When lack of food waste concern curbs youths' intention to reduce it: The role of nudging as a solution

Structured Abstract

Purpose: This study proposes a model of consumer intention to reduce food waste. It uses norm activation theory, and includes lack of food waste concern as an important barrier. The effect of nudging on the model variables is also examined.

Design/methodology/approach: The study reports on results of an online questionnaire-based survey aimed at the youth segment. A total of 716 final questionnaires were obtained to test the model.

Findings: The findings show that lack of food waste concern is a trigger variable that limits food waste reduction intention. Nudging can be used to reduce food waste directly, as well as indirectly through increased ascription of responsibility and personal norms. Furthermore, nudging helps to mitigate lack of food waste concern.

Theoretical implications: Norm activation theory effectively explains young people's intentions to reduce food waste, with lack of concern as a key factor. Furthermore, social marketing and nudging strategies can foster pro-environmental and pro-social values, increasing awareness and personal responsibility.

Social implications: Consumers and institutions must raise awareness among young people about the consequences of food waste as a key factor for waste reduction. Social marketing strategies using nudges appear promising. Institutional collaboration is essential to change young consumers' habits.

Originality/value: The role played by lack of food waste concern in young consumers' food waste-related behavior is of central concern, and nudging strategies mitigate this effect.

Keywords: norm activation theory, food waste, lack of food waste concern, personal norms about food waste, intention to reduce food waste, nudging.

1. Introduction

Food waste (FW) is one of the most important problems facing society. According to the Food and Agricultural Organization (FAO), food can be lost or wasted throughout the entire food chain. Food loss occurs when food is misplaced or spoiled before it reaches the consumer, and FW occurs when food is fit to eat but is discarded by both retailers and consumers (FAO, 2023). Every year, about 950 million tons of food are discarded around the world (Castilla, 2023). This amount represents not only an environmental problem, due to the amount of greenhouse gasses that are emitted into the atmosphere (3,300 million tons of CO_2), but also an ethical problem, since this amount could feed the 1,260 million people globally who are suffering from hunger (Castilla, 2023). These figures are cause for significant social alarm because they reflect a society that does not value food and does not care about wasting it.

Studies have shown that people waste more food (Principato *et al*., 2015; Stefan *et al*., 2013; Talwar *et al*., 2022) when they are in a holiday or party mood (Gretzel *et a*l., 2020), underestimate its costs (van Geffen *et al*., 2016), or assign food low value (Parfitt *et al*., 2010). This reduced value is a consequence of the low price of food and consumers' perception of abundance, which make them not unconcerned about the economic, social, or environmental impact of FW. This aspect is known as lack of FW concern, and some authors have proposed it as a driver of FW (Le Borgne *et al*., 2021; Buzby *et al*., 2011; Pearson *et al*., 2013). However, contradictory results have been found regarding the direct effect of lack of FW concern on intention to reduce FW. While some authors have found a negative effect of lack of FW concern in FW reduction intention (Janssens *et al* 2019; Stefan *et al.*, 2013), others have questioned this relationship (Principato *et al.*, 2015). Furthermore, these articles

have only examined direct effects, with no attention to possible indirect impacts. Such indirect impacts could better explain the relationship through the intervention of variables such as awareness of the consequences of an action, ascription of responsibility, and personal norms, among others. Therefore, more research is needed to understand the importance of this variable in FW research.

Social marketing is suggested to be effective in reducing consumers' FW behavior, especially if a range of economic agents are involved, such as governments, educators, and companies (Hodgkins *et al.*, 2019; Kim *et al.*, 2019). Social campaigns can induce behavioral change in individuals by increasing the knowledge and awareness of FW and its social consequences (Hodgkins *et al.*, 2019; Sutinen, 2022). Social marketing researchers have recently considered nudging as a tool that institutions can use to change consumers' behavior and prompt them to behave in responsible ways (Ong *et al*., 2023). Most previous research has suggested that nudges help to increase awareness of the consequences of environmental problems. Wensing *et al*. (2020) suggested that nudges develop social norms and influence beliefs. Furthermore, nudging can contribute to the reduction of household waste (Zhang and Wang, 2020; Kallbekken and Sælen, 2013). Although nudging is a recognized approach to gently guiding consumer behavior in a certain direction, there is little experience of its application in FW reduction (Giaccherini *et al*., 2021; Ong *et al*., 2023; von Kameke and Fisher, 2018). Thus, the present study aims to clarify how nudging increases consumer intention to reduce FW.

Norm activation theory (NAT; Schwartz, 1977) presents a useful model for measuring individuals' behavioral intention regarding FW reduction (Iriyadi *et al*., 2023; Obuobi *et al*., 2024; Filimonau *et al*., 2023). NAT establishes that an individual's personal norms are determined by their awareness of the (negative) consequences that an action may entail, and their assumption of responsibility for those consequences (Schwartz, 1977). When

individuals see the amount of FW generated they feel morally obligated to avoid it, triggering an intention to reduce it (Filimonau *et al*., 2023). Expanding on previous research, NAT is extended in this study by adding lack of FW concern as a determining factor that, directly and indirectly, prevents the individual from having the intention to reduce FW (Obuobi *et al*., 2024), and exploring the effect of nudging on each of the variables in the model. Ong *et al*. (2023) recently showed that positive reinforcement can help reduce FW behavior. However, they did not show the effects of nudges on consumers' awareness of consequences, lack of FW concern, and personal norms. Consequently, the objectives of this study are

1. to investigate, using NAT, the direct and indirect effect of consumers' lack of FW concern on their intention to reduce FW and;
2. to examine the role of nudging in the different variables of the chain proposed by NAT applied to the reduction of FW.

Fulfilling these objectives will provide insights that highlight, to both consumers and public and private institutions, the need to raise awareness among young people about the relevance of food and the consequences of its waste as a key factor to increase their intention to reduce such waste. To this end, the design of nudging strategies is fundamental, as is social marketing through which these strategies are implemented to provoke behavioral change in individuals. Against this backdrop, the present study contributes to FW research in several areas: First, it provides evidence of the role of lack of FW concern in consumer behavior; although recent articles have applied the NAT approach in this context (Iriyadi *et al*., 2023, Obuobi *et al*., 2024; Filimonau *et al*., 2023, Wang *et al*., 2022; Kim *et al*., 2022), such studies have considered neither lack of FW concern as the root cause of the FW problem, nor the effect of nudges on the variables of the chain proposed by this theory. Second, this study expands the debate on the effect of lack of FW concern on pro-environmental and pro-social behavior. Third, we elucidate the factors that influence consumer intention toward reducing

waste, which can enlighten specific interventions to promote responsible consumption habits to curb FW. These new contributions to sustainable marketing literature are made by providing evidence of how nudging strategies can directly and indirectly influence intention to reduce FW. In this context, nudging, as a behavioral intervention, helps to guide consumers toward more conscious decisions and fosters a culture of FW reduction. Fourth, this study provides valuable insights to researchers and institutions regarding the development of effective strategies to deal with the social and environmental problem of FW.

2. Theoretical background and hypothesis development

2.1 NAT in the FW context

NAT is a theoretical approach that allows researchers to predict an individual's behavioral intention (Schwartz, 1977) in both social and environmental contexts. Here, environmental behavior can be seen as a subset of social behavior because positive environmental actions favor social well-being in the long term (Iriyadi *et al*., 2023). NAT was developed to analyze how a behavioral intention is explained by the individual's moral obligation to behave in a responsible way (Schwartz, 1977), making it relevant to this study. Personal norms explain the intention underlying a certain behavior, which in turn is determined by two other factors: awareness of consequences and ascription of responsibility. In the context of FW, the greater individuals' awareness of the negative repercussions of FW, the more responsibility they will feel for the negative consequences of such actions and the greater their moral obligation – and hence intention – to reduce FW will be (Filimonau *et al*., 2023; Kim *et al*., 2022).

NAT has been widely utilized within this field. For example, recent papers have considered the relationships between NAT factors sequentially (Filemonau *et al*., 2023; Wang *et al*., 2021), while others have treated the variables awareness of consequences and ascription of responsibility as moderators rather than mediators (Iriyadi *et al*., 2023; Obuobi *et al*., 2024; Wang *et al*., 2022; Kim *et al*., 2022; T'ing *et al*., 2021). The present study

follows the sequential version of NAT due to its higher predictive capacity (Filimonau *et al*., 2023), and adds two new factors within these sequential relationships – lack of FW concern and nudging – in order to further increase its explanatory power.

2.2 Lack of FW concern, and awareness of FW consequences

Lack of FW concern refers to the minimal or absent value that consumers assign to food, waste of food, and the consequences of wasting food. Individuals who are unaware of, or do not care about, the negative consequences of FW are likely to show no intention to reduce FW. This represents one of the main barriers to reducing FW (Obuobi *et al*., 2024; Graham-Rowe *et al*., 2014; Principato *et al*., 2015; Sirieix *et al*., 2017; Stefan *et al*., 2013, Buzby *et al*., 2011).

Principato et al. (2015) analyzed the level of concern about FW-related issues in young people, and observed that the more concerned youths were about this problem, the greater their awareness of the economic, environmental, and social consequences of FW. Thus, it is expected that the higher (lower) a consumer's lack of FW concern is, the lower (higher) their awareness of FW consequences (i.e., knowledge or perception of the economic, social, and environmental costs of FW) will be.

Therefore, the first hypothesis of this study focuses on this new relationship:

H1: There is a negative relationship between lack of FW concern and awareness of FW consequences.

2.3 Lack of FW concern and intention to reduce FW

NAT proposes that behavioral intention is only influenced by personal norms, which is the last term of the causal chain. However, the present study also analyzes the direct effect of lack of FW concern on the intention to reduce FW. In FW research, mixed results have been found regarding this relationship. For instance, Stefan *et al*. (2013) observed that consumers' lack of FW concern determines their intention not to waste. Principato *et al*. (2015)

questioned the expected relationship between individual concern toward FW and its reduction, mainly in the context of youths' concerns about food freshness. Janssens *et al.* (2019) found a significant and negative relationship between concern about FW and intention not to waste, but no significant impact between concern and FW-related behavior. Graham-Rowe *et al*. (2014) identified FW concern as a primary motivator to minimize such waste, mainly due to the economic and financial consequences thereof. More recently, Obuobi *et al.* (2024) concluded that lack of FW concern negatively influences individuals' FW reduction intentions. Therefore, we propose:

H2a: There is a negative and direct relationship between lack of FW concern and intention to reduce FW.

Although NAT proposes only direct effects among the variables, creating a chain of effects, the literature also recommends analyzing indirect effects in the causal chain regarding final consumer behavior (Yildirim and Semiz, 2019). Some studies have shown that the variables of NAT can exert an indirect effect on behavioral intention, mediated by the chain of variables involved in this theory. For example, Yildirim and Semiz (2019) studied teachers' sustainable water consumption behavior, and found that awareness of consequences indirectly influenced behavioral intention through ascription of responsibility and personal norms. Fornara *et al*. (2020) demonstrated that social norms influenced consumers' commitment toward responsible actions indirectly, through perceived behavioral control, and Hamerman *et al*. (2018) found that these norms can affect consumers' decisions regarding whether to take leftovers home from a restaurant. Han *et al*. (2020) found mediating effects of ascription of responsibility and personal norms on the relationship between problem awareness and ecological behavior. Lai *et al*. (2020), analyzing meat intake, found that descriptive norms (via personal norms) exerted an indirect influence on intention. Farr-Wharton *et al*. (2014) concluded that the greater or lesser willingness of an individual to

consume or reuse leftovers depends on the value that they assign to food. Carfora *et al*. (2021) also showed an indirect effect of pro-environmental beliefs on consumer intention to buy natural food via awareness of consequences, ascription of responsibility, and personal norms. Therefore, we propose the following hypothesis:

H2b: Lack of FW concern has a negative and indirect relationship with intention to reduce FW through awareness of FW consequences, ascription of responsibility about FW, and personal norms about FW.

2.4 The role of nudging on NAT variables

The social marketing literature has considered informational nudges as a new policy tool for encouraging pro-environmental choice (Schubert, 2017; Ong e*t al*., 2023; Zhang and Wang, 2020). The significance of such nudges is that they help to align behavior with intention (Schubert, 2017). Previous initiatives have shown that nudges can lead to behavioral change and fulfill social objectives, such as improving eating habits and avoiding addictive behaviors (Ong *et al*., 2023; Zhang *et al*., 2023). Informational nudges have been described as tools "to direct people into making better choices and judgments" (Ong *et al.,* 2023, p. 454). In the present study, nudges are information messages focused on reducing FW, such as pro-environmental recommendation-based and information-based campaigns. Several authors have supported the use of nudges in promoting sustainable food consumption and norm activation (Debucquet *et al*., 2023; Barker *et al*., 2021). These interventions or FW-reduction triggers vary in nature, as their messaging can encourage pro-environmental behavior or a social experience, or be neutral (Debucquet *et al*., 2023). The style of the nudge can also have varying effects. The direction of the message – that is, positive versus negative reinforcement – also varies the effect, with a positive message leading to modification of FW habits (Ong *et al*., 2023). This broad nature of nudges was also found in a systematic review by Barker *et al.*

(2021), which identified that, in the field of FW reduction, nudges may pertain to social norms, reminders, or disclosures.

Nudges can also raise awareness of food value or provide knowledge about the impact of FW (Zhang *et al*., 2023). The ability of nudges to encourage conscientiousness also makes them an appropriate tool to impact those with a lack of FW concern. Some authors have identified the need for further research regarding how nudges can change consumer behavior regarding lack of FW concern (Wu *et al*., 2023). Specifically, we propose that informational nudges can reduce lack of FW concern:

H3a: Nudging has a negative relationship with lack of FW concern.

Due to nudges' usefulness as a behavioral policy tool, they have been used as a strategy to inform while pushing a certain response (Schubert, 2017; Zhang *et al*., 2023). Hence, information nudges can raise FW concern and make individuals more aware of the problem and its consequences (Giaccherini *et al*., 2021, von Kameke and Fisher, 2018; Wu *et al*., 2023). Informational nudges also increase knowledge about the problem and about the consequences of unsustainable behaviors. Most informational nudges emphasize the consequences of individual behaviors. De Groot *et al.* (2021) analyzed how a majority versus a minority social-normative message impacts intention to reduce FW, showing that this relationship is moderated by personal norms and that the majority message has a stronger effect on intention to reduce FW when people show weak (vs. medium or strong) personal norms. Soma *et al.* (2021) found that nudging strategies related to FW interventions can influence consumer behavior by increasing awareness of FW and its environmental, economic, and moral consequences. Social media marketing messages have also been explored as a way to reduce FW by spreading awareness (Teoh *et al*., 2022). Likewise, nudges related to information about FW consequences are also associated with an increase in

awareness and knowledge about the environmental problem (van Valkengoed *et al*., 2022; Zhang *et al*., 2023). Therefore, the following hypothesis is proposed:

H3b: Nudging has a positive relationship with awareness of FW consequences.

Nudging toward a responsible behavior is considered a means of reducing FW (Landells *et al*., 2022; Carlsson *et al.*, 2021). Nudges work at an individual level by highlighting the individual's responsibility toward the environmental problem (Carlsson *et al*., 2020). In social marketing literature, social media has been used to awaken a sense of responsibility associated with reducing FW (Sutinen and Närvänen, 2022). In a qualitative study about FW, Ellison *et al*. (2019) positioned FW as a form of personal waste, and called for ascription of responsibility. Informational nudges generate information about individual aspects or small behavioral changes that consumers can make to reduce FW, or about the consequences of inappropriate FW behavior (Soma *et al.,* 2021). Additionally, it has been suggested that consumers' ascription of responsibility can be improved by providing information about the environmental consequences of specific behaviors (van Valkengoed *et al*., 2022). Therefore, we propose the following:

H3c: Nudging has a positive relationship with ascription of responsibility about FW.

Personal norms are rules of morality that people follow in their daily lives. Nudges, as triggers of positive behavior, have also been employed in the study of social expectations, under the label of norm-nudging or moral nudges (Capraro *et al*., 2019). In the field of environmental research, personal norms have been found to be influenced by nudges (Carlsson *et al*., 2019; Carlsson *et al*., 2020). Often, the effectiveness of nudging strategies relies on the creation of certain emotions, such as guilt or shame (Jagau *et al*., 2017; Qi and Roe, 2016). Jagau *et al*. (2017) examined specific interventions aimed at reducing FW in a restaurant, and found that social emotions are related to intention to reduce FW. Qi and Roe (2016) suggested that generating guilt, prompted through awareness campaigns or other

nudging strategies, may lead to household FW reduction by delineating a personal norm. In general terms, people that perceive nudging strategies as useful are usually more pro-environment oriented, so will have more reasons for feeling moral disapproval of FW behavior (Misiak *et al*., 2020). Therefore, we propose the following hypothesis:

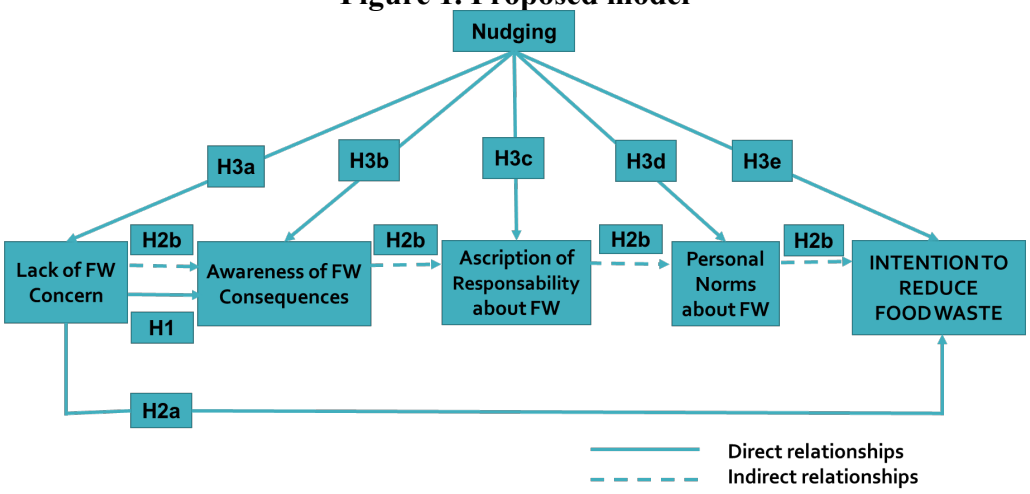
H3d: Nudging has a positive relationship with personal norms about FW.

Previous research has also examined the direct effect of nudging on behavior, finding positive effects. In an experiment regarding hotel waste, Kallbekken and Sælen (2013) concluded that nudges reduced FW in hotel restaurants by approximately 20%. In another experiment in a restaurant setting, Ong *et al*. (2023) determined that social media marketing nudges can reduce FW from consumption three times more than when nudging is not used. Most nudging initiatives at the household level have been informational, based on leaflets emphasizing the economic and environmental impact of FW (Zhang and Wang, 2020; Shaw *et al*., 2018), while others have encouraged neighbors to reduce FW via community-based social marketing nudges (Linder *et al*., 2018). Therefore, the following hypothesis is proposed:

H3e: Nudging has a positive relationship with intention to reduce FW.

Figure 1 summarizes the proposed model of this study, and the relationships to be tested.

Figure 1. Proposed model



Source: Authors own work.

3. Methodology

The target population of this study was young people aged between 18 and 34. The FW problem is especially prevalent in this segment, which has been shown to waste more food than people in other age groups (Mondéjar-Jiménez *et al*., 2016; Principato *et al*., 2015). Supporting this argumentation, a recent study showed that people aged under 34 were the segment that produces the most FW (Too Good To Go, 2022). The survey was administered online through a specialized marketing research agency in Spain (Netquest.com), in early 2020. The respondents had to meet the age requirement (18–34), and we ensured that the sample was representative of the Spanish population by collecting data from all regions of the country (see Table I for details).

Table I. Sample Characteristics

Characteristic	**N = 716 (%)**
Gender	
Female	370 (51.7)
Male	346 (48.3)
Age (years)	
18–24	223 (31.1)
25–34	493 (68.9)
Education	
None	2 (0.3)
Primary	5 (0.7)
Secondary	37 (5.2)
College	272 (38)
Technical degree	87 (12.2)
Bachelor's degree	168 (23.5)
Master's degree	135 (18.9)
PhD	10 (1.4)
Employed	
Yes	527 (73.6)
No	189 (26.4)
Living arrangements	
With parents	257 (35.9)
With flatmates	71 (9.9)
Alone	66 (9.2)
In student halls of residence	9 (1.3)
With partner	232 (32.4)
With partner and child(ren)	65 (9.1)
Other	16 (2.2)

Source: Authors own work.

All scales used in the survey were adapted to the FW context from previous research (see detailed information in Appendix). Specifically, awareness of FW consequences (three items), ascription of responsibility about FW (three items) and intention to reduce FW (three items) were adapted from Wang *et al*. (2019), whose scales have been used in previous and recent studies on waste separation (Singh *et al*., 2025; Zhang *et al*., 2013) and FW (Long *et al.*, 2022). These scales contain very similar items to those used in other FW studies applying NAT (e.g., Chun T'ing *et al*., 2021; Iriyadi *et al*., 2023; Wang *et al*., 2022). The lack of FW concern scale (foud items) was adapted to the FW context from Stefan *et al*. (2013); the personal norms about FW scale (four items) was adapted from Smith and McSweeney's (2007) moral norms construct, since it faithfully captures the sense of moral obligation that guides responsible behavior; and the nudging scale (12 items) was adapted from von Kameke and Fischer (2018). All constructs are reflective and were measured using a 7-point Likert scale. Nevertheless, the nudging construct, although originally proposed as a reflective construct by von Kamele and Fischer (2018), was in this study treated as a formative construct, creating an index of nudging, because the indicators contribute to the construct rather than just reflecting an underlying latent variable (Jarvis *et al.,* 2003; Diamantopoulos and Winklhofer, 2001).

Since common method variance could pose a problem in this study, we conducted Harman's one-factor test. The results showed that a single factor explained 19% of the variance, but the variance explained increased to 66% when all factors were considered. Thus, we conclude that common method variance is not an issue in this study.

4. Results

4.1 Measurement model

The results of Bartlett's test suggested that the data were suitable for factorial analysis ($chi^2 = 4348.33$, $p < .000$). Because some constructs were adapted to our study context, exploratory factor analysis using SPSS implementing principal component analysis and varimax rotation was utilized to check the unidimensionality of the reflective constructs. The results confirmed five dimensions with eigenvalues above 1. All items were grouped as proposed in the literature, except for an item from the intention scale (INT_3). Subsequently, confirmatory factor analysis (CFA) was carried out using SmartPLS 3.0 software to test the hypothesis that a relationship existed between observed variables and their underlying latent constructs. The results of the CFA confirmed the previous results of exploratory factor analysis (EFA), and INT_3 was excluded as its factor loading was below 0.7. Results are provided in Table II.

Following analysis of the formative constructs, three items for nudging had to be excluded in order to meet the quality criteria (see Table II). Following this exclusion, all factor loadings of the constructs exceeded the minimum acceptable value of 0.7 (Carmines and Zeller, 1979), and all items of the formative construct were positive. All reflective constructs showed acceptable Cronbach's alpha values and good levels in the composite reliability index (Hair *et al*., 2011; Nunnally, 1978), confirming internal consistency. To evaluate discriminant validity, the average variance extracted (AVE) was examined. All values exceeded the minimum value of 0.6 (Hair *et al*., 2011). For the formative construct, nudging, the variance inflation factor (VIF) was examined to confirm that there were no multicollinearity problems (Table II).

Table II. Measurement Model

Construct	Loadings /Weights	Cronbach's Alpha	Rho_A	Composite Reliability	Indicator Reliability	VIF
LACK of FW		0.749	0.757	0.841		n.a.
LC_1	0.790				0.621	
LC_2	0.742				0.533	
LC_3	0.785				0.637	
LC_4	0.701				0.491	
AWARENESS		0.756	0.756	0.861		n.a.
AW_1	0.840				0.714	
AW_2	0.846				0.724	
AW_3	0.773				0.584	
ASCRIPTION		0.743	0.757	0.854		n.a.
AS_1	0.743				0.549	
AS_2	0.834				0.689	
AS_3	0.858				0.743	
PERSONAL NORMS		0.780	0.793	0.858		n.a.
PN_1	0.716				0.518	
PN_2	0.813				0.664	
PN_3	0.778				0.602	
PN_4	0.791				0.619	
NUDGING		n.a.	n.a.	n.a.		
NUD_1	0.004					1.52
NUD_2	Excluded					n.a.
NUD_3	0.103*					1.94
NUD_4	0.034					2.19
NUD_5	0.114**					1.76
NUD_6	0.122**					1.89
NUD_7	0.336***					2.25
NUD_8	0.172*					2.30
NUD_9	0.168***					1.73
NUD_10	Excluded					n.a.
NUD_11	Excluded					n.a.
NUD_12	0.236**					2.30
INTENTION		0.758	0.763	0.892		n.a.
INT_1	0.908				0.823	
INT_2	0.887				0.787	
INT_3	Excluded					

NOTE: LC = Lack of FW concern; AW = awareness of FW consequences; AS = ascription of responsibility for FW; PN = personal norms; NUD = nudging; INT: intention to reduce FW.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.
Source: Authors own work.

Table III shows the discriminant validity results according to the Fornell and Larcker (1981) criterion and the HTMT (heterotrait–monotrait) ratio proposed by Henseler et al. (2015). All values are below 0.90, indicating discriminant validity among the constructs. The

analysis used a consistent partial least squares algorithm to ensure the robustness of the results.

Table III. Discriminant Validity of Reflective Constructs

	LC	AW	AS	PN	INT
LC	**0.755**	*0.626*	*0.180*	*0.641*	*0.676*
AW	-0.476	**0.820**	*0.501*	*0.722*	*0.746*
AS	-0.132	0.378	**0.813**	*0.317*	*0.379*
PN	-0.502	0.564	0.256	**0.776**	*0.855*
INT	-0.513	0.567	0.285	0.696	**0.897**

NOTE: LC = Lack of FW concern; AW = awareness of FW consequences; AS = ascription of responsibility for FW; PN = personal norms; INT: intention to reduce FW. Values in bold on the diagonal are square roots of the AVE and values below the diagonal are correlations between variables (Fornell and Larcker criterion). Values above the diagonal are HTMT ratios, as proposed by Henseler *et al.* (2015).
Source: Authors own work.

4.2 Structural results

Table IV shows the structural results of the model. SmartPLS 3.0 M3 software was used to test the hypotheses (www.smartpls.de). In addition, the Q^2 value was used to test predictive relevance, as recommended by Stone (1974) and Geisser (1974); the Q^2 value for each of the dependent variables was positive in our models.

Four models were examined, which differed according to the variables included. Model 1 comprises the NAT model; Model 2 adds to Model 1 the direct effects on intention to reduce FW of lack of FW concern, awareness of FW consequences, and ascription of responsibility for FW. Model 3 adds to Model 1 the effect of nudging on the different variables of NAT theory. Model 4 is the complete model, which includes the direct effects of lack of FW concern, direct effects of the NAT variables, and the effect of nudging on intention to reduce FW. A comparison of the coefficients of each model indicates that the results are highly robust, with only slight differences (in the values of the coefficients and not in the significance level of the relationships).

Model 4 has the highest variance explained for intention (Table IV). The results show that adding lack of FW concern to NAT is important, as this variable has a strong negative impact on awareness of FW consequences. This supports H1. The findings also confirm the other effects of the NAT theory variables, with a positive effect of awareness on ascription, and a positive effect of ascription on personal norms. Finally, it is worth highlighting the direct and strong role of personal norms on intention to reduce FW (see Model 1 in Table IV). The results also show that lack of FW concern has a negative effect on FW reduction intention, which supports H2 (see Model 2 in Table IV).

In terms of the nudging effect (see Model 3 in Table IV), nudging has a negative and strong influence on lack of FW concern, and a positive effect on awareness of FW consequences, ascription of responsibility for FW, personal norms, and intention to reduce FW. Therefore, H3a–e are supported.

Table IV also indicates the effect of four control variables: gender, education, household size, and income. These control variables are essential in studies of consumer behavior, as they clarify the nature of relationships between variables, enhance the accuracy and generalizability of results, and prevent potential biases in model estimation (Wooldridge, 2015). The control variables were selected based on previous qualitative research, in which they were found to be relevant to explain FW reduction intentions (Quested *et al*., 2013; Graham-Rowe *et al*., 2014; Stancu *et al*., 2016; Visschers *et al*., 2016). Gender is a dummy variable (1 = woman, 0 = man); age is a continuous variable; household size and income are categorical variables. Of these, gender and household size, were found to be positive and significant in the four models tested. This means that compared to men, women, on average, have a greater intention to reduce FW, and households with more members, on average, show a greater intention to reduce FW.

Table IV. Structural Results

RELATIONS	Model 1 (NAT)		Model 2 (NAT + Dir. EFF)		Model 3 (NAT + NUD)		Model 4 (NAT + NUD + Dir. EFF)	
	Coeff.	R^2/Q^2	Coeff.	R^2/Q^2	Coeff.	R^2/Q^2	Coeff.	R^2/Q^2
LC ⇒ AW	-0.475***		-0.474***		-0.388***		-0.327***	
AW ⇒ AS	0.380***		0.380***		0.300***		0.300***	
AS ⇒ PN	0.257***		0.257***		0.095***		0.096***	
PN ⇒ INT	0.685***		0.584***		0.579***		0.574***	
LC ⇒ INT			-0.214***				-0.189***	
NUD ⇒ INT					0.208***		0. 216***	
NUD ⇒ LC					-0.383***		-0.383***	
NUD ⇒ AW					0.385***		0.384***	
NUD ⇒ AS					0.156***		0.155***	
NUD ⇒ PN					0.518***		0.519***	
CONTROL VARIABLES								
Gender	0.191***		0.134***		0.153***		0.153***	
Education	0.009		-0.001		0.009		0.009	
Household size	0.035*		0.046**		0.048**		0.045**	
Income	-0.014		-0.016		-0.014		-0.014	
ENDOGENOUS VARIABLES								
Intention		0.495/0.053		0.528/0.195		0.526/0.270		0.526/0.271
Lack of FW		Ind. Vble.		Ind. Vble.		0.147/0137		0.146/0.136
Awareness		0.225/0.219		0.224/0.219		0.352/0.245		0.353/0.248
Ascription		0.144/0.013		0.144/0.013		0.162/0.08		0.161/0.088
Personal norms		0.06/ 0.044		0.06/0.04		0.308/0.286		0.308/0.176

NOTE: LC = Lack of FW concern; AW = awareness of FW consequences; AS = ascription of responsibility for FW; PN = personal norms; NUD = nudging.
*** Significant at the 1% level. ** Significant at the 5% level.
Source: Authors own work.

Finally, we examined the indirect effects of lack of FW concern through awareness, ascription, and personal norms on intention to reduce FW (Table V). A detailed analysis of the mediation effect of NAT variables was carried out using PROCESS (Preacher and Hayes,

2008). The findings show partial mediation effects from lack of FW concern. Specifically, lack of FW concern has a negative indirect effect on intention, mediated by the development of awareness of FW consequences, ascription of responsibility, and personal norms. This supports H2a.

Table V. Analysis of Mediation Effects

Direct Effect on Intention to Reduce FW		**Direct and Indirect Effects on Intention to Reduce FW**			
	Coefficient	**Direct effect**	**Mediators**	**Coefficient**	**95% CI**
NUD	0.532***M	0.1852***	**LC**	0.0734	(0.04; 0.11)
			PN	0.259	(0.207; 0.31)
			AS-PN	0.158	(0.0002; 0.368)
			AW-AS-PN	0.0055	(0.015; 0.012)
			LC-AS-AW-PN	0.0018	(0.005; 0.0039)
			Total effect	*0.3471*	(0.28; 0.41)
LC	-0.245***	-0.218***	**AW-AS-PN**	*-0.027*	(-0.04; -0.01)
			Total effect	*-0.027*	(-0.04; -0.01)

NOTE: LC = Lack of FW concern; AW = awareness of FW consequences; AS = ascription of responsibility for FW; PN = personal norms; NUD = nudging; Note 2: *** Significant at the 1% level.
Source: Authors own work.

Although not part of our hypotheses, we considered it interesting to examine whether there were indirect effects of nudging (Table V). The results show that nudging has a very important positive indirect effect on intention to reduce FW, mediated mainly by ascription of responsibility for FW and personal norms. This highlights, above all, the indirect influence of nudging on intention to reduce FW through personal norms.

5. Discussion, and theoretical and social implications

Following the NAT framework, this study incorporates lack of FW concern as a determining variable of individuals' level of awareness of FW consequences, and as a factor that both directly and indirectly influences individuals' intention to reduce FW. This fulfills the first objective of this research. In addition, we examine the role of nudging in the different variables of the extended norm activation model applied to the reduction of FW, thereby achieving the second objective.

The findings confirm the effectiveness of the NAT framework in explaining young individuals' intention to reduce FW at home; this aligns with other recent works (Obuobi *et al*., 2024; Filimonau *et al*., 2023; Wang *et al*., 2021). The present study not only demonstrates the direct and indirect influence of lack of FW concern on this intention, but also the relevant role of nudging in counteracting this effect, both directly and indirectly – especially through personal norms about FW. This supports findings by Carlsson *et al*. (2019, 2020) in the field of environmental research.

Analysis of the influence of all variables involved in the conceptual model revealed the important explanatory direct effect of lack of FW concern, again confirming previous findings (Wang et al., 2022; Pearson *et al*., 2013; Principato *et al*., 2015; Sirieix *et al*., 2017). The lower the lack of FW concern (i.e., the higher the concern regarding FW), the higher young consumers' intention to reduce it. Lack of FW concern also explains lower awareness of the various consequences of FW: young consumers who are less concerned about FW also show less awareness about the consequences of FW and do not try to reduce it. Awareness of FW consequences has a significant positive influence on ascription of responsibility about FW, which means that young people who are aware of FW consequences feel greater personal responsibility regarding the issue, and will try to mitigate it. Further, the findings also validate the effect of ascription of responsibility about FW on personal norms to reduce FW, with a significant positive relationship, while the strongest positive influence was found for personal norms on intention to reduce FW. This finding supports the results of previous research – for example, on how NAT could help to explain the intergenerational influence on consumer intention to reduce FW (Filimonau *et al.*, 2023).

To increase the intention to reduce FW among young people, four factors should be enhanced: (1) the perceived value of food, (2) awareness of the societal consequences of FW, (3) feelings of responsibility for the repercussions of FW on others, and (4) personal

obligation to avoid FW. To achieve these aims, informational nudges that highlight the cost of producing different foods (lettuce, steak, etc.) and also the economic, social, and environmental consequences of wasting it, would be very effective – per our findings and also previous research on FW using NAT (Iriyadi *et al.* 2023; Kim *et al*. 2022; Obuobi *et al.* 2024; T'ing e*t al*. 2021; Wang *et al*. 2021).

The present study also builds on previous research by examining the indirect effects of lack of FW concern on intention to reduce FW, and on the NAT chain. Thus, findings related to indirect relationships show that lack of FW concern influences intention to reduce FW because it also leads to a decrease in personal norms. In fact, in this study personal norms were found to be the variable with the greatest predictive power to increase intention to reduce FW, with or without the cumulative effect of antecedent variables of NAT, supporting Filimonau's *et al*. (2023) results.

To the best of our knowledge, no work so far has considered the variable lack of FW concern as the trigger for all other chain effects of the model proposed by NAT. Further, the results suggest that consumers who do not exhibit lack of FW concern will show a high awareness of FW consequences, high ascription of responsibility about FW and, overall, high personal norms about FW, making them more willing to reduce this kind of waste. Therefore, the objective should be to reduce the effect of lack of FW concern; as the findings show, the role of informational nudging in this task is decisive.

Nudging influences consumer intention both directly and indirectly, as suggested by previous research (Carlsson *et al*., 2020; Schubert, 2017). On the one hand, nudging helps to reduce lack of FW concern (i.e., increases perceived food value), which generates a chain effect on the other NAT variables that results in increased intention to reduce FW. On the other hand, nudging was found to help directly increase intention to reduce FW, which also confirms previous findings (Zhang and Wang, 2020). Nudging has a positive impact on

increasing awareness of the consequences of FW, ascription of responsibility, and personal norms, again confirming previous results (Capraro *et al*., 2019; Carlsson *et al*., 2020). Finally, although previous research has focused on nudging to increase awareness of the consequences of the problem, in this study the results suggest that the main means by which nudging influences intention to reduce FW is through the creation of personal norms, as well as via ascription of individual responsibility for FW. In this sense, some researchers have highlighted the value of generating certain emotions, such as guilt or shame, by means of nudging strategies, since such strategies seem to be effective for stimulating moral disapproval of FW behavior (Jagau *et al*., 2017; Qi and Roe, 2016). In addition, van Valkengoed *et al*. (2022) confirmed that consumers' ascription of responsibility can be improved by providing information about the environmental consequences of specific behaviors, such as those pertaining to FW.

Finally, this study tested the influence of four control factors (gender, education, household size, and income) in the four measurement models. Of these, gender (women vs. men) and household size (more vs. fewer members in the family) were found to exert a positive and significant effect in all tested models. Thus, young women and families with more members expend greater effort against FW. However, neither educational level nor income were found to be significant, indicating that these variables are not determinants for young people to show a greater intention to reduce FW. However, this outcome could vary in other population segments. Indeed, Quested *et al*. (2013) and Graham-Rowe *et al*. (2014) found differences in FW levels across different demographic segments, pointing to age, gender, and household size as influential variables.

5.1 Theoretical implications

The current study enriches the research on FW reduction and young people's environmentally friendly intentions to manage food at home. Therefore, it contributes to the stream of work

that promotes sustainable behaviors, mainly among the younger generations, in two ways. First, it validates the predictive capacity of NAT in the context of the intention of young people to reduce FW, providing evidence that lack of FW concern serves as a trigger variable that reflects young people's lack of attention to this problem. The study shows that lack of FW concern is a key factor in both the intensity and direction of the relationships within the NAT model. Thus, within the context of this study, the findings suggest that the extended NAT model we propose is highly appropriate for assessing the young people's intention to reduce FW, in line with other recent research (Obuoby *et al*., 2024; Wang *et al*., 2022). Second, this study augments social marketing and FW research by examining the effect of nudging strategies on creating pro-environmental and pro-social values, specifically reducing lack of FW concern, increasing the awareness of consequences about FW, ascribing responsibility, and personal norms, which together lead to greater intention to reduce FW. While previous research focused only on end behavior or on the awareness of consequences, the present research shows how nudging can also influence personal norms, which represents the main driver of intention to reduce FW. From a social marketing perspective, incorporating nudging within the NAT framework can facilitate the identification of stimuli that can most effectively lead to a change in individual behavioral intention – in this case, to a greater intention to reduce FW. As previous research has indicated, receiving information about the consequences of FW (van Valkengoed *et al*., 2022), as well as the generation of emotions of guilt and shame (Jagau *et al*., 2017; Qi and Roe, 2016), enhance young people's sense of responsibility and, overall, their moral drive to curb FW.

5.2 Social implications

These findings also have a number of policy and societal implications for institutions and governments seeking to promote responsible behavior among young people, particularly regarding Goal 12 of the United Nations Sustainable Development Goals (2021). For

instance, governments could implement consumer policies that promote more responsible demand, encouraging consumers to make food purchases that are more tailored to their needs. For this purpose, governments could use nudging strategies that rely on communication campaigns, giving consumers ideas on how to avoid FW (Hodgkins *et al*., 2019). For example, these communication campaigns could highlight the importance of taking a shopping list to the supermarket, avoiding large packages of food that may not be consumed in time, and being aware of expiry dates and the shelf life of food. In addition, private institutions could deploy various initiatives that increase awareness of the FW problem and help consumers avoid or reduce FW. For example, retailers could offer packaged food of various sizes, so that consumers can adapt their shopping to their actual needs.

Lack of FW concern has proven to be a significant barrier for consumers trying to reduce their waste. In this sense, public–private collaboration could be more effectively used in developing informational nudging strategies on this problem, with the aim of enhancing young people's concern about the economic, social, and environmental consequences of FW. Such collaboration could include initiatives such as the use of images showing the amount of food wasted, information on the economic cost linked to the waste of different types of food (a head of lettuce, a beef steak), and challenges or games between families or friends to reduce FW at home. For example, creating challenges or competitions to encourage young people to waste less food would gamify the experience and encourage individuals to share their achievements and inspire their peers to adopt more responsible food habits (Ong *et al*., 2023). These initiatives would reach more participants if they were frequently communicated through digital media with regular reminders (Ong *et al*., 2023).

However, creating a social shift toward valuing food and reducing waste requires a combination of educational, practical, and technological initiatives that help to instill a sense of responsibility and value for food resources among youth. In this line, educational

institutions play a relevant role in making sure that a desirable attitude toward food management is gradually but firmly established in young people's minds. Such a task would undoubtedly take place over the long term, and would begin with constant information and awareness-raising activities among young people about the consequences of FW and the importance of avoiding it. To achieve this, the collaboration of different social agents (governments, private companies, educational institutions, etc.) is essential.

On a more practical, day-to-day level, educational institutions such as universities could implement initiatives for students to acquire leftovers from their canteens to eat at home. Such action could be organized via mobile applications, which educators could promote in their classes while highlighting the benefits of being a FW warrior.

6. Conclusions

This study analyzed the effect of lack of FW concern as one of the obstacles to consumer intention to reduce FW, and as a first step in explaining FW behavior. It provides new empirical evidence of how nudging can be used as a strategy to reduce FW by helping to reduce consumers' lack of FW concern and increasing awareness of the consequences of FW, ascription of responsibility for FW, and personal norms about FW. Personal norms are shown to be a key factor in consumers' intention to reduce FW, as well as a catalyst for the indirect effect of ascription of responsibility on such intention. The results show that nudging not only has a direct influence on the creation of a positive attitude toward reducing FW but also an indirect influence through adscription and personal norms. Therefore, this study confirms the relevance of nudging in the literature on environmental consumer behavior. Given the importance of reducing FW, these results can be used by institutions to design and implement social nudging initiatives that promote a culture of valuing food and that encourage young consumers to manage food more responsibly.

7. Limitations and future lines of research

This work is subject to several limitations. First, the study used a cross-sectional design; future research would benefit from using a longitudinal design so as to monitor variations in consumers' intentions to reduce FW before and after being exposed to nudges. Second, utilizing the NAT perspective, this study demonstrated the main determinants of young people's intention to reduce FW, as well as the role of nudging on the entire causal chain. However, regarding changes in actual consumer behavior, per the aims of social marketing, future lines of research could integrate both intention and actual behavior to reduce FW, in which nudging appears as a variable that narrows the intention–behavior gap (Fraj-Andrés *et al.*, 2023). In this sense, nudging could be considered a valuable tool for social marketing in achieving the expected change in consumer behavior. Third, a general perception of nudging is presented in this study using a survey methodology; further research could be conducted using experiments and field studies that focus on just one type of nudging strategy, in this same context of study, to verify its effectiveness. Fourth, this study analyzed intention to reduce FW in the young Spanish segment, and how the use of nudges encourages them to increase their intention not to waste. Future research could explore the youth's attitudes toward FW in other cultures in order to better understand the effectiveness of different interventions. Finally, while certain demographic control variables were considered (i.e., gender, education, household size, and income), future research could incorporate other control variables, such as age, in order to better understand how FW can be reduced (Quested *et al*., 2013; Graham-Rowe *et al*., 2014; Stancu *et al.*, 2016; Visschers *et al*., 2016).

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Competing interests

The authors declare no competing interests.

Appendix. Measurement Scales

	VARIABLES
	Awareness of FW consequences (Adapted from the work of **Wang et al., 2019)**
AW_1	Food waste can cause severe environmental pollution problems
AW_2	Food waste can cause the ecological damage issues
AW_3	Food waste can lead to resources waste
	Personal norms about FW (Adapted from the work of **Smith and McSweeney, 2007)**
PN_1	I am the kind of person who does not waste food
PN_2	I would feel guilty if I waste food
PN_3	I believe I have a moral obligation not to waste food
PN_4	Wasting food goes against my principles
	Lack of FW concern (Stefan et al., 2013)
LC_1	I do not really worry about the environmental impact of the food that I throw away
LC_2	I do not really worry about the impact of my food waste on the distribution of resources in the world
LC_3	I do not really worry about the amount of food that I throw away
LC_4	I do not really worry about the cost of the food that I throw away
	Ascription of responsibility about FW (Adapted from the work of **Wang et al., 2019)**
AS_1	I feel jointly responsibility for wasting food in my daily lives
AS_2	I feel jointly responsibility for the negative consequences of wasting food
AS_3	I feel jointly responsibility for the environmental pollution and ecological damage problems caused by wasting food
	Intention to reduce food waste (Adapted from the work of **Wang et al., 2019)**
INT_1	I am willing to reduce food waste in my daily lives
INT_2	I will do my best and make effort to reduce food waste in my daily lives
INT_3	In the future, I will actively participate in food waste reduction activities
	Nudging (von Kameke and Fischer, 2018)
	I think food waste could be prevented through the following actions/initiatives:
NUD_1	External meal planning
NUD_2	Tips on shopping planning via mail.
NUD_3	Tips on shopping planning via email or app.
NUD_4	Tips on shopping planning via an internet platform.
NUD_5	Public promotion of food waste reduction by a respected person.
NUD_6	Regular suggestions for weekly meal planning.
NUD_7	Feedback on financial costs of the individual food waste produced.
NUD_8	Pictures that demonstrate the extent of the food waste amounts.
NUD_9	Regular exchange about personal experiences on the reduction of food waste with friends and neighbors.
NUD_10	Reminders about using shopping plans in order to reduce food waste.
NUD_11	A challenge on household food waste reduction with a friend.
NUD_12	Feedback on the actual food waste amounts generated by the individual household.

Source: Authors own work.