlighted that single-source data is vulnerable to common method bias (CMB) (Podsakoff et al., 2003). Hence, the authors undertook both *a priori* and *a posteriori* countermeasures to ensure that CMB did not impact the study. The *a priori* controls included communicating the following to the respondents: ensuring confidentiality to improve accuracy, communicating that no answer is (in)correct, asking respondents to answer honestly, utilizing item shuffling, administering an online survey to reduce social desirability bias, and using pilot testing to confirm that the items were expressed with lucidity. Podsakoff et al. (2003) noted that these *a priori* measures are important as they improve the likelihood of receiving honest answers by reducing respondents' apprehension, thereby minimizing CMB. For our *a posteriori* measure,

Table 2
Validity and reliability analysis.

	CR	AVE	MSV	ASV	PB	VC	OTC	EC	ITR	PR
PB	.76	.51	.29	.09	.72					
VC	.75	.51	.29	.11	.54	.71				
OTC	.70	.54	.32	.08	-.10	.04	.73			
EC	.83	.54	.32	.11	-.01	.16	.56	.74		
ITR	.75	.51	.23	.13	.40	.48	.24	.44	.71	
PR	.82	.55	.02	.01	-.04	-.06	.05	-.14	-.14	.74

Note: Composite reliability = CR, Average variance extracted = AVE, Maximum shared variance = MSV, Average shared variance = ASV, Intention to recycle = ITR, Environmental concerns = EC, Value compatibility = VC, Openness to change = OTC, Perceived benefit = PB, Perceived risk = PR.

Harman's single-factor test was performed to examine whether CMB was a threat to our study. Exploratory factor analysis was carried out, with the unrotated solution returning a variance of 21.99% (significantly below the 50% cutoff value). Therefore, CMB was not a significant problem for the study.

5.4. Structural model

This study tested the proposed hypotheses using SEM. Similar to the measurement model, the model fit indices were also checked on the structural model. The results demonstrated a good model fit with NFI = 0.93, CFI = 0.96, TLI = 0.94, χ^2/df = 2.07, and RMSEA = 0.04 (Anderson and Gerbing, 1988). In the next step, the path coefficients were estimated, and their significance was assessed. The SEM results showed that three of the five hypotheses were supported, while two were rejected (Table 3). Among the three consumer values considered in the study, value compatibility and environmental concerns were positively associated with intentions to recycle, i.e., H1 ($\beta = 0.29$; $p < .001$) and H3 ($\beta = 0.34$; $p < .001$) respectively (Fig. 3). The association of openness to change with intentions to recycle, i.e., H2 ($\beta = 0.08$; $p > .10$), however, was not supported (Fig. 2). Among the VT measures (perceived benefit and perceived risk), hypothesis H4 ($\beta = 0.24$ and $p < .001$) was statistically significant, thus indicating an association between perceived benefit and intentions to recycle. However, the authors did not find support for H5 ($\beta = -0.07$ and $p > .10$), representing no association between perceived risk and intentions to recycle (Fig. 3). Moreover, value compatibility, environmental concerns, and perceived benefit were able to explain a 42% variance in consumer's intentions to recycle e-waste (Fig. 3).

5.5. Moderation analysis

The moderation effect was tested using the PROCESS macro in SPSS. The results suggest that hypotheses H6, H7, and H8 were partially supported (Table 4). Conditional effects at different values of the moderators showed that people who contacted the retailer/recycling center significantly differed from those who did not (Fig. 4(a) & (b)). The moderator, 'contacted a retailer/recycling center', positively moderated the relationship of both value compatibility and environmental concerns with the intention to recycle. The analysis further revealed that 'contacted local government office' positively moderated the relationship of value compatibility and perceived benefit with intentions to recycle (Table 4). Moreover, the results of the conditional effect showed that, for the association of value compatibility and perceived benefit with

Table 3
Results of hypotheses.

Hypothesis	Path	Support
H1	Perceived benefit → Intentions to recycle	Yes
H2	Perceived risk → Intentions to recycle	No
H3	Value compatibility → Intentions to recycle	Yes
H4	Openness to change → Intentions to recycle	No
H5	Environmental concerns → Intentions to recycle	Yes

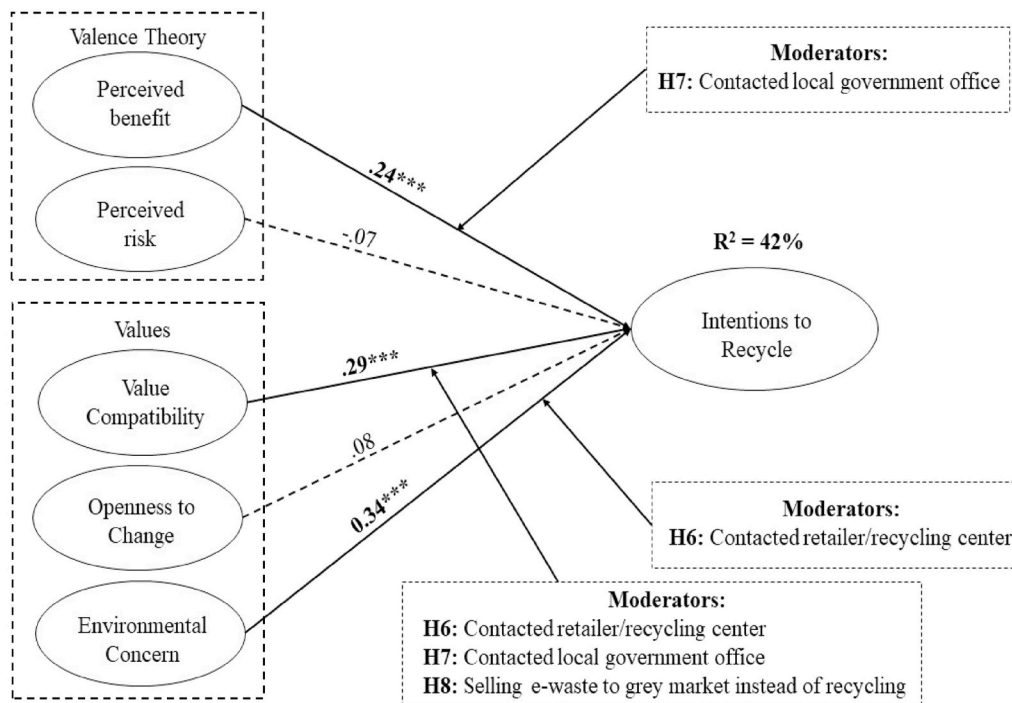


Fig. 3. Results of the structural model.

Table 4
Moderation analysis.

Contacted retailer/recycling center						
	β	t	p	LLCI	ULCI	Moderation?
VC → ITR	.16	1.97	.05	.0002	.3133	Yes
OTC → ITR	.04	.67	.50	-.0724	.1483	No
EC → ITR	.16	3.02	.003	.0551	.2599	Yes
PB → ITR	.06	.75	.46	-.0937	.2086	No
PR → ITR	-.07	-.99	.32	-.2002	.0660	No
Contacted local government office						
VC → ITR	.17	1.95	.05	-.0012	.3429	Yes
OTC → ITR	.05	.82	.41	-.0687	.1682	No
EC → ITR	.05	.83	.41	-.0645	.1590	No
PB → ITR	.16	1.81	.07	-.0131	.3253	Yes
PR → ITR	-.08	-1.02	.31	-.2237	.0705	No
Selling e-waste to the gray market instead of recycling						
VC → ITR	-.22	-2.82	.01	-.3786	-.0676	Yes
OTC → ITR	.08	1.35	.18	-.0354	.1900	No
EC → ITR	.03	.61	.54	-.0726	.1381	No
PB → ITR	.06	.72	.47	-.0953	.2078	No
PR → ITR	-.01	-.17	.87	-.1460	.1231	No

intentions to recycle, consumers who had contacted local government offices significantly differed from those who did not (Fig. 4(c) and (d)). Finally, consumers who sold e-waste to gray markets instead of recycling it significantly differed from those who did not for the association between value compatibility and intentions to recycle (Fig. 4(e)).

5.6. Control variables

The study results suggest that all four control variables, namely age, gender, educational background, and home and personal income, did not influence the intentions to recycle e-waste. This implies that none of these demographic variables affected the studied associations.

6. Discussion

This study pioneers an attempt to test the extended VT model's

robustness in explaining consumer's intentions to recycle e-waste. The research model consists of perceived benefit, perceived risk, and three values, namely value compatibility, openness to change, and environmental concerns. Furthermore, the authors examined the moderating role of three contemporary recycling behaviors on the studied associations. These moderating variables were whether participants had ever contacted a retailer/recycling center, contacted the local government office, or sold e-waste to the gray market instead of recycling it.

Hypotheses H1 and H2 examined the association between intentions to recycle and perceived benefit and perceived risk. The results supported H1, suggesting a positive association between perceived benefits and intentions to recycle. This finding follows from previous research (Wang and Hazen, 2016), indicating that (i) people have a positive perception of e-waste recycling and believe it is beneficial for them; (ii) environmental and personal benefits, coupled with e-waste recycling, inculcate favorable recycling intentions among Japanese consumers. Although H2 was not supported, thus contradicting past studies suggesting a negative association between perceived risks and user intentions to engage in a given behavior (Kaur et al., 2020; Li et al., 2018; Wang and Hazen, 2016), this finding is in conjunction with other studies (Marriott and Williams, 2018), which highlights the need for further investigation in future research. Marriott and Williams (2018) reported that perceived risk shared an insignificant relationship with intentions in mobile shopping. Given that the impact of an individual's risk perception is influenced by their level of awareness (Sohn et al., 2016), it is possible that consumers are significantly aware of e-waste recycling in Japan, and thus, the associated perceived risks were rendered insignificant.

Our results further supported H3, suggesting that value compatibility is positively associated with intentions to recycle e-waste. These results conform to most of the past literature, indicating that (i) e-waste recycling is compatible with Japanese consumers' beliefs, values, and existing needs; (ii) this value compatibility may be related to favorable societal/social norms toward e-waste recycling (Kang et al., 2015).

The effect of openness to change on the intentions to recycle was insignificant, meaning that H4 was not supported. This unexpected finding is in contrast with Hansen et al. (2018) and implies that people

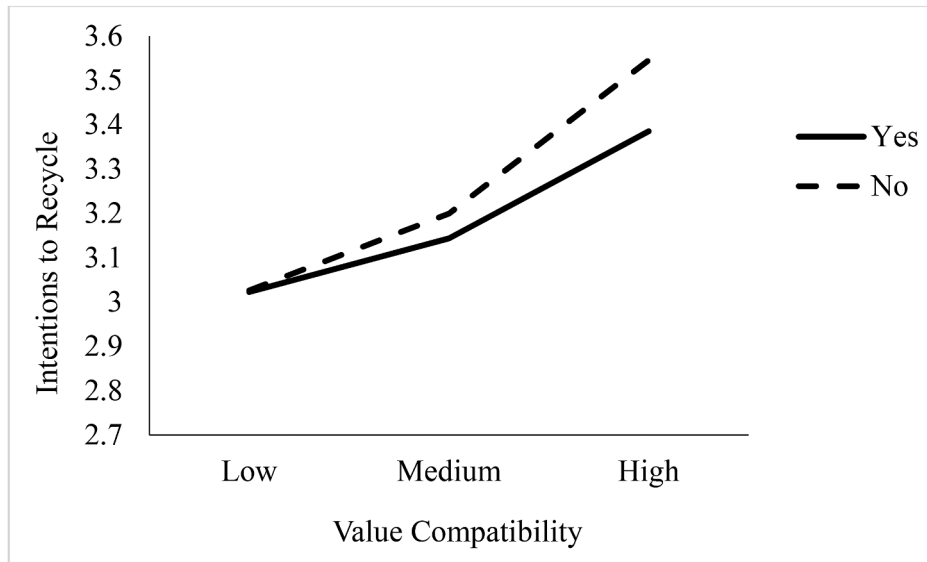


Fig. 4a. Moderating influence of contacted retailer or recycling center on the association between value compatibility and intentions to recycle.

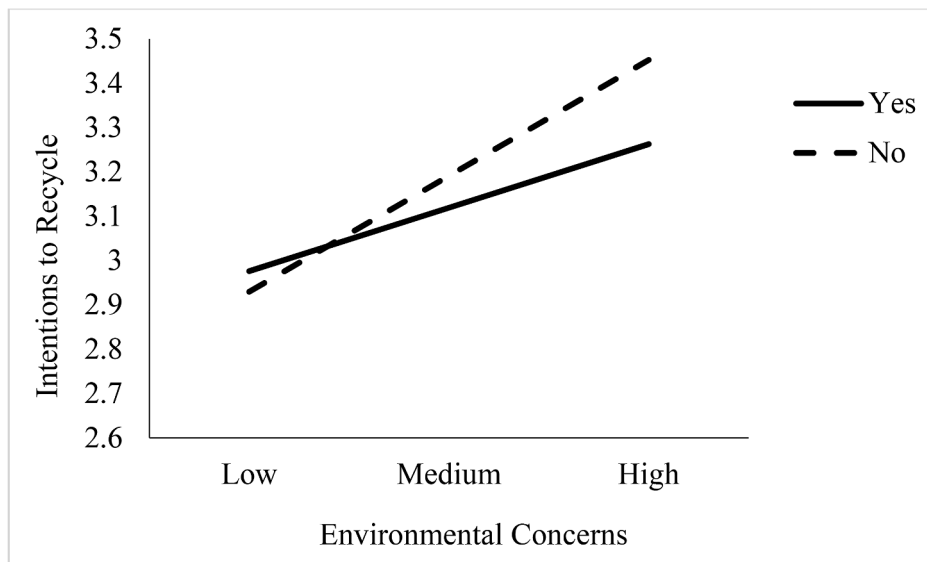


Fig. 4b. Moderating influence of contacted retailer and recycling center on the association between environmental concern and intentions to recycle.

do not perceive e-waste recycling as exciting, satisfactory, and pleasurable. The possible reasons for this finding could be that (i) in Japan, the government has mandated that consumers pay e-waste recycling fees. Thus, consumers may perceive a financial loss from recycling e-waste. Accordingly, they may not achieve pleasure and excitement in engaging in this behavior; (ii) the openness to change components of values are culture-dependent (Schwartz, 2012) and may not be predominant in Japanese culture. However, H5, which posits that environmental concerns are positively related to recycling intentions, was supported. This conforms to the prior literature (Dwivedy and Mittal, 2013), suggesting that greater environmental concerns lead to a higher possibility of consumers recycling their e-waste. The explanation for this could be that (i) consumers are aware of environmental degradation and are willing to take steps to reduce it; (ii) they are mindful that selling e-waste to informal recyclers or disposing of it with household waste can result in negative consequences. Hence, they may be willing to recycle e-waste to protect the environment (Dhir et al., 2021).

All three moderation hypotheses (H6, H7, and H8) were partially supported. The moderating variable, namely, ‘contacted a retailer/

recycling center’, positively moderated the association of value compatibility and environmental concerns with the intention to recycle, thereby suggesting that this structural path is amplified if the consumer has contacted such sources. Similarly, ‘contacted a local government office’ positively amplified the association of value compatibility and environmental concerns with the intention to recycle e-waste. The possible reasons for this could be that (i) the people who contacted a retailer/recycling center or local government office had a positive and satisfying experience, which may have further motivated them to recycle e-waste in the future (Nguyen et al., 2018); (ii) the people in respondents’ social circles may have already been recycling e-waste, making the respondents feel obligated to do the same (Dixit and Badgaiyan, 2016); (iii) consumers care for the environment and intend to do their part to safeguard it (Wang et al., 2016).

The third moderating variable, ‘selling e-waste to the gray market instead of recycling it’, negatively moderated the relationship between value compatibility with the intention to recycle. This finding implies that people who have sold their WEEE products to the second-hand market and had high value compatibility with doing so are less likely

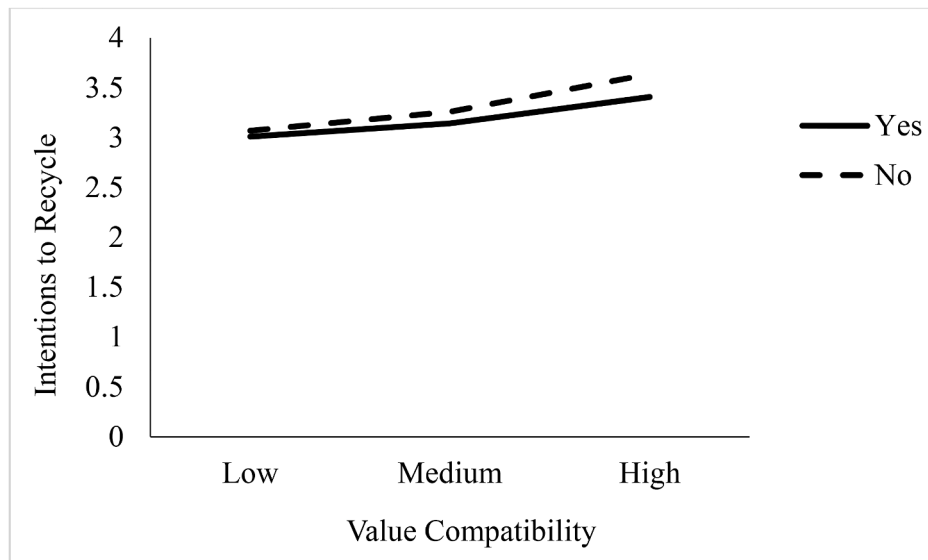


Fig. 4c. Moderating influence of contacted local government office on the association between value compatibility and intentions to recycle.

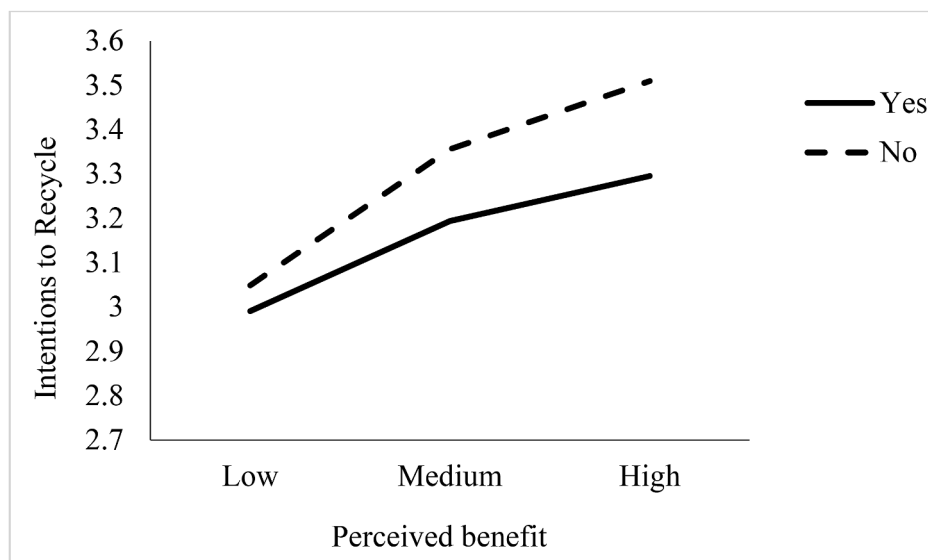


Fig. 4d. Moderating influence of contacted local government office on the association between perceived benefit and intentions to recycle.

to recycle their e-waste. This could be because the experience of selling products to second-hand stores led to a monetary benefit (Jayaraman et al., 2019) while recycling the e-waste would have incurred a cost instead. Accordingly, consumers may have perceived this economic incentive as a positive experience, thereby making them hesitant to recycle e-waste in the future. The reason behind consumers selling e-waste to second-hand stores could also be that they perceive obsolete products as still containing some monetary value. Moreover, there could be no societal norm related to e-waste recycling that could motivate or force consumers to recycle it. It is interesting to note that experience and past behavior can both strengthen and weaken consumers' intentions to recycle, depending on whether these experiences were pro-environmental or not. Thus, if the consumers' past behavior had a pro-environmental motive, it would strengthen their intentions to recycle and vice versa.

6.1. Theoretical implications

The current study makes three major theoretical contributions. First,

it significantly contributes to the theory building in the emerging literature on e-waste recycling and waste management. This is mainly due to three main reasons: (a) the present paper is a pioneering empirical study that examines consumer e-waste recycling intentions through an extended VT framework that considers various values (i.e., value compatibility, openness to change, and environmental concerns); (b) the study tests the moderating role of novel contemporary recycling variables, such as 'contacted retailer/recycling center', 'contacted the local government office', and 'sold e-waste to the gray market instead of recycling it'; (c) the current study utilizes VT as a theoretical framework, which has never before been utilized in the prior literature on e-waste recycling and waste management.

Second, a number of studies from different contexts, including internet use (Choden et al., 2019) and electric car adoption (Barbarossa et al., 2017), have provided support to Schwartz's (2012) argument, which emphasizes the impact of values on behavioral intentions. The present study adds to this body of literature by providing partial support to the argument that values (e.g., value compatibility and environmental concerns) are predictors of intentions in the context of e-waste recycling

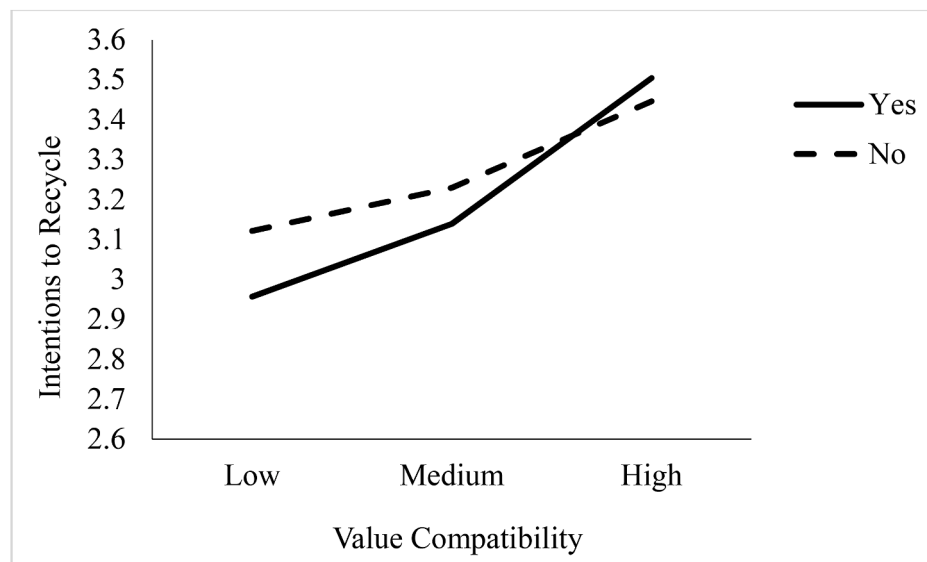


Fig. 4e. Moderating influence of selling e-waste to the gray market instead of recycling on the association between value compatibility and intentions to recycle.

(Schwartz, 2012). The openness to change value, however, was insignificant. Thus, this study calls for further investigation in the future.

Third, unlike most of the earlier studies that separately examined the benefits and risks associated with e-waste recycling intentions, the authors proposed a value-net valence (value-VT) framework that incorporated various values, perceived risk, and perceived benefit in a single model to give a holistic view of consumers' e-waste recycling intentions. The current study, therefore, contributes to a profound understanding of the intentions to recycle e-waste.

6.2. Practical implications

The current research has significant practical implications for both policymakers and decision-makers. First, the decision-makers can utilize the study findings to better understand the benefits and risks associated with consumers' e-waste recycling intentions. For example, perceived benefit is a significant positive predictor of recycling intentions; therefore, manufacturers should propose certain schemes that further motivate consumers to return their products for safe disposal, such as providing consumers with discount coupons, lucky draws, social recognition through advertisements, and so on.

Second, as highlighted in the study, environmental concerns positively affected consumers' intentions to recycle. Thus, organizations and governments need to spread awareness regarding the negative effects of informal e-waste disposal on human health and the environment. Given that Kumar (2019) has highlighted the importance of information in changing consumers' behavior, the authors recommend that steps be taken to spread relevant information on e-waste recycling so that willing consumers can contact a designated retailer/recycling center or local government office to do so. This information could be circulated on various platforms, such as the internet, print media, and social media.

Third, the government should take necessary steps to stop the buying and selling of obsolete electrical and electronic products to the second-hand market because consumers who sell their e-waste to second-hand stores are less likely to recycle it in the future. Consumers often believe that their obsolete electronic products still have some value (Borthakur and Govind, 2018), and, thus, their willingness to donate the product free of cost to be recycled is low. Moreover, selling to second-hand stores yields monetary benefits. In contrast, if the e-waste is disposed of with a recycler or government office, the consumer has to bear the cost of recycling, per Japanese e-waste management law. Therefore, a stringent policy is needed to minimize the disposal of

e-waste at second-hand stores or with household waste.

7. Limitations and future work

The present study simultaneously examines the perceived benefits, perceived risks, and consumer values associated with e-waste recycling to consolidate the fragmentary knowledge in this area. However, it does not differentiate between the types of e-waste. In particular, obsolete electronic products differ in size; for example, mobile phones are smaller than refrigerators or washing machines. People may thus find mobile phones more convenient and cost-effective to recycle than larger electronic products. Moreover, as highlighted by Dixit and Badgaiyan (2016), people usually dump their old cell phones along with household waste due to their smaller size. Similar behavior may be present toward other small-sized e-waste. Therefore, future research could focus on studying consumers' e-waste disposal behavior depending on the size of the e-waste items. This type of study, if carried out, will be useful for stakeholders in designing e-waste collection interventions that can deliver positive valence to consumers.

Similarly, the study identifies value compatibility and environmental concerns as important consumer values that significantly impact behavioral intentions to recycle e-waste. It would be interesting to include other altruistic and biospheric values in future studies (Verma et al., 2019). In the future, researchers may also combine the Value-Belief-Norm (VBN) theory with VT. Additionally, scholars can include the impact of economic incentives, such as buy-back and exchange offers, in the proposed research framework.

Although this study makes significant theoretical and practical contributions, it is restricted in terms of sample limitations. First, the study used a cross-sectional online survey method to collect self-reported data, which may bias the results of the research. Second, the sample of the study was limited to individuals, even though organizations, such as educational institutions, hotels, and other business units, generate a considerable amount of e-waste as well. Future research could study the return intentions and behavior of various organizations with respect to e-waste recycling. Finally, the findings of the study are generalizable only in the context of developed countries and countries sharing similar cultural values to those found in Japan. Hence, it would be interesting for future scholars to conduct a study across countries with different economic statuses and cultures.

Author contribution

AD: participated in the conceptualization, design, Methodology, data collection and curation. wrote the first draft of the manuscript, participated in data analysis, modelling and validation. All authors participated in reviewing and editing of the final draft as well as the revision. SM: participated in the conceptualization, design, Methodology, data collection and curation. participated in data analysis, modelling and validation. All authors participated in reviewing and editing of the final draft as well as the revision. UA: participated in the conceptualization, design, Methodology, data collection and curation. wrote the first draft of the manuscript, participated in the literature review. PK: participated in the conceptualization, design, Methodology, data collection and curation. wrote the first draft of the manuscript, participated in data analysis, modelling and validation. All authors participated in reviewing and editing of the final draft as well as the revision. carried the project administration and supervision. MS: participated in the conceptualization, design, Methodology, data collection and curation. carried the project administration and supervision. MA: participated in the literature review.

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.

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