



Drivers of food waste reduction behaviour in the household context

Saman Attiq^a, Muhammad Danish Habib^b, Puneet Kaur^{c,d}, Muhammad Junaid Shahid Hasni^e,
Amandeep Dhir^{d,f,g,*}

^a Air School of Management Science (AUSOM), Air University Islamabad, Pakistan

^b Air University Islamabad, Aerospace and Aviation Campus Kanra, Pakistan

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

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

^e Department of Economics and Management, School of Social Sciences, University of Trento, Italy

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

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

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ABSTRACT

Studies on the drivers of household consumer engagement in various food waste reduction strategies have been limited. We thus address this gap by developing a research model that utilises two well-known theories, namely, the Theory of Interpersonal Behaviour (TIB) and the Comprehensive Model of Environmental Psychology (CMEP), to explain food waste reduction behaviour in household consumers. The model hypothesises positive associations between emotional, social, and cognitive factors and food waste reduction behaviour, as conceptualised using the 3Rs (reuse, reduce, and recycle). A total of 515 U.S. household consumers participated in the cross-sectional survey. The results suggest that emotional (anticipated guilt), social (sense of community), and cognitive factors (awareness about consequences and environmental knowledge) were positively associated with food waste reduction behaviour. However, the study results did not support the association between a sense of community and reuse intentions. Moreover, anticipated guilt and awareness of consequences were significant drivers of the reuse and reduce food waste behaviours, respectively. The age of the study participants also had a significant controlling influence on the reduce intentions. The study findings have significant implications for governments, policymakers, marketers, and academics that are interested in developing strategies to mitigate the impact of food waste.

1. Introduction

The growing magnitude, complexity, and relevance of food waste have attracted the attention of scholars as well as practitioners (Issock, Roberts-Lombard, & Mpinganjira, 2020; Dhir, Talwar, Kaur, & Malibari, 2020). Food waste is a major problem for many developing and developed nations and has various environmental and economic implications (Filimonau et al., 2020). Food waste is referred to as the proportion of edible food that goes unconsumed (Smith & Landry, 2021), which includes materials for human consumption that are subsequently lost, degraded, discharged, or contaminated (Giroto et al., 2015). Specifically, household food waste is a subset of the total food losses conceived as a result of consumers' decisions (Cicatiello et al., 2016), particularly in domestic households, such as preparing extra large meals, buying too

much food, and not reusing food leftovers (Boulet et al., 2021). Global statistics have shown that close to 800 million people are facing undernourishment or suffering from hunger (Bravi et al., 2020) and this food security problem can be solved by reducing food waste (Galli et al., 2019). Global food waste is valued at \$1 trillion annually, causing a significant financial burden (Septianto, Kemper, et al., 2020). This avoidable food loss adversely affects the incomes of food supply chain members (suppliers and consumers) and also contributes towards the monetary losses of both individuals and national economies (Heidari et al., 2019).

Food waste accounts for the damage of a significant amount of production resources (e.g., capital and energy) and continues to add stress on natural resources like water and land (Aamir et al., 2018). Survey reports have shown that in the United States, about 30–40% of

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

E-mail addresses: saman.attiq@mail.au.edu.pk (S. Attiq), danshabib@au.edu.pk (M. Danish Habib), puneet.kaur@uib.no (P. Kaur), mohammad.hasni@unitn.it (M. Junaid Shahid Hasni), amandeepp.dhir@uia.no (A. Dhir).

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the food supply remains uneaten, representing nearly \$160 billion in economic losses. Furthermore, the average U.S. household wastes 31.9% of their food, a cost of \$1,866 per household annually or an annual cost of \$240 billion nationwide (Yu & Jaenicke, 2020). Food waste is a serious threat, making it crucial to understand food consumption (e.g., over-purchasing of food) and wastage patterns. A better understanding will thus enable scholars and practitioners to develop appropriate solutions and policies for food waste prevention (Agbefe, Lawson, & Yirenya-Tawiah, 2019).

Food waste is much higher in volume at the household-level than at the business-level, causing households to be considered the main contributing factor to food waste (Hebrok & Heidenström, 2019). Therefore, scholars have highlighted the need for more empirical research on the different consumer behavioural intentions related to food waste, specifically at the household-level (Filimonau et al., 2020). Consumer involvement in food waste reduction would enhance sustainability by eliminating or reducing the overall volume of food waste (Kim, Rundle-Thiele, & Knox, 2019). As the waste produced is a byproduct of household consumption, consumers must deal with this waste by using leftover household food (Ferrara & Missios, 2016). Food waste reduction strategies may refer to the minimisation of food disposal through the planning of purchasing, cooking, and eating practices. For example, households may carefully plan and shop only for needed food items and practice efficient cooking and eating of purchased items to prevent food waste (Stancu et al., 2016). Consumers may also get more information about the environmental, economic, and social impacts caused by food waste and encourage their peer groups to prevent wasting their food by reducing, reusing, or recycling their household food waste. Reuse is a food waste reduction practice that involves reusing leftover food (Stancu et al., 2016) and may manifest as consumers transforming their leftover food into different dishes by adding new ingredients to them.

In comparison, recycling is an environmental behaviour (Foon et al., 2020) to reduce the human impacts on society, the economy (Echegaray & Hansstein, 2017), and the environment (Wan et al., 2017). Specifically, recycling intentions play a critical role in the waste management hierarchy (Chan & Bishop, 2013). The increased importance of reducing food wastage in recent times has driven researchers to explore recycling intentions (Mak et al., 2020; Sujata et al., 2019). A number of scenarios have been proposed for recycling household food waste, such as through gardening (composting) (Kim et al., 2020) and creating animal feed (Papargyropoulou et al., 2014). For example, consumers may utilise food leftovers to make valuable fertiliser that can enrich the soil and plants or feed their pets. In waste management, a number of studies have adopted the concept of the 3Rs to address waste behaviours, such as plastic waste (e.g., Khan, Ahmed, & Najmi, 2019) and food waste (e.g., Kim et al., 2019). Furthermore, the 3Rs have been used in the food sector to study food waste from the consumer perspective (Kim et al., 2020).

The review of the prior literature on household food waste has uncovered several open research gaps. First, the existing research on food waste behaviour has been heavily dominated by qualitative investigations probing different issues related to motives and barriers to minimise food waste (Graham-Rowe et al., 2014). However, these qualitative investigations suffer from an inherent inability to establish the associations and causality between the studied variables (Graham-Rowe et al., 2014). In addition to this, most prior qualitative studies have utilised smaller samples and suffer from social desirability bias (Barone et al., 2019).

Second, most of the existing studies have focussed on better understanding the amount of food wasted and the global impact on food systems (Bravi et al., 2020). Similarly, the quantification of the determinants of food waste has been well-studied (e.g., Bravi et al., 2020). In comparison, few studies have focussed on ways to engage consumers to reduce their food waste. Consequently, scholars have emphasised the need to study different ways of engaging consumers in food waste reduction strategies (Russell et al., 2017; Schanes & Stagl, 2019).

Moreover, food waste reduction has been acknowledged as one of the promising avenues for addressing the problem of food waste (Visschers et al., 2016).

Third, scholars have extensively focused on recycling and reuse behaviours while largely ignoring reducing food waste behaviours (Zamri et al., 2019). Scholars have argued that reduction should be the most critical factor, while reuse and recycling should be treated as secondary factors in waste-reducing strategies (Kim et al., 2020). Specifically, the focus on waste reduction is thus one of the necessary elements in waste prevention behaviour, while reuse or recycling are not necessarily waste minimisers. Scholars have thus proposed Reduce, Reuse, Recycle, or the 3Rs in the context of food waste behaviour (Khan, Ahmed, & Najmi, 2019; Kim et al., 2020). The 3Rs measure is considered to be more holistic and comprehensive in measuring food waste reduction, reuse and recycling behaviour than traditional measures, such as intentions to waste food (Khan, Ahmed, & Najmi, 2019; Kim et al., 2020).

Fourth, prior related literature has focussed on cognitive variables like informational appeals, normative aspects, sense of community, awareness about consequences, and consumer perceptions towards food waste reduction intentions (Heidari et al., 2019). However, emphasis on the non-cognitive variables, such as emotions (Filimonau et al., 2020; Septianto, Kemper, et al., 2020), has been limited. Indeed, emotions are an influential variable in food consumption and food waste-related behaviour (Falasconi et al., 2019). Scholars have argued that food waste may induce negative emotions, such as anticipated guilt, whereby individuals who feel guiltier about food wastage are more active in reducing such waste (Richter & Bokelmann, 2018). Consequently, emotions like anticipated guilt can significantly predict consumer intentions towards engaging in food waste (Russell et al., 2017). Furthermore, prior literature examining the relationship between knowledge and food waste intentions has yielded contradictory results and requires further exploration to validate these findings (Khan, Ahmed, & Najmi, 2019). Therefore, there is a need to include emotion-related aspects alongside the key cognitive aspects to overcome these explanatory limitations and gain a comprehensive understanding of intentions to reduce food waste.

Fifth, human behaviour is complex and difficult to predict accurately (Khan, Ahmed, & Najmi, 2019). Scholars have suggested that multiple unknown reasons can instigate food waste, highlighting the need for appropriate theoretical frameworks to uncover these reasons behind such complex human behaviour (Bravi et al., 2020; Heidari et al., 2019). The theory of planned behaviour (TPB) is a widely used theoretical lens for analysing behavioural intentions in the context of food waste (Russell et al., 2017; Yuriev et al., 2020). However, recent studies have noted that TPB, which adopts a cognitive approach to explore human behaviours (Ajzen, 2001), offers a lower explanatory power in the food waste context, mainly due to the interdisciplinary nature of such a topic (Heidari et al., 2019; Yuriev et al., 2020). Furthermore, TPB does not offer support in explaining the emotions related to food waste, as suggested by the recent literature (Filimonau et al., 2020; Russell et al., 2017). Scholars have thus emphasised the need to explore other suitable theoretical approaches, such as the theory of interpersonal behaviour (TIB) (Russell et al., 2017), the comprehensive model of environmental psychology (CMEP) (Graham-Rowe et al., 2019), and social practice theory (Schanes & Stagl, 2019).

The current study aims to address the aforementioned gaps by examining the three different strategies of food waste reduction, i.e., the 3Rs (Reduce, Reuse, Recycle), using a cross-sectional survey of 515 household consumers (between 25 and 60 years of age) in the United States. The study results rely on self-reported responses and behavioural intentions rather than actual behaviours. The current study examines the role of emotions (anticipated guilt), cognitive factors (awareness about consequences and environmental knowledge), and social factors (sense of community) in driving food waste reduction intentions. Moreover, the developed research model utilises two well-known theoretical lenses, namely, the TIB and CMEP. The results of the study

validate the propositions of these two theoretical lenses and find that anticipated guilt (emotion) is a significant predictor of the 3Rs. Furthermore, social factors (sense of community) and cognitive factors, namely, awareness about consequences and environmental knowledge, also significantly predict the 3Rs.

This research study contributes to the current literature by investigating consumer waste reduction intentions at the household-level. The study findings will thus help scholars understand the role of emotions and cognition in engaging consumers in food waste reduction intentions. Policymakers, governments, and practitioners can utilise the study's results in educating the public and developing advertisements and social marketing campaigns to persuade consumers to engage in pro-environmental behaviours.

2. Theoretical framework and hypotheses development

2.1. Theoretical foundations

The current study integrated two theoretical lenses, namely, TIB and CMEP, to explain the emotional, cognitive, and social factors associated with food waste reduction intentions in the household context (see Fig. 1). TIB offers a comprehensive and versatile explanation of the behavioural change (Donovan, 2011). We argue that TIB is better suited for the problem at hand than other theoretical lenses, including TPB, cognitive learning theory, and social practise theory. The main reason for this is food waste behaviour is a complex human behaviour that is difficult to predict accurately (Bravi et al., 2020; Heidari et al., 2019). Furthermore, scholars have emphasised that studying cognitive factors alone will not help in explaining the food waste reduction behaviour and that newer investigations should focus on the cognitive, social, and emotional factors related to food waste behaviour instead (Filimonau et al., 2020; Russell et al., 2017). This need is addressed by the TIB, which suggests that behaviours are complex and represent multifaceted phenomena, such as the formulation of behavioural responses (Tsauro, Luoh, & Syue, 2015). Furthermore, TIB suggests that any behavioural response is an outcome of cognitive (e.g., perceived value, ease of use, etc.), emotional (e.g., regret, guilt, etc.), and social factors (e.g., social norms, sense of community) (Ibrahim et al., 2018).

The current study thus considers the role of emotional (i.e., anticipated guilt) (Russell et al., 2017), cognitive (i.e., awareness about consequences and environmental knowledge), and social factors (sense of

community) in the formulation of food waste reduction intentions. The main reasons for choosing these variables are: (a) the recent literature has suggested that emotions are associated with food consumption and waste (Falasconi et al., 2019). Furthermore, food waste may induce negative emotions like anticipated guilt, whereby individuals who feel guiltier about food wastage are more active in reducing such behaviours (Richter & Bokelmann, 2018); (b) a sense of community is associated with socially responsible actions (Omoto & Packard, 2016) as it may trigger pro-environmental behaviour and convince consumers to avoid actions that have long-term consequences on future generations (Yuriev et al., 2020).

CMEP offers a holistic explanation of the determinants of individuals' environmentally relevant behaviour and is derived from theories in environmental psychology (Klößner, 2013). It provides theoretical grounding to study the mitigation of environmental problems (e.g., food wastage) (Schanes et al., 2018) and helps in explaining pro-environmental behaviour, such as food waste reduction (Graham-Rowe et al., 2019). In particular, CMEP suggests that norms, perceived behaviour control, awareness about consequences, and environmental knowledge are the drivers of pro-environmental behaviour (Klößner, 2013). The present study thus considers two main variables suggested by the comprehensive model, namely, environmental knowledge and awareness about consequences. The two main reasons behind this choice were: (a) scholars have argued that environmental knowledge enhances the explanation of behavioural intentions and consumption choices towards pro-environmental behaviours (Filimonau et al., 2020). However, the prior literature examining these associations has suggested contradictory results (Visschers et al., 2016). Thus, it requires further exploration; (b) scholars have argued that awareness about the consequences of an identified problem may evoke a moral obligation and activate a positive behaviour (Corsini et al., 2018). Consequently, it is likely that awareness about the consequences of food waste is positively associated with food waste reduction intentions.

3. Research model

We chose the integration of TIB and CMEP to overcome the drawbacks of TPB (e.g., lower explanatory power and the complex nature of food waste reduction). The developed model aims to investigate the drivers of food waste reduction intentions in the household context. The independent variables, such as emotions (i.e., anticipated guilt) and

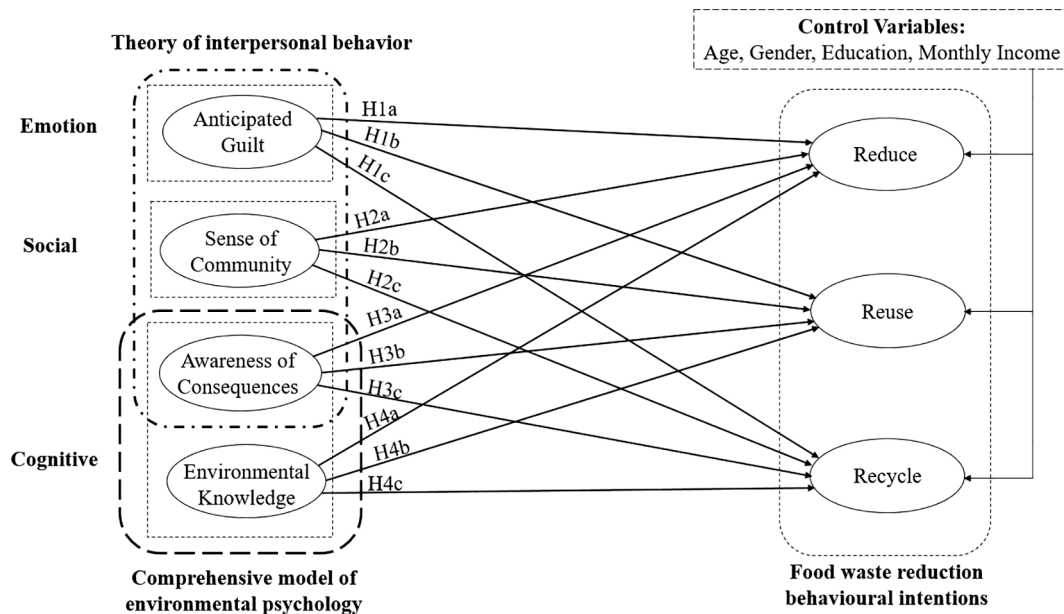


Fig. 1. The Proposed Research Model.

social factors (i.e., sense of community), are derived from TIB, while the cognitive factor (i.e., environmental knowledge) is derived from CMEP. In comparison, awareness about consequences is a cognitive factor that is derived from both TIB and CMEP. The dependent variables are the 3Rs (Reduce, Reuse, and Recycle). The definitions of the study measures are presented in Table 1.

3.1. Emotions related factor and the 3Rs

Scholars have argued that emotions can provide a deeper understanding of the various facets of food waste behaviour (Russell et al., 2017). Negative emotions like guilt and regret were observed to be significant predictors of behavioural intentions (Soscia et al., 2019). Furthermore, Richard et al. (1996) established that within the limits of Ajzen's TPB framework, anticipated guilt independently forecasted behavioural intentions regardless of the attitudes (evaluations) behind that behaviour. Scholars have similarly suggested that negative emotions, such as anticipated guilt (Russell et al., 2017; Stefan et al., 2013) and anxiety (Graham-Rowe et al., 2014), play an influential role in food

Table 1
Definitions of study measures.

Study Measure	Variable Specification	Definition	References
Reduce	Dependent variables	Reduce refers to the minimisation of food waste by obtaining more information on the environmental, economic, and social impacts caused by food waste.	Heidari et al. (2019)
Reuse		Reuse is a food waste reduction practice that involves transforming leftover food to mitigate its hazardous effects on landfills and the environment.	Stancu et al. (2016); Khan et al. (2019)
Recycle		Recycle food waste involves practising and promoting activities related to recycling household food waste, such as animal feed and fertiliser production.	Han et al. (2019); Heidari et al. (2019)
Emotion	Independent variables	Emotions are the representation of individual feelings as well as the interpretations of the individual's physical and social surroundings.	Achar et al. (2016)
Anticipated Guilt		Anticipated guilt conceptualises guilt as a constituent of moral attitudes and documents that the consumer feels guilty for wasteful behaviours.	Stefan et al. (2013)
Sense of community		Sense of community is considered a socially-based perceptible measure to exhibit socially responsible actions.	Omoto & Packard (2016)
Awareness about consequence		Awareness about consequences refers to one's awareness of the potential consequences of one's action.	Khan, Ahmed, & Najmi (2019)
Environmental Knowledge		Environmental knowledge is defined as the ability to understand different issues and terminologies related to the environment.	Tong et al. (2020)

consumption and wastage (Septianto, Tjiptono et al., 2020).

Guilt is a more relevant negative emotion than fear, anger, and hate in the context of food behaviours (Ruddock & Hardman, 2018). Anticipated guilt has been acknowledged as one of the most important pro-social emotions for the development of the affective-cognitive-action patterns of social norms by motivating individuals to rectify the caused damage (Soorani & Ahmadvand, 2019). Anticipated guilt is a common negative feeling experienced by an individual and involves an immediate punishment through inner feelings of unpleasantness to avoid wasteful behaviour (Lefebvre et al., 2019). This anticipation of guilt increases the individual's learning and ultimately results in behavioural change (Soorani & Ahmadvand, 2019). Scholars have observed that guilt motivates individuals to engage in behaviours that mitigate the effect of perceived violations (Allard & White, 2015). Applied in the context of food waste, the consumer feel guilt for wasteful behaviour, which motivates them to amend/change their behaviour towards food waste (Evans, 2012). Therefore, anticipated guilt serves as an inner inhibitor that helps individuals stabilise their food waste reduction by motivating them to comply with the abstract norms and standards expected by others (Soorani & Ahmadvand, 2019). Consumers who do not have a feeling of guilt for wasteful behaviours are thus more likely to waste food. In the hospitality sector, it was found that the consumer feels guilty about the food wasted as it is both a waste of money as well as harmful to the environment (Goh & Jie, 2019). Restaurant operators and management organisations were similarly shown the anticipation of guilt towards food waste (Grandhi & Singh, 2016). The anticipation of guilt evokes consumers to reduce their food waste to balance out their negative feelings. Moreover, anticipated guilt is significantly associated with the waste reduction behaviour of young travellers (Han et al., 2018). Based on the above-mentioned literature, it can be anticipated that:

H1a. Anticipated guilt is associated with increased intentions towards reducing food waste.

H1b. Anticipated guilt is associated with increased intentions towards reusing food leftovers

H1c. Anticipated guilt is associated with increased intentions towards recycling food waste.

3.2. Social factor and the 3Rs

The pride felt in being a group member and the symbols, values, and fate shared either explicitly or implicitly is known as group identification (Van Stekelenburg & Klandermans, 2017). Identification with a social group causes individuals to feel, think and behave in alignment with group norms and to act according to group goals by bringing their self-perception and behaviours in line accordingly (Hogg et al., 1995). There is enormous empirical support in the literature that collective action participation is strongly predicted by identification with a group (Schanes & Stagl, 2019). Instead of working for one's goals and aspirations, most individuals have shown a common interest and reflected a high identification with a group (Van Stekelenburg & Klandermans, 2017). Although there is diversity among food savers, as individuals may belong from different social categories and diverse backgrounds, consumers may have strong connections and ties with each other based on shared goals and moral standards.

Schanes et al. (2018) found a sense of community to be one of the overreaching categories that motivate individuals to share food with others to prevent food from being wasted. Indeed, the most effective way to trigger pro-environmental behaviour was observed to be arousing a deeper sense of community and convincing consumers that their actions have long-term consequences on future generations (Schanes et al., 2018). It can thus be argued that the sense of community increased individuals' participation in socially responsible actions, such as food reduction behaviours. Yuriev et al. (2020) similarly found that a sense of community is associated with pro-environmental behaviours, while other studies have shown that the relationship of community members

appears to be associated with consumers' engagement in waste management, such as recycling (Xu et al., 2016). Based on our extensive literature review, we propose that:

H2a: Sense of community is associated with increased intentions towards reducing food waste

H2b: Sense of community is associated with increased intentions towards reusing food leftovers

H2c: Sense of community is associated with increased intentions towards recycling food waste

3.3. Cognitive factors and the 3Rs

Cognitive factors represent the characteristics of an individual that may influence learning and performance (Roy, 2013). These factors comprise attention, memory, and reasoning, which may serve as performance modulators by causing the performance to improve or decline (Danili & Reid, 2006). Using the cognitive approach, TPB (Ajzen, 1991) has postulated that behaviours are controlled by cognitive factors like beliefs, attitudes, and intentions (Sommer, 2011). In the context of food waste research, scholars have found some additional influential cognitive factors, such as saving money, concerns over health risk (Barone et al., 2019), marketing addiction (Heidari et al., 2019), sense of community (Schanes & Stagl, 2019) and environmental knowledge (Filimonau et al., 2020). In the present study, two different cognitive factors, namely, awareness about consequences and environmental knowledge, are considered.

Awareness about the consequences of an identified problem activates a personal moral obligation and subsequent positive behaviour (Corsini et al., 2018). However, awareness about consequences has yielded contradictory results in the context of pro-environmental behaviours (Kim, Njite, & Hancer, 2013) and requires validation for its generalisability in the food context (Corsini et al., 2018). In comparison, environmental knowledge enhances the explanation of behavioural intentions through the description of consumer awareness about the possible implications of their choices (Filimonau et al., 2020).

3.3.1. Awareness about consequences

The altruistic model for studying behaviours assumes that one must be aware of their consequences as well (Schwartz, 1977). The behaviours exhibited and their consequent outcomes are essential for investigating consumer intentions. Individuals tend to develop and maintain positive attitudes towards these behaviours, which may yield positive results or consequences. Moreover, the awareness about consequences was found to be positively associated with behavioural intentions, such as return intentions (Khan, Ahmed, & Najmi, 2019; Kochan et al., 2016). While other scholars have established an indirect effect on recycling intentions (Corsini et al., 2018; Park & Ha, 2014), Tonglet et al. (2004) found a negative relationship between awareness about consequences and pro-environmental behavior. These contradictory results provide a basis for considering awareness of consequences as a predictor of food waste reduction intentions. The literature has found that food waste can be minimised by raising awareness about its consequences (Di Talia et al., 2019). Furthermore, Von Kameke and Fischer (2018) claimed that campaigns seeking to increase awareness could enhance consumers' sensitivity towards food waste and encourage them to improve their food management practices. Empirical evidence has also supported that consumers with greater awareness about food security and the environmental and economic consequences of food waste will exhibit food waste reduction behaviours (Bravi et al., 2019). Based on the extensive literature review, it can be hypothesised that:

H3a. Awareness about consequences is associated with increased intentions towards reducing food waste.

H3b. Awareness about consequences is associated with increased intentions towards the reuse of food leftovers

H3c. Awareness about consequences is associated with increased intentions towards recycling food waste.

3.3.2. Environmental knowledge

Ecological knowledge has been associated with pro-environmental attitudes and behavioural intentions (e.g., Eilam & Trop, 2012), serving as a direct influencer to pro-environmental behavioural intention and an indirect influencer as well via attitude as a mediator. Environmental concerns and awareness-related attitudes of people may be enhanced through increased knowledge (Scott & Vigar-Ellis, 2014). Conversely, not knowing about the environment may hamper pro-environmental behaviour, thereby increasing the chances of making wrong or inefficient decisions. Environmental knowledge has not only affected environmentally responsible behaviours but has also been found to affect intentions to act responsibly (Liao & Li, 2019). Kaiser and Fuhrer (2003) empirically proved a positive association between environmental knowledge and behavioural intentions by considering both general knowledge as well as techniques increasing the likelihood of solving ecological issues. Vicente-Molina et al. (2013), meanwhile, found environmental knowledge to be a significant predictor of pro-environmental intentions and behaviours. Moreover, Visschers et al. (2016) stated that knowledge about environmental consequences was associated with individuals' intentions to reduce waste. Scholars have also observed that food loss typically occurs due to insufficient knowledge or poor management of production and transportation conditions (Schmidt, 2016). Furthermore, household consumers are in search of information about the social, economic and environmental consequences and their associations with recycling and waste to counteract their food waste behaviours (Richter, 2017). Similarly, the acquired knowledge regarding expired domestic food is associated with consumption behaviour (Farr-Wharton et al., 2014). Based on the extensive literature, it can be anticipated that:

H4a. Environmental knowledge is associated with increased intentions towards reducing food waste.

H4b. Environmental knowledge is associated with increased intentions towards reusing food leftovers

H4c. Environmental knowledge is associated with increased intentions towards recycling food waste.

3.4. Control variables

The study uses the age, gender, education, and monthly income of the study participants as control variables. The existing literature has suggested that these demographic factors are associated with food waste reduction intentions (Heidari et al., 2019). Specifically, younger consumers were more willing to develop favourable evaluations for food waste reduction (Heidari et al., 2019). It was also found that more educated individuals are more likely to exert pro-environmental behaviours at home (Filimonau et al., 2020). The amount of food wasted was significantly associated with household income, as a household with increasing income is likely to waste less food (Ammann et al., 2021). Contrary to this, some studies found an adverse association between income and food waste (Li et al., 2021; Szabó-Bódi et al., 2018; Zhang et al., 2018). Thus, in line with previous studies, we investigate the 3Rs through the proposed hypotheses by keeping age, gender education, and a monthly income as control variables.

4. Method and data

This section provides the details of the measurement scales, research context, data collection, study sample, and the method of data analysis.

4.1. Measurement scale

We used a structured survey to collect data from the target respondents. All of the study constructs were adapted and conceptualised on the basis of well-established scales.

The first part of the survey was structured to measure the respondents' demographic profile, while the second part measured the

constructs included in the study. Measurement items for the constructs were based on measurement scales adopted from different sources and utilised a five-point Likert scale ranging from one (strongly disagree) to five (strongly agree) to record the responses. The developed survey instrument was reviewed for its face validity by a team of experts (three researchers and one practitioner) with experience in food waste research (Sultan et al., 2020). The measurement items were then revised for better clarity based on the experts' feedback.

5. Research context

Generating 40 million tons of food waste annually, the U.S. contributes 22% of the municipal solid waste (Yu & Jaenicke, 2020). Household food waste, the final consumption stage of the food supply chain, is the largest source of food waste in the U.S. (Bellemare et al., 2017). Thus, U.S. households may offer valuable findings in the context of food waste reduction. Consequently, this study has focussed on household consumers based in the United States.

5.1. Data collection

An online survey was utilised in a cross-sectional survey design to collect the data. We asked Prolific to select participants living in the U.S. between the ages of 25 to 60 years old. The respondents were requested to voluntarily participate in the research. They were also addressed about confidentiality and the anonymity of their information before providing responses.

5.2. Study sample

The returned survey responses were cross-checked to eliminate incomplete responses, yielding a total of 515 valid responses (completely filled, no missing data) in the final analysis (see Table 2). Approximately 77.7% of the sample median income was less than the median income of households in the general population (\$68,703 per annum or \$5,725 per month) (Semega et al., 2020). We considered different criteria for the sample size selection, e.g., at least five responses per item estimate as well as utilising a sample size of 300 or more for covariance-based structural equation modelling (CB-SEM analysis). The total number of measurement items was 35. Based on the five cases per parameter estimate, 175 responses were deemed sufficient. However, as suggested by the methodological literature, a larger sample is preferable to overcome sampling errors (Wolf et al., 2013).

Table 2
Sample Characteristics (N = 515).

Demographic	Category	Percentage (Frequency)
Gender	Male	47.8 (246)
	Female	52.2 (269)
Age (In years)	24 years or less	0.2 (1)
	25–34 years	55.5 (286)
	35–44 years	27.2 (140)
	45–54 years	12.8 (66)
	55 years or more	4.3 (22)
Education	High School	24.3 (125)
	Professional degree/vocational school	7.0 (36)
	Bachelors	45 (232)
	Masters	18.8 (97)
Monthly Income	Doctorate	4.9 (25)
	<2000 USD	31.5 (162)
	2000–3999 USD	29.7 (153)
	4000 – 5999 USD	16.5 (85)
	6000–7999 USD	7.6 (39)
	8000–9999 USD	4.7 (24)
	10,000 & more USD	10.1 (52)

Note. USD = United States dollars.

5.3. Method of data analysis

Data analysis was conducted using IBM SPSS 24 and AMOS 24, which allows simultaneous estimations of the measurement and structural models. Data were tested to identify the issues of missing values, outliers, and normality before conducting further analyses. CB-SEM was confirmed as a suitable data analysis method since the collected data met the sample size and multivariate requirements of normality (e.g., Talwar et al., 2020)

6. Analysis and results

6.1. Data normality and common method bias (CMB)

The final dataset, which contained no missing values and outliers, was treated for further analysis. Results regarding normality showed that the Skewness and Kurtosis values were within the expected range of ± 3 , indicating that there were no normality issues (Mishra et al., 2019). Variance Inflation Factor (VIF) was then estimated to assess the multicollinearity (Thompson et al., 2017). The results of VIF ranged from 1.14 to 1.80; as these were below the threshold value of 4, the model was thus free from the issue of multicollinearity (O'Brien, 2007). CMB was calculated using Harman's single-factor (Podsakoff et al., 2003). The results of Harman's single-factor showed that the single largest factor accounted for 38.92% variance, which is less than the threshold value of 50%, thereby indicating that CMB was not present in our data (Habib & Qayyum, 2017; 2018;; Podsakoff et al., 2003).

6.2. Assessment of measurement model

Confirmatory factor analysis was performed to examine the measurement model for reliability and validity (convergent and discriminant). The resulting goodness-of-fit indices, $\chi^2 = 605.57$, $df = 254$; $CFI = 0.96$; $TLI = 0.95$; $RMSEA = 0.05$, were in concordance with the recommended threshold values (Hair et al., 2010; Tabachnick & Fidell, 2007). Study measures, measurement items, and factor loadings are presented in Table 3. Furthermore, the factor loading for each item was greater than 0.60 (see Table 4), which is well above the recommended value of 0.40 (Hair et al., 2010) and satisfies the requirement of unidimensionality (Awang, 2012). The Cronbach's alpha and composite reliability values of all measurement scales were greater than 0.70, thereby supporting the reliability of the measurement scales (see Table 4). The Average Variance Extracted (AVE) values for each measurement scale were greater than 0.50, which thus established the convergent validity of the measurement scales (see Table 4) (Hair Jr et al., 2017; Odou & Schill, 2020). The discriminant validity was established by estimating Fornell and Larcker's criterion. The results revealed that the square root of the average variance extracted was greater than the correlation between latent constructs (see Table 4), thus supporting discriminant validity (Aftanorhan, 2013; Hair Jr et al., 2017; Ho & Chung, 2020). The heterotrait-monotrait ratio of correlations (HTMT) analysis was also in support of discriminant validity since the correlations among the study constructs were less than the recommended threshold value of 0.85 (Henseler, Ringle, & Sarstedt, 2015) (see Table 5).

6.3. Structural model and hypotheses testing

Following the measurement analysis, we performed a structural model assessment and structural path analysis. The results for the structural model supported the goodness-of-fit indices, as $\chi^2 = 931.95$, $df = 365$, $CFI = 0.94$, $TLI = 0.92$; $RMSEA = 0.05$ were in concordance with the recommended threshold values. The results of the path analysis indicated a significant association between anticipated guilt and reduce (H1a: $\beta = 0.30$, $p < 0.001$), reuse (H1b: $\beta = 0.32$, $p < 0.001$) and recycle (H1c: $\beta = 0.19$, $p < 0.01$). Findings also confirmed the association

Table 3
Factor loading of measurement items.

Measures	Measurement items	CFA	SEM
Anticipated Guilt (ANG) (Soorani & Ahmadvand, 2019)	ANG1: I feel guilty when I waste household food as it has an adverse effect on the environment	0.90	0.90
	ANG2: I feel guilty when I waste household food as it has severe negative implications for the economy	0.64	0.64
	ANG3: I feel guilty when I waste household food as it has severe negative implications for society	0.76	0.76
	ANG4: I feel ashamed when I waste household food as it has a negative impact on our environment	0.90	0.89
Sense of Community (SOC) (Dixon et al., 2015)	SOC1: I feel a sense of community with the people from my workplace or school/college	0.70	0.70
	SOC2: I feel a sense of community with the people that live in my state	0.84	0.84
	SOC3: I feel a sense of community with the people that live in my suburb/neighbourhood	0.83	0.83
	SOC4: I feel a sense of community with the people that live in my city	0.90	0.90
	SOC5: I feel a sense of community with the people that live in my country	0.74	0.74
Awareness of Consequences (AOC) (Khan, Ahmed, & Najmi, 2019)	AOC1: I consider household food waste reduction to be a major way to reduce pollution	0.79	0.80
	AOC2: I believe that household food waste reduction creates a better environment for future generations	0.84	0.82
	AOC3: I believe that household food waste reduction is a major way to reduce wasteful use of landfills	0.77	0.78
	AOC4: I consider household food waste reduction to be a major way to conserve natural resources	0.79	0.79
Environmental Knowledge (ENK) (Filimonau et al., 2020)	ENK1: I possess knowledge regarding the purchase of environmental products	0.86	0.86
	ENK2: I possess knowledge of recycling food waste	0.75	0.75
	ENK3: I possess knowledge on the purchase of waste-reducing packaging	0.77	0.77
	ENK4: I possess knowledge regarding environmental symbols/labels literacy	0.79	0.80
	ENK5: I possess knowledge of different environmental issues	0.82	0.82
Reduce (RED) (Heidari et al., 2019)	RED1: I plan to reduce household food waste by obtaining more information on the environmental, economic, and social impacts caused by food waste	0.84	0.86
	RED2: In the near future, I plan to prevent people from losing their food by reducing household food waste	0.77	0.76
Reuse (REU) (Khan et al., 2019)	REU1: I reuse leftover household food because it can significantly benefit the environment	0.86	0.88
	REU2: I try to reuse household leftover food for other purposes because throwing it away significantly contributes to the landfill problem	0.86	0.84
Recycle (REC) (Han et al., 2019; Heidari et al., 2019)	REC1: I plan to take part in activities related to recycling household food waste	0.84	0.85

Table 3 (continued)

Measures	Measurement items	CFA	SEM
	REC2: I plan to recycle household food waste instead of throwing food waste away to reduce landfill problems	0.82	0.82
	REC3: I plan to promote recycling of household food waste to my friends, family, and peers	0.84	0.83

Note. CFA = Confirmatory factor analysis, SEM = Structural equation modelling.

between a sense of community and reduce (H2a: $\beta = 0.19, p < 0.001$) and recycle (H2c: $\beta = 0.08, p < 0.05$). However, the results did not support the association between sense of community and reuse (H2b: $\beta = -0.00, p$ greater than 0.05). Moreover, the results indicated a positive association between awareness about consequences and reduce (H3a: $\beta = 0.34, p < 0.001$), reuse (H3b: $\beta = 0.35, p < 0.001$) and recycle (H3c: $\beta = 0.32, p < 0.001$), as well as the positive association of environmental knowledge and reduce (H4a: $\beta = 0.20, p < 0.001$), reuse (H4b: $\beta = 0.22, p < 0.001$) and recycle (H4c: $\beta = 0.36, p < 0.001$), as well. In sum, all of the hypotheses were supported except for H2b. The results supported the significant controlling influence of only age on reduce ($\beta = -0.14, p < 0.001$). In comparison to this, other control variables did not exert any significant controlling influence on the three dependent variables. Finally, the results showed that the variance explained by the structural model was 65% for reduce, 56% for reuse, and 58% for recycling. Table 6 and Fig. 2 present the findings.

7. Discussion

The study findings suggest a positive association between anticipated guilt and the 3R intentions, thereby supporting H1a, H1b, and H1c. These results validate the existing research, which has similarly suggested that anticipated guilt is significantly associated with household food waste reduction intentions (Graham-Rowe, Jessop, & Sparks, 2015; Kim et al., 2013). These findings suggest that: (a) the mechanism behind the formation of behavioural intentions is complex, and anticipated emotions provide the impetus for the formation of behavioural intentions (Russell et al., 2017; Yuriev et al., 2020). For example, the prior literature has suggested that emotions play a significant role in the decision-making process of consumers (Kim et al., 2013); (b) anticipated guilt enforces consumers to act in an ethically and socially responsible way and motivates them to reduce food wastage. Accordingly, consumers feel guilty if they do not contribute to the prevention of food waste. It is also a common practice to prepare excessive food in the household to avoid the embarrassment of running out of food on the dinner table. However, people anticipate guilt when they do not finish the served food. These anticipations of guilt motivate them to engage in reusing and recycling wasted food. In a nutshell, consumers anticipate that wasteful behaviours violate their moral standards or internalised personal norms, which lead to feelings of unpleasantness and guilt and, in turn, motivate consumers to overcome wasteful behaviour.

The study results also supported H2a and H2c, suggesting that the sense of community is positively associated with reducing and recycling intentions. These findings are consistent with Dixon et al. (2015) and Schanes and Stagl (2019) and indicate that the feeling of affiliation with society stimulates consumers to consider societal norms actively and respect the opinions of others (Yuriev et al., 2020). For instance, a consumer with a higher sense of community will be actively involved in reducing the harmful social effects of food waste. The existing literature has further suggested that consumers not only experience a feeling of membership and belongingness with their group and community but also feel responsible for complying with the social standards and norms established within them (Schanes & Stagl, 2019). It can thus be concluded that consumers reduce and recycle their wasted food to

Table 4
Convergent and discriminant validity.

	Mean	SD	A	CR	AVE	MSV	ASV	REU	ANG	AOC	SOC	ENK	RED	REC
REU	3.48	1.02	0.85	0.85	0.73	0.56	0.34	0.86						
ANG	3.87	0.92	0.87	0.88	0.65	0.59	0.36	0.67	0.81					
AOC	3.14	0.99	0.87	0.88	0.64	0.59	0.34	0.65	0.77	0.80				
SOC	3.49	0.91	0.90	0.90	0.65	0.14	0.09	0.23	0.22	0.23	0.81			
ENK	3.28	1.10	0.89	0.90	0.64	0.34	0.21	0.48	0.44	0.39	0.34	0.80		
RED	3.42	1.17	0.79	0.79	0.65	0.65	0.39	0.56	0.70	0.68	0.38	0.51	0.81	
REC	3.22	1.16	0.77	0.87	0.70	0.65	0.40	0.75	0.61	0.60	0.32	0.58	0.80	0.83

Note: REU = Reuse, ANG = Anticipated guilt, AOC = Awareness of consequences, SOC = Sense of community, ENK = Environmental knowledge, RED = Reduce, REC = Recycle, SD = Standard deviation, α = Cronbach's alpha, Composite reliability = CR, Average variance extracted = AVE, Maximum shared variance = MSV, Average shared variance = ASV.

Table 5
HTMT Analysis.

	ANG	AOC	SOC	ENK	RED	REC	REU
ANG							
AOC	0.76						
SOC	0.27	0.23					
ENK	0.43	0.38	0.35				
RED	0.75	0.68	0.38	0.51			
REC	0.62	0.60	0.32	0.59	0.81		
REU	0.69	0.66	0.24	0.48	0.56	0.75	

Note: ANG = Anticipated guilt, AOC = Awareness of consequences, SOC = Sense of community, ENK = Environmental knowledge, RED = Reduce, REC = Recycle, REU = Reuse.

contribute to the betterment of society. In comparison, the study findings did not support H2b, meaning that no significant association was found between a sense of community and reuse intentions. This unusual finding cannot be explained as there is no *a priori* basis for this in the prior literature. Therefore, we recommend that scholars conduct qualitative studies to better understand the reasoning behind the non-significant associations between these two variables. However, another possibility could be that REU items did not include any words directly referring to a social group or community. Therefore a possible explanation is that the questionnaire may have biased the data towards these results.

The study results also supported H3a, H3b, and H3c, in line with the altruistic behaviour model. The awareness of consequences was

confirmed to be a contributing factor towards food waste reduction behaviour. The study results are thus consistent with the prior literature (Kochan et al., 2016) and establish that the household consumers who declare higher food waste reduction intentions are aware of the negative consequences of household food waste and engage in food waste reduction behaviour accordingly. Furthermore, they believe that household food waste reduction is a major way to reduce pollution and landfills and is important for conserving natural resources and creating a better environment for future generations.

The study findings suggest that consumers with a higher level of environmental knowledge are likely to engage in food waste reduction behaviour as well, thus supporting H4a, H4b, and H4c. These results validate the existing research, which suggests that consumers with better environmental knowledge are likely to engage in food wastage reduction practices (Filimonau et al., 2020; Zamri et al., 2019). The results regarding control variables showed that age also has a significant controlling influence (negative) on the reduce intentions. Our finding is consistent with the observation of Heidari et al. (2019) that younger consumers are more likely to engage in food waste reduction compared to older counterparts. In comparison to this, the significant confounding influence of other control variables was not found, which is contradictory to the observations of prior literature (e.g., Filimonau et al., 2020; Ammann et al., 2020). The study findings thus confirmed that environmental knowledge regarding the purchase of environmental products and waste-reducing packaging, recycling of food waste, environmental symbols/labels literacy, and other environmental issues are more likely to engage in the 3Rs with respect to food waste.

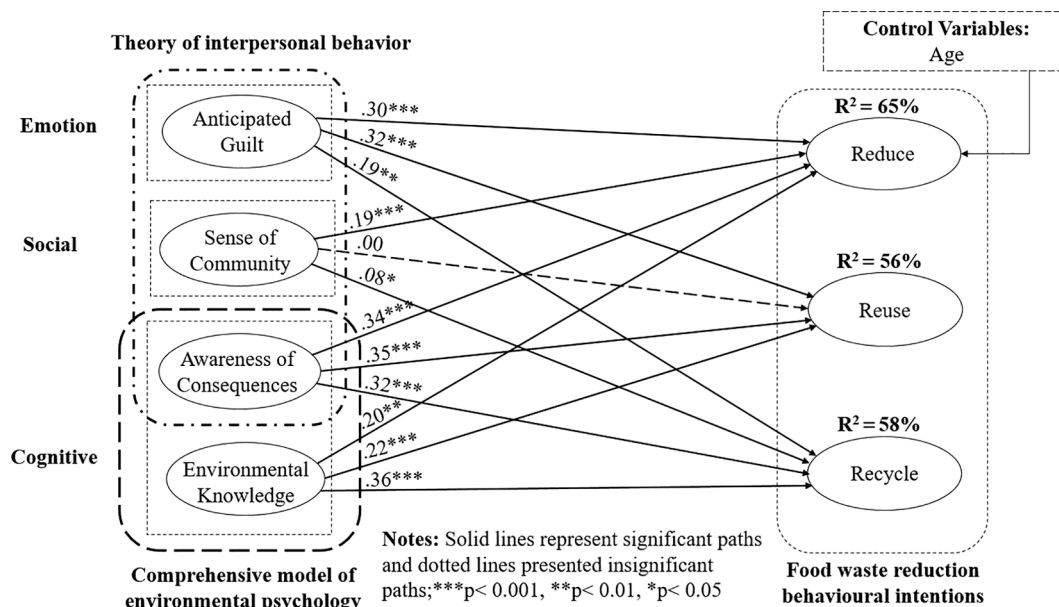


Fig. 2. Results of the Structural Model.

8. Study implications

8.1. Theoretical implications

This study addresses the significant conceptual, theoretical, and methodological gaps in the prior literature on household food waste and consumer behaviour. The key theoretical implications of this study are: first, the prior literature has been dominated by qualitative studies with smaller sample sizes, while limited quantitative investigations have been conducted in the context of household food waste (Graham-Rowe et al., 2014; Barone et al., 2019). In addition, most of the prior investigations have focussed on quantifying the generated food waste instead of examining the drivers of food waste reduction behaviour (Russell et al., 2017; Schanes & Stagl, 2019). The current study addresses both of these gaps in the prior literature on household food waste.

Second, most of the prior studies have focussed on two aspects of food waste reduction behaviour, namely, reuse and recycle. In comparison, limited studies have examined reduce intentions with respect to household food waste (Zamri et al., 2019; Kim et al., 2020). Subsequently, the current study has considered all three types of food waste reduction behaviour by utilising the 3Rs as the dependent variables.

Third, the present study extends the theoretical foundations of the prior research regarding the drivers of food waste reduction behaviour. This was necessary since most of the prior studies have focussed exclusively on a single theoretical framework (i.e., TPB), which may not be appropriate for accurately predicting complex human behaviour (Khan, Ahmed, & Najmi, 2019; Bravi et al., 2020; Heidari et al., 2019).

Fourth, this study theoretically contributes to the prior extended literature by examining the influential role of emotions (anticipated guilt) in predicting food waste reduction behaviour. The inclusion of anticipated guilt in the model, along with cognitive aspects, comprehensively explains consumer food waste reduction behaviour, thereby addressing the potential limitations regarding the explanatory power of TPB in this context (Khan, Ahmed, & Najmi, 2019).

8.2. Practical implications

These study results significantly contribute to the UNs' Sustainable Development Goals (SDGs) that are part of the UNs' 2030 agenda and plan of action for sustainable development, which includes food security and improved nutrition (Chakrabarty & Das, 2020). The study findings thus provide various implications for practitioners and policymakers.

First, the findings establish that anticipated guilt arising from unnecessary food waste may cause consumers to develop a stronger sense of inherent wrongness. Thus, the inclusion of guilt becomes more productive, specifically in the case of socially prescribed behaviours, such as food waste reduction. Due to this, both policymakers and practitioners should highlight the anticipated guilt associated with food waste in educational programs as well as advertising strategies to motivate consumers to actively engage in food waste reduction initiatives.

Second, awareness about consequences encourages consumers to re-evaluate their food consumption patterns and their possible impact on society, the environment, and the economy. Various media and awareness campaigns should link the negative outcomes or consequences of wasteful behaviours to alarm consumers regarding the harmful impact of food consumption patterns. Furthermore, building a sense of association with community members also encourages consumers to contribute to food waste reduction. Opinion leaders may thus serve as strong influencers to encourage household consumers to engage in better food management. Social media platforms, such as Facebook, Instagram, and YouTube, can also be utilised to promote these opinion leaders and other influencers in encouraging food waste reduction behaviours.

Third, the results highlight the importance of educating household consumers about general environmental issues as well as specific

environmental challenges caused by food waste behaviours. This can be achieved by designing a comprehensive public awareness campaign and social marketing practices. Awareness campaigns may help household consumers to realise the importance of environmental problems, including food waste and its adverse impact on the economy and society.

9. Conclusion

This study has examined the relatively under-explored topic of food waste reduction intentions among household consumers. A comprehensive model based on two different theoretical lenses, namely, TIB and CMEP, was developed and tested with 515 U.S. household consumers. The study examined the influential role of emotion-related factor (anticipated guilt), social (sense of community) and cognitive factors (awareness about consequences and environmental knowledge) in driving individuals' reduce, reuse, and recycle (3Rs) intentions towards household food waste. The current study significantly contributes to the body of knowledge in this area by considering the influential role of emotional, social, and cognitive factors to overcome the poor explanatory powers of the existing theoretical models, including TPB. The findings are consistent with the propositions of TIB and CEMP, suggesting that anticipated guilt, awareness about consequences, and environmental knowledge were positively associated with food waste reduction intentions (3Rs). The findings have further revealed that anticipated guilt and awareness of consequences are key measures of reuse and reduce food waste intentions, respectively. Furthermore, age has a significant controlling influence on the reduce intentions.

9.1. Limitations and future recommendations

The current study offers interesting findings and addresses key gaps in the literature. However, there are still certain limitations and research gaps that should be taken into consideration. Firstly, the study's participants were recruited only from the U.S., which makes the generalisability of the study findings to other cultures and countries unwarranted. Future research should thus consider another cultural group of household consumers dwelling in Asia, Africa, and Europe to obtain a comprehensive understanding of food waste reduction intentions. Second, this study adopted a cross-sectional design. The self-reported measures utilised in this study may, therefore, be prone to methodological biases. For example, respondents might have exaggerated their intentions towards food waste reduction, thereby affecting the quality and generalisability of the study results (Schmidt, 2016). Future research should consider actual waste reduction behaviour to increase generalisability by exploring the link between intentions and actual behaviour. Third, other relevant variables, such as financial attitudes, religion, and food expenditures, should be considered. Furthermore, psychographics, household size, family life cycle, and income may also provide some critical insights into consumer behaviour. In addition, we recommend that future studies focus on consumers that purchase food items for older parents and relatives since those in authority and respected family roles may provide novel insights into food waste behaviour.

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CRedit authorship contribution statement

Saman Attiq: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **Muhammad Danish Habib:** Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **Puneet Kaur:** Conceptualization, Formal analysis, Writing - review & editing, Project administration. **Muhammad Junaid Shahid**

Hasni: Conceptualization, Formal analysis, Writing - review & editing, Project administration. **Amandeep Dhir:** Conceptualization, Validation, Writing - review & editing, Supervision, Project administration.

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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