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From Meanings to Action: Understanding and Promoting Food Waste Reduction

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ABSTRACT

Food waste is a complex issue that arises in the later stages of the food supply chain and involves a wide range of actors, from retailers and households to schools, offices, and healthcare facilities. Its implications extend far beyond the mere disposal of edible goods, encompassing substantial environmental and economic costs as well as ethical and value-based considerations. The complexity of food waste lies precisely in the diversity of its causes, manifestations, and consequences. This thesis seeks to explore that complexity through a series of complementary studies that combine qualitative and quantitative methods with the aim of offering an integrated understanding of food waste behaviours and their underlying drivers. This thesis also has practical implications, as it explores different intervention strategies aiming to help manage and reduce household food waste.

Study 1 employs a qualitative approach, conducting twenty semi-structured interviews with Italian adults to capture their in-depth experiences, narratives, and perceptions surrounding food waste. The study explores the symbolic and value-based meanings attributed to food and food waste, as well as everyday waste-related behaviours and preventive strategies across domestic and out-of-home contexts. Thematic analysis reveals the multifaceted nature of food waste in everyday life, highlighting the significant influence of emotions, perceptions of injustice, institutional roles, communication practices, and differing views on the value of food and responsibility for waste.

Study 2 employs a correlational design grounded in the Theory of Planned Behaviour, expanding this framework to identify a broader set of psychological variables capable of predicting intentions to reduce food waste and adoption of preventive strategies. It explores the roles of guilt, institutional trust, perceptions of personal responsibility, and food injustice in predicting food waste intentions.

Studies 3 to 6, instead, translate the knowledge gained in the initial phases into intervention-oriented research targeting household food waste. Studies 3 and 4 test the effectiveness of implementation intentions and coping strategies within a single-wave experimental design (a pilot study) and a longitudinal experimental design, aiming to facilitate change in attitudes, intentions, and control over the goal of reducing food waste, as well as in actual food waste.

Study 5 investigates the motivational drivers sustaining intentions to reduce food waste, delivering via a smartphone application informational and motivational nudges that leverage three key value-based motivations: the economic, environmental, and social consequences of food waste, over a 9-day period, to help participants reduce their food waste over time.

Study 6 extends this motivational perspective to a non-domestic leisure context, examining food waste behaviours among campers at Camping Village Le Esperidi in Tuscany, exploring the issue on a novel ground. This project was funded and conducted within the *Dipartimenti di Eccellenza* of the University of Milano-Bicocca.

Taken together, this thesis aims to offer a comprehensive and empirically grounded account of the socio-psychological, contextual, and value-based factors that shape food waste behaviours. By integrating diverse methods and perspectives, the thesis contributes to a more nuanced understanding of food waste and provides evidence-informed directions for designing effective interventions in both domestic and leisure settings.

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1

INTRODUCTION

Food waste is tied to one of the greatest contradictions of our time. The progress of modern medicine and technological advancement has allowed us to improve living conditions and ensure the availability of abundant and safe food. However, the same advancements have led to continuous population growth, which now represents an increasingly urgent challenge. From 1970 to 2025, the world population more than doubled, rising from 3.7 billion to 8.3 billion. By 2050, the global population is expected to reach 9.7 billion, and with the current consumption model, food demand is projected to increase by 70% (*Circularity Gap Report 2020 - Insights - Circle Economy*, retrieved 2025; Hamad & Tayel, 2025; UN, 2019).

The question, then, is how we will feed an ever-expanding population while simultaneously reducing our environmental impact, as the food system is one of the sectors with the greatest global environmental footprint, contributing a significant share of greenhouse gas emissions and other ecological pressures. Around one-third of all human-made greenhouse gas emissions come from food systems when all stages from production to waste are included, and they also drive biodiversity loss, deforestation, and heavy water use (Crippa *et al.*, 2021; Ritchie, 2019; Scherhauser *et al.*, 2018). Food lost and wasted across the supply chain accounts for approximately 8–10% of global greenhouse gas emissions, releasing around 3.3 billion tons of CO₂ (Food Waste Index Report 2021, UNEP).

Food loss and waste exacerbate these challenges, posing risks to food security, nutrition, and water resources. Food waste alone reached 1.05 billion metric tons in 2022, representing one-fifth of all food available to consumers, and the food discarded in households each day would be enough to provide over a billion meals. Every year, 1.3 billion tonnes of food are wasted worldwide, which correspond to four times the amount needed to feed the 865 million people who suffer from hunger (“Waste Watcher International Observatory | Spreco Zero,” retrieved 2025). Nevertheless, a large

proportion of the global population still experiences food insecurity: one in eleven people goes hungry, one in three cannot afford a healthy diet, and 343 million people are severely food insecure (WFP 2025 Global Outlook | World Food Programme, 2025). This issue is also addressed within the Sustainable Development Goals of the 2030 Agenda.

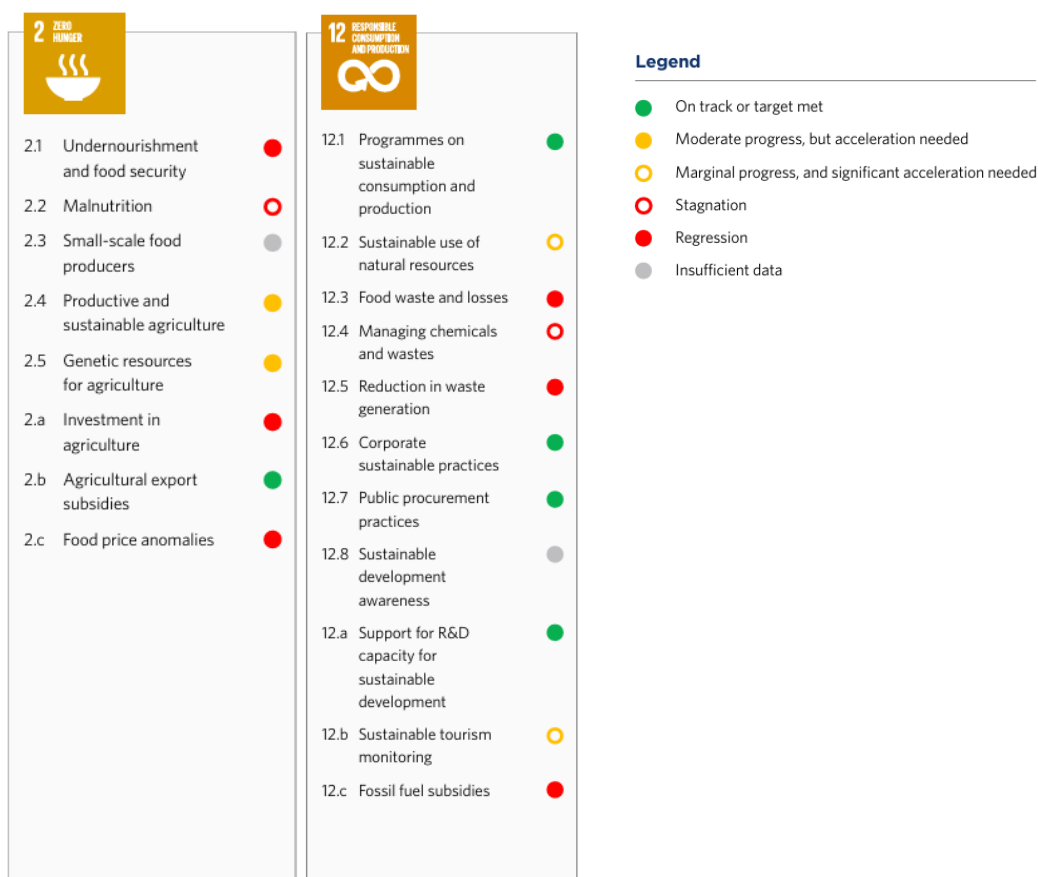
The Sustainable Development Goals (SDGs) are 17 global objectives adopted by the United Nations Member States in 2015, representing a universal call to action to end poverty, protect the planet, and ensure peace and prosperity for all people by 2030, in a series of interconnected goals, also known as the 2030 Agenda for Sustainable Development. Among these shared global commitments, the 2030 Agenda identifies food waste as an important issue to address and sets a goal of reducing it by at least half as a key target.

The transition to a sustainable food system is crucial to achieving environmental sustainability and social equity. Specifically, the issue of food loss and waste is addressed in Goals 2 and 12 of the Agenda.

- Goal 2: Zero hunger. This goal focuses on “*End hunger, achieve food security and improved nutrition and promote sustainable agriculture*”.
- Goal 12: Responsible consumption and production. This goal focuses on ensuring sustainable consumption and production patterns.

Figure 1.1 shows the progress made to date on SDGs 2 and 12. While some targets have been achieved, much remains to be done.

Figure 1.1
SDG progress by target



Note. Source: The Sustainable Development Goals Report 2025.

Food waste and food loss also have a significant economic impact, which can be observed at various levels, for instance, in the loss of goods during production or livestock farming, the financial resources required to restore conditions for new agricultural and breeding activities, as well as the costs of disposing of food that becomes waste at every stage of the food supply chain. The inefficiency of the food supply system also leads to higher expenditures on land and water for food that is ultimately not consumed.

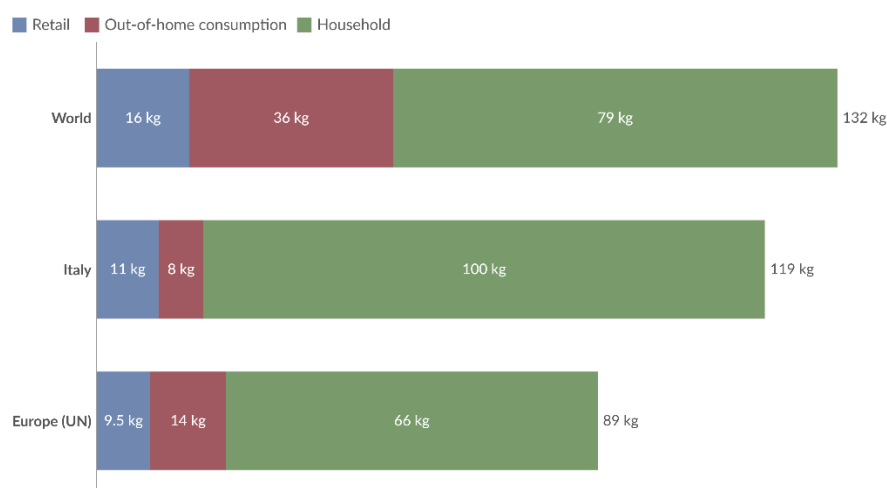
It is estimated that food loss and waste globally amount to around \$1 trillion annually, and food waste alone accounts for around 870 billion euros (US EPA, 2015).

The Italian context

The issue of food waste and loss is also evident in the Italian context. In Italy, food waste alone – so only accounting for food at the consumer level, such as retail and households – was around 119 kg per capita in 2022. Figure 1.2 shows the disproportionate weight of household food waste in the overall number.

Figure 1.2

Amount of food waste per capita, measured in kilograms, 2022



Note. Data source: Food and Agriculture Organization of the United Nations and United Nations Environment Programme – processed by *Our World in Data*

In Italy, each citizen wastes approximately 400–600 grams of food per week, with national estimates reporting an average of around 617 grams per person (ANSA, 2025). These figures vary depending on the measurement method, with diary-based studies generally yielding lower, more conservative estimates than survey-based approaches (Sustainability, MDPI, 2021). According to the Waste Watcher Observatory, food wasted is roughly 30 kilograms per person per year, resulting in an economic loss of about €126 annually (Waste Watcher, *Spreco Zero* survey, 2023). Overall, food waste in Italy amounts to approximately €4.8 billion each year. The environmental impact is also substantial, with an estimated 13 million tons of CO₂ emissions annually. At the same time, around 3 million people in Italy experience food insecurity (Waste Watcher, *Spreco Zero* survey, 2023).

Definition of food waste

The Food and Agriculture Organization (FAO) defines food waste as “*the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers*” (FAO, 2011).

Under this definition, the reason for food being discarded is not specified, which may include safety concerns, aesthetic standards, spoilage, or storage issues. The Waste and Resources Action Programme (WRAP) distinguishes between “non-avoidable waste”, which refers to parts of food that are inherently inedible, such as bones and peels, and “avoidable waste”, which refers to edible food that is discarded for any other reason. In the definition adopted by FAO and used in this thesis, non-avoidable waste is not considered food waste.

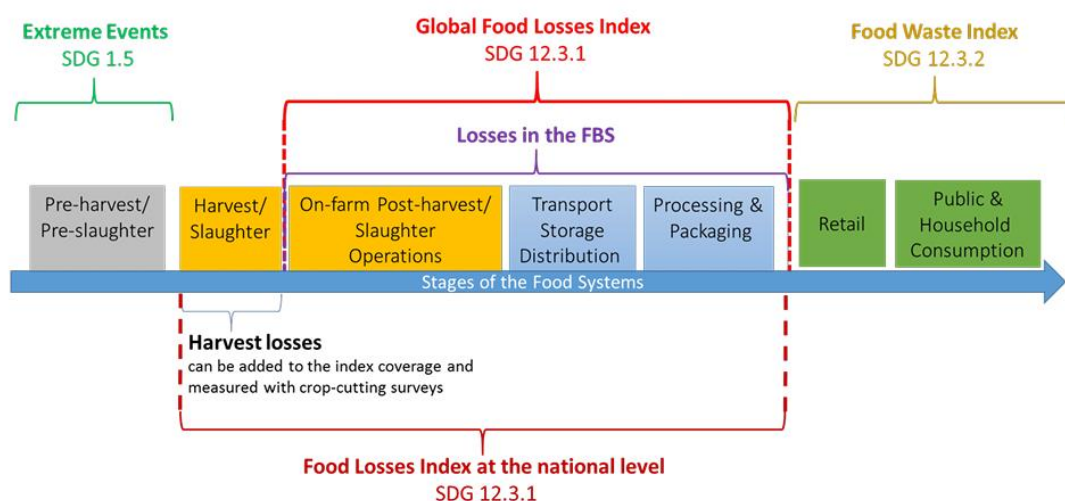
A further classification of the definitions is needed. When we talk about food waste, we generally refer to all types of waste, regardless of the stage of the food supply chain at which it occurs. However, from a formal perspective, there is a clear distinction between *food losses* and *food waste*.

- **Food losses** encompass agricultural and livestock products that are still edible for humans but, directly or indirectly, are lost after harvest or slaughter and do not enter any other use, such as animal feed, industrial processing, or other applications.
- **Food waste** encompasses all products discarded along the food supply chain that, for economic, aesthetic, or proximity-to-expiry reasons, are still edible and therefore potentially suitable for human consumption but are ultimately disposed of or eliminated.

Figure 1.3 presents a visual representation of the distinction between food losses and food waste in the report of the SDG 12.3.1: Global Food Loss Index (FAO, 2018).

Figure 1.3

Boundaries of the food supply chain



Note. Source: FAO, 2018 (Fabi & English, 2018).

Therefore, when we use the term *food waste*, we specifically refer to edible, safe food that, for various reasons, is not consumed. This accounts for all the food waste at the retail level – supermarkets, shops – in restaurants, schools, workplaces, hospitals, and most of all, households.

Food losses and food waste do not occur to the same extent across the supply chain. According to the Food and Agriculture Organization (FAO, 2023), approximately 13% of food is lost between post-harvest and pre-retail stages. The United Nations Environment Programme (UNEP, 2022) further reports that around 19% of food is wasted at consumer-facing stages, including retail, food service, and households. Taken together, these estimates indicate that roughly one-third of all food produced is ultimately not consumed.

The higher proportion of waste observed at the later stages of the chain can be partly explained by structural and organisational differences. In the early production phases, processes are embedded within large, highly regulated systems designed to minimise economic losses and optimise efficiency. Such structured oversight is

considerably more difficult to implement in domestic settings or in public institutions such as hospitals and schools. Nevertheless, the issue of overproduction generated at production levels often has a greater effect on the later stages of the food supply chain, where managing excessive food availability becomes a substantial challenge. Moreover, food products reach the point of consumption only after passing through multiple stages of production, processing, and distribution, resulting in a certain level of loss at the final stages that is both a logistical consequence and, to some extent, unavoidable.

2

LITERATURE ON FOOD WASTE

In Chapter 1, we introduced the theme of food waste, its formal definition, and its implications on global security. We have seen the impact that food waste has on the environment, the economies of individuals and nations, and the ethical dilemmas it poses to humanity.

This second chapter will provide an overview of the literature on food waste, illustrating the main mechanisms and intervention strategies investigated, as well as an overview of the empirical studies with the gaps this thesis aims to address.

Food waste and the household context

The definition of food waste is clear:

“The discard of edible food at the retail and consumer levels, referring to food that is fit for consumption but is discarded or left to spoil” (FAO, 2013).

In other words, food waste is all the food that *could be* but *is not* consumed at the retail and consumer levels. This definition is somewhat precise, but it also leaves some room for interpretation. For example, we usually think of food waste as the food that is thrown away in the garbage, perhaps because it is not good to eat anymore, because it was left at the bottom of the fridge, overshadowed by other goods, for poor planning, or because we do not really care for leftovers and get seduced by fresh meals or food deliveries.

Nonetheless, there are various other actions we sometimes unconsciously adopt that can be considered food waste or food-waste-leading behaviours. Food waste is an umbrella term that encompasses a range of behaviours that result in the loss or discarding of edible food. One such example is overeating. Although eating too much is not formally included in the definition, since no food is physically discarded, it can still be seen as a

form of waste. From a global perspective, overconsumption contributes to unnecessary resource depletion and exacerbates food scarcity in other parts of the world. Overconsumption also harms individual health and, at both national and global levels, may impose a social and economic burden by increasing public health expenditure. It therefore represents a critical concern when considered alongside the overpopulation trends discussed in Chapter 1 and the escalating global demand for food required to sustain human life. Similarly, other habits that might lead to food waste include overpreparing food, not properly storing food or leftovers, speeding up degradation, which increases the risk of having to throw them away.

Household food waste. Even though some studies investigating food waste in other settings are present, such as retail (Cicatiello *et al.*, 2016, 2017; Young *et al.*, 2018), restaurants (Filimonau *et al.*, 2019), hotels (Appel *et al.*, 2025; Okumus, 2020), schools (e.g., Antón-Peset *et al.*, 2021), and workplaces (e.g., Wang *et al.*, 2022), most of the studies in the literature focus on household food waste, which is food waste that happens in the domestic context.

This discrimination is due mainly to two reasons: one is logistical; it is easier to reach individuals or families and to design interventions for the general population than to implement and conduct studies and experiments in work environments, schools, canteens, and retail settings. The second reason is more practical: as we saw in Chapter 1, the largest share of food waste occurs in households. This makes studying and intervening in the domestic context more prominent.

For these reasons, the studies presented in this thesis will investigate food waste within the household context, with two specific exceptions. Study 1 explores food waste experiences in everyday life across multiple domains, and Study 6 examines food waste in a leisure context, which can nonetheless be regarded as part of the household sphere, albeit a temporary and distinct one.

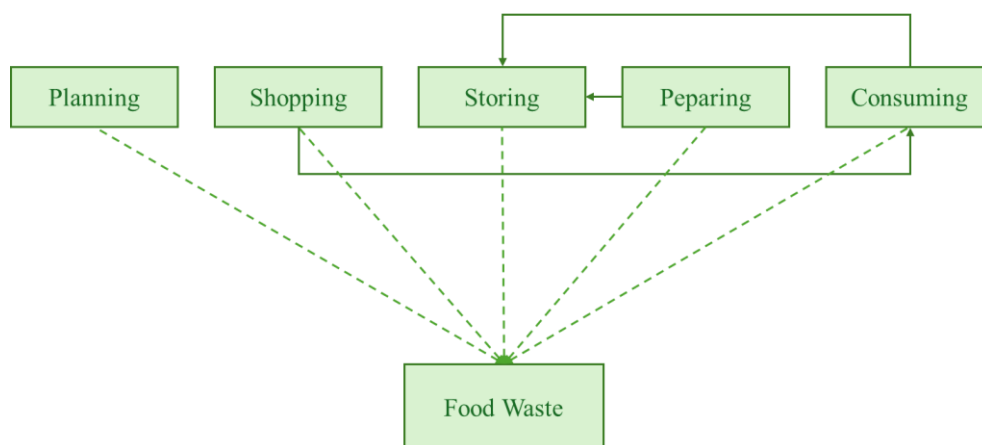
Factors influencing food waste

In the domestic context, food waste results from a range of behaviours stemming from poor food management, such as inaccuracies in meal planning and shopping, inappropriate storage practices at home, and inefficiencies in meal preparation (Etim *et al.*, 2025; Graham-Rowe *et al.*, 2014; Lim *et al.*, 2017; Neff *et al.*, 2015; Quested *et al.*,

2013; Schanes *et al.*, 2018; Stancu *et al.*, 2016; Stefan *et al.*, 2013; Thyberg & Tonjes, 2016). Prior studies in the literature summarised and systematised these food waste-leading behaviours and the strategies that can help prevent it. Attiq and colleagues (2021), for example, identified three main rules for better managing food waste at home: reducing the amount of food purchased and stored (*reduce*), reusing what has not been fully consumed (*reuse*), and recycling what cannot be consumed, such as scraps for gardening (composting) or leftovers for animal feeding (*recycle*). Another conceptualisation of these rules (Blondin & Attwood, 2022; Van Geffen, 2025) identified five stages of household food management, as we see in Figure 2.1 (Principato *et al.*, 2021; Stancu *et al.*, 2016; Stefan *et al.*, 2013; Visscher *et al.*, 2016).

Figure 2.1

Household food management stages



Note. Representation from Blondin & Attwood (2022).

The first stage of food management is *planning*. Planning what food to buy and in what quantities and estimating the needs of a single person or an entire household can pose different challenges. Planning meals in advance for the whole week, for example, is a good way to make more informed and accurate purchases (Quested *et al.*, 2013; Schmidt, 2016; Parizeau *et al.*, 2015).

Shopping is the second stage, and it involves a complex array of decisions and often conflicting values. What needs to be bought is not always compatible with what we would like to buy. Food consumption choices are guided by diverse competitive goals,

including hedonic, normative, and conflicting goals, that can affect food waste by shaping daily food management behaviours (Nguyen *et al.*, 2023). Having planned these decisions in advance, for example by using a shopping list, can make this process easier. Moreover, food waste varies depending on shopping preferences, such as how often trips to the supermarket are made and whether purchases are large or small. Bigger and less frequent purchases usually lead to more food waste (Evans, 2011; Mallinson *et al.*, 2016; Radzymińska *et al.*, 2016.)

Storing is the third stage of household food management. Food waste can occur when food is not stored properly, and not all aliments should be placed in the same locations (Aschemann-Witzel *et al.*, 2015; Graham-Rowe *et al.*, 2014). Some foods lose freshness if left out of the refrigerator, such as meat, cheese, fruits, and vegetables, but even inside the refrigerator, there are rules for arranging foods correctly to ensure safety and prolong their shelf life as much as possible (*Refrigeration & Food Safety | Food Safety and Inspection Service*, retrieved 2025).

The fourth stage is *preparation*. It is sometimes linked to planning, for example, when meals are planned and prepared in advance for the week, known as “meal prepping”. Inadequate preparation can also lead to waste, for instance, if too much food is cooked (Williams *et al.*, 2012; Evans, 2012), making it also harder to consume and manage leftovers. A lack of cooking skills or accidental events can also damage food, such as cutting vegetables incorrectly and discarding more than necessary, burning food, or preparing dishes that are unpleasant or inedible (Williams *et al.*, 2012; Evans, 2011; Brook Lyndhurst, 2007).

The last stage of food management is *consuming*. As mentioned at the beginning of this chapter, overeating can, at least from an ethical point of view, be considered a form of waste, and waste can also occur depending on how leftovers are managed after the meal. While some people find it convenient to consume leftovers in the following days and enjoy being creative in upcycling recipes (Donato *et al.*, 2024), others prefer to avoid leftovers (Porpino, Wansink, and Parente, 2016) either for hedonic reasons, perceiving a decrease in quality of the product, or because they associate leftovers to a potential health risk (Block *et al.*, 2022). Consumption is linked to storage because leftovers must also be stored properly to ensure food safety and quality preservation (Nikravech *et al.*, 2023).

In the Italian context, the Gadda Law 166/2016, introduced in 2016, was enacted to combat food waste by simplifying processes for food reuse and donation to reduce food

insecurity and improve overall food system efficiency. Thanks to this law, the National Observatory on Food Surplus, Recovery, and Waste (OERSA) was also established, serving as the technical body supporting Italy's national policies on food loss and waste, and mapping initiatives at different stages of the supply chain, and strategies to help avoid and overcome food waste (Figure 2.2).

Figure 2.2

Preventive strategies to avoid household food waste



Note. From Grant and Rossi (2022).

However, these pragmatic aspects are not the only ones involved in household food management. Food-related behaviours are inherently complex, as they are shaped by the interaction of multiple internal and external factors (Bhattacharya *et al.*, 2021; Rosas *et al.*, 2021b), encompassing not only pragmatic aspects of food management but also affective, educational, environmental, and economic considerations.

Several reviews address the intertwining of psychological, cognitive and contextual antecedents of food waste (Bhattacharya *et al.*, 2021; Boulet *et al.*, 2021; Etim *et al.*, 2025; Hebrok & Boks, 2017; Rosas *et al.*, 2021b). Bhattacharya and colleagues (2021) identified a wide range of behavioural antecedents that determine household food

waste, such as lack of awareness of food regulations, lack of knowledge about recycling, reuse, and waste minimisation, lack of shopping or planning skills, perceived value of food, and so on. These determinants shape how consumers purchase, store, prepare and consume food as well as their ability to use labels and interpret date labels appropriately. In addition to individual factors, food waste is also affected by household routines and constraints, as well as broader contextual influences such as retail practices, cultural norms, and socioeconomic conditions (Bhattacharya *et al.*, 2021; Boulet *et al.*, 2021; Etim *et al.*, 2025; Hebrok & Boks, 2017).

Measures of food waste

In the literature, several approaches have been employed to measure food waste behaviour (for a review, see Bhattacharya *et al.*, 2021). Some studies have relied on direct measurement methods, such as weighing leftover food with scales, conducting bin audits, or direct observation. More frequently, however, self-reported measures of various kinds are used. Some studies use food diaries in which participants record their daily waste, while others ask participants to estimate the amount of discarded food. For instance, van Herpen and colleagues (2019) developed and validated a food waste measure based on portion estimation using handfuls, spoons, or bowls, depending on food type. These portions are then converted into grams through a reference table, allowing comparisons across different food categories. Other studies combine multiple measurement approaches to enable comparison and to identify potential response biases or measurement errors.

Generally, direct measurements of food waste are more accurate and are not affected by self-report or self-presentation biases or by memory-related distortions. However, they are often more difficult to implement, as they may require specific equipment and a considerable investment of time and resources. Such methods can also fatigue participants, potentially leading to disengagement. Conversely, self-reported measures are easier to administer and less demanding for participants, but they are subject to several limitations. These include memory biases – participants may not accurately recall what or how much food they wasted – and self-presentation biases, especially given that food waste is a socially undesirable behaviour that individuals may underreport in order to appear more responsible (Milfont, 2009). Indeed, van Herpen *et al.* (2019) identified different measurement approaches and reported differences in the quantity of

waste estimated across them. They found that survey-based scales are less strongly correlated with more precise tools such as food diaries, caddies, and photographs, especially when they are general and do not specify the reference period, leading to an underestimation of household food waste. This makes it essential, when using questionnaires and self-report measures, to clearly specify the reference period, or, in longitudinal studies, to repeatedly ask respondents to report behaviour from only a few days earlier.

The empirical chapters of this thesis employ different operationalisations of food waste. In some cases, it is assessed through self-reported habits and behaviours. In other cases, food waste is measured using self-reported portions and grams (van Herpen *et al.*, 2019). No study has yet directly measured food waste, such as weighing participants' waste, due to practical constraints and to avoid intrusiveness into participants' lives.

Models of food waste

Different theoretical models have been employed in the study of food waste. Chia and colleagues (2024) recently made a review of the main models employed in the study of household food waste, among which are the theory of Interpersonal Behaviour (Saman Attiq *et al.*, 2021), the Norm Activation Model (Radde *et al.*, 2025), and the Theory of Planned Behaviour (Ajzen, 1991).

The Theory of Planned Behaviour

Among them, the most used model in the food waste literature is the Theory of Planned Behaviour (Chia *et al.*, 2024). Previous research has investigated the predictive effects of constructs from the Theory of Planned Behaviour, namely attitudes, subjective norms, and perceived behavioural control, on intentions to reduce food waste (Abbate *et al.*, 2025; Nguyen & Nguyen, 2025; Schrank *et al.*, 2023). In a recent review, Etim and colleagues (2025) included 42 studies that employed the TPB, confirming the model's applicability to the study of food waste. It illustrates the interconnection of the TPB components and their useful role as strategies to reduce household food waste. Other studies tested the TPB for household food waste, along with other possible determinants, such as personal norms and planning habits (Van Der Werf *et al.*, 2019).

Following, a description of the TPB components and some additional components from TPB extensions:

Attitudes are generally intended as dispositions toward an object or a goal. In other words, they reflect positive or negative evaluations of a given attitudinal object. Within the Theory of Planned Behaviour, attitudes are meant to evaluate the behaviour under investigation, typically measured through semantic differential scales, in which participants rate an object along two opposing poles. A simple example could be “Reducing food waste is...” 1 = bad to 7 = good. The higher the participant’s score, the more positive their attitude toward reducing food waste. The empirical chapters will often show attitudes towards food waste reduction or a specific preventive strategy.

Social norms. These are norms commonly shared within a society that help regulate behaviour. For example, a person may start smoking because they see their peers smoke or pick up litter in a park because a friend tells them not to leave trash behind. These two scenarios illustrate the two types of social norms employed in this thesis: the *descriptive norm* (the smoking example: “People important to me do [goal]”) and the *injunctive norm* (the littering example: “People important to me would disapprove/approve of my [goal]”). In the Theory of Planned Behaviour, social norms are typically represented by *subjective norms*, which are conceptually similar to injunctive norms but place greater emphasis on the individual’s perception of the social pressure to perform or avoid a specific behaviour.

Perceived behavioural control (PBC). This is the fundamental addition that distinguishes the Theory of Planned Behaviour from the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). PBC reflects the individual’s perceived level of confidence and the likelihood of successfully performing a given goal. It is commonly measured using three items that assess perceived control and difficulty, for example: “How much control do you have over [goal]?” “[Goal] for me is difficult/easy”, or “If I wanted to, it would be easy for me to [goal].” In this context, the goal might refer to behaviours such as “avoiding food waste in my household” or “maintaining a waste-free diet”, depending on the study design and aim.

Intentions. Intentions are the motivational component of the TPB model and the most proximal determinant of behaviour, meaning they reflect how strongly a person is motivated to act. They are typically measured using three items, such as “I am planning to [goal] during the next four weeks” or “I intend to [goal] during the next four weeks”,

and “I will expend effort on [goal] during the next four weeks”, using a 5 or 7-point likelihood or agreement response scale.

The literature shows that intentions to reduce food waste are significantly positively predicted by positive attitudes, social norms, and perceived behavioural control (Aydin & Aydin, 2022; Canova *et al.*, 2024; Habib *et al.*, 2023; Lizcano-Prada *et al.*, 2025; Nguyen & Nguyen, 2025; Salem & Wagner, 2025). This suggests that individuals are more likely to intend to avoid food waste when they evaluate the behaviour positively, perceive that important others approve of it, observe others engaging in it, and feel capable of carrying it out.

The Model of Goal-Directed Behaviour

The Model of Goal-Directed Behaviour by Perugini and Bagozzi (2001) extends the Theory of Planned Behaviour by incorporating additional predictors (anticipated emotions), desire as an additional mediator, and past behaviour (frequency and recency) as a direct predictor of future behaviour (Richetin *et al.*, 2008). In this section, we present two constructs used in this thesis and integrated within the TPB framework: frequency of past behaviour and anticipated emotions.

Past behaviour. Measured with an item of frequency, e.g. “*How often did you perform [beh] during the past year?*” can be a powerful influence on behaviour. Actions that are performed frequently and stably, and sometimes represent concrete habits, shape behaviour, making it more likely that the behaviour will be repeated (Danner *et al.*, 2008).

Anticipated emotions are usually assessed by asking participants to indicate how strongly they would feel positive emotions such as happiness and satisfaction if they succeeded in achieving their goal, and negative emotions such as frustration and guilt if they failed in the attempt, using a 11-point scale (as in Perugini & Bagozzi, 2001) indicating the strength of the emotion, or using semantic differentials (bipolar scales with negative emotion on the left end and corresponding positive emotion on the right end).

The Theory of Planned Behaviour – and its extension in the MGB – provides the theoretical foundation for this research and underpins almost all empirical studies in the thesis. Some studies include all, while others incorporate only a subset, depending on the study design. Sometimes, instead, the TPB model was integrated with additional variables that could have predictive value for determining food waste intentions and behaviours.

In the following empirical chapters, we will examine the specific additional constructs and particularities of each study. Although the TPB is the model employed in all our studies (besides Study 1), we tested different predictors and behaviours and integrated them with different conceptual frameworks – like the Model of Goal-directed Behaviour for anticipated emotions (Perugini & Bagozzi, 2001), or the Motivation-Ability-Opportunity model (Atkins & Michie, 2013) and the Nudge Theory (Thaler & Sunstein, 2008) for Studies 5 and 6 – and methods – implementation intentions technique and EMA-style interventions – to add significant contributions to the existing literature.

The Motivation-Opportunity-Ability model

Another theoretical framework frequently applied in the study of food waste behaviour is the *Motivation–Opportunity–Ability* (MOA) model (Ölander & Thøgersen, 1995; Van Geffen, 2025). This model posits that behaviour results from the interaction of three main components: *motivation*, *opportunity*, and *ability*. *Motivation* refers to the internal drivers that lead an individual to perform a certain behaviour. In the context of food waste, motivational factors may include attitudes towards waste, moral or environmental concerns, and awareness of the consequences of food waste. *Opportunity* represents the external or contextual factors that can either facilitate or hinder the behaviour. These may include environmental and logistical factors, such as food availability, storage conditions, access to stores, household infrastructure, and broader factors such as local policies and unforeseen events that affect food management. *Ability* encompasses the individual’s knowledge and skills that enable the performance of the behaviour. In the case of food waste, this refers to cooking skills, knowledge about food preservation and storage techniques, and general competence in meal planning and leftover management. Together, these three dimensions determine the likelihood of engaging in food waste or, conversely, adopting behaviours that contribute to its reduction. In the matter of household food waste, the model has been extensively tested by van Geffen and colleagues (2025), proving its validity in predicting food waste.

Food waste interventions

Several types of interventions aimed at reducing food waste have been examined in the literature, based on psychological, behavioural, and contextual drivers across

different domains. In a recent review, Vittuari and colleagues (2023) identified key factors like attitudes, awareness, perceived control, emotions, social and personal norms, skills, and knowledge as potential psychological determinants of food waste, and therefore identified them as potential levers, operating at micro (individual), meso (social), and macro (systemic) levels. Effective levers include promoting knowledge and skills in food management, such as cooking and storage, as well as self-learning and awareness campaigns to enhance food management.

Bonte and colleagues (2026) conducted a meta-analysis of interventions targeting food-related behaviour. These interventions include educational approaches aimed at increasing food-related knowledge (Gimenez *et al.*, 2023) and training programs to improve food management skills (Soma *et al.*, 2020). Other strategies focus on making it easier for participants to perform the target behaviour, for instance, by providing containers and shopping lists (van der Werf *et al.*, 2021). Interventions can also leverage persuasion by appealing to emotions associated with food waste (Qi & Roe, 2016) or use positive and negative incentives to motivate behavioural change (Katare *et al.*, 2019). Social influences are another important mechanism, with interventions employing social norms and modelling (Martins *et al.*, 2016). Additional approaches include limiting options, which may produce short-term rebounds (Lombardini & Lankoski, 2013), and environmental restructuring, which can include nudges such as smaller plates (Kallbekken & Sælen, 2013).

Digital interventions, such as longitudinal study designs employing mobile applications, have been shown to be effective in reducing food waste across different contexts (Bhattacharya *et al.*, 2021; Haas *et al.*, 2022; Ong *et al.*, 2023). Various techniques can be implemented within these interventions, including nudges, gamification, and feedback mechanisms (Hedin *et al.*, 2019; Thieme *et al.*, 2012). However, the use of digital applications also presents usability challenges that, in some cases, may reduce participants' engagement (Qi *et al.*, 2022). Such interventions tend to be more effective when they are guided by a sound theoretical framework, sustained over time, and structured around simple, repeated actions (Hedin *et al.*, 2019). This approach facilitates gradual behavioural change and supports the formation of lasting habits that help reduce food waste.

The Nudge Theory (Thaler & Sunstein, 2008). The concept of nudge emerged within the field of behavioural economics in the mid-2020s but was first formally defined

by Thaler and Sunstein in their book “Nudge: Improving Decisions About Health, Wealth, and Happiness”. They describe a nudge as

“any aspect of the choice architecture that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic incentives.” (Thaler & Sunstein, 2008, p. 6)

A nudge is often referred to as a “gentle push” because its goal is to steer consumers (or participants) toward one behaviour rather than another, without restricting their freedom of choice.

Nudge interventions have been shown to be useful for reducing food waste, as they can increase awareness and knowledge, and reduce the cognitive load associated with daily food management by making desirable behaviours easier and more intuitive (Zhang *et al.*, 2023). Different types of nudges can be employed: making the desired choice the most accessible or automatic (Default Options); leveraging others’ behaviour (Social Norms); modifying or simplifying the choice environment (Simplification); emphasizing the positive aspects of a behaviour (Framing); using Reminders and Feedback, highlighting key information (Priming, Anchoring, Salience); or asking participants to commit to a behaviour in advance (Commitment Devices).

Subsequently, Sunstein (2016) distinguished between non-educative and educative nudges. Non-educative nudges require less attention and may even operate below awareness, such as changing the position of one choice relative to another. In contrast, educative nudges require greater awareness and attention, for instance by providing factual information that enables individuals to make more informed behavioural choices. In the context of food waste, an example is the study by Prelez *et al.* (2023), which investigated educative nudges that presented information on the economic and environmental consequences of fruit and vegetable waste and assessed their effect on intentions to reduce personal food waste.

Barker and colleagues (2021) conducted a systematic review on the use of nudges for food waste reduction at the consumer level, confirming their potential effectiveness in promoting sustainable and less wasteful consumption behaviours, especially simple messages and reminders over time.

In summary, the literature on household food waste highlights critical management behaviours (planning, shopping, storage, preparation, consumption) shaped by pragmatic, psychological, and contextual factors, with the Theory of Planned Behaviour (TPB) established as the dominant predictive framework. However, key gaps persist: limited integration of emotions like guilt and injustice into TPB extensions, insufficient attention to non-domestic contexts (e.g., leisure settings), and the need to test scalable motivational interventions. These gaps motivate the exploratory studies in Chapter 3, which combine qualitative and quantitative approaches to identify emerging drivers, laying the groundwork for the intervention strategies in Chapters 4-5.

Overview of the studies

The general aim of this thesis is to investigate food waste across different life contexts and to test a range of intervention methods designed to reduce food waste and related behaviours. The thesis is structured around six studies, each addressing a specific empirical and theoretical gap in the literature.

Study 1 ($N = 20$) consisted of face-to-face semi-structured interviews aimed at gaining a deeper understanding of how participants talk about and conceptualise food waste. The interviews explored what is considered food waste and the mental images evoked by the term, the habits that lead to waste and how individuals deal with it, and the meanings attached to food, abundance, and waste. They also addressed responsibility, the role of institutions, the way food waste is discussed and communicated, and its environmental, economic, and social consequences. This study addresses a gap in the literature on the personal and political dimensions of responsibility for food waste, including communication, trust in institutions, feelings of injustice and guilt, and the ethical dilemmas surrounding food waste. In particular, limited attention has been paid to how these ethical and responsibility-related factors are associated with household food waste behaviours.

Study 2 ($N = 287$) consisted of an online survey administered through the Prolific platform. It examined some of the main socio-psychological factors underlying food waste intentions and behaviours, including attitudes, social norms, perceived behavioural control, anticipated emotions, and past behaviour. It also considered additional predictors that are often overlooked in the literature but may increase the explanatory power of the

Theory of Planned Behaviour model, namely perceived responsibility regarding food waste, institutional trust, eco-guilt, guilt related to food waste, and perceptions of injustice related to food waste. This study builds on the same literature gap as Study 1, namely the limited understanding of the role of responsibility, trust, guilt, and injustice in shaping household food waste behaviours.

Study 3 ($N = 86$) integrated the Theory of Planned Behaviour with implementation intentions and coping strategies to help participants predefine food waste reduction goals and plan how to manage potential obstacles. The study used a single-wave experimental design and a convenience sample of students from the University of Milano-Bicocca, and it can be considered a pilot for Study 4. This study addresses a key gap in the literature: the limited use of implementation intentions to promote specific food waste prevention behaviours, and the scarcity of studies incorporating coping strategies in this context.

Study 4 ($N = 233$) was a modified and refined version of Study 3, using a sample of Italian adults invited and compensated through the Prolific platform and a two-wave longitudinal experimental design. The same variables assessed in the pilot study were measured at two time points, two weeks apart. The pilot study showed that asking participants to adopt only one specific prevention behaviour might have been too restrictive. Therefore, Study 4 allowed participants to choose the strategy they wanted to implement over the following weeks, offering greater flexibility and better alignment with their goals. Like Study 3, this study addresses the gap in the lack of implementation-intention-based interventions and the limited incorporation of coping strategies in food waste prevention research.

Study 5 ($N = 125$) investigated food waste and the motivations for avoiding it using a longitudinal online experimental design delivered through *Time2Rate*, an application developed by the University of Milano-Bicocca that provides links to online questionnaires and daily notifications. The study focuses on and utilises the concept of food waste's impact on the environment, economy, and society as levers – with the use of informational and motivational nudges – to promote more favourable attitudes, intentions, and reduce food waste over a 9-day period. The study was conducted in collaboration with Erica van Herpen, Professor at Wageningen University and Research. This study addresses the relatively recent literature on the motivations underlying food waste avoidance, highlighting the need for research that uses these diverse motivations as

drivers of waste reduction and for longitudinal studies employing app-based interventions.

Study 6 ($N = 270$) investigated food waste and the motivations for avoiding it in a leisure context, using a single-wave online experimental design. Similarly to Study 5, it focuses on the impact of food waste and the level of awareness associated with it, the motivations behind avoiding food waste, and the use of informational nudges to increase awareness and intentions. The study was conducted in a leisure setting, at Camping Le Esperidi in Marina di Bibbona, Tuscany. This study addresses an important gap: no previous studies have examined food waste in the context of vacations, which remains an underexplored setting for pro-environmental behaviours more broadly.

3

EXPLORATIVE STUDIES

Research on food waste at the consumer level has expanded considerably in recent years. Scholars have identified a wide range of habits that shape food waste, including shopping preferences, food management behaviours, and prevention strategies like meal planning and prepping, good storage and reuse of leftovers (Annunziata *et al.*, 2022; Bhattacharya *et al.*, 2021; Boulet *et al.*, 2021; Etim *et al.*, 2025). Research has extensively investigated the psychological and cognitive determinants of food waste, with a large body of literature grounded in the Theory of Planned Behaviour (TPB; Ajzen, 1991), examining attitudes, social norms and perceived behavioural control over intentions to reduce food waste, and some studies has included in their research additional predictors drawn on TPB extensions such as the Model of Goal-Directed Behaviour (MGB; Perugini & Bagozzi, 2001), including anticipated emotions and the influence of past behaviour on future actions (Bhattacharya *et al.*, 2021; Dane Chia *et al.*, 2024; Hebrok & Boks, 2017; Principato *et al.*, 2021; Reisch *et al.*, 2021; Vittuari *et al.*, 2023).

Attitudes towards food waste or food waste reduction, social norms, anticipated emotions, perceived behavioural control and past behaviour consistently predict intentions to reduce food waste (Al Mamun *et al.*, 2024; Aydin & Aydin, 2022; Barone *et al.*, 2019; Chandra *et al.*, 2024; Etim *et al.*, 2025; Floriano, 2024; Habib *et al.*, 2023; Mansouri & Kaswengi, 2025; Melnyk *et al.*, 2025; Yasini *et al.*, 2025).

For example, emotions have emerged as significant predictors of food waste intentions, though findings on the direction of this relation remain mixed. Negative emotions, such as feeling guilty about one's own food waste, often promote more virtuous anti-waste behaviours (Saman Attiq *et al.*, 2021; S. Attiq, Chau, *et al.*, 2021; Chakraborty & Mattila, 2025; Fazal-e-Hasan *et al.*, 2024; Lau *et al.*, 2024). However, in some cases, negative emotions appear to have counterproductive effects, leading to feelings of avoidance or ignoring the desired or normative behaviour (Chakraborty & Mattila, 2025; Russell *et al.*, 2017). These mixed results reflect a broader body of research and an

ongoing debate concerning the role of emotions in pro-environmental behaviours (Saman Attiq *et al.*, 2021; Russell *et al.*, 2017).

Additional predictors of food waste intentions and behaviours

Despite the relevance of these findings, what is currently missing, and what our study seeks to address, is an examination of some aspects that have not yet been investigated in depth, such as individuals perceived personal responsibility in reducing food waste, as well as their perceptions of the responsibilities held by different societal actors, the role of trust in institutions regarding the issue of food waste, and the role of guilt, specifically in the declinations of eco-guilt and food waste guilt.

Although the aforementioned aspects have received less attention in the literature, emerging evidence suggests they may influence understanding of food waste and its determinants at the individual or household level. For instance, *eco-guilt* and *guilt related to food waste* have been shown to be effective drivers of food waste reduction intentions in settings such as restaurants (Chakraborty & Mattila, 2025) and in consumer decision-making (Unger-Plasek *et al.*, 2025), while perceptions of personal *responsibility* and ethics are key elements in determining food waste attitudes and behaviours, in some cases positively enhancing anti-waste practices (Chang, 2019; Kumar *et al.*, 2025; Mansouri & Kaswengi, 2025) and, in other cases, being an obstacle to pro-environmental behaviours (Kollmuss & Agyeman, 2010). *Institutional trust*, though rarely examined in relation to food waste intentions and behaviours, appears to enhance consumer attitudes toward reduction through mechanisms like corporate social responsibility initiatives and political stability (Pronti & Zoboli, 2024). Many studies have been conducted in the context of company trust; however, there is a lack of literature exploring how the perception of institutional responsibility affects everyday household food waste. Similarly, the literature on pro-environmental behaviours shows that *pro-environmental identity*, or self-perception as a green or environmentally conscious person, contributes to shaping pro-environmental behaviours more generally (Chuck *et al.*, 2016; Graham-Rowe *et al.*, 2019; Nezlek & Forestell, 2020). This construct has also been preliminarily investigated in the food waste domain, where individuals who see themselves as “anti-waste” and environmentally responsible are more likely to act sustainably in experimental settings (Bartels & Onwezen, 2014; Carfora & Catellani, 2022; Graham-Rowe *et al.*, 2019). However, the relationship between self-identity and food waste intentions and behaviours remains in need of more investigation. Finally, the social issue of *food injustice*, understood as the dual problem of some people or regions consuming and wasting

excessive amounts of food while others face scarcity or insecurity, is a key concept that has received little attention in the socio-psychological literature. One study highlights the importance of addressing ethical dilemmas in balancing individual and community well-being (Chang, 2019), firmly suggesting that tackling the ethical issues underlying food waste is necessary. This research aims to address this gap.

Overview of Studies 1 and 2. In Study 1, we aimed to explore these aspects in depth through interviews to gain insight into the real-life experiences and perceptions of an Italian sample. In Study 2, we aimed to develop a model that combines the constructs of responsibility, guilt, institutional trust, pro-environmental self-identity and food injustice with the more established components of the TPB. Our goal was to examine whether such an integrated model could better explain both general and more specific intentions to reduce food waste behaviours and increase preventive strategies for reducing household food waste. This research employs two complementary methodologies to explore novel predictors of intentions to reduce food waste and to engage in food waste prevention behaviours. In doing so, it addresses a significant gap in the literature, which has largely overlooked the roles of perceived responsibility, injustice, environmental concern, and institutional trust in the management of food waste. Establishing the relevance of these factors in shaping household food waste behaviours would provide a foundation for future research to further investigate these dimensions and to leverage them as potential drivers for promoting more sustainable consumption practices.

STUDY 1 – QUALITATIVE STUDY

INTRODUCTION AND RESEARCH AIM

Study 1 adopts an exploratory qualitative approach to investigate food waste across all aspects of an individual's daily life.

The aim of this qualitative study was to gain an in-depth understanding of how individuals experience, perceive, and manage food waste across all domains of their daily lives. This study also aims to explore several themes that are often overlooked in the food waste literature, such as responsibility, the role and communication of institutions, issues of social injustice, and the values associated with food and food waste.

MATERIALS AND METHODS

Study design

The study included 20 semi-structured interviews, a sample size consistent with established methodological guidance for qualitative research.

Participants

Sample size estimation. Because prior work indicates that thematic saturation is typically achieved within 15–30 interviews for studies of this type (Francis *et al.*, 2009; Marshall *et al.*, 2013), the minimum sample size was set at 20 participants. Respondents were invited to participate through snowball sampling and were compensated with €10 per interview. The only selection criteria were that participants were adults and not experts in the field of food waste. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2024-864).

Sample. The sample consisted of 20 participants, including 13 women and 7 men, with a mean age of 36.95 ($SD = 13.21$, range 21–65). All participants were residents of Northern Italy. Regarding education, 13 participants held at least one university degree, 6 held a high school diploma, and 1 held a middle school diploma. In terms of occupation, the sample included 4 self-employed individuals, 10 employees, 2 retirees, 3 working students, and 1 full-time student. Household composition was generally small, with 7 participants living alone, 3 in two-person households, 4 in three-person households, and 6 in four-person households. Only 2 participants lived with children under 18 years old.

Measures

The study investigated participants' experiences and opinions regarding both the practical and broader aspects of food waste. *Practical aspects* included food management, cooking, leftover handling, strategies implemented at home to reduce food waste, and shopping and consumption habits. Broader aspects encompassed the economic and environmental, as well as the *impact of food waste* on society and the related perception of *social injustice*, including the perception of *responsibility* among various actors, such as participants themselves, regarding who is accountable for addressing food waste at the national and global levels. In addition, the study examined *communication* about food waste, including institutional messaging and traditional and social *media*, and explored participants' *emotions* and hopes for the future. For a more detailed interview guideline, see the Appendix.

RESULTS

Analyses were conducted using NVivo (version 14). Interviews were transcribed verbatim and, with the help of NVivo, the main thematic nodes were identified by following the interview skeleton and evaluated whether to create ad hoc nodes from the participants' spontaneous information. Two approaches were applied. First, a content analysis was conducted to identify recurring themes and key concepts expressed by participants. Second, a cluster analysis based on coding similarity was performed to explore relationships between codes and highlight potential groupings or associations within the dataset. All quotes presented here are anonymised, and participants are identified by a code indicating their gender and age range (e.g., M30-35).

Content Analysis

The following section presents the thematic content analysis results, including selected excerpts that illustrate key insights from the participant interviews.

Food waste behaviours and preventive strategies

Logistical and organisational issues, such as excessive purchasing, poor food management at home, and inadequate planning, are among the main causes of food waste.

Many participants admitted to buying more than they needed and subsequently struggled to manage their food storage, particularly for perishable items such as dairy products or foods that required more preparation time, like fruits and vegetables.

“Well, definitely whatever’s left in the fridge, forgotten, going bad...” and “So maybe it ends up being something barely edible, like... not exactly delicious. And the problem is that since I’m alone, I have to eat all of it myself.” (F20-25)

“Well, definitely buying things that just rot in the fridge without ever being used — basically, poor planning of what you actually intend to eat in the next few days.” (M25-30)

When a family goes shopping big and doesn’t eat everything... They didn’t really need it, so most of it ends up being thrown away. Especially the fresh stuff, if the expiration dates are pretty close. You just don’t have a clear idea of what to buy, right?”(F60-65)

Time also plays a crucial role in shaping food consumption behaviours. A fast-paced and demanding lifestyle often leads to food waste, even when good intentions are present.

“I buy a broccoli and then have to leave for work... it inevitably ends up in the bin.” (F25-30)

Outside the home, participants highlighted additional issues related to portion sizes that are not determined by the consumer, as well as issues related to the type of restaurants. They also express the usefulness of asking to take away leftovers, which can sometimes cause embarrassment.

“So it’s wasteful not to offer more options for actually choosing the portion size. Having only a single portion option seems kind of wasteful.” (F20-25)

“I think asking to take food home creates embarrassment because of a sense of personal pride. It feels a bit shabby to take food away. It’s not a habit yet, but once it becomes a habit, there’s no negative judgment — a habit is just a habit.” (M25-30, talking about what he thinks people do)

“I always ask for it, because it often happens that... rather than letting it go to waste, I ask for a doggy bag. At first, the looks I got bothered me, to be honest. Now, I just don’t care at all.” (F30-35)

Portion issues also apply in institutional settings such as school canteens, where managing leftovers and the quantity of food consumed by children is even more difficult to control.

“When I work at school with the kids, they throw away a ton of food because they don’t eat everything you give them. Then the cook comes and throws away not just the scraps the kids left, but also the food that wasn’t even touched. Every time I see that, I... I just get this chill running through me.” (F30-35)

Participants show awareness of the issue, and although they recognise the partial inevitability of food waste, they nonetheless adopt various preventive behaviours to minimise it. For instance, some described how they creatively reuse leftovers. Freezing food is also a common strategy to reduce waste and optimise time spent cooking or planning and prepping meals in advance for the week ahead.

“A leftover legume soup became patties... the main point is not to throw food away.” (F30-35)

“If you look at my freezer, it’s full of stuff. All those Tupperware containers with food inside.” (M30-35)

Emotions

Emotions are one central aspect in the interviews. Negative emotions are constantly expressed verbally or nonverbally throughout almost every interview. The most frequently reported emotions associated with food waste are guilt, stemming from the inability to manage food properly or from discarding it, sadness, anger and disgust. Participants described these negative emotions not only as an immediate reaction to waste but also as a lingering sense of having failed to act responsibly, especially when they consider the difficulties some people face in securing sufficient food. Participants also expressed anger toward those who waste food carelessly, especially family members or housemates, as well as toward themselves, akin to guilt. Such feelings reveal an

underlying sense of violating a moral norm that one strives to uphold, but which circumstances occasionally force one to betray, or the difficulty of not always being able to properly manage food at home and minimise one's own food waste.

"Mostly sadness and guilt. Guilt because I think of those who have nothing to eat."

(M25-30)

"It made me so angry when they threw everything away... they'd open three cartons of milk at once!" (F20-25)

"This reflects an ideological disgust, which, in effect, also manifests as anger" (M30-35)

One aspect of food waste that elicits contrasting emotional responses is *food abundance*. Whether abundance is perceived as positive or negative depends on the context. It may symbolise wealth, generosity, or festive occasions, evoking memories of holidays, family, and joy. Yet when abundance becomes excessive, and the quantity of food suggests opulence, negligence, or waste, it is framed negatively, and it is associated with moral discomfort and social critique. In this sense, abundance embodies both aspiration and unease, representing prosperity while also evoking the potential breach of self-control and ethical responsibility.

"I don't know, maybe I'm a bit influenced by my grandfather's stories from the war, but having food at home feels like a positive thing — better to have too much than too little.

So abundance, for me, is always good. Of course, it's also tied to waste sometimes, because having more can mean wasting more, which is bad, but still, having more gives you a sense of security." (M25-30)

"The image that comes to mind is like a cartoon-style banquet, a classic Thanksgiving scene. I've always associated it with... well, now that I'm thinking out loud, it's about conviviality, being surrounded by loved ones. For me, abundance of food is almost equivalent to being in a group, sharing that food together. So I'd say it's positive."

(F30-35)

One participant also explicitly emphasised the importance of the person who prepares or cooks food and its impact on the perception of food waste. A homemade dish

carefully prepared by a family member or someone we care about is perceived as more valuable than a packaged product, and discarding it entails a greater emotional burden. This might also suggest that waste can be perceived more or less negatively based on the quality of the food and the emotional connection to it.

“Guilt towards food waste when the figure of the person who prepared the food is also involved. Maybe in front of grandma's lasagna...” (F25-30)

Injustice

The idea that food waste is somehow linked to the problem of some people not having enough to eat is immediately apparent to many participants. Many participants, when asked what came to mind upon hearing the term food waste, referred to the contrast between wasted food and the injustice faced by those who lack access to adequate nutrition. This perception is strongly influenced by Italian cultural traditions, in which it is very common to hear, as a reproach from parents or other family members, “Think of the children who are starving”, to encourage finishing the food on one’s plate as a child, in an attempt to convey the value of having that food available in front of you. Many participants report this family-driven teaching in the interviews.

“Absolutely, it’s an issue of injustice. People who are hungry don’t waste that much. It’s only those who already have full stomachs, that’s where the injustice lies. Privilege, full stomachs, waste.” (M30-35)

“I think environmental waste is also an ethical problem. Beyond the animal aspect, like I was saying, knowing that there are people at war who don’t have food while I’m here throwing it away makes me feel morally and ethically bad.” (M20-25)

“In my opinion, it is a problem in itself that so much is produced that we cannot consume it, while at the same time there are people who have nothing. So I think, isn’t there a way to... We both waste food and let people starve, how is that possible? I mean, then only those who have money eat, and those who don’t... it’s really a contradiction.” (M20-25)

The sense of injustice is also intertwined with, again, feelings of sadness, anger, and disgust when considering the disparities in opportunities and access to food among individuals or populations.

“Well, because all in all, even though I’m not someone who donates to charity or actively tries to make things better, I can’t deny that you see the suffering of people around you, of populations who don’t have enough to eat. So, clearly, even if I’m not able to do anything to help them, it still bothers me and weighs on me.” (M60-65)

“Disgust and anger. Disgust is perhaps more of a gut reaction. Anger comes from recognizing in that act a part of an unfair whole. I mean, even there, you see, throwing away five chickens doesn’t exactly change the world, of course, but every day, in every place in Italy, everywhere in the world, there are people outside sleeping on the ground, with empty stomachs... that makes you angry, you know?” (M30-35)

Responsibility

The issue of responsibility for food waste and who should address it is a complex matter. Some participants argue that responsibility lies solely with consumers or citizens, as they make the choices, drive the market, and can enact change if they wish.

“Then, the responsibility is entirely ours, not anyone else’s, because we are thinking beings [...]. So, regarding food waste, the blame is ours.” (F60-65)

Others attribute responsibility primarily to institutions, companies, and multinational corporations, as they shape the shared spaces of society and possess greater capacity to effect change.

“It should definitely be the State. Responsibility always lies with the State. First, because it must be able to oversee and ensure, let’s say, the well-being of the entire population.” (M60-65)

Yet the majority perceive responsibility as distributed across all levels of society, from individual actors to institutions, while assigning different weights depending on their varying impacts on society and the environment, as well as their capacity to address the problem effectively.

“Everyone has a responsibility when it comes to food waste, but the state needs to implement regulations to combat it.” (F60-65)

Consequences of food waste

An interesting dimension concerns the perceived global consequences of food waste. Participants were asked whether they viewed food waste as an environmental, economic, or social issue. While the connection between food waste and climate change was not immediate or spontaneously mentioned, many acknowledged its existence. Some referred to the overproduction of food, distinguishing between animal-based and plant-based products, while others noted the environmental impact of organic waste disposal or food packaging. The economic aspect appeared more evident: participants referred to food waste as a financial loss, particularly at the individual level, though it was often perceived as a secondary problem. The social dimension, on the other hand, emerged as one of the most salient and spontaneously mentioned themes.

“There’s definitely also an aspect of social justice, just as there’s an environmental aspect.” (M30-35)

“Yes, and also in terms of the potential environmental impact [...]. From a certain perspective, I also feel a sense of danger, because waste also implies increased consumption, higher production, greater pollution, and therefore a greater threat to the planet [...].”(M25-30)

“And also the economic situation we’re going through. Everything is expensive now, and we don’t earn that much. That’s why people should really be careful not to waste [food], also for this reason.” (F30-35)

Source of information

Regarding communication, most participants reported never having heard about food waste through top-down channels, such as institutional or traditional media. Some participants expressed greater engagement due to content encountered on social media platforms offering anti-waste tips. However, the overall perception is that the topic receives limited public discussion and that communication efforts are largely absent. Awareness is primarily transmitted through families, cultural traditions, and habits passed down by parents or grandparents, often as a moral value tied to the ethical and symbolic importance of food. This may contribute to the perception of food waste as a “domestic” rather than global issue, considered less significant in economic or environmental terms.

“It’s definitely not talked about much. Most of what I’ve said... well, not most, but some of the things I mentioned are actually thoughts that came to me for the first time today. I just pulled them out off the top of my head.” (M30-35)

Personally, I’d like to see an approach that politics almost never takes, or only rarely, a scientific approach to facts. Instead, there’s a strong tendency to approach everything ideologically. (F25-30)

“I was always taught that way, by my mom, my grandfather... I often lived with my grandfather, he actually fought in the war [...] and was very poor, so that really left a strong impression on me.” (M30-35)

Additional Insights

Some noteworthy cases emerged from the individual interviews, offering valuable insights. One participant identified water waste as a form of food waste, highlighting the significant environmental impact of excessive water consumption at all stages of food production and suggesting that domestic water use should also be considered within food waste studies.

“But I think we’re on a planet that’s being depleted more and more – water, food, resources – and wasting any of it is really serious. That goes for water too.” (F30-35)

Another participant emphasised the religious dimension of food practices. Spirituality might also serve as a powerful motivator for reducing food waste.

“In my faith, food is a gift from God; it should not be wasted out of respect.” (F30-35)

Finally, a participant working in an “all-you-can-eat” sushi restaurant described the structural and cultural roots of waste, where excessive availability and overeating lead to both discarded food and health issues. Such examples underline the need for institutional and systemic approaches to counter a wasteful, consumer-driven food culture.

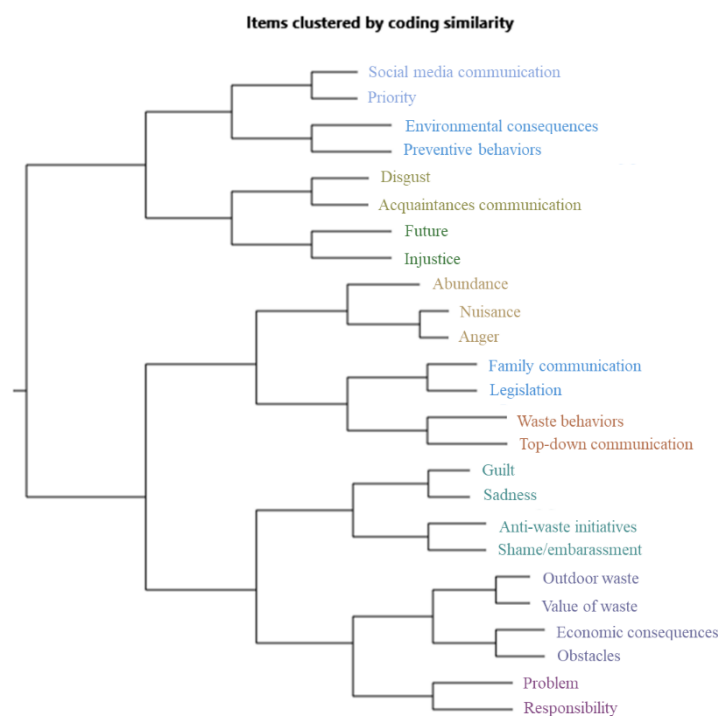
“Yes, I think it’s mostly a problem in this type of restaurant. Since a person can order as much as they want and then obviously doesn’t eat it all, especially kids, who often leave a lot uneaten, sometimes they hide it in the sofas or stuff like that, and then you have to clean up all that mess. Or they send it back half-eaten, and it just has to be thrown away.” (F20-25)

Cluster Analysis based on Coding Similarities

A cluster analysis was conducted in NVivo to examine similarities among the themes. Using coding similarity, the analysis generated a hierarchical dendrogram that highlighted patterns of co-occurrence (Figure 3.1). The findings are exploratory and serve to complement the thematic analysis by highlighting structural relationships among themes.

Figure 3.1

Items clustered by coding similarity



One branch indicates that the perception of food waste as an environmental issue is primarily associated with communication through social media, and that environmental consequences are related to preventive behaviours and strategies aimed at reducing food waste. Disgust related to food waste is likely discussed more with acquaintances and housemates, whereas future-oriented perspectives are linked to the sense of injustice inherent in food waste.

A second branch reveals that the theme of food abundance is linked to feelings of annoyance and anger. Communication about food waste occurs predominantly within families and traditions, while it is notably absent at the legislative level, which explains its association. Self-reported waste behaviours by participants are instead closer to top-

down communication, potentially reflecting the perception that initiatives against food waste managed by higher-level institutions may be more effective. Guilt and sadness, which are strongly linked, are associated with anti-waste initiatives, primarily cited as apps that help reduce store-level food waste (e.g., Too Good To Go), as well as with feelings of shame and embarrassment. Food waste occurring outside the household is discussed in relation to the perceived value of waste, likely referring to meals at restaurants or school canteens. Economic consequences, situated near everyday obstacles that may contribute to food waste, are closely associated with the conceptualisation of food waste as a problem and with the theme of responsibility.

DISCUSSION

The interviews presented here highlight the complexity of the food waste issue. Participants reported numerous difficulties in managing food waste, including challenges related to planning and organisation, as well as pressures from the surrounding environment that encourage overproduction and overconsumption. At the same time, they described various strategies to manage and prevent waste and demonstrated a generally high level of awareness and concern regarding the topic. Participants also showed considerable sensitivity to issues of food inequity and expressed strong negative emotions when discussing both food waste in general and social injustice in particular.

The topic of food waste is more readily associated with domestic and familiar contexts in participants' minds. However, when the connection between waste and the environment is highlighted, the discussion broadens: participants begin to describe a larger system that is dysfunctional, overproduces, and consequently generates excessive waste.

They also link it to many other problems that this system causes at environmental, social, and other levels, such as the animal food industry, fast fashion, pollution, and global warming, among others. Overall, the prevailing sentiment expressed in the interviews is that most participants perceive the severity of the problem and feel a deep sense of sadness and disillusionment toward the broader system within which food waste occurs. The perceived lack of communication, a sense of helplessness, and the absence of effective strategies to cope with the daily challenges and the increasingly catastrophic consequences of food waste – particularly for the environment – set an overall negative and disenchanted tone for nearly all participants.

STUDY 2 – CORRELATIONAL STUDY

INTRODUCTION

In Study 2, we aimed to develop a model that combines the new components of responsibility, guilt, institutional trust, pro-environmental self-identity, and food injustice with the more established components of the Theory of Planned Behaviour. While Study 1 allowed us to explore in depth some aspects of food waste that have been less frequently investigated in social psychology, Study 2 seeks to examine how these dimensions contribute to predicting both general and specific intentions to reduce food waste and engage in preventive household strategies to combat food waste in the specific household context.

HYPOTHESES

The first aim of this study was to test an extended version of the Theory of Planned Behaviour (TPB; Ajzen, 1991), incorporating the variables of anticipated emotions and past behaviour from the Model of Goal-directed Behaviour (Perugini & Bagozzi, 2001) in the context of household food waste. According to the literature mentioned above, we proposed the following hypothesis:

H1. Attitudes, social norms, anticipated emotions, perceived behavioural control and past behaviour are significant predictors of intentions to reduce household food waste.

Second, we aimed to test additional predictive variables to develop a new model of food waste behavioural intentions that can delve deeper into the mechanisms underlying household food waste.

H2. Perception of responsibility, perception of food injustice, eco-guilt, guilt related to food waste, trust in institutions, and pro-environmental self-identity positively predict intentions to reduce household food waste.

Study design

The study employed a single-wave correlational design. Participants completed an online Qualtrics questionnaire via the Prolific platform.

Participants

Sample size estimation. The sample size was predetermined prior to data collection, with a priori power analysis conducted using G*Power 3.1.9.4 (Faul *et al.*, 2007) for the "Linear multiple regression: Fixed model, R² deviation from zero" test. With a significant criterion of $\alpha = 0.05$, power = 0.95, and 7 initial predictors. The minimum required sample size for this effect size was $N = 153$. A posteriori analysis with 12 predictors, using the same criteria, confirmed that the minimum sample size ($N = 184$) was met. Except for the minimum age requirement, no specific inclusion or exclusion criteria were applied. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2024-864).

Sample. Participants were invited to participate in the study through the Prolific platform and were compensated with £1.75. They consented to complete an anonymous 12-minute online questionnaire via Qualtrics. The sample consisted of 287 participants, including 142 women, 139 men, and 6 non-binary individuals, with an average age of 34.2 years ($SD = 11.1$, range 18–71). Participants were geographically diverse, representing all 20 Italian regions, and different occupations and household compositions. Regarding education, 62% ($n = 177$) of participants held at least one university degree, 41% ($n = 118$) had a high school diploma, and 2% ($n = 6$) had completed middle or elementary school. Regarding their economic situation, 44.3% of participants reported experiencing some difficulty in meeting their needs, while 55.7% indicated that they were able to meet their needs with relative ease. Political orientation, a 7-point scale from 1 (extreme left) to 7 (extreme right), averaged 3.16 ($SD = 1.14$), with 88 participants identifying as left or extreme left, 101 as centre-left, 58 as centre, 32 as centre-right, and 7 as right or extreme right. Dietary habits were predominantly omnivorous (80%), with 8 pescatarians, 30 flexitarians, 13 vegetarians, 3 vegans, and 1 raw foodist.

Measures

After providing informed consent, participants completed socio-demographic questions followed by the scales reported in Table 3.1. The scales are presented in the table in the same order in which they were administered to participants. Items within each scale were randomised.

Table 3.1

Measures Included in the Study and Example Items

Variable	Reference	Example item	N° of items	Response scale
Value-driven motivations to avoid food waste	Adapted from Nezelek & Forestell, 2020	<i>Environment, economy, and culture/religion</i>	3	1 = Completely disagree, 5 = Completely agree
Eco-guilt	Adapted from Ágoston <i>et al.</i> , 2022	<i>“I feel guilty because I don’t pay enough attention to the issue of climate change”</i>	3	1 = Completely disagree, 5 = Completely agree
Food waste guilt	Adapted from Culiberg <i>et al.</i> , 2022	<i>“I feel guilty when I throw away food that is still edible”</i>	3	1 = Completely disagree, 5 = Completely agree
Individual responsibility	Boto-García & Bucciol, 2020	<i>“To what extent do you feel personally responsible for reducing food waste?”</i>	1	1 = Completely disagree, 5 = Completely agree
Perception of responsibility of various actors	Ad hoc	<i>Citizens, the state, governments, multinationals, etc.</i>	8	0-100 slider 1 = Not responsible at all, 100 = Most responsible
Priority of food waste	Ad hoc	<i>“Compared to other environmental problems, how urgent and prior is food waste?”</i>	1	1 = Not a priority, 5 = Completely a priority
Pro-environmental self-identity	Adapted from Kuswati <i>et al.</i> , 2021	<i>“I consider myself someone who cares about the environment”</i>	3	1 = Completely disagree, 5 = Completely agree
Institutional trust	Adapted from Di Napoli <i>et al.</i> , 2024	<i>“In managing the food waste problem, please indicate how much trust you place in the following entities: Regional and local governments, the state, etc.</i>	6	1 = No trust, 5 = Complete trust

Food injustice	ad hoc; Schmader <i>et al.</i> , 2001	<i>“Wasting food is an injustice towards people who do not have food security”</i>	4	1 = Completely disagree, 5 = Completely agree
Past behaviours	Perugini & Bagozzi, 2001	<i>“Please indicate how often these food waste-related behaviours are typically carried out by you or other members of your household.” E.g., meal planning, throwing away leftovers, etc.</i>	14	1 = Never, 5 = Always
Anticipated emotions	Perugini & Bagozzi, 2001	<i>“If I succeed/not succeed in reducing my household food waste, I will feel...”</i>	3	1 = Not at all, 5 = Very much
Attitude towards food waste reduction	Ajzen, 1991	<i>“I think that reducing my household food waste over the next two weeks is...”</i>	6	E.g., 1 = Useless, 5 = Useful
Social norms (descriptive, and injunctive norms)	Ajzen, 1991; Graham-Rowe <i>et al.</i> , 2015	<i>E.g., “The important people in my life try to reduce their household food waste”</i>	3	1 = Completely disagree, 5 = Completely agree
Perceived Behavioural Control	Ajzen, 1991	<i>“I believe I have control over reducing household food waste”</i>	3	E.g., 1 = Completely disagree, 5 = Completely agree
Intentions to reduce food waste	Ajzen, 1991	<i>“I intend to reduce my household food waste in the future”</i>	3	1 = Completely disagree, 5 = Completely agree
Intentions (waste) and (preventive)	Ad hoc	<i>The same 14 items used for past behaviour were framed to prompt participants to consider behaviours they would modify in the future.</i>	14	1 = Drastically reduce the behaviour, 5 = Drastically increase the behaviour

RESULTS

Analyses were conducted using Jamovi (The Jamovi project 2024) and R (R Core Team 2024), including validity and reliability assessments for all measures.

Descriptive analysis

As is common in self-reported studies (Armitage & Conner, 1999), virtuous behaviours are consistently reported more frequently than wasteful behaviours (Table 3.2). On average, the preventive behaviours most frequently enacted by participants included *making a shopping list, checking labels and expiration dates, and reusing leftovers*. Among wasteful behaviours, the most reported was *overeating*.

Table 3.2

List of food waste preventive behaviours (items 1-9) and waste behaviours (items 10-14)

Item	N	Mean	SD
<i>Preventive behaviours</i>			
1. Meal planning	286	3.22	1.11
2. Meal prepping	286	2.43	1.09
3. Shopping list	287	4.00	1.05
4. Measure aliments	287	3.66	1.08
5. Reuse leftovers	287	3.87	1.01
6. Check labels	286	4.40	0.70
7. Composting	286	2.15	1.32
8. Organise food in the household	287	3.73	0.95
<i>Waste behaviours</i>			
9. Overprepare	287	2.38	0.82
10. Overeat	287	2.52	0.96
11. Throw away leftovers	287	2.09	0.81
12. Let food spoil	287	2.08	0.70
13. Change one's mind on purchased food	287	1.93	0.85
14. Cooking errors (e.g., burning food)	286	1.95	0.85

Table 3.3 illustrates how participants attribute responsibility for food waste to different actors and institutions. It is noteworthy that, although the greatest responsibility is attributed to retailers and multinationals, the value assigned to citizens is also high.

Table 3.3*Descriptives of the perceived responsibility of different actors in determining food waste*

Item	N	Mean	SD
Citizens	287	61.5	28.3
Institutions	287	48.3	27.9
Governments	287	56.7	29.1
Companies	287	65.9	25.0
Retail	287	74.0	21.7
Multinationals	287	70.0	26.1
Traditional media	287	33.7	26.8
Social media	287	32.6	27.7

The perceived priority of food waste relative to other environmental issues appears to be remarkably high (Table 3.4), particularly when considered in light of the qualitative findings. Moreover, Table 3.4 also presents the mean values for the motivations to reduce food waste. The primary motivation appears to be economic, followed by environmental considerations, and, lastly, cultural or religious reasons.

Table 3.4*Descriptives of priority and motivations*

Item	N	Mean	SD
Priority of food waste	287	3.74	0.94
Motivation Environment	287	3.97	0.90
Motivation Economy	287	4.12	0.79
Motivation Culture/religion	287	2.31	1.24

Table 3.5*Descriptive statistics and reliability coefficients (Cronbach's α) for the composite variables included in the tested model*

Variable	N	Mean	SD	C. alpha
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Attitudes	287	4.23	0.66	.85
Social norms	287	4.06	0.77	.58
Positive anticipated emotions (PAE)	287	1.57	0.87	.81
Negative anticipated emotions (NAE)	287	2.82	0.94	.86
Eco-guilt	287	2.80	0.90	.76
Food waste guilt	287	4.12	0.79	.85
Pro-environmental self-identity (PESI)	287	3.76	0.70	.82
Responsibility	287	3.67	0.91	-
Institutional trust	286	2.16	0.62	.85
Food injustice	287	3.76	0.55	.75
Perceived behavioural control (PBC)	287	3.89	0.76	.74
Past behaviour (preventive)	283	3.43	0.59	.69
Past behaviour (waste)	286	2.16	0.51	.66
Intentions (general)	287	4.24	0.75	.95
Intentions (preventive)	283	3.67	0.48	.80
Intentions (waste)	284	2.03	0.63	.76

Note. *Social norms* is a composite variable combining descriptive and injunctive norm items. *Intentions (preventive)* = intentions to increase specific preventive behaviours in the future. *Intentions (waste)* = intentions to decrease specific wasteful behaviours in the future.

Table 3.5 illustrates descriptive statistics and reliability analysis for all measured variables. Attitudes toward reducing household food waste and perceived social norms are, on average, very high. Negative anticipated emotions associated with food waste were reported more strongly than positive anticipated emotions. A notable distinction emerges between eco-guilt and food-waste guilt: the former centres around the midpoint of the response scale, whereas guilt specifically related to food waste is substantially higher. On average, pro-environmental self-identity also indicates a sample with a strong pro-environmental orientation. Perceived individual responsibility is high, while trust in institutions to address the food waste issue is relatively low. Levels of food-injustice perceptions related to waste, as well as perceived behavioural control, are high. Past food-waste behaviours are reported as less frequent than preventive behaviours. General intentions to reduce one's food waste are very high, whereas intentions regarding specific

preventive behaviours are somewhat lower, though still elevated. Intentions to reduce specific wasteful behaviours in the future are, however, very low.

Correlation analysis

We conducted correlation analyses among the main variables to examine their interrelationships and to provide preliminary evidence of their associations. We report here only the most relevant correlations regarding the additional predictors and the intentions to reduce food waste, both general and specific (Table 3.6). For the complete correlation matrix, see the Appendix.

Table 3.6
Correlation matrix of the key variables

	1	2	3	4	5	6	7	8	9
1. Eco-guilt	—								
2. Food waste guilt	.11	—							
3. PESI	-.10	.37***	—						
4. Responsibility	.08	.47***	.47***	—					
5. Institutional trust	.07	.03	.19***	.21***	—				
6. Food Injustice	.22***	.23***	.13*	.18**	.01	—			
7. Intentions	.12*	.38***	.36***	.44***	.13*	.30***	—		
8. Intentions (prev)	.15*	.33***	.21***	.30***	.12*	.18**	.45***	—	
9. Intentions (waste)	.13*	.23***	.16**	.23***	.09	.19**	.33***	.50***	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Eco-guilt was not significantly correlated with food waste guilt but was positively related to perceived food injustice, suggesting a contradictory relationship between food waste and ecological issues. Food waste guilt positively correlated with pro-

environmental self-identity, perceived individual responsibility and food injustice. It did not correlate with institutional trust, indicating that guilt about food waste may be more personally or domestically grounded rather than connected to broader institutional attitudes. Pro-environmental self-identity was positively related to responsibility, institutional trust, and food injustice. Perceived responsibility showed strong positive correlations with institutional trust, food injustice. Institutional trust had no significant correlation with food injustice or intentions to reduce negative behaviours in the future. Although significant, these correlations were generally weak, suggesting that institutional trust plays only a limited role in shaping food-waste-related attitudes and behaviours in everyday life.

All additional predictors – eco-guilt, food waste guilt, PESI, responsibility, institutional trust, and injustice – were positively and significantly correlated with both general and specific intentions to reduce food waste. The only exception is the non-significant correlation between institutional trust and intentions to reduce food waste behaviours in the future.

Path analyses

A path analysis approach was employed, with predictors added sequentially to monitor change in model fitness and in R^2 . Model fit was evaluated following the criteria proposed by Hu and Bentler (1999). Good model fit was indicated by CFI and TLI values close to or above .95, RMSEA values below .06, and SRMR values below .08.

Table 3.7 illustrates the models tested.

Table 3.7

Fit indices of tested models

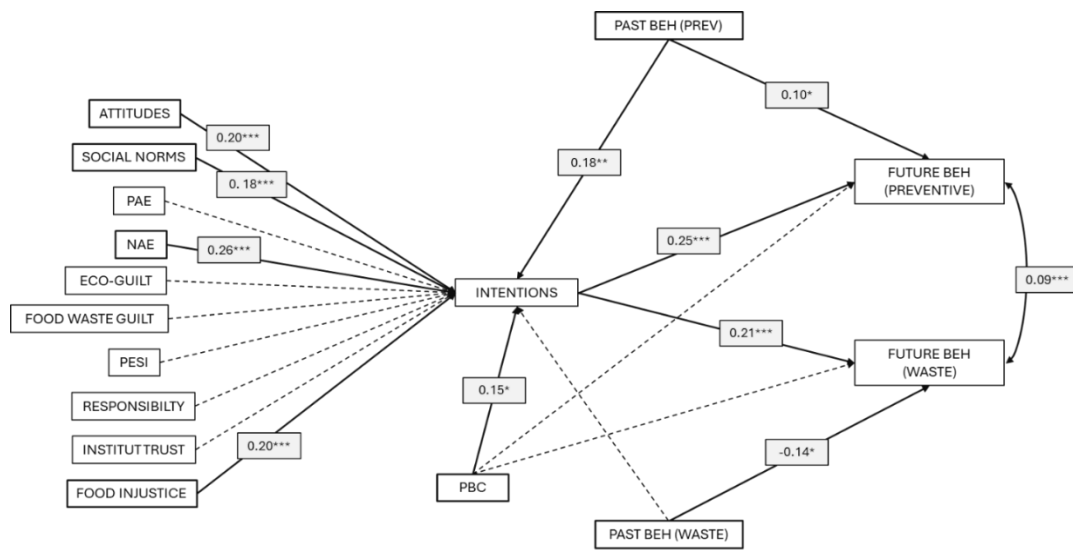
	X^2	df	p	CFI	TLI	RMSEA	SRMR	R^2
Model 1	178	6	<.001	1.00	1.00	.00	.00	.30
Model 2	438	28	<.001	1.00	1.00	.00	.00	.46
Model 3	1063.2	105	<.001	.98	.89	.06	.04	Int. general = .50 Int. (prev) = .20 Int. (waste) = .10

								Int. general = .50
								Int. (prev) = .21
Model 4	1142	120	<.001	.98	.91	.05	.03	Int. (waste) = .12

Note. Model 1 = attitudes, social norms and PBC as predictors and general intentions as dependent variable; Model 2 = adds anticipated emotions and past behaviour (from MGB); Model 3 = adds additional predictors, general intentions function as mediator and specific behavioural intentions as dependent variable; Model 4 = adds direct effects of past behaviours and PBC on the dependent variables.

In Table 3.7, Model 4 reports the most comprehensive model, including additional predictors and intentions to increase preventive and decrease food waste behaviours in the future as dependent variables. The overall model fit was satisfactory, $\chi^2(120) = 1142$, $p < .001$, CFI = .98, TLI = .91, RMSEA = .05, and SRMR = .03, and it adds explained variance compared to the original model of TPB. Consistent with the literature on TPB and its extensions, attitudes, social norms, perceived behavioural control, and past behaviour emerged as significant positive predictors of general intentions to reduce food waste. Interestingly, anticipated emotions have predictive significance for intentions only for negative emotions, not for positive ones. General intention to reduce food waste mediates the effect of emotions, social norms, perceived behavioural control, attitudes and past behaviours on both dependent variables (3.8). Among the additional variables, only food injustice has a significant effect on general intentions. Table 3.9 shows the direct effects of the predictors on intentions to increase positive behaviours in the future (e.g., planning, using leftovers) and intentions to decrease negative behaviours in the future (e.g., over-eating, throwing away leftovers). This model revealed that general intentions to reduce food waste partially mediated the effects of the additional predictors on both outcomes, but some direct effects also emerged (Tables 3.8 and 3.9). Specifically, eco-guilt and food waste guilt directly predict both types of behaviours, while responsibility predicts only preventive behaviours, and food injustice predicts only waste behaviours. Pro-environmental self-identity and institutional trust do not have a direct effect on the dependent variables. Overall, results suggest that the inclusion of additional predictors improved the explanatory power of the traditional TPB framework, with satisfactory fit indices.

Figure 3.2
Model of TPB plus additional predictors.



Note. $X^2 = 1142$ ($df=120$), $p < .001$. $CFI = .98$, $TLI = .91$, $RMSEA = .05$, and $SRMR = .03$. $R^2 = .50$ for generic intentions, $.21$ for future preventive behaviours, and $.12$ for future waste behaviours. Coefficients are unstandardised (*b*) values.

These additional measures were placed at the same level as the TPB antecedents of intentions because, as constructs, they measure similar aspects to those already established in the model, such as anticipated guilt, which aligns with anticipated emotions. Similarly, a sense of injustice, though cognitively laden rather than purely emotional, might operate analogously to emotions in driving waste avoidance, and a sense of responsibility could approximate perceived behavioural control (PBC), potentially representing its belief-based component.

Table 3.8
Indirect effects

Description	Estimate	SE	Lower C.I.	Upper C.I.	B	z	p
Attitudes ⇒ Intentions ⇒ Intentions (preventive)	0.05	0.02	0.02	0.08	0.07	3.00	.00
Attitudes ⇒ Intentions ⇒ Intentions (waste)	0.04	0.02	0.01	0.07	0.05	2.75	.01
Social norms ⇒ Intentions ⇒ Intentions (preventive)	0.05	0.01	0.02	0.07	0.07	3.29	.00
Social norms ⇒ Intentions ⇒ Intentions (waste)	0.04	0.01	0.01	0.06	0.05	2.97	.00

PBC ⇒ Intentions ⇒ Intentions (preventive)	0.04	0.02	0.01	0.06	0.06	2.46	.01
PBC ⇒ Intentions ⇒ Intentions (waste)	0.03	0.01	0.01	0.06	0.04	2.31	.02
PAE ⇒ Intentions ⇒ Intentions (preventive)	0.01	0.01	-0.01	0.03	0.01	0.66	.51
PAE ⇒ Intentions ⇒ Intentions (waste)	0.01	0.01	-0.01	0.02	0.01	0.66	.51
NAE ⇒ Intentions ⇒ Intentions (preventive)	0.07	0.02	0.04	0.09	0.13	4.36	<.001
NAE ⇒ Intentions ⇒ Intentions (waste)	0.06	0.02	0.03	0.09	0.09	3.69	<.001
Past behaviour (preventive) ⇒ Intentions ⇒ Intentions (preventive)	0.05	0.02	0.01	0.08	0.06	2.61	.01
Past behaviour (preventive) ⇒ Intentions ⇒ Intentions (waste)	0.04	0.02	0.01	0.07	0.04	2.44	.02
Past behaviour (waste) ⇒ Intentions ⇒ Intentions (preventive)	0.01	0.02	-0.03	0.05	0.01	0.38	.70
Past behaviour (waste) ⇒ Intentions ⇒ Intentions (waste)	0.01	0.02	-0.03	0.04	0.01	0.38	.70
Food guilt ⇒ Intentions ⇒ Intentions (preventive)	0.00	0.01	-0.02	0.03	0.00	0.21	.84
Food guilt ⇒ Intentions ⇒ Intentions (waste)	0.00	0.01	-0.02	0.02	0.00	0.21	.84
PESI ⇒ Intentions ⇒ Intentions (preventive)	-0.00	0.02	-0.03	0.03	-0.00	-0.06	.95
PESI ⇒ Intentions ⇒ Intentions (waste)	-0.00	0.01	-0.03	0.02	-0.00	-0.06	.95
Food Injustice ⇒ Intentions ⇒ Intentions (preventive)	0.05	0.02	0.02	0.08	0.06	2.88	.00
Food Injustice ⇒ Intentions ⇒ Intentions (waste)	0.04	0.02	0.01	0.07	0.04	2.66	.01
Responsibility ⇒ Intentions ⇒ Intentions (preventive)	0.02	0.01	-0.00	0.05	0.04	1.79	.07
Responsibility ⇒ Intentions ⇒ Intentions (waste)	0.02	0.01	-0.00	0.04	0.03	1.73	.08
Institution Trust ⇒ Intentions ⇒ Intentions (preventive)	-0.01	0.02	-0.04	0.02	-0.02	-0.91	.36
Institution Trust ⇒ Intentions ⇒ Intentions (waste)	-0.01	0.01	-0.04	0.01	-0.01	-0.91	.37
Eco-guilt ⇒ Intentions ⇒ Intentions (preventive)	0.01	0.01	-0.01	0.027	0.012	0.61	.55
Eco-guilt ⇒ Intentions ⇒ Intentions (waste)	0.01	0.01	-0.01	0.02	0.01	0.60	.55

Note. C.I. = 95% Confidence Intervals.

Table 3.9*Direct effects of new predictors on the dependent variables*

Predictor	Dependent	Estimate	z	p
Eco-guilt	Intentions (prev)	0.07	2.37	.02
	Intentions (waste)	0.08	2.35	.02
Food waste guilt	Intentions (prev)	0.15	4.13	<.001
	Intentions (waste)	0.09	2.11	.03
PESI	Intentions (prev)	0.02	0.50	.62
	Intentions (waste)	0.01	0.13	.90
Responsibility	Intentions (prev)	0.09	2.16	.03
	Intentions (waste)	0.05	1.39	.16
Institutional trust	Intentions (prev)	0.05	1.15	.25
	Intentions (waste)	0.05	0.96	.34
Food injustice	Intentions (prev)	0.05	1.05	.29
	Intentions (waste)	0.11	1.91	.056

Note. These effects are computed in the model (Figure 3.2) one at a time.

DISCUSSION

The study tested the validity of the Theory of Planned Behaviour (Ajzen, 1991) and its extension, the Theory of Goal-Directed Behaviour (Perugini & Bagozzi, 2001), which incorporates anticipated emotions and past behaviour, in explaining household food waste intentions and behaviours. The proposed model demonstrates a good fit and provides additional explained variance by including new predictors.

The first hypothesis (*H1*) is supported. Attitudes, perceived behavioural control, social norms, and anticipated emotions significantly predict food waste reduction intentions. Anticipated emotions show an interesting pattern: experiencing negative emotions related to waste appears to act as an actual motivator to reduce household food waste, supporting previous studies in the literature (Attiq, Chu, *et al.*, 2021; Attiq, Danish Habib, *et al.*, 2021; Chakraborty & Mattila, 2025; Fazal-e-Hasan *et al.*, 2024; Floriano, 2024; Lau *et al.*, 2024; Russell *et al.*, 2017), while positive emotions had no effect in determining intentions.

The second hypothesis (*H2*), which tested additional predictors in the extended TPB model, was partially confirmed. Guilt related to food waste, responsibility, and perception of injustice influenced intentions to reduce food waste, either indirectly through general intentions or directly on behavioural intentions to change food waste-related behaviours in the future. In contrast, eco-guilt, trust in institutions, and pro-environmental self-identity showed no significant effect. One possible explanation is that household food waste involves specific, everyday behaviours at the individual and family levels, whereas trust in institutions and perceptions of injustice related to food waste are perceived as more general and abstract and not directly linked to one's own waste behaviour.

GENERAL DISCUSSION

This first empirical chapter contains two explorative studies that aim at examining how people understand food waste, including whether they perceive it as a priority issue and what motivations underlie their efforts to reduce it; to investigate aspects that have been less extensively studied in the food waste literature, such as eco-guilt and guilt related to food waste, personal responsibility and the responsibility of various societal actors, social injustice linked to food waste, pro-environmental identity, the economic, environmental, and social consequences of food waste, institutional trust, and communication. Study 1 investigated in-depth personal experiences and opinions regarding food waste, while Study 2 tested a complex socio-psychological model of household food waste intentions, adding new predicting variables to the extended model of TPB. The two studies investigated the same themes using different methodologies, with the primary distinction being that the interviews allowed for a more nuanced and comprehensive exploration of all types of food waste, not limited to the domestic context but also encompassing school, workplace, and restaurant settings, among others.

Overall, the results highlight the importance of addressing food waste, both in household settings and in other areas of public life, within a broader framework that considers not only the individual dimension of waste but also wider issues such as collective and institutional responsibility. They also emphasise the crucial role of communication in tackling a problem that extends beyond the individual level and entails global environmental, economic, and social justice consequences.

In both studies, attitudes towards food waste are strongly negative, and the importance of emotions, particularly negative ones, is clearly evident. In Study 1, negative emotions are the most frequently and emphatically reported, including sadness, anger, and, above all, guilt associated with one's own food waste. In Study 2, intentions to reduce food waste are predicted by negative, but not positive, emotions. Social norms positively affect intentions to reduce household food waste. However, in Study 1, participants reported social norms only in a familiar context, highlighting the importance of traditions and values regarding food. Perceived behavioural control had a positive effect on intentions to reduce household food waste, but no significant effect on either specific preventive or waste behaviours. A possible explanation is that it is easier to feel competent in a general skill than to feel in control of specific and frequent activities that consume a significant amount of time in everyday life. Another possible explanation is that the variable of general intentions is designed within the MGB and therefore works best in conjunction with perceived behavioural control, whereas the two proxies of behaviours are ad hoc scales.

Interviews in Study 1 allowed for the investigation and categorisation of a wide range of food waste behaviours and strategies to prevent it. Participants generally report, in both studies, more preventive strategies or virtuous behaviours than wasteful ones, probably because they understood the scope of the study and wanted to appear mindful, and because they all share the belief that food has great value. This can be inferred, especially for participants in the interviews.

Additional variables. Guilt, both related to environmental issues and to food waste, has a significant positive effect on household intentions to reduce food waste, both general and specific. In Study 1, guilt is frequently mentioned, particularly in relation to the social issue of people in need not having enough food to eat. This is also reflected in the results of Study 2. Eco-guilt, however, is not explicitly mentioned by participants, but many display concern about the future related to the environmental crisis, indicating a generally good level of awareness of the problem.

The crucial role of guilt aligns with previous research on food waste (Attiq, Chu, *et al.*, 2021; Attiq, Danish Habib, *et al.*, 2021; Chakraborty & Mattila, 2025; Floriano, 2024; Lau *et al.*, 2024). But although guilt and negative emotions more broadly predict behavioural intentions, this does not imply that they represent the most appropriate or effective basis for

intervention. Explicitly eliciting negative emotions to promote behavioural change – thereby relying on extrinsic rather than intrinsic motivation – may produce counterproductive effects and potentially undermine the desired outcome (Chakraborty & Mattila, 2025; Russell *et al.*, 2017).

The theme of responsibility is consistently reflected across both studies. Participants in Study 2 report that responsibility is attributed to both individual citizens and large companies and institutions, highlighting a dual narrative. On the one hand, there is the awareness that each person has a duty to act and that collective action can produce a significant impact. On the other hand, there is recognition that the responsibility and impact of an individual are not equivalent to those of a large multinational corporation or a coalition of states. Similar patterns are observed in the interviews, where some participants attribute responsibility primarily to individuals, others to higher-level actors, and yet others perceive a distribution of responsibility across all levels, albeit with varying degrees and roles.

It is noteworthy that the perceived priority of food waste relative to other environmental issues appears to be remarkably high, particularly when considered in light of the qualitative findings. In the interviews, however, a secondary question addressing this dimension within the broader context of the environmental consequences of food waste revealed a more nuanced perspective: food waste was not perceived as a particularly pressing issue. Rather, it was regarded as a concern comparable to other environmental challenges, all of which were viewed as interrelated components of a broader systemic problem. Moreover, in Study 2, the primary motivation to reduce food waste appears to be economic, followed by environmental considerations, and, lastly, cultural or religious reasons. This finding is particularly relevant when compared with qualitative data, which reveal a markedly different pattern. In the interviews, participants identified cultural and value-related aspects as the most important drivers in their efforts to reduce food waste. A possible explanation could be related to self-presenting biases that occur in self-response surveys.

Institutional trust was not directly investigated in Study 1, but participants generally reported dissatisfaction with the institutions' handling of food waste, also indicating a lack of adequate information and communication regarding the problem. Food injustice is strongly perceived as a central issue in the context of food waste by participants in Study 1; however, in Study 2, individual responsibility showed little to no predictive effect, neither on general nor specific intentions to reduce food waste. The non-

significant effect of pro-environmental self-identity and institutional trust on intentions to reduce food waste, as shown in Study 2, does not reflect a lack of interest in the importance of these aspects. The central aspect of the issues emerges in the interviews. A potential explanation is a matter of proximity. Study 2 explored household food waste, and institutions and injustice tackle bigger systems that might be perceived as not related to food waste at the individual level. The fact that institutional trust, pro-environmental self-identity, and food injustice predict general intentions, but not specific ones, may be due to the specific household context, whereas the other variables have a more global perspective.

4

IMPLEMENTATION INTENTIONS AND COPING STRATEGIES

Having explored the issue of food waste in Studies 1 and 2, the next step is to determine how to design and implement interventions that help individuals reduce household food waste.

The literature on household food waste is extensive (Van Geffen *et al.*, 2020) with a substantial body of research grounded in the theoretical framework of the Theory of Planned Behaviour (Ajzen, 1991; Graham-Rowe *et al.*, 2015; Russell *et al.*, 2017), which conceptualises intentions to reduce food waste as a strong predictor of food waste behaviour. However, as is well established, a consistent gap has been observed between individuals' intentions to reduce food waste and their actual behaviours (Fraj-Andrés *et al.*, 2023; Nguyen & Nguyen, 2025; Shan *et al.*, 2024; Visschers *et al.*, 2016). Intending to do something and actually following through on that intention are two very different things. There are many factors that can obstruct the pursuit of a goal, thereby increasing the distance between one's intention and behaviour, such as opportunities, logistical obstacles, mood, competing goals or desires, and the difficulty of the goal. According to Goal-Setting Theory (Locke, 1968), setting specific and challenging goals leads to higher performance and greater employee engagement than vague or easy goals; therefore, promoting specific preventive behaviours to combat food waste should be more effective than fostering a general intention to avoid it. For example, wanting to avoid food waste is one thing, but actually managing to control all situations in the supermarket, at home, storing the food properly, having the time to cook and take care of the leftovers, etc., are all factors that can hinder the goal of not wasting any food, even if the intention is there (e.g., Tuu and colleagues, 2023).

One way to intervene and reduce this “intention-behaviour gap”, making intentions more closely aligned with their actual realisation, is to use implementation intentions (Carrington, 2010).

Implementation intentions are a method designed to help individuals translate intentions into actions, requiring participants to formulate specific plans that explicitly state *what, how, or when* an intention will be implemented. By making the intended action more cognitively accessible, implementation intentions provide a clearer mental representation of the goal and the steps required to achieve it. For example, turning a general intention, such as “I intend to get vaccinated,” into a concrete plan, like “I intend to book an appointment for the vaccination on [date] at [clinic].”

Implementation intentions have been shown to increase the likelihood of enacting the intended behaviour (Gollwitzer, 1999), and they have been proven to be an effective method in numerous studies involving health-related behaviours, such as engaging in physical activity (Bélanger-Gravel *et al.*, 2013), breast self-examination for cancer prevention (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Kompf, 2020; Sheeran *et al.*, 2005, 2005; Sheeran & Orbell, 2000), or monitoring behaviours or medical procedures that can be difficult or uncomfortable, such as home blood glucose monitoring (Schweiger-Gallo *et al.*, 2009).

Implementation intentions have been proven effective not only in the medical domain but also in the food domain. Using implementation intentions helped participants to improve healthy eating habits, increasing fruit and vegetable intake, or reducing snacking and unhealthy food consumption (Achtziger *et al.*, 2021; Adriaanse *et al.*, 2011; Carrero *et al.*, 2019; Guillaumie *et al.*, 2012; Loy *et al.*, 2016; Sullivan & Rothman, 2008). We therefore hypothesised that this approach could also be useful in achieving behavioural goals related to food waste. Although some studies investigated the effect of implementation intentions on food waste-related behaviours (Purwanto *et al.*, 2023), the literature is still relatively new (Reisch *et al.*, 2021; Reynolds *et al.*, 2019), and additional studies are required to understand how implementation intentions can actually work to push strategies to reduce food waste.

Coping planning. Although the literature on implementation intentions is vast, only a few studies have integrated coping strategies into their interventions. As we saw, many obstacles can interpose between good intentions and their actual realisation. Reducing the gap between what one intends to do and what one does might be easier if

one anticipates those problems and plans a strategy to address them. Sniehotta and colleagues (2005) formalised two distinct aspects of planning: action planning – in our case, implementation intentions – and coping planning, which involves thinking ahead about how to overcome potential obstacles in achieving the goal. Sniehotta and colleagues (2005) found that, after four weeks, participants tended to engage in physical exercise more frequently if they reported a higher level of coping planning at the end of the experiment, suggesting that coping planning can enhance the implementation intentions method and foster more efficient behaviour change. Research shows that planning how to avoid and cope with distractions before performing a cognitive task enhances actual performance on that task, (Gollwitzer & Schaal, 1998; Patterson & Mischel, 1976). Despite this, some studies suggest a different pattern. For example, Vinkers *et al.* (2015) found that including a plan B actually reduced the effectiveness of implementation intentions. One possible explanation is that, similarly to the mechanism underlying implementation intentions, mentally simulating negative outcomes may inadvertently prepare participants for failure rather than success. Further research is needed to examine the effectiveness of coping planning in addressing this issue.

Control and self-efficacy. Self-regulatory variables such as perceived control and self-efficacy can play an important role in achieving behavioural goals. Previous research highlights the importance of self-efficacy in determining behaviours and behaviour change (Vaughan-Johnston & Jacobson, 2020; Warner & French, 2022). In the framework of the Theory of Planned Behaviour (Ajzen, 1991), higher perceived behavioural control can strengthen the impact of implementation intentions by making it more likely that people will turn their intentions into real actions (Atakan & Bagozzi, 2024; Kompf, 2020; La Barbera & Ajzen, 2021). Moreover, implementation intentions can improve self-efficacy and goal attainment in various contexts (Arbour & Martin Ginis, 2004, 2009; Bayer & Gollwitzer, 2007; Murray *et al.*, 2009).

Overview of Studies 2 and 3. The studies presented in this chapter incorporate the Theory of Planned Behaviour, along with implementation and coping intentions, to foster food waste intentions and behaviour change. The two studies share the same objectives, most measures and materials, and questionnaire structure, with only a few differences. Study 3 is a single-wave pilot experiment conducted within a predominantly student sample, whereas Study 4 is a two-wave longitudinal experimental study on the general population.

STUDY 3 – EXPERIMENTAL STUDY WITH IMPLEMENTATION INTENTIONS (PILOT)

INTRODUCTION

This pilot study employed the implementation intentions technique to promote a specific food waste preventive behaviour: using a shopping list to improve household food management and reduce domestic food waste. Among the preventive behaviours observed in Study 2, we selected this strategy because it was relatively simple and manageable for all participants, regardless of whether they were students or other household members, as well as independent of household composition or employment status.

HYPOTHESIS

Because this is a single-wave study, the key variables were placed after the intervention, allowing comparisons among the experimental groups.

H1. Intentions to reduce food waste and its antecedents – attitudes, anticipated emotions, social norms and perceived behavioural control – differ among the three experimental groups, with the coping intentions group showing the greatest improvement, followed by the implementation intentions group, and finally the control group.

MATERIALS AND METHODS

Study design

The study aimed to examine the effectiveness of implementation and coping intentions in promoting food waste reduction, using a shopping list to better manage household food and waste. To achieve this aim, a single-wave experimental study was employed, in which participants were randomly assigned to different conditions to evaluate the impact of planning and coping strategies on both antecedents and food waste behaviours.

Participants completed an online 10-minute questionnaire assessing food-related habits, a goal-setting measure, and key variables from the Theory of Planned Behaviour (TPB; Ajzen, 2001), including attitudes, injunctive and descriptive norms, perceived

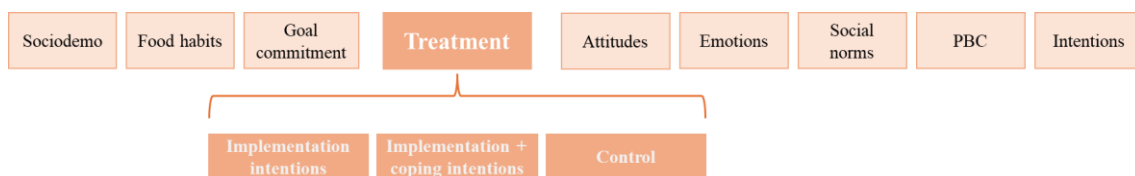
behavioural control, and intentions, as well as anticipated positive and negative emotions (MGB; Perugini & Bagozzi, 2001).

Depending on their assigned condition, participants formulated specific implementation intentions detailing how they would enact their goal (implementation intentions treatment group) or formulated both implementation and coping intentions for what to do if something went wrong in pursuing their goal (implementation + coping group). Participants in all groups reported their intention to use a strategy to reduce food waste, as well as the strength of that intention (Goal commitment).

See Figure 4.1 below for a representation of the study design.

Figure 4.1

Visual representation of the study structure



Note. Dependent variables were measured after randomisation into the experimental groups.

Participants were randomly assigned to one of three conditions:

- *Implementation intentions group:* Participants completed two brief implementation intentions exercises. They specified *where*, *how*, and *when* they would implement the chosen strategy, along with its potential benefits (Figure 4.2).
- *Implementation + coping group:* Participants completed the same implementation intentions exercises and an additional section in which they planned how to cope in case something went wrong (Figure 4.3).
- *Control group:* Participants did not complete any exercise.

Figure 4.2

Intervention section for the implementation intentions treatment group

D_It
It is likely that you will manage food better if you decide when and how to do it.
Please write in the spaces below when and how you will implement the \$(q://OID139/ChoiceGroup/SelectedChoices) in the next two weeks.

II_Text
How/When

II_Why
What are the potential benefits of this activity? (\$(q://OID139/ChoiceGroup/SelectedChoices))

Figure 4.3

Additional exercise for the coping intentions treatment group

Exercise No. 2 Anticipating possible obstacles and preparing coping strategies is another way to increase the chances of success. **"What could go wrong, and how can I deal with the situation?"**

With this in mind, we ask you to answer the following question:

Strategies to implement if something goes wrong:

Participants

Sample size estimation. An a priori power analysis was conducted using G*Power 3.1.9.4 (Faul *et al.*, 2007) for a repeated-measures within-between ANOVA. With a significance criterion of $\alpha = 0.05$ and power = 0.95, the analysis indicated that 198 participants (66 per group) would be required to detect the expected effect. Due to recruitment and time constraints, only 86 participants were enrolled in the present study. As a result, this study is considered a pilot study of Study 4, aimed primarily at assessing feasibility, refining procedures, and providing preliminary data to inform future, adequately powered studies. The sample is a convenience sample of students from the University of Milano-Bicocca, and others were invited to participate through snowball

sampling. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2024-864).

Sample. The sample consisted of 86 participants, including 32 males, 48 females, and 6 individuals who identified as non-binary, with a mean age of 28.45 (SD=9.87) and a range of 18 to 66 years. Regarding geographic distribution, the majority were from the North-West (62), followed by the North-East (18), while 3 participants were from the Centre and 3 from the South. Regarding occupation, the sample included 33 students, 4 independent workers, 38 employees, 5 unemployed individuals, and 6 were categorised as 'other'. The scale of economic strain indicates a generally wealthy sample, with approximately 71% reporting that they manage somewhat or very easily.

Measures

After providing informed consent, participants completed socio-demographic questions followed by the scales reported in Table 4.1. The scales are presented in the table in the same order in which they were administered to participants. Items within each scale were randomised.

Table 4.1

Measures Included in the Study and Example Items

Variable	Reference	Example item	N° of items	Response scale
Responsibility	ad hoc	<i>How often are you personally responsible for preparing and managing meals for yourself and/or the people you live with?</i>	1	1 = Never, 5 = Always
Environmental awareness	ad hoc	<i>"I believe that food waste has a strong impact on the environment"</i>	1	1 = Completely disagree, 5 = Completely agree
Importance	ad hoc	<i>"I believe that it is important to control food waste within my household"</i>	1	1 = Completely disagree, 5 = Completely agree

Food waste habits and preventive habits	Di Napoli <i>et al.</i> , Study 2	<i>Please indicate how often these food waste-related behaviours are typically carried out by you or other members of your household. E.g., meal planning, throwing away leftovers, etc.</i>	17	1 = Never, 5 = Very often
Goal commitment	ad hoc	<i>Please estimate the strength with which you intend to pursue the {Goal} to reduce food waste in the household</i>	1	1 = Not at all, 5 = Extremely
Intentions	Ajzen, 1991	<i>"I intend to {Goal} to reduce household food waste during the next two weeks".</i>	3	1 = Completely disagree, 5 = Completely agree
Positive Anticipated emotions	Perugini & Bagozzi, 2001	<i>"If I succeed in reducing my food waste over the next two weeks through the action to {Goal}, I will feel..."</i>	3	1 = Not at all, 5 = Very much
Negative Anticipated emotions	Perugini & Bagozzi, 2001	<i>If I do NOT succeed in reducing my food waste over the next two weeks through the action of {Goal}, I will feel..."</i>	4	1 = Not at all, 5 = Very much
Attitude towards the goal	Ajzen, 1991	<i>I think that to {Goal} to reduce my household food waste over the next two weeks is..."</i>	6	E.g., 1 = Useless, 5 = Useful
Attitude towards food waste reduction	Ajzen, 1991	<i>"I think that reducing my household food waste over the next two weeks is..."</i>	6	E.g., 1 = Useless, 5 = Useful
Injunctive norm	Ajzen, 1991	<i>"The important people in my life would approve/disapprove of my attempt to {Goal} to reduce household food waste over the next two weeks."</i>	1	1 = They would disapprove, 5 = They would approve
Descriptive norm	Cialdini <i>et al.</i> , 1990	<i>"The important people in my life do {Goal} to reduce household food waste."</i>	1	1 = Completely false, 5 = Completely true
Perceived Behavioural Control	Ajzen, 1991	<i>How much control do you have over the goal to {Goal} to reduce household food waste during the next two weeks?</i>	3	E.g., 1 = No control, 5 = Full control

Facilitators and barriers	Ad hoc	<i>Do you think these factors could hinder or facilitate the achievement of the goal? E.g. Bad mood, household composition</i>	8	1 = Obstacles, 5 = Facilitates
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Note. {Goal} = "Use a shopping list to reduce household food waste".

RESULTS

Descriptive analyses

Table 4.2 presents the distribution of participants across the three experimental conditions. The table also shows descriptive statistics for the measure of Goal commitment, which is the extent to which "*Reducing food waste at home is a goal of mine for the next 2 weeks*". Average levels of goal commitment were neither high nor low across the three groups, with the implementation intentions condition reporting the lowest mean value.

Table 4.2

Descriptive statistics of Goal commitment strength for the three experimental conditions

	N	Mean	SD
Control group	29	3.62	1.12
I.I. group	27	3.04	1.22
I.I. + coping group	30	3.63	1.19

Note. I.I. = Implementation intentions

Table 4.3

Descriptive statistics of food waste preventive behaviours and food waste behaviours

	N	Mean	SD
<i>Preventive habits</i>			
Meal planning in advance	86	2.90	1.26
Meal prepping	86	2.52	0.99
Making a shopping list	86	3.85	1.12
Measure the ingredients to cook	86	3.64	1.16
Reuse leftovers	86	4.29	0.87
Check labels	86	3.87	1.06
Composting	86	1.78	1.35
Organise food in the household	86	3.52	0.98

<i>Waste habits</i>			
Overprepare	86	2.48	0.90
Overeat	86	2.93	1.05
Throw away leftovers	86	1.95	0.81
Let food rot or expire	86	2.26	0.75
Change one's mind on a previously purchased item	86	1.87	0.94

The prevention behaviours reported in Table 4.3 show considerable variation in their mean values. The most frequently reported behaviours are reusing leftovers, checking labels and expiration dates, measuring ingredients when cooking, and organising food in the household, such as in the refrigerator and pantry.

Among the waste-related behaviours, the most frequently reported are inadvertently allowing food to expire or spoil – likely referring to highly perishable items such as fruits and vegetables – and cooking and eating more food than necessary. These behaviours can be interpreted as errors in estimating the quantity of food available at home.

Table 4.4

Descriptive statistics of facilitators and barriers.

	N	Mean	SD
<i>Do you think these could hinder or facilitate the achievement of the goal?</i>			
Do the activity with other people	82	3.62	1.21
Lack of time	82	1.80	0.97
Bad mood	82	2.29	1.04
Household composition	82	3.13	1.32
Unpredictability of events or dinners	82	2.22	1.09
Distraction or forgetfulness	82	1.82	1.15
Online grocery shopping	82	3.49	1.25
Having a digital shopping list	82	4.24	0.96

Note. The items were rated on a scale from 1 (Hinders) to 5 (Facilitates).

Table 4.4 describes several potential factors that may hinder or facilitate achieving the behavioural goal of reducing food waste through the use of a shopping list. These items were included to identify factors worth investigating in future studies and to provide an additional intervention to reinforce the behavioural intention. Among them, lack of time and distraction or forgetfulness were perceived as the most potentially hindering

factors, whereas having a digital shopping list and online grocery shopping were seen as the most facilitating – likely because they are directly aligned with the target goal – followed by doing the activity with other people, highlighting the social aspect of household food management.

Table 4.5

Descriptive statistics and Cronbach's alpha of the variables

Variable	N	Mean	SD	C. alpha
Responsibility	86	4.53	0.73	.
Environmental awareness	86	4.66	0.57	.
Importance	86	3.76	0.92	.
Attitudes waste	79	4.21	0.69	.88
Attitudes list	82	4.04	0.69	.82
PAE	83	3.84	0.77	.89
NAE	83	2.83	0.99	.89
Social norms	82	4.13	0.83	.41***
PBC	82	3.71	0.76	.81
Waste habits	86	2.30	0.58	.64
Preventive habits	86	3.30	0.55	.56
Goal commitment	86	3.44	1.19	.
Intentions	83	3.97	0.87	.90
Coping strategies (coping group)	29	3.20	0.92	.89

Note. PAE = Positive Anticipated Emotions, NAE = Negative Anticipated Emotions, PBC = Perceived Behavioural Control. The social norms measure is composed of two items; therefore, instead of Cronbach's alpha, Pearson's correlation is reported. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.5 reports the descriptive statistics and reliability tests for the composite variables. The results show very high mean values for responsibility in household food management and environmental awareness, as well as for attitudes toward food waste and the use of a shopping list. Participants also reported high social norms and strong intentions to reduce food waste over the next two weeks. Anticipated positive emotions in case of success were greater than anticipated negative emotions in case of failure. Perceived Behavioural Control and Goal commitment were both at moderately high levels.

Correlation analyses

Below are the reported correlation analysis results for the main variables. To review the complete correlation matrix, refer to the Appendix.

Greater coping planning was associated with stronger intentions to reduce household food waste by using a shopping list ($r = .50, p = .01$). Higher negative anticipated emotions were positively related to coping planning ($r = .59, p < .001$). Goal commitment was positively and significantly correlated with attitudes toward food waste ($r = .31, p = .01$), attitudes toward using a shopping list ($r = .26, p = .02$), positive anticipated emotions ($r = .50, p < .001$), negative anticipated emotions ($r = 0.48, p < .001$), social norms ($r = .26, p = .02$), perceived behavioural control ($r = 0.24, p = .03$), intentions ($r = .54, p < .001$), and coping mechanisms ($r = .65, p < .001$). However, goal commitment showed no significant correlation with food waste prevention or waste habits ($ps > .09$).

ANOVAs

One-way ANOVAs were conducted to determine whether there were statistically significant differences among the conditions (Table 4.6).

Table 4.6

One-way ANOVA results of the main variables among conditions

	F	df1	df2	p
PAE	0.16	2	53.0	.85
NAE	0.68	2	52.9	.51
Attitude towards shopping list	0.38	2	50.1	.68
Attitude towards food waste reduction	1.01	2	48.4	.37
Social norms	0.32	2	50.5	.73
PBC	0.07	2	51.9	.93
Intentions	0.09	2	52.8	.92

Note. PAE = Positive Anticipated Emotions, NAE = Negative Anticipated Emotions, PBC = Perceived Behavioural Control.

There were no significant differences among the conditions in the main variables. The non-significant results may be attributed to the small sample size and to the study design, which, being a single-wave study, is not sufficiently robust.

DISCUSSION

The goal of this study was to promote the use of a shopping list as a strategy to manage food more effectively and reduce household food waste. Data show a relatively young sample reporting high levels of perceived responsibility, awareness, attitudes, and social norms regarding food waste. The experimental design included three groups: a control group and two experimental groups. Participants in the *implementation intentions* group completed exercises on how and in what ways they would carry out the behavioural goal, while participants in the *implementation + coping intentions* group completed additional exercises on how they would cope with potential obstacles in the next two weeks.

The *main hypothesis* was not confirmed. There were no statistically significant differences among the three groups in the variables measured after randomisation. The non-significant results may be attributed to the small sample size and to the study design, which, being a single-wave study, is not sufficiently robust.

A key insight emerging from this study is that participants were not allowed to choose their own behavioural goal. Future studies should allow participants to personalise the goal to be implemented over the following two weeks. This could potentially increase engagement and curiosity when completing the implementation and coping intention exercises. Study 4 addresses this point.

STUDY 4 – EXPERIMENTAL LONGITUDINAL INTERVENTION WITH IMPLEMENTATION INTENTIONS

INTRODUCTION

In this study, we aim to employ implementation intentions and coping intentions techniques to promote specific preventive behaviours that reduce household food waste. These techniques are embedded within the theoretical framework of the Theory of Planned Behaviour. The research adopts a two-wave longitudinal experimental design involving three experimental groups.

HYPOTHESES

Building on the pilot study that tested the implementation intentions technique in a single-wave design, we conducted a second, longitudinal experiment with an appropriate sample size to evaluate the intervention's effectiveness and its impact on food waste intentions and behaviours over time.

H1. Food waste will decrease between T1 and T2.

H2. Perceived behavioural control will increase between T1 and T2.

H3. The intervention is expected to produce differential effects across conditions, with the coping intentions group showing the greatest improvement, followed by the implementation intentions group, and finally the control group.

MATERIAL AND METHODS

Study design

The present study aimed to examine the effectiveness of implementation intentions in promoting long-term food waste reduction behaviours. To achieve this aim, a two-week longitudinal experimental study was employed, in which participants were randomly assigned to different conditions to evaluate the impact of planning strategies and coping strategies on food waste behaviours and their antecedents.

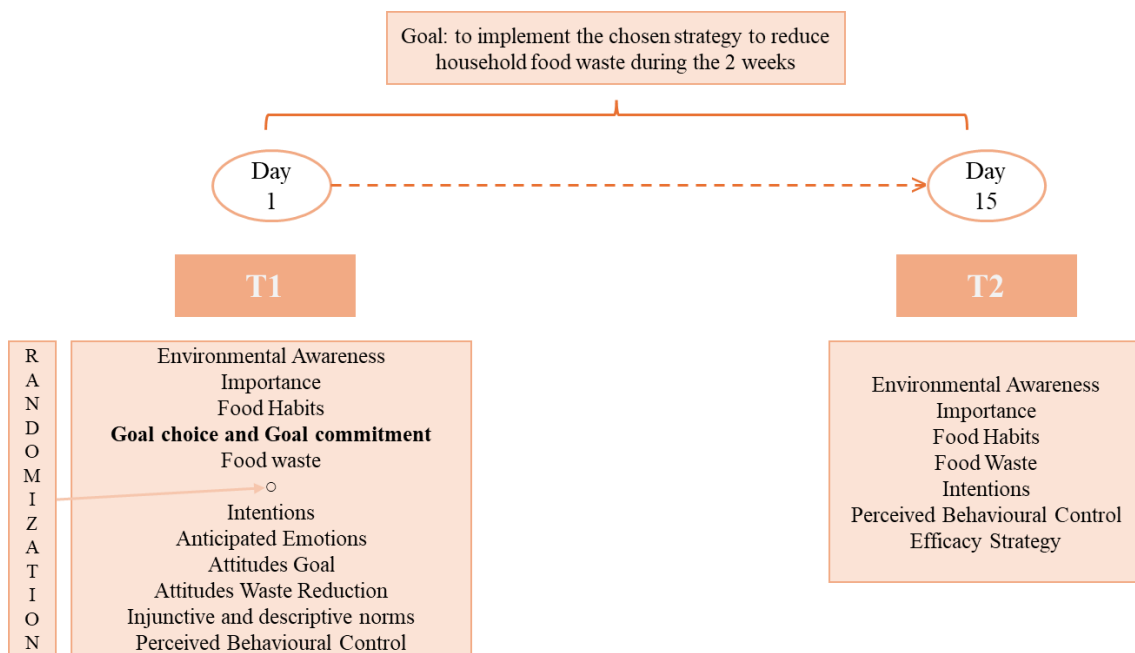
During the first wave (T1), participants completed an online 10-minute questionnaire assessing food-related habits, key variables from the Theory of Planned Behaviour (TPB; Ajzen, 2001), including attitudes, social norms, perceived behavioural control, and intentions, as well as other additional variables such as anticipated emotions (Perugini & Bagozzi, 2001), importance of household food waste, and environmental awareness of food waste. Participants could then select a goal to implement over the next two weeks from a list of anti-waste strategies. Like in Study 3, depending on their assigned condition, participants formulated specific implementation intentions detailing how they would enact their goal (implementation intentions treatment group) or formulated both implementation and coping intentions for what to do if something went wrong in pursuing their goal (implementation + coping group). Participants in all groups reported their intention to use a strategy to reduce food waste, as well as the strength of that intention (Goal commitment).

After two weeks, participants were invited to complete a 5-minute follow-up survey (T2) assessing the effectiveness of the intervention and changes in behaviour and the psychological constructs over time.

See Figure 4.4 below for a visual representation of the study design.

Figure 4.4

Visual representation of the study structure



Note. Participants were randomised into the three experimental groups before stating intentions, at T1.

Participants were randomised into the three conditions immediately after choosing their goal and reporting past food waste behaviour, and this was followed by intentions and their antecedents. Participants were randomly assigned to one of three conditions:

- *Implementation intentions group:* Participants completed two brief implementation intentions exercises. They specified *where*, *how*, and *when* they would implement the chosen strategy, as well as the potential benefits (see Figure 4.5).
- *Implementation + coping group:* Participants completed the same implementation intentions exercises and an additional section in which they planned how to cope in case something went wrong (see Figure 4.6).
- *Control group:* Participants did not complete any exercise.

Figure 4.5

Intervention section for the implementation intentions treatment group

The figure shows a screenshot of a digital intervention section. It consists of three vertically stacked text input boxes. The first box, labeled 'D_H', contains the text: 'It is likely that you will manage food better if you decide when and how to do it. Please write in the spaces below when and how you will implement the \$(q:/QID139/ChoiceGroup/SelectedChoices) in the next two weeks.' The second box, labeled 'H_When', contains the text 'How/When' and a large empty text area. The third box, labeled 'H_Why', contains the text 'What are the potential benefits of this activity? \$(q:/QID139/ChoiceGroup/SelectedChoices)' and a large empty text area. Each of the second and third boxes has a small icon of a speech bubble and a star in the top right corner.

Figure 4.6

Additional exercise for the coping intentions treatment group

Exercise No. 2 Anticipating possible obstacles and preparing coping strategies is another way to increase the chances of success. "What could go wrong, and how can I deal with the situation?"

With this in mind, we ask you to answer the following question:

Strategies to implement if something goes wrong:

Participants

Sample size estimation. To estimate the sample size, an a priori power analysis was conducted using G*Power 3.1.9.4 (Faul *et al.*, 2007) for a repeated-measures within-between ANOVA. With a significance criterion of $\alpha = 0.05$ and power = 0.95, the minimum required sample size for this effect size is $N = 66$ per group. Therefore, the minimum sample required is 198 participants. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2024-864).

Sample. Participants were invited to participate through the Prolific platform (www.prolific.com). The informed consent form was presented at the beginning of T1. At the end of T2, participants received £2.55 in monetary compensation for their participation, in accordance with Prolific's payment guidelines (£1.80 for T1 and £0.75 for T2). A total of 251 participants took part in the study, and 233 also completed T2. The sample consisted of 125 males (49.8%), 118 females (47.0%), 7 non-binary participants (2.8%), and 1 participant (0.4%) who preferred not to disclose their gender. Mean age of the sample was 32.01 years ($SD = 10.64$, range = 18–68). Participants were distributed across Italy, with 55 from the North-East, 66 from the North-West, 57 from the Centre, 48 from the South, and 25 from the Islands. For the complete list of sociodemographic data, see the Appendix.

Measures

After providing informed consent, participants completed socio-demographic questions followed by the scales reported in Table 4.7. The scales are presented in the table in the same order in which they were administered to participants. Items within each scale were randomised. Most of the measures and materials reported in this section are the same as, or slightly modified from, those used in Pilot Study 3. Table 4.7 and Figures 4.7a-bb present them in full.

Table 4.7

Measures Included in the Study and Example Items

Variable	Reference	Example item	N° of items	Response scale
Responsibility	ad hoc	<i>How often are you personally responsible for preparing and managing meals for yourself and/or the people you live with?</i>	1	1 = Never, 5 = Always
Environmental awareness	ad hoc	<i>"I believe that food waste has a strong impact on the environment"</i>	1	1 = Completely disagree, 5 = Completely agree
Importance	ad hoc	<i>"I believe that it is important to control food waste within my household"</i>	1	1 = Completely disagree, 5 = Completely agree
Food waste habits and preventive habits	Di Napoli <i>et al.</i> , Study 2	<i>Please indicate how often these food waste-related behaviours are typically carried out by you or other members of your household. E.g., meal planning, throwing away leftovers, etc.</i>	17	1 = Never, 5 = Very often
Goal choice	ad hoc	<i>Select one and only one option from the choices presented below (e.g., planning food in advance). Your selection will be the goal you aim to pursue over the next 2 weeks with the aim of reducing your household food waste.</i>	1	.
Goal commitment	ad hoc	<i>Please estimate the strength with which you intend to pursue the</i>	1	1 = Not at all, 5 = Extremely

		<i>following goal: {SelectedChoices}</i>		
Food waste	van Herpen <i>et al.</i> , 2019	<i>Presentation of a list of foods (e.g., vegetables and salads, fruit, pasta, etc.) and request to select those that were discarded in the last 4 days. For each food category selected, participants will be asked to indicate the approximate amount thrown away in the last week (e.g., less than a tablespoon, 1-2 tablespoons)</i>	13	E.g., 1 = Less than 1 serving spoon, 5 = More than 6 serving spoons
Intentions	Ajzen, 1991	<i>"I intend to {SelectedChoices} to reduce household food waste during the next two weeks".</i>	3	1 = Completely disagree, 5 = Completely agree
Positive Anticipated emotions	Perugini & Bagozzi, 2001	<i>"If I succeed in reducing my food waste over the next two weeks through the action to {SelectedChoices}, I will feel..."</i>	3	1 = Not at all, 5 = Very much
Negative Anticipated emotions	Perugini & Bagozzi, 2001	<i>If I do NOT succeed in reducing my food waste over the next two weeks through the action to {SelectedChoices}, I will feel..."</i>	4	1 = Not at all, 5 = Very much
Attitude towards goal	Ajzen, 1991	<i>I think that to {SelectedChoices} to reduce my household food waste over the next two weeks is..."</i>	6	E.g., 1 = Useless, 5 = Useful
Attitude towards food waste reduction	Ajzen, 1991	<i>"I think that reducing my household food waste over the next two weeks is..."</i>	6	E.g., 1 = Useless, 5 = Useful
Injunctive norm	Ajzen, 1991	<i>"The important people in my life would approve/disapprove of my attempt to {SelectedChoices} to reduce household food waste over the next two weeks."</i>	1	1 = They would disapprove, 5 = They would approve
Descriptive norm	Cialdini <i>et al.</i> , 1990	<i>"The important people in my life do {SelectedChoices} to reduce household food waste."</i>	1	1 = Completely false, 5 = Completely true
Perceived Behavioural Control	Ajzen, 1991	<i>How much control do you have over the goal to {SelectedChoices} to reduce household food waste during the next two weeks?</i>	3	E.g., 1 = No control, 5 = Full control

Note. {SelectedChoices} refers to the strategy participant selected in Goal choice.

An adapted version of the food waste scale originally developed and validated by van Herpen and colleagues (2019) was used to measure food waste (Figures 4.7a-b). A first question asks participants to select the categories of food they discarded during the four days preceding the completion of the questionnaire. They are then asked, for each selected item, to estimate the portions. The responses were then converted into grams, as outlined in the paper supporting materials and can be seen in this thesis's Appendix.

Figures 4.7a-b

Food waste measures

Please tick the boxes of the products that were disposed in your household during **the past week** (you can select multiple answers). For each of the selected products, you will then be asked to estimate the quantity thrown away.

Fresh vegetables and salads	Meat (cold cuts included)
Fresh fruit	Fish (canned fish included)
Potatoes and similar product (e.g., fries)	Cheese
Bread and similar products (e.g., focaccia, cracker, grissini)	Yogurt and Milk
Pasta	Eggs
Rice and other cereals (e.g., couscous)	Sweets and desserts
Legumes	I have not thrown away any food or drink products

In your household, how much **vegetables and salads** were disposed of in the past week?
One serving spoon equals 50 gram.

Less than one serving spoon
1 to 2 serving spoon
3 to 4 serving spoon
5 to 6 serving spoon
More than 6 serving spoons

Note. Above = list of food categories, below = example of the estimate of each food category (van Herpen *et al.*, 2019).

RESULTS

Descriptive analyses

Table 4.8 shows the frequency of strategies chosen by the participants at T1. The reuse of leftovers is the most frequently chosen strategy, closely followed by planning meals in advance. The less frequently chosen strategy is Composting, which involves using food scraps for gardening.

Table 4.8

Frequency of Goal choice

Item	Counts	% of Total
Reuse leftovers	56	22.3%
Meal planning	52	20.7%
Organise food in the household	36	14.3%
Check labels	29	11.6%
Making a shopping list	28	11.2%
Measure the ingredients to cook	20	8.0%
Meal prepping	17	6.8%
Composting	13	5.2%

Table 4.9 presents the distribution of participants across the three experimental conditions. The sample is perfectly distributed. The table also shows descriptive statistics for the measure of Goal commitment, which is how much *"Household food waste reduction with the {SelectedChoices} will be my goal for the next 2 weeks"* (response scale from 1 = Not at all to 5 = Extremely). Goal commitment is generally high for all groups, particularly for the implementation intentions group.

Table 4.9

Descriptive statistics of Goal commitment for the three experimental conditions

Group	N	Mean	SD
Control group	84	3.95	0.78
I.I. group	84	4.00	0.79
I.I. + coping group	83	3.92	0.82

Table 4.10 shows mean levels, standard deviation and Cronbach's alpha of all measures presented. Participants reported high mean levels of responsibility, environmental awareness, and perceived importance of reducing food waste. Preventive habits were at medium–high levels and occurred more frequently than food waste habits. Goal commitment and perceived behavioural control were generally high, indicating a strong propensity and confidence to implement the chosen strategy. Attitudes toward both the goal itself and food waste reduction were also highly positive, with intentions to reduce food waste reaching very high levels. Perceived positive anticipated emotions were stronger than negative ones. The perceived opinion of significant others (injunctive norms) was high, while they perceived that other people somewhat perform the goal to reduce their food waste (descriptive norm).

Table 4.10

Descriptive statistics and Cronbach's alpha of the variables

	Time	N	Mean	SD	C. alpha
Responsibility	T1	251	3.83	0.94	.
Environmental awareness	T1	250	4.20	1.00	.
	T2	231	4.34	0.72	.
Importance	T1	251	4.29	1.04	.
	T2	231	4.55	0.56	.
Preventive habits	T1	251	3.44	0.60	.69
	T2	232	3.40	0.58	.63
Waste habits	T1	251	2.20	0.54	.70
	T2	232	1.94	0.57	.69
Goal commitment	T1	251	3.96	0.79	.
Food waste	T1	251	292.39	392.90	.
	T2	251	176.30	361.68	.
Intentions	T1	251	4.43	0.56	.94
	T2	232	4.42	0.58	.92
PAE	T1	250	3.99	0.74	.86
NAE	T1	250	2.89	0.89	.86
Attitudes towards the goal	T1	250	4.11	0.58	.79
Attitudes towards food waste	T1	250	4.28	0.57	.80
Injunctive norm	T1	250	4.51	0.83	.
Descriptive norm	T1	250	3.45	1.06	.
PBC	T1	250	3.91	0.61	.73
	T2	231	3.99	0.63	.78

Note. PAE = Positive Anticipated Emotions, NAE = Negative Anticipated Emotion, PBC = Perceived Behavioural Control. Food waste measure is reported in grams.

T-test analyses

Paired t-tests were conducted to determine whether the changes in measurements over time were statistically significant.

Table 4.11

Paired Samples T-Test results comparing variables at T1 and T2

		statistic	df	<i>p</i>	Mean difference	SE difference	Effect Size
Preventive habits T1	Preventive habits T2	0.88	231	.38	0.03	0.03	0.06
Waste habits T1	Waste habits T2	8.03	231	<.001	0.26	0.03	0.53
Intentions T1	Intentions T2	1.06	231	.29	0.04	0.04	0.07
PBC T1	PBC T2	-2.32	230	.02	-0.08	0.04	-0.15
Food Waste T1	Food Waste T2	4.39	250	<.001	116.10	264.60	0.28

Note. Statistic = Student's *t*, Effect Size = Cohen's *d*. Food waste measure is reported in grams.

Table 4.11 reports the results of the t-test analyses between T1 and T2. The results show a significant increase in perceived behavioural control and a decrease in waste habits and food waste, expressed in grams. Although preventive habits and intentions show an increase between the two measurements, the difference is not yet significant.

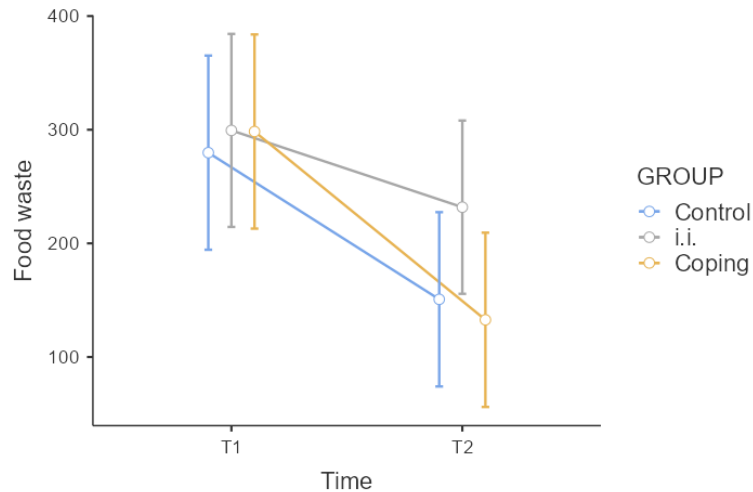
Repeated measures ANOVAs

After observing the differences between T1 and T2, repeated-measures ANOVAs were conducted to examine whether changes over time also varied as a function of the treatment condition. The treatment had no effect on the variables over time. For example, the effect of time on food waste over time is significant, $F(1) = 19.34, p < .001$, but the effect of the treatment is not, $F(2) = 0.63, p = .53$, nor the interaction between time and treatment, $F(2) = 1.15, p = .32$. Similar results were observed for PBC and waste habits, with all *p*-values (*ps*) < .001 for the effect of time, *ps* > .50 for the treatment, and *ps* > .06 for the interaction of time and treatment. This suggests that it is not the type of motivation targeted by the informational and motivational nudges that influences the dependent

variables, but rather the act of participating in a longitudinal experiment aimed at reducing food waste.

Figure 4.8

*Estimated marginal means plot for Group*Time*



Note. Group = treatment the participants were randomly assigned to.

Figure 4.8 illustrates how the three groups behaved across the three measures of food waste. Participants across all groups appear to follow a similar decreasing trend, but the coping treatment shows a steeper decline. Despite this, the differences are not significant, and the variability in the measures is very high.

We then examined whether the main variables differed over time, using *Goal commitment* as a grouping variable. If the type of treatment did not influence behaviours or their antecedents, the strength with which participants formulated their goals for the following two weeks might still have affected these outcomes.

Figure 4.9

*Estimated marginal means plot for Goal commitment*Time*

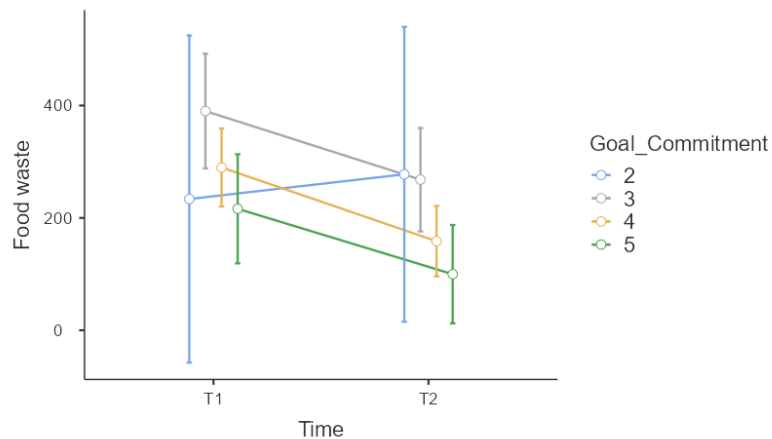


Figure 4.9 reports the plot for Food waste as the dependent variable. Goal commitment had a significant effect on food waste over time, with $F(3) = 3.12, p = .03$. Results report differences in levels of responses for Goal commitment at T1. Only one response to this question was 1 (“Not at all”) and therefore was excluded from the analyses. The only significant result is the difference between participants who responded “moderate strength” in their pursuit of the goal and those who responded 5 (“Extremely”).

See Appendix for post-hoc comparison of food waste for levels of Goal commitment.

Correlation analyses

Correlation analyses were performed on all the mentioned variables. Table 4.11 reports only the main variables that were later included in the Path Analyses (see Appendix for the complete correlation matrix). All main variables correlated strongly and positively with each other, except for descriptive norm and attitudes towards food waste reduction.

Injunctive and descriptive norms did not show a strong correlation with each other and therefore they were treated as distinct constructs rather than combined into a single social norms measure. As we will see, they also play different roles in the model predicting intentions.

Table 4.12*Correlation matrix*

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Attitudes waste	—												
2. Attitudes goal	.79***	—											
3. Injunctive norm	.24***	.24***	—										
4. Descriptive norm	.06	.17**	.44***	—									
5. PBC PRE	.43***	.48***	.30***	.21***	—								
6. PAE	.50***	.48***	.35***	.20**	.38***	—							
7. NAE	.32***	.38***	.23***	.18**	.21***	.57***	—						
8. Goal commitment	.37***	.39***	.23***	.23***	.40***	.43***	.25***	—					
9. Intentions PRE	.44***	.46***	.33***	.17**	.47***	.48***	.27***	.53***	—				
10. Intentions POST	.46***	.48***	.28***	.19**	.48***	.43***	.25***	.42***	.51***	—			
11. Food Waste POST	-.20**	-.14*	-.05	-.02	-.10	-.00	.05	-.21**	-.15*	-.20**	—		
12. Waste Beh POST	-	-	-.17**	-.09	-	-.13*	-.10	-.20**	-	-	.40***	—	
13. Preventive Beh POST	.31***	.27***	.17**	.16*	.31***	.37***	.36***	.37***	.24***	.34***	-.20**	-	—
	.40***	.39***	.17**	.16*	.28***	.37***	.36***	.37***	.33***	.36***	-.20**	-.21**	—

Note. Attitudes waste = Attitudes towards food waste reduction, PBC PRE = Perceived Behavioural Control at T1, PAE = Positive Anticipated Emotions, NAE = Negative Anticipated Emotions. * $p < .05$, ** $p < .01$, *** $p < .001$.

Path analysis

We conducted a series of path analyses to first test a basic TPB model, with attitudes, social norms, and perceived behavioural control (PBC) as antecedents of Intentions PRE at T1, and Intentions POST at T2 as the dependent variable, to test if intentions are sustained coherently over time. The model showed good fit indices (Table 4.13). Models 2 and 3 add, respectively, anticipated emotions and goal commitment as predictors of intentions.

Table 4.14 shows the final model of TPB plus additional predictors and direct effects of PBC and goal commitment but testing a different dependent variable. Model 5 food waste in portions and grams, and in Model 6, the measures of waste and preventive behaviours.

Table 4.13

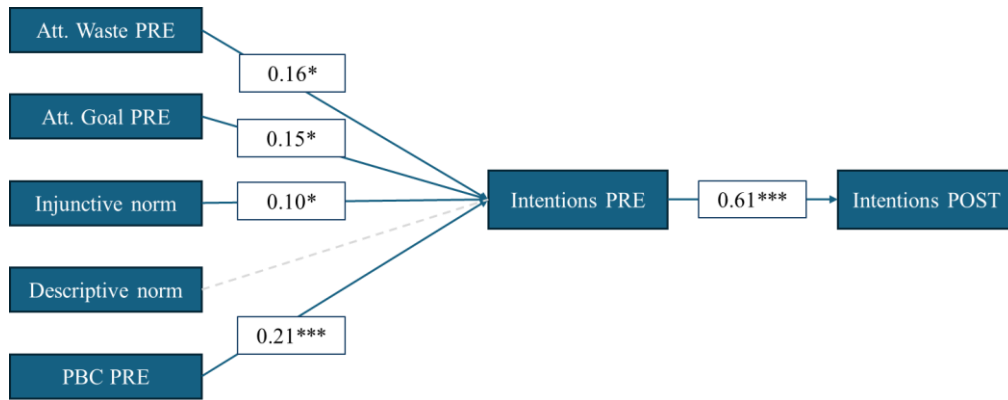
Comparison of models using χ^2 , R^2 , and fit indices

	χ^2	d.f	<i>p</i>	CFI	TLI	RMSEA	SRMR	R^2
<i>Model 1</i>	522.0	21	<.001	.87	.56	.21	.12	Intentions PRE = .31 Intentions POST = .25
<i>Model 2</i>	757.1	36	<.001	.95	.74	.15	.07	Intentions PRE = .39 Intentions POST = .26
<i>Model 3</i>	895.7	45	<.001	.96	.76	.14	.06	Intentions PRE = .51 Intentions POST = .26

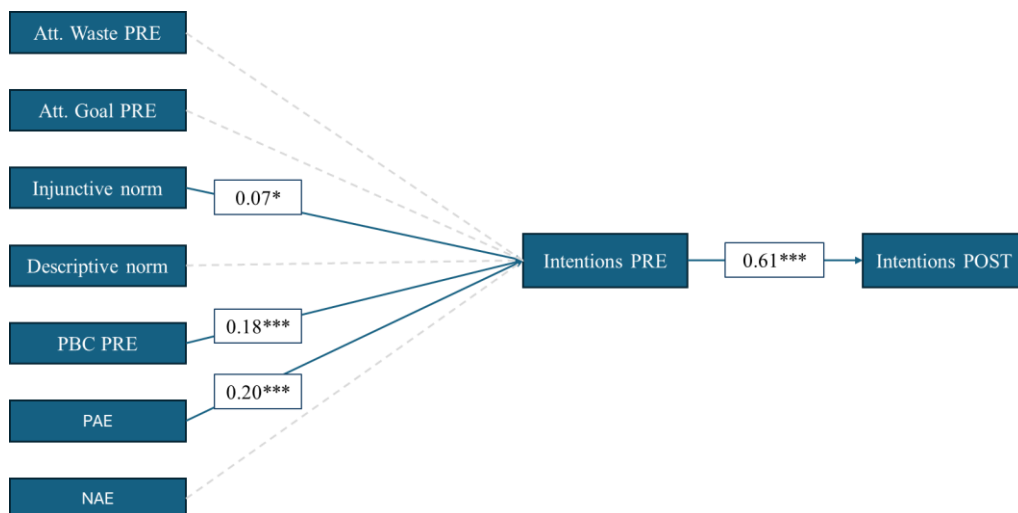
Note. Model 1 = TPB; Model 2 = TPB + anticipated emotions; Model 3 = TPB + emotions + Goal commitment.

Figures 4.10a-c

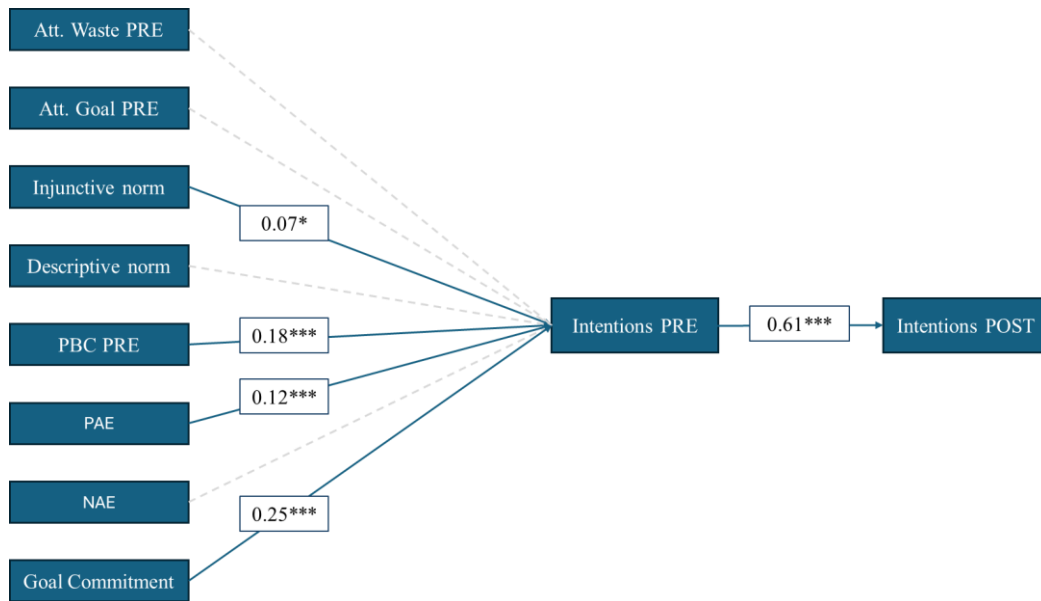
Model 1



Model 2



Model 3 (A)



Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4.14

Fit indices of tested models

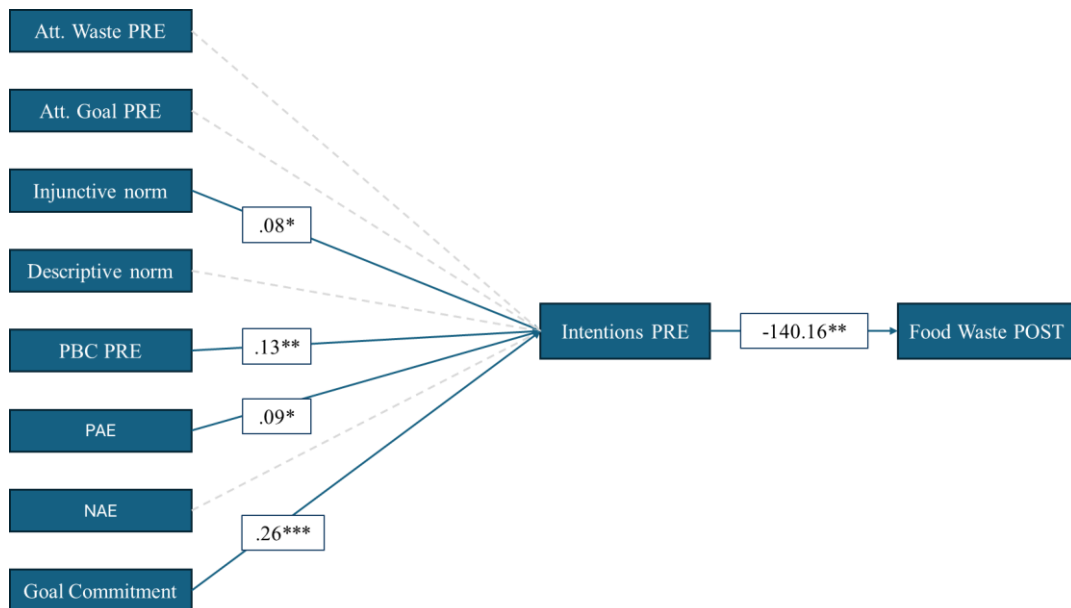
	X ²	d.f	P	CFI	TLI	RMSEA	SRMR	R ²
Model A	895.7	45	<.001	.99	.90	.09	.03	Intensions PRE = .51 Intensions POST = .34
Model B	852.0	45	<.001	.99	.94	.07	.03	Intensions PRE = .50 Food Waste POST = .04
Model C	895.7	55	<.001	.94	.80	.12	.07	Intensions PRE = .51 Waste habits POST = .11 Preventive habits POST = .17

Note. Model A = Final model with Intensions POST as dependent variable; Model B = Final model with Food waste as dependent variable; Model C = Final model with food waste and preventive habits as the dependent variables.

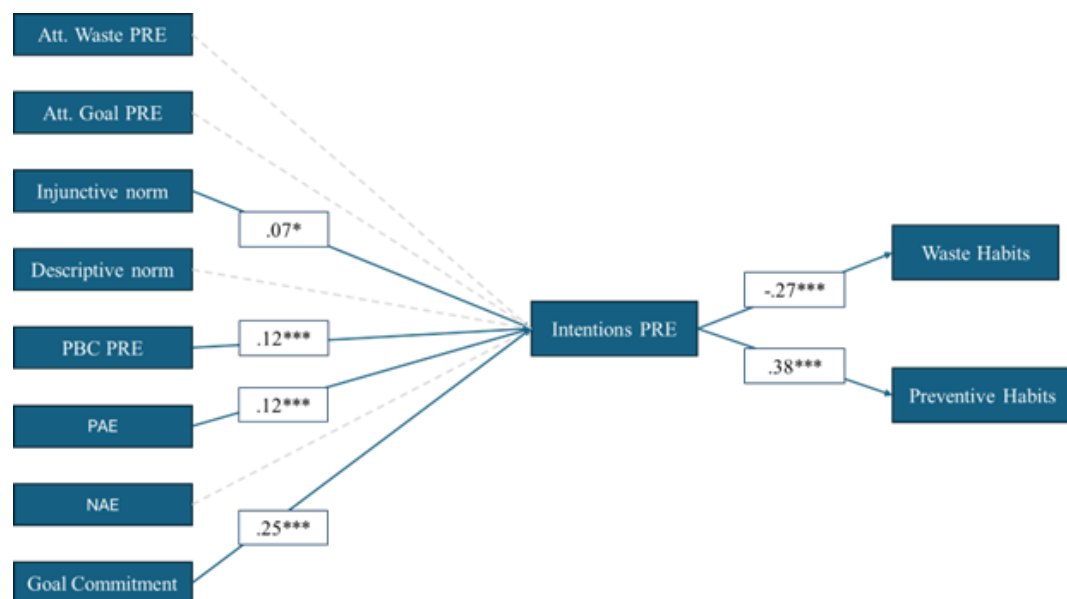
Goal commitment predicts intentions at T1 and directly affects intentions at T2, further highlighting its relevance in this sample and setting. Coefficients are unstandardised (b) values.

Figures 4.11a-b

Model B



Model C



Across Models A, B, and C, the same pattern emerges. Neither attitude measure significantly predicts intentions to use the behavioural tool at T1. In contrast, injunctive norm exerts a significant effect, whereas descriptive norm does not. Similarly, anticipated positive emotions have a significant effect, whereas anticipated negative emotions do not. Goal commitment strongly correlates with intentions and, as expected, predicts them.

In Models A, B, and C, intentions consistently predict all dependent variables. In Model A, intentions remain temporally stable between T1 and T2. Food waste expressed in grams is significantly predicted by intentions at T1 (Model B), though the explained variance is minimal. Likewise, in Model C, with food waste and preventive habits as dependent variables, intentions at T1 predict both outcomes, yet the explained variance is substantially lower than in Model A, where intentions themselves serve as the dependent variable.

DISCUSSION

This experimental longitudinal study aimed to investigate how implementation intentions and coping intentions influence household food waste over time. Confirming the *first hypothesis*, food waste and food waste behaviours have decreased over time, while perceived behavioural control has decreased between T1 and T2, confirming the *second hypothesis*.

The *third hypothesis*, however, was not met. In fact, treatment had no significant influence on the measured variables.

Despite the lack of significant differences between groups, the study provides important insights. Participation in the study was associated with reductions in both self-reported waste behaviours and actual food waste across all groups, including the control group. This suggests a possible mere-exposure effect, indicating that simply participating in a study on food waste and setting a strategic goal to reduce it could influence reported intentions and behaviours. Although most measures were self-reported, the inclusion of an objective proxy for food waste adds confidence to these results. The trends observed over a short two-week period suggest that more sustained interventions could produce stronger effects.

Enhancing the impact of interventions may require increasing engagement or the intensity of the intervention. Strategies could include continuous engagement through diaries, repeated exercises, or activities such as photographing reused meals and sharing them with peers (van Herpen *et al.*, 2019). Future studies could replicate this study's structure by using more consistent prompts or implementing an ecological momentary assessment approach. Studies with a longitudinal design should increase engagement, providing incentives, or leveraging collaboration within households or peer groups to further enhance the effectiveness of the intervention.

Perceived behavioural control and Goal commitment played an important role in shaping intentions, consistent with prior evidence that self-efficacy is a key determinant of behaviour change (Vaughan-Johnston & Jacobson, 2020; Warner & French, 2022; Wieber *et al.*, 2010). Goal commitment emerged as a critical factor influencing both behavioural outcomes and perceived behavioural control. The intensity of participants' commitment appears central to intervention success, underscoring the need for interventions to align with participants' real objectives. Altogether with perceived behavioural control, having the perception of being involved and in control of the situation is fundamental to ensuring the success of the goal. Social influence also played a role, with injunctive norms consistently affecting behaviour, suggesting that future interventions could leverage social expectations and collaboration to enhance adherence.

Although the treatment did not produce statistically significant differences between groups, trends in the expected direction suggest potential for future interventions. Results show a steeper decline in food waste for the group that included coping planning compared to the other groups. Planning coping strategies in advance could set the goal more strongly and help overcome the many potential barriers.

Limitations. Some limitations should be noted. Recruiting participants with low initial interest in reducing food waste remains a challenge. Many prevention behaviours were already performed frequently, leaving limited room for improvement, which may have contributed to non-significant results. Moreover, food waste and food waste preventive behaviours vary in complexity and frequency, indicating that interventions may need to be tailored to specific behaviours.

GENERAL DISCUSSION

Study 3, which we consider here as a pilot, and Study 4 shared variables and intents. They aim to promote the use of preventive strategies to help participants reduce their household food waste.

As we saw, the results of Study 3 did not confirm the main hypothesis, as no significant differences were found among the groups on attitudes, intentions, emotions and perceived behavioural control. This may be due to the small sample size, the single-wave study design. A key insight was that participants were not allowed to choose their own behavioural goal, suggesting that future studies should incorporate personalised goals to increase engagement and motivation.

Study 4 built on these insights. It incorporated personalised goals, a longitudinal design, and repeated engagement over a two-week period. While significant differences between groups were still not observed, trends suggest that longitudinal designs, combined with personalised goal commitment, social influence, and repeated engagement, hold promise for reducing household food waste. These results emphasise the importance of intervention intensity, participant engagement, and leveraging behavioural determinants such as perceived behavioural control and injunctive norms.

Overall, both studies highlight that while short-term interventions may not produce statistically significant group differences, careful attention to goal personalisation, combination with motivational factors, social factors, and repeated engagement can enhance the effectiveness of behavioural interventions aimed at reducing food waste.

5

MOTIVATIONS TO AVOID FOOD WASTE

So far, we have seen how food waste is a global phenomenon with repercussions on the environment, the economy, and society. We reviewed the existing literature, the main variables, and the mechanisms considered in studies on food waste, particularly in the domestic context. In Studies 1 and 2, we delved deeper into innovative aspects of food waste, its implications for Italian citizens, and broader themes such as environmental issues, responsibility, and injustice. The following studies propose two interventions using the well-established implementation intentions methodology to reduce actual household food waste. We observed that personalisation and the implementation of longitudinal practices can be effective tools for combating domestic waste.

This final empirical chapter examines the role of diverse motivations in promoting sustainable food waste behaviours. As noted, food waste impacts extend beyond individual or family levels to significant environmental, economic, societal, and food injustice consequences. The two studies presented here investigate environmental, economic, moral, and social-norm motivations underlying waste-reduction efforts across distinct contexts, shifting the focus from intentions to their underlying drivers.

The literature on this topic is quite recent and has been systematised, starting with the studies by Ribbers and colleagues (2023), who developed the Motivation to Avoid Food Waste scale (MAFW). This measure includes subscales for environmental,

economic, moral, and social-norm motivations, and has already been validated and tested in relation to food waste measures (Ribbers *et al.*, 2024).¹

Interventions in the literature. A growing number of studies have also evaluated interventions aimed at reducing food waste at the individual and household levels (Hebrok & Boks, 2017; Reynolds *et al.*, 2019; Stöckli *et al.*, 2018). Nudges, subtle changes in the choice environment that guide behaviour without restricting individual freedom, have become increasingly common in food-waste interventions (Thaler & Sunstein, 2008). Examples include informational cues, reminders, and feedback that make the consequences of waste more salient at the moment decisions are made (Johnson *et al.*, 2012).

Building on this growing evidence on behavioural interventions, there is increasing recognition that the effectiveness of nudges may depend on the specific motivations they activate. While intention is widely recognised as a central predictor of behaviour, comparatively little is known about the underlying motivations that lead individuals or families to waste – or deliberately avoid wasting – food. Recent research has begun to address this gap. Ribbers *et al.* (2023) identified four key motivations by reviewing the existing literature: the *environmental* one, driven by concern over the ecological impact of wasted food, such as resource depletion and CO₂ emissions (e.g., “Food waste leads to more CO₂ emissions”), the *moral* one, reflecting feelings of guilt or ethical discomfort about discarding food, especially in light of global hunger (e.g., “Wasting food is disrespectful to poor people”), the *financial* one, related to the desire to avoid personal economic loss (e.g., “Wasting food is a waste of my money”); and the *social* one, linked to the wish to avoid negative judgment from others for behaviours perceived as wasteful or disrespectful (e.g., “I avoid food waste because I do not want other people to think I’m greedy”). Among these, moral concern has been consistently found to be the most influential in reducing food waste, with individuals who perceive food waste as immoral tending to waste less (Bretter *et al.*, 2023; Graham-Rowe *et al.*, 2014; Misiak *et al.*, 2025; Principato *et al.*, 2021; Stancu *et al.*, 2016; Stefan *et al.*, 2013; Talwar *et al.*, 2022; Van Geffen *et al.*, 2020). While Ribbers and colleagues (2024) found moral and environmental concerns to be most influential, other studies, such as van der

¹ *Definition clarification.* In this context, the term "motivation," as used in relation to food waste avoidance, is understood as defined by the MAFW scale. That is, the beliefs and reasons that drive people to avoid food waste.

Werf *et al.* (2019), highlighted the primacy of financial impact. This suggests that motivational influences may vary across contexts and populations. For example, some studies show that financial reasons act as a better motivator for price-sensitive people (Aschemann-Witzel *et al.*, 2018). Few interventions have directly tested the effectiveness of these motivations as an intervention method. For instance, Shaw *et al.* (2018) used leaflets to address the financial and environmental impacts of food waste. However, they found no significant effects, possibly due to a small sample size and the exclusion of the moral aspect.

Background theories. Drawing on the Theory of Planned Behaviour (Ajzen, 1991), the Motivation-Opportunity-Ability framework (MOA; Atkins & Michie, 2013), and Nudge Theory (Thaler & Sunstein, 2008), an intervention aimed at understanding how the financial, environmental, and moral motives determine actual food waste behaviours was designed. According to the Theory of Planned Behaviour, behaviour is more likely to be enacted when supported by intention, attitudes, subjective norms, and perceived behavioural control. The MOA framework adds that behavioural performance also depends on knowledge and skills, and has been advocated as a theoretical lens in the context of household food waste (Ribbers *et al.*, 2023; Soma *et al.*, 2020; Van Geffen *et al.*, 2020). Finally, the Nudge Theory emphasises the role of subtle contextual cues in shaping behaviour. Our study integrates these frameworks to test the effects of three distinct motivational framings – financial, environmental, and moral – on food waste attitudes, awareness, and behaviours, which can be influenced through indirect reinforcements and cues rather than direct enforcement.

Overview of Studies 5 and 6. The following two studies examine the motivational factors underlying intentions to reduce food waste in two distinct contexts. The first study is a longitudinal experimental study that uses informational and motivational nudges about the economic, environmental, and moral consequences of food waste to encourage reductions in household food waste. The second study is a single-wave experimental study, also employing informational nudges about the economic and environmental consequences, but in a novel leisure context: the Camping Site Le Esperidi in Tuscany.

STUDY 5 – LONGITUDINAL EXPERIMENTAL STUDY

INTRODUCTION

This study explores household food waste through a longitudinal experimental design. Throughout the study period, participants received daily informational and motivational nudges concerning food waste and its impact on various aspects of life, allowing us to examine how such interventions shape motivations, awareness, attitudes, intentions, and behaviours over time.

The study employed the *Time2Rate* application developed by the BiCApP (Bicocca Center for Applied Psychology, <https://www.bicapp.it/it/prodotti/time-2-rate/>) to deliver both nudges and online surveys via Qualtrics. Previous research has shown that longitudinal experimental interventions using mobile applications can generally reduce food waste, both in the domestic (Haas *et al.*, 2022; Mathisen & Johansen, 2022) and other contexts such as restaurants (Ong *et al.*, 2023). However, some studies have highlighted challenges related to the usability of such apps, which may hinder user engagement and limit their overall effectiveness (Ong *et al.*, 2023; Qi *et al.*, 2022).

Drawing on the existing evidence and conceptual framework, the following section presents the methodological approach guiding this study.

HYPOTHESES

H1: There is a difference in food waste between T1 and T3 for all groups.

H2: The difference in food waste between T1 and T3 depends on the type of nudges the participants are exposed to (differences among the groups).

H3: Being exposed to the specific nudge (economic, environmental, moral) increases the corresponding motivational scale at T3.

MATERIALS AND METHODS

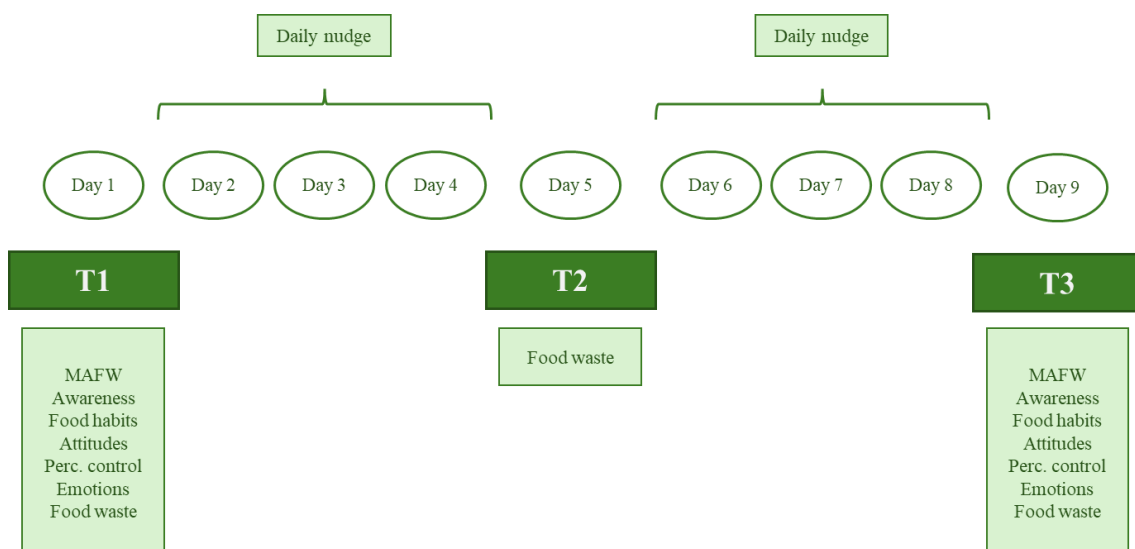
Study design

This study was conceived and conducted in collaboration with Professor Erica van Herpen, a professor and researcher at Wageningen University & Research in the Netherlands.

The online study followed participants over a 9-day period, divided into three time points: T1 (Day 1), T2 (Day 5), and T3 (Day 9). Participants received daily informative nudges emphasising the consequences of food waste. Food waste behaviour was measured at each time point, while motivation, awareness, food habits, attitudes, perceived behavioural control, and emotions were assessed at T1 and T3, as illustrated in Figure 5.1. All questionnaires and nudges were implemented via Qualtrics and delivered through the *Time2Rate* mobile application, developed by the BiCapP (Bicocca Center for Applied Psychology). In each survey, an embedded data point, “user ID,” consisting of numbers and letters (e.g., P5ONMZr_c), is set via the survey flow to store the identifier assigned by Time2Rate to each user, allowing for the anonymous identification and matching of participants' responses over time. Only participants who completed both T1 and T3 were included in the analyses.

Figure 5.1

Visual representation of the study structure



The questionnaire at T2 was included to help participants provide more accurate estimates of their food waste. Reporting portions and grams over the full 9-day period would have been difficult, increasing the potential for recall biases, whereas breaking it into shorter 4-day intervals allowed for more precise estimates and facilitated comparisons across T1, T2, and T3.

Daily nudges: Between T1 and T2, and between T2 and T3, participants received daily nudges containing information or motivational messages regarding the consequences of food waste on one aspect of life, corresponding to the experimental group to which they had been randomly assigned.

In a 2 (within subject factor: time point measurement) x 3 (between subject factor: type of motivation received) design, participants were randomly assigned to one of three experimental groups. Each group will receive informative and motivational nudges about the consequences of food waste:

Group 1: financial consequences of food waste (*financial treatment*)

Group 2: environmental consequences of food waste (*ecological treatment*)

Group 3: social side of food waste (*moral treatment*)

Participants

Sample size estimation. A sample size calculation for a repeated-measures (within-between) ANOVA was performed to ensure adequate statistical power, with three experimental groups and two time points. The calculation was performed using the WebPower package in R (version 2024.12.1+563). With an expected effect size of 0.25 (Cohen's f), significance level (α) of 0.05 and desired statistical power ($1 - \beta$): 0.90, the minimum number of participants required for each group is 53 (total 159). We decided not to include a control group due to the high sample size required and the longitudinal structure of the study. We considered T1 as a baseline for the main variables. Participants included students from the University of Milano-Bicocca, recruited via the Sona System platform and compensated in ECTs. Additional adult participants were recruited via snowball sampling. No specific inclusion/exclusion criteria apply. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2025-987). As data collection is still

ongoing, the minimum sample size has not yet been achieved; therefore, the present analyses are based on preliminary data.

Sample. The final sample consisted of 125 participants, including 86 women (68.8%), 35 men (28.0%), 1 nonbinary participant (0.8%), and 3 participants (2.4%) who preferred not to answer. Participants' ages ranged from 19 to 70 years ($M = 26.24$, $SD = 85.72$). The majority resided in the North-West of Italy (110 participants, 88.0%), and held a high school diploma (48.8%), while the rest held a bachelor's (18.4%) or a master's degree (18.4%), and 7 (5.6%) a post-degree qualification or doctorate. Most participants reported a relatively stable economic situation, with 68 participants (54.4%) indicating they made ends meet "somewhat easily," 28 (22.4%) "very easily," 28 (22.4%) "with some difficulty," and 1 participant (0.8%) "with great difficulty". See Appendix for more sociodemographic information.

A comprehension check on the upcoming steps to follow over the course of the study was included to ensure participants understood the study procedure; all 125 participants successfully completed it and were therefore included in the analyses

Measures

The following section presents all the measurement scales used in the study (Table 5.1) and the nudges implemented during the intervention (Figures 5.2). The full MAFW scale, including all items, is reported in the Appendix. After providing informed consent, participants completed socio-demographic questions followed by the scales reported in Table 5.1. The scales are presented in the table in the same order in which they were administered to participants. Items within each scale were randomised.

Table 5.1

Measures Included in the Study and Example Items

Variable	Reference	Example item	Number of items	Response scale
Motivation to Avoid Food Waste (MAFW)	Ribbers <i>et al.</i> , 2023	Environmental motivation: <i>Wasting food leads to overproduction which damages our environment</i>	7	1 = Completely disagree, 7 =
		Financial motivation: <i>I try to avoid wasting food because I worked so hard to earn the money I paid for it</i>	4	Completely agree

		Moral motivation: <i>Food waste is not right because it depletes resources for future generations</i>	4	
		Social norms motivation: <i>I avoid wasting food because I'm afraid other people will think I'm ungrateful</i>	6	
Awareness of food waste consequences	Di Napoli <i>et al.</i> , Study 2	<i>I believe that food waste has a strong impact on the environment; my finances; the global economy; the collective wellness (e.g., people not having enough food)</i>	3	1 = Completely disagree, 7 = Completely agree 7-point semantic differential scale
Attitudes - Food waste	Ajzen, 1991	<i>In your opinion, food waste is... useless-useful</i>	6	1 = Not at all, 7 = Very much
Emotions	Ad hoc	<i>What food waste means to you and what do you feel when you think about it... sadness, anger, etc.</i>	10	1 = Never, 5 = Very often
Food waste habits and preventive habits	Di Napoli <i>et al.</i> , Study 2	<i>Please indicate how often these food waste-related behaviours are typically carried out by you or other members of your household. E.g., meal planning, throwing away leftovers, etc.</i>	17	1 = Not at all confident, 7 = Completely confident E.g., 1 = Less than 1 serving spoon, 5 = More than 6 serving spoons
Perceived Behavioural Control	Ajzen, 1991	<i>How confident are you in your ability to reduce food waste in your household?</i>	1	
Food waste	van Herpen <i>et al.</i> , 2019	<i>How much [food category] was discarded in the last 4 days?</i>	13	

Note. All scales were administered at T1 and T3, except Food waste (van Herpen *et al.*, 2019), which was also measured at T2.

Food waste was measured with the scale presented and validated by van Herpen and colleagues (2019), which was already used in Study 4. The first question asks participants to select the categories of food they threw away during the four days preceding the completion of the questionnaire. They are then asked, for each selected item, to estimate the portions. The responses were then converted into grams, as outlined in the paper appendix (van Herpen *et al.*, 2019).

Nudges. Participants received daily informational or motivational nudges throughout the intervention. Each condition included three distinct nudges (Nudge 1–3), three nudges per condition across three motivational domains: environmental, economic, and moral.

Each nudge was presented twice: Nudge 1 on Days 2 and 6, Nudge 2 on Days 3 and 7, and Nudge 3 on Days 4 and 8.

The first two nudges across all conditions shared an identical introductory text on the importance of food waste and its mention in the 2030 UN Agenda, followed by condition-specific information. Specifically, the first nudge focused on food waste data in Italy, and the second on global food waste data. For each group, these texts were framed according to one of the three motivational domains (financial, environmental, or moral). The third nudge differed in format, consisting of an interactive visual element featuring a moving circle labelled “you” approaching another circle representing a domain-specific concept (e.g., *the environment, the economy, or those in need*). Below the image, participants read a short motivational message consistent with their assigned condition.

Below, we present the motivational nudge for the environmental condition. For a comprehensive review of the nudges, see the Appendix.

Figure 5.2

Motivational nudge for the environmental treatment



*“Keep up the good work! Your effort today protects the environment!
Remember that food waste harms the nature of your community
and the planet.”*

RESULTS

Descriptive analyses

Table 5.2

Descriptive analyses and Cronbach's alpha of the variables

Variable	Time	N	M	SD	C. alpha
Motivation – Environmental	T1	125	5.62	0.86	.86
	T3	125	5.76	0.83	.87
Motivation – Moral	T1	125	5.94	0.80	.74
	T3	125	5.93	0.79	.79
Motivation – Financial	T1	125	5.17	0.88	.71
	T3	125	5.27	0.94	.81
Motivation – Social norms	T1	125	3.12	1.18	.91
	T3	125	3.37	1.32	.96
Awareness of food waste consequences (all)	T1	125	6.03	0.74	.67
	T3	125	6.09	0.74	.74
Environmental impact	T1	125	6.33	0.801	.
	T3	125	6.27	0.874	.
Economic impact	T1	125	5.73	1058	.
	T3	125	5.91	0.925	.
Social impact	T1	125	6.05	0.983	.
	T3	125	6.07	0.926	.
Attitudes - Food waste	T1	122	1.60	0.60	.77
	T3	121	1.63	0.77	.86
Negative emotions	T1	125	4.56	1.09	.87
	T3	125	4.71	1.04	.87
Food waste habits	T1	125	2.49	0.51	.62
	T3	125	2.43	0.51	.67
Preventive habits	T1	125	3.90	0.52	.73
	T3	125	3.85	0.52	.76
Perceived Behavioural Control	T1	125	5.06	1.00	.
	T3	125	5.11	1.03	.
Food waste	T1	125	194.00	282.00	.
	T2	125	111.70	185.60	.
	T3	125	98.45	163.30	.

Note. Food waste is expressed in grams.

Levels of awareness regarding the impact of food waste are, on average, very high, particularly regarding environmental issues. Aligned with previous literature (Ribbers *et al.*, 2023; 2024), the components of the Ribbers scale indicate the highest levels of moral motivation, followed by environmental, and then financial, with social-norm-related motivation being the lowest. Attitudes toward food waste are low, indicating that participants associate it with strongly negative attributes and experience strong negative

emotions when thinking about it. Participants reported a low frequency of waste habits, a high frequency of waste-preventive habits, and a medium to high level of perceived control over household food waste. The estimated food waste over the last four days was 194 grams per household, with a decreasing trend observed throughout the study.

T-test analyses

Paired t-tests were conducted to determine whether the changes in measurements over time were statistically significant.

Table 5.4

Paired Samples T-Test results comparing all measured variables at T1 and T3

		statistic	df	p	Mean difference	SE difference	Effect Size
Motivation - Environmental PRE	Motivation - Environmental POST	-3.13	124	.002	-0.14	0.04	-.28
Motivation - Moral PRE	Motivation - Moral POST	0.15	124	.88	0.01	0.05	.01
Motivation - Financial PRE	Motivation - Financial POST	-1.48	124	.14	-0.09	0.06	-.13
Motivation - Social norms PRE	Motivation - Social norms POST	-2.73	124	.007	-0.25	0.09	-.24
Awareness all PRE	Awareness all POST	-0.94	124	.35	-0.05	0.05	-.08
Attitudes PRE	Attitudes POST	-0.28	117	.78	-0.02	0.07	-.03
Negative Emotions PRE	Negative Emotions POST	-2.25	124	.03	-0.15	0.07	-.20
Preventive habits PRE	Preventive habits POST	1.54	124	.13	0.05	0.033	.14
Waste habits PRE	Waste habits POST	1.98	124	.05	0.06	0.032	.18
FW T1	FW T2	3.01	124	.003	8230.40	273.74	.27
	FW T3	3.53	124	<.001	9553.60	270.56	.32
FW T2	FW T3	0.83	124	.41	1323.20	160.04	.07
Awareness Environment PRE	Awareness Environment POST	0.84	124	.40	0.06	0.07	.08
Awareness Finance PRE	Awareness Finance POST	-2.10	124	.04	-0.18	0.09	-.19
Awareness Moral PRE	Awareness Moral POST	-0.35	124	.73	-0.02	0.07	-.03

Note. Statistic = Student's t, Effect Size = Cohen's d.

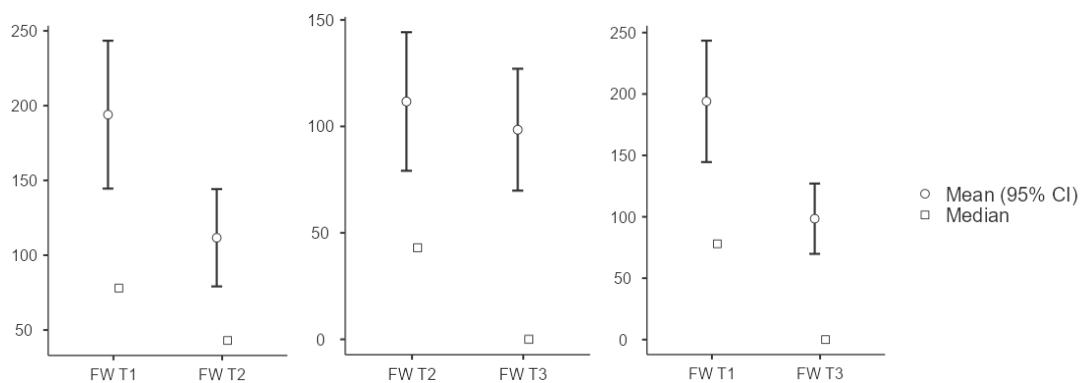
Table 5.3 reports the results of the t-test analyses between T1 and T3. The results show an increase in levels of environmental and social-norm motivations to avoid household food waste. Moral and financial motivations, on the other hand, did not change

significantly. Awareness of the economic consequences of food waste and negative emotions also increased, while waste-related habits and food waste itself consistently decreased over time.

Interestingly, food waste decreased constantly over time, but the difference between T2 and T3 is not statistically significant (Figures 5.3a-c).

Figures 5.3a-c

Descriptive plots comparing T1, T2 and T3 for food waste

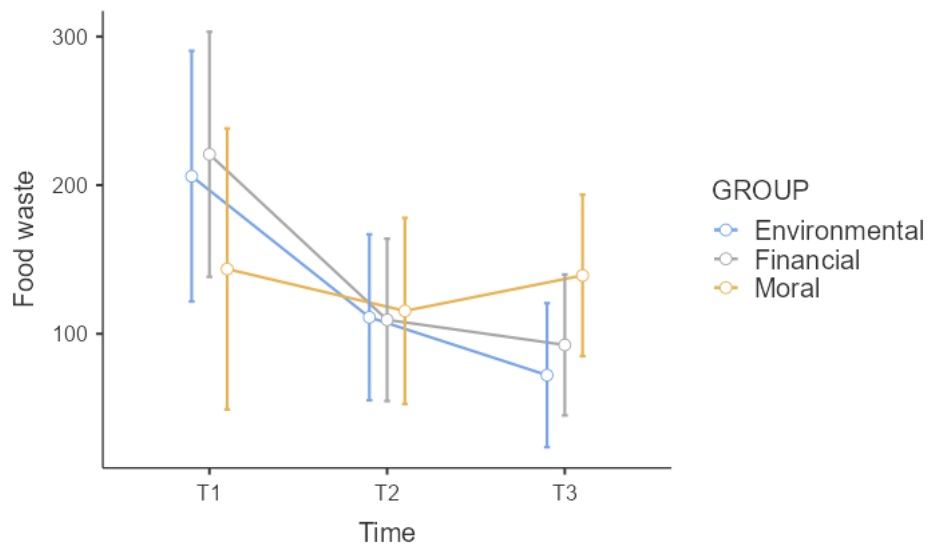


Repeated-measures ANOVAs

After observing the differences between T1 and T3, repeated-measures ANOVAs were conducted to examine whether changes over time also varied as a function of the treatment condition. The treatment had no effect on the variables over time. For example, the effect of time on food waste over time is significant, $F(2) = 8.07, p < .001$, but the effect of the treatment is not, $F(2) = 0.06, p = .94$, nor the interaction between time and treatment, $F(4) = 1.46, p = .21$. This suggests that it is not so much the type of motivation targeted by the informational and motivational nudges that influences the dependent variables, but rather the very act of participating in a longitudinal experiment with the aim of reducing food waste.

Figure 5.4

*Estimated marginal means plot for Group*Time*



Note. Group = treatment the participants were randomly assigned to.

Figure 5.4 shows how the three groups behaved across the three measurements of food waste. Participants in the environmental and financial treatment groups appear to follow a similar decreasing trend, while food waste among participants in the moral treatment group slightly decreases before rising again at T3. Despite this, the differences are not significant, and the variability in the measures is very high.

DISCUSSION

This experimental longitudinal study aimed to investigate how different motivational nudges, delivered through an app, can influence household food waste over time. Confirming the *first hypothesis*, results show a significant decrease in food waste, expressed in portions and grams. Moreover, we saw an increase in environmental and social norms motivations to avoid food waste, of awareness linked to its economic impact, and a decrease in habits that represent – or lead to – food waste. At the same time, there is also an effect that might, in some cases, backfire: while attitudes towards food waste remain – statistically – the same, negative emotions increase. Essentially, participants do not change their attitudes towards food waste, but they feel more negatively about it.

The *second* and *third hypotheses* were not confirmed, as paired-sample t-test and Repeated-measures ANOVAs did not find any significant effect of treatment on food waste or the different scales of motivations, as they did not on any other dependent variable.

Strengths. A major strength of this study lies in the fact that it measures not merely the frequency of the behaviour, but an estimate of the actual grams of food wasted, following the procedure outlined by van Herpen and colleagues (2019). In most research – as discussed in Chapter 2, devoted to the psychological literature, and in Studies 2 and 3 – behaviour is typically represented by a proxy measure, such as intentions, past behaviour, or the reported frequency of a series of actions that may be related to, but do not always directly demonstrate, food waste (van der Werf *et al.*, 2020).

Another strength of this study is its longitudinal design. As observed in Study 4, the impact of the intervention does not seem to depend so much on the type of treatment, but rather on the participation effect (i.e., the Hawthorne effect). Furthermore, receiving daily reminders about food waste and its importance, alongside motivational messages regarding their own behaviour, may have served as an attention-focusing mechanism, reinforcing participants' awareness and engagement. A control group should, in a future study, confirm this interpretation.

Limits and future research. First, it is not possible to establish with certainty whether the effectiveness of the intervention can be attributed solely to participation in a longitudinal study with multiple measurements, or whether it is also influenced by the presence and type of nudges. To clarify this, a subsequent data collection with a control group in a similar setting and with a comparable sample composition – either without any informational nudges, or with nudges on unrelated topics – could provide further insight into these results.

Results shown in Figures 5.3a–c indicate a decreasing trend in food waste across all nine days of the experiment. However, already between T2 and T3, the difference in food waste measurements is no longer significant. This may suggest that after five days, participants' attention or interest in behavioural control diminished. These findings suggest the potential value of designing interventions that consider participants' motivations, availability, and abilities, which could be explored further in future studies.

STUDY 6 – EXPERIMENTAL STUDY IN A LEISURE CONTEXT

INTRODUCTION

Study 5 examined the role of different motivations in shaping food waste in the household context, using a longitudinal design with continuous presentation of informational and motivational nudges over a nine-day period. The final study now presented has a similar core, as it also investigates the role of different motivations (Ribbers *et al.*, 2023) in shaping intentions towards food waste and wasteful behaviour, but in a leisure context. The study was conducted at Camping Le Esperidi, located in Marina di Bibbona, Tuscany, and the participants who took part in the experiment were, in fact, campers.

Due to logistical and opportunity constraints, the psychological literature shows very few examples of studies conducted in a camping site (Li & Wu, 2019; Yang *et al.*, 2024; Zhang *et al.*, 2023). For this reason, the rarity of the sample type and the context in which participants were invited to take part makes this study valuable in itself. Yang and colleagues (2024) investigated pro-environmental behaviours in a camping site, also illustrating the relationship between a leisure context and place attachment. Other studies (e.g., Li & Wu, 2019; Zhang *et al.*, 2023) did not take place in a camping site per se, but investigated pro-environmental intentions in nature-based destinations or parks, focusing on tourists' behaviour.

This study explores a novel context in sustainable food behaviour research: a camping site, where individuals are outside their usual household environment, removed from domestic routines and immersed in a micro-community of fellow campers. In this vacation setting surrounded by others, one might expect heightened attention to food waste and greater influence of social norms – particularly descriptive norms – due to the visibility of others' conduct and potential moral licensing in contexts of social comparison (Monin & Miller, 2001; Effron & Conway, 2015).

HYPOTHESES

H1: People are expected to report higher levels of environmental motivation than financial or moral motivation, given that the camping site Le Esperidi has strong pro-environmental self-identity.

H2: Participants in the experimental conditions are expected to report higher levels of motivation to reduce food waste, and a stronger perceived sense of control to those in the control condition.

H3. Exposure to a specific informational message (economic or environmental) is expected to increase the corresponding motivation scale.

MATERIALS AND METHODS

Study design

Participants accessed the online questionnaire via a QR code printed on a flyer (Figure 5.5), which was distributed by the researchers throughout the campsite, including in the pool and on the beach. The researchers briefly explained the general topic of the study to the campers without revealing the experimental aim and invited them to participate. The questionnaire was distributed in three languages (Italian, English, and German) and took approximately 10 minutes to complete. Before starting, each participant was presented with an information sheet and data processing regulations on the questionnaire screen. Providing consent to data processing allowed participants to proceed.

As an incentive and token of appreciation for participation, participants received a small gift upon completion of the questionnaire. Gifts included corn-starch sunglasses, a T-shirt representing the collaboration between the University of Milano-Bicocca and the Campsite, or a small pot and some sunflower seeds (Figure 5.5). Completion was verified via a unique code provided at the end of the questionnaire.

Figure 5.5

Flyer in three different languages distributed to promote the study



Figure 5.6

The sunflower plants we were growing on our stay at the camping, with the University logo on the pot.



After answering some initial questions about their sociodemographic characteristics and their stay at the campsite, participants were randomly assigned to one of three experimental groups:

Group 1: financial consequences of food waste (*financial treatment*)

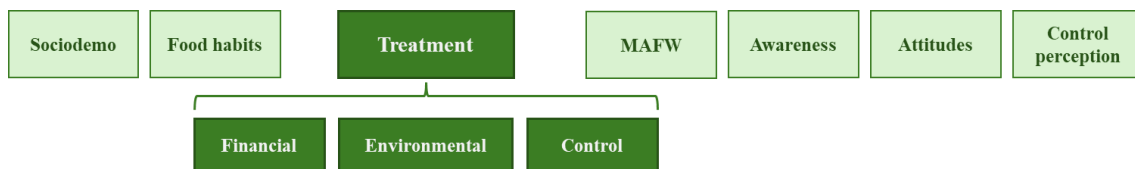
Group 2: environmental consequences of food waste (*environmental treatment*)

Group 3: no information (*control group*)

They then all completed the same measures of motivations, awareness, attitudes, and perceived behavioural control (see Figure 5.7).

Figure 5.7

Visual representation of the study structure



Informational messages. Participants received messages tailored to the experimental group to which they have been randomly assigned (Figures 5.8a-b). The messages hand out information on the economic consequences of food waste (*financial treatment*) or environmental consequences of food waste (*environmental treatment*). To achieve more engagement, the messages included information on both the Italian and the global context, and differed in the presentation format, including sentences, numbers, and images. In the control condition, participants did not receive any information.

The scale developed by Ribbers and colleagues (2023) includes four motivational reasons to avoid food waste. We could have used all four as interventions to induce different motivational changes. However, due to sample size limitations, we decided to focus on only two experimental groups, targeting environmental and financial motivations. These were considered the most relevant to the potential population of Le Esperidi campsite, which is a medium-to-high-end site promoting sustainability. We also included a control group to account for the fact that the context is already strongly pro-

environmental, and participants are generally exposed to information on food waste and recycling. This allowed us to ensure that any observed effects could be attributed specifically to our intervention rather than to prior exposure to these contextual factors shared by all participants.

Participants

Sample size estimation: To estimate the sample size, an a priori power analysis was conducted using the software *GPower** 3.1.9.4 (Faul *et al.*, 2007), with the test “ANOVA: Fixed effect, omnibus, one-way.” With a significance level of $\alpha = 0.05$ and a statistical power of 0.95, the minimum required sample size - considering an effect size of 0.25 - was calculated to be 249 participants (83 per each of the three groups). All participants were guests of legal age staying at the Camping Village Le Esperidi (Marina di Bibbona, Italy). No specific inclusion/exclusion criteria apply. Prior to participation, all subjects provided written informed consent, and the study was approved by the *Comitato per la Ricerca Interdisciplinare in Psicologia* (CRIP) Ethics Committee of the University of Milano-Bicocca (protocol no. RM-2025-987).

Sample. The total sample comprises 270 participants, with a mean age of 46.7 years ($SD = 12.6$), indicating a heterogeneous adult population spanning a wide age range. Regarding gender, there is a slight female prevalence (149 women), followed by 120 men and one participant identifying as non-binary. Most participants are Italian nationals ($n = 184$), accompanied by a significant presence of guests from Germany ($n = 69$), and, to a lesser extent, from Switzerland ($n = 8$), Austria ($n = 4$), and individual participants from Lithuania, Bosnia and Herzegovina, Serbia, and the United States. The internal geographic distribution within the Italian sample reflects a strong concentration in Northern Italy: specifically, Lombardy ($N = 54$), Piedmont ($N = 42$), and Liguria ($N = 19$) make up the largest share (Northwest, total = 115), followed by the Northeastern regions (total = 18) and Tuscany ($n = 50$). No participants came from Southern Italy or the islands, in line with the seasonal tourist profile of the data collection context. As for dietary habits, most participants identify as omnivores ($N = 233$), while 37 individuals report alternative dietary types (e.g., vegetarian, flexitarian, or other variants).

Measures

The following section presents all the measurement scales used in the study (Table 5.5), and the messages implemented during the intervention (Figures 5.8a-b). After providing informed consent, participants completed socio-demographic questions followed by the scales reported in Table 5.5. The scales are presented in the table in the same order in which they were administered to participants. Items within each scale were randomised.

Table 5.5
Measures Included in the Study and Example Items

Variable	Reference	Example item	Number of items	Response scale
Motivation to Avoid Food Waste (MAFW)	Ribbers <i>et al.</i> , 2023	Environmental motivation: <i>Wasting food leads to overproduction which damages our environment</i>	7	1 = Completely disagree, 7 = Completely agree
		Financial motivation: <i>I try to avoid wasting food because I worked so hard to earn the money I paid for it</i>	4	
		Moral motivation: <i>Food waste is not right because it depletes resources for future generations</i>	4	
		Social norms motivation: <i>I avoid wasting food because I'm afraid other people will think I'm ungrateful</i>	6	
Awareness of food waste consequences	Di Napoli <i>et al.</i> , Study 2	<i>I believe that food waste has a strong impact on the environment; my finances; the global economy; the collective wellness (e.g., people not having enough food)</i>	3	1 = Completely disagree, 7 = Completely agree
Attitudes - Food waste reduction	Ajzen, 1991	<i>I believe that reducing food waste on vacation is... useless - useful</i>	6	7-point semantic differential scale
Perceived Behavioural Control	Ajzen, 1991	<i>I am confident I can reduce food waste on vacation</i>	2	1 = Completely disagree, 7 = Completely agree
Injunctive norm	Ajzen, 1991	<i>People who are important to me would approve of my attempt to reduce food waste on vacation</i>	1	1 = Completely disagree, 7 = Completely agree
Descriptive norm	Cialdini <i>et al.</i> , 1990	<i>I believe that other campers try to control and reduce food waste on vacation</i>	1	1 = Completely disagree, 7 = Completely agree

Food waste	van Herpen <i>et al.</i> , 2019	Presentation of a list of foods (<i>e.g.</i> , vegetables and salads, fruit, pasta, <i>etc.</i>) and request to select those that were discarded in the last 4 days. For each food category selected, participants will be asked to indicate the approximate amount thrown away in the last 4 days (<i>e.g.</i> , less than a tablespoon, 1-2 tablespoons)	13	E.g., 1 = less than 1 serving spoon, 5 = more than 6 serving spoons
Intentions	Di Napoli <i>et al.</i> , Study 2	<i>How much I intend to commit to adopting these anti-food waste strategies during their stay at Camping Village Le Esperidi, e.g., reuse leftovers, meal planning</i>	7	1 = Not at all, 5 = Very much

Figures 5.8a-b

Informational messages of group 1 (left) and group 2 (right)



Every year, **3.3 billion tons of CO₂** are released into the atmosphere worldwide due to food waste. In Italy, the amount of CO₂ is **13 million tons of CO₂**.



Every year, **870 billion Euros** are thrown away worldwide due to food waste. In Italy, the amount is **4.8 billion Euros**.

Note. A brief introductory text was presented in both conditions: “Worldwide, approximately one-third of food is wasted. In Italy, each citizen throws away approximately 30 kg of food per year. What impact does food waste have on the environment/the economy?”.

RESULTS

Results show that the sample exhibits high levels of awareness, particularly regarding the environmental consequences of food waste (Table 5.6). Concerning the motivations for reducing food waste on vacation, moral motivation emerges as the predominant factor, followed by environmental motivation, while economic and normative motivations appear less central (Table 5.7). This pattern aligns with findings reported in the literature on motivations for food waste prevention (Ribbers *et al.*, 2023)

and confirms evidence previously observed in studies conducted by the same research group. Moral motivation thus appears to be the most strong component.

Overall, these findings describe a particularly sensitive sample to issues of environmental sustainability, consistent with the context in which the study was carried out, namely, a facility that identifies and promotes itself as “green” and environmentally oriented. However, it cannot be ruled out that the situational context and the direct interaction with a research team focused on environmental issues may have accentuated self-presentation bias, a phenomenon frequently documented in studies on sustainable behaviour.

Table 5.6

Descriptive analyses of the levels of awareness regarding the environmental, financial (individual level), economic (global level), and social impact of food waste

	N	Mean	SD
Awareness – Environmental impact	264	6.47	0.97
Awareness – Financial (individual) impact	264	5.69	1.31
Awareness – Economic (global) impact	264	6.03	1.22
Awareness – Social impact	264	6.09	1.12

Table 5.7

Descriptive analyses and Cronbach’s alpha of the variables

	N	Mean	SD	C. alpha
Motivation – Environmental	260	5.90	0.85	.84
Motivation – Moral	257	6.06	0.79	.72
Motivation – Financial	261	5.10	1.09	.79
Motivation – Social norms	262	3.09	1.26	.91
Awareness (all)	264	6.07	0.96	.84
Attitudes – Food waste reduction	264	4.38	0.71	.77
Perceived Behavioural Control	263	5.94	1.08	.78***
Social norms	264	5.28	0.86	.23***
Intentions	263	4.24	0.69	.86

Note. Awareness (all) = composite variable for environmental, financial, economic and social impact consequences of food waste. Intentions = composite variable of all intentions to perform anti-waste strategies during their stay at the camping. For scales

with two items, the correlation between items is reported instead of Cronbach's alpha. *** $p < .001$.

The social norms did not correlate strongly with each other and exhibited different relationships with other variables (Table 5.8). Additionally, they differed in their mean levels, with the injunctive norm ($M = 5.96$, $SD = 1.08$) being higher than the descriptive norm ($M = 4.61$, $SD = 1.12$). The social norms were therefore kept distinct in their items for injunctive and descriptive norms. As we will see, they also play different roles in the model predicting intentions.

ANOVAs

ANOVAs were conducted to determine whether the different treatments determined differences in the main variables.

As shown in Table 5.9, the ANOVAs conducted did not reveal statistically significant differences in the examined variables following exposure to the informational messages about the consequences of food waste. This result suggests that, for this sample, informational interventions alone were insufficient to produce measurable changes in the considered indicators. This finding may also be interpreted in light of the mere exposure effect, whereby repeated exposure to sustainability and waste-related issues could influence participants regardless of the intervention. In this sense, it is worth questioning whether a true control condition exists, given that all participants were embedded in an environment that already promotes pro-environmental and anti-waste behaviours.

Table 5.9

Analysis of Variance on the Effect of Experimental Groups

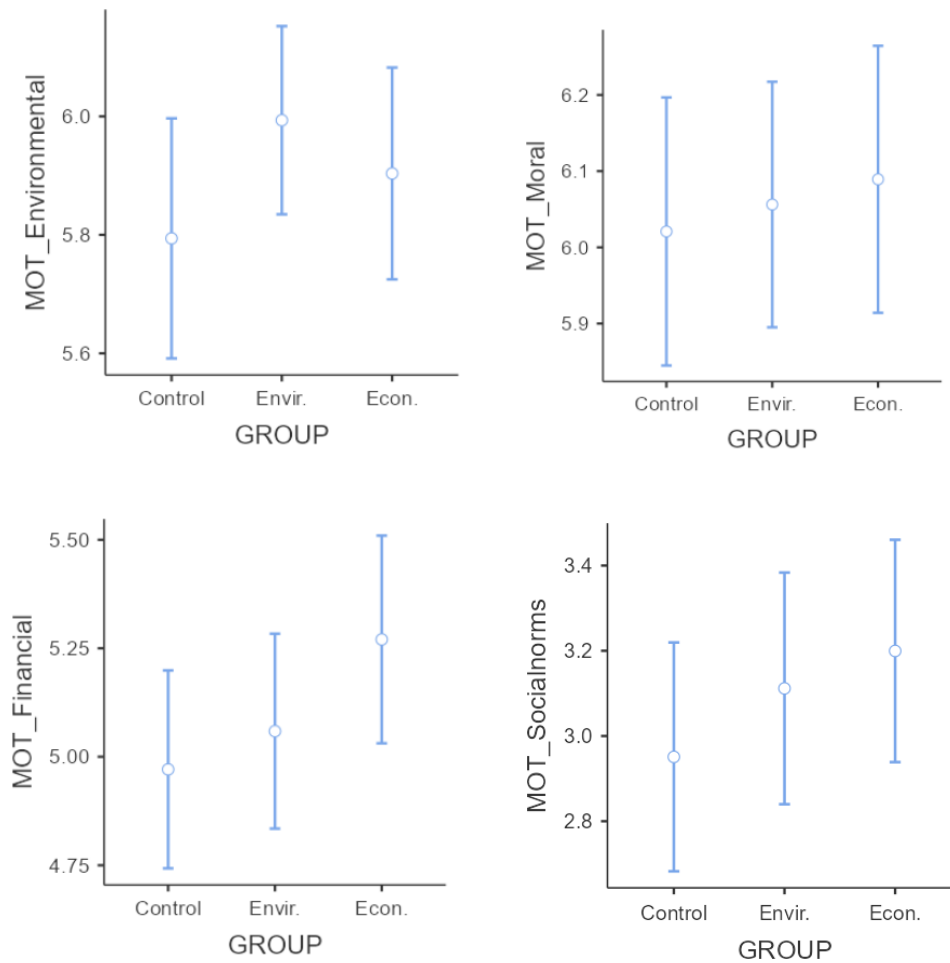
	F	df1	df2	p
Motivation – Environmental	1.19	2	169	.31
Motivation – Moral	0.15	2	169	.86
Motivation – Financial	1.69	2	172	.19
Motivation – Social norms	0.89	2	173	.41
Awareness (all)	0.36	2	173	.70

Environmental impact	0.37	2	173	.69
Financial impact	0.68	2	172	.54
Economic impact	0.45	2	174	.64
Social impact	0.74	2	170	.48
Attitudes – Food waste reduction	2.13	2	172	.12
Perceived Behavioural Control	0.34	2	173	.71
Injunctive norm	0.16	2	173	.86
Descriptive norm	0.56	2	173	.57
Intentions	0.50	2	173	.61

Although no statistically significant differences among the three groups emerged, some interesting trends can be observed regarding the factors of the motivation scale on motivations to avoid food waste (Figures 59.a-d). In particular, environmental motivation is higher in the group exposed to the environmental condition compared to both the control group and the group focused on the economic aspect. Regarding moral motivation, no differences between groups are evident; however, the means are already very high across all conditions, confirming that the moral dimension represents a central and stable factor in the context of food waste. Economic motivation shows a higher mean in the group exposed to the “economic” condition, consistent with expectations. Finally, for social-norm-related motivation, the means are generally lower compared to the other factors, but an increase is observed in the two experimental groups relative to the control group. This may indicate that exposure to information on the quantities of food waste and its consequences implicitly activated social norms, increasing the perception of shared responsibility.

Figures 5.9a-d

Average trends in relation to motivational factors for avoiding food waste



The observed trends, although not statistically significant, are warrant careful consideration. They reveal a possible distinction between the groups, consistent with our hypotheses. The lack of significance could be addressed in future replication studies through larger samples, participants with higher awareness or stronger pre-existing motivations, or modified study contexts. These considerations underscore the potential of the observed patterns and promising directions for future research, particularly by intensifying the intervention for greater effect.

Nationality-based differences

To explore potential differences attributable to cultural factors, the analyses were repeated by dividing the sample according to participants' nationality, comparing the

main motivational and attitudinal indicators related to food waste. The ANOVA analyses (adjusted using Welch's test; Table 5.9) revealed significant differences between nationalities for several variables related to motivation and awareness of food waste (Table 5.9). In particular, environmental motivation to avoid food waste varied across groups ($p = .05$), with German participants showing higher levels ($M = 6.08$) compared to Italian participants ($M = 5.82$). In contrast, Italians reported greater awareness of economic consequences, both at the individual level (financial awareness, $p = .04$) and at the macro level (economic awareness, $p < .001$), along with higher awareness of the social impact of food waste (social awareness, $p = .03$) and more favourable attitudes toward reducing food waste while on vacation (attitudes, $p = .01$).

Table 5.9

Significant nationality differences on key variables

	F	df1	df2	p
Motivation – Environmental	3.16	2	43.3	.05
Awareness – Financial impact	3.50	2	44.5	.04
Awareness – Economic impact	18.37	2	48.2	<.001
Awareness – Social impact	3.86	2	46.5	.03
Attitudes – Food waste reduction	5.80	2	43.0	.01

Note. Only significant results are reported.

Descriptives per nationality

	Nationality	N	Mean	SD	SE
Motivation – Environmental	Italian	175	5.82	0.90	0.07
	German	68	6.08	0.66	0.08
	Other	17	6.03	0.83	0.20
Awareness – Financial impact	Italian	180	5.82	1.36	0.10
	German	66	5.42	1.07	0.13
	Other	18	5.28	1.41	0.33
Awareness – Economic impact	Italian	180	6.30	1.12	0.08
	German	66	5.26	1.21	0.15
	Other	18	6.11	0.83	0.20
Awareness – Social impact	Italian	180	6.21	1.18	0.09
	German	66	5.82	0.91	0.11

	Other	18	5.94	1.00	0.24
Attitudes – Food waste reduction	Italian	180	4.48	0.64	0.05
	German	66	4.11	0.82	0.10
	Other	18	4.32	0.69	0.16

On average, Italians exhibit lower environmental motivation to avoid food waste compared to other nationalities, but report higher awareness of economic consequences at both the individual and family levels, as well as at the global level, greater awareness of social impact, and more favourable attitudes toward reducing food waste while on vacation (Table 5.9).

Non-significant ANOVAs were not reported. There is no significant difference among the other motivations of the MOA scale, nor is there a difference for awareness (environmental), intentions, or PBC (all $ps > .05$).

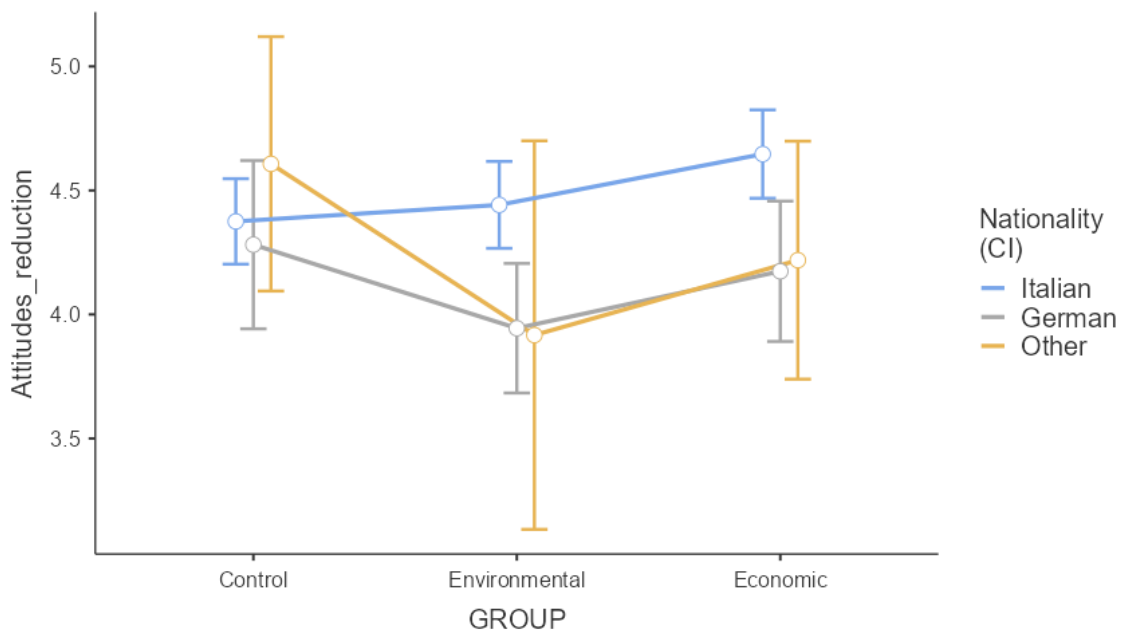
These results outline two distinct motivational profiles: Italian participants appear to be primarily guided by economic and social considerations, and they report stronger attitudes toward reducing food waste. In contrast, German participants show a motivation more oriented toward environmental protection. The analysis using a general linear model (GLM), which considered the interaction between experimental condition and nationality (Figure 5.10), suggests this distinction: among Italians, exposure to the experimental stimuli led to more positive attitudes toward reducing food waste; conversely, among non-Italian participants, it was the control group members who reported higher attitudes compared to the experimental groups. This pattern suggests that responses to informational interventions are culturally modulated, reflecting different motivational systems and meanings attributed to food waste across groups.

The main finding is that there were no differences between the experimental groups in terms of various motivations to avoid food waste and awareness of its impact across different contexts. One possible interpretation is that the questions posed in the vacation context may not have fully captured participants' general intentions or motivations to reduce food waste for a given reason. For example, now that participants are aware of the economic impact of food waste, they might be more motivated in everyday life to pay attention to this aspect, but not necessarily during a vacation, since it is a limited period, and they may not be willing to make the effort at that time.

At the same time, awareness itself did not appear to depend on the experimental condition. The questions about motivations were framed in general terms and were not limited to the vacation context. Nevertheless, it is possible that participants, when considering the vacation context, adopted a “different mindset” compared to their everyday life, and therefore responded in terms of which motivations would drive them to avoid food waste in that specific moment.

Figure 5.10

GLM with interaction between experimental condition and nationality



Note. Italian participants report higher attitudes toward reducing food waste while on vacation in both experimental conditions (environmental and economic), whereas participants from other nationalities show higher attitudes in the control condition compared to the experimental conditions.

Correlation analyses

Correlation analyses were performed on all the mentioned variables. Table 5.8 reports only the main variables that were later included in the Path Analyses (see Appendix for the complete correlation matrix).

Table 5.8*Correlation matrix of the main variables*

	1	2	3	4	5	6	7	8	9
1. Motivation Environmental	.								
2. Mot. Moral	.67***	.							
3. Motivation - Financial	.32***	.34***	.						
4. Motivation - Social norms	-.02	-.09	.16*	.					
5. Attitudes - Food waste reduction	.31***	.35***	.16**	-.02	.				
6. Perceived Behavioural Control	.31***	.44***	.30***	-.10	.43***	.			
7. Injunctive norm	.42***	.45***	.18**	-.11	.38***	.46***	.		
8. Descriptive norm	.16**	.15*	.17**	.05	.20**	.26***	.23***	.	
9. Intentions	.36***	.47***	.21***	-.10	.43***	.45***	.45***	.11	.

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

The variable related to social norms motivation does not correlate with any other measures, except for financial motivation (see also Ribbers *et al.*, 2024). Environmental motivation correlates positively and strongly with all other variables. This may be due to the vacation context immersed in nature, particularly because the camping site positions its identity around environmental sustainability. Self-presentation effects are also likely contributing to this strong pattern. Moral motivation is also strongly and positively correlated with all other variables. This aligns with the literature, which identifies moral motivation as the most influential factor in attempts to avoid food waste. This result is especially notable because no informational messages targeting moral motivation were presented. Financial motivation also correlates positively with all variables. This was somewhat expected, given the clear link between waste and economic loss. However, considering that most campers belong to a middle-to-high socioeconomic bracket, it was anticipated that its influence might be smaller.

Overall, the high correlations among nearly all variables suggest the presence of self-presentation bias and possible measurement issues in the questionnaire. In addition, the fact that participants were continuously exposed to sustainability-related messaging at the campsite and during the research activities throughout the summer likely contributed to this bias.

Path analysis

We conducted a hierarchical linear regression model and then tested two path analysis models. Initially, we ran a model in which intentions to implement strategies against food waste while on vacation were determined by all predictor variables. The model was significant, but many constructs were not significant, despite their consistent and predictive effect on intentions in the literature, such as attitudes or social norms.

After several attempts to interpret these results, and a further review of the literature on how the Ribbers (2023) motivation scale had been previously treated and in relation to other psychological variables, we realized that the motivation scale (understood more as a set of beliefs about food waste across various aspects) was likely being used solely as a predictor of measurable waste behaviour. The Ribbers' motivation scale, as conceptualised, could be a predictor of the variables typically considered antecedents of intentions and therefore behaviour. We then conducted two path analysis models to test:

1. The classic TPB model (attitudes, anticipated emotions, social norms, and perceived behavioural control as predictors of intentions) shows good fit indices: $X^2 = 255$ ($df = 10$), $p < .001$. CFI = 1.00, TLI = 1.00, RMSEA = .00, and SRMR = .00. $R^2 = .33$, with all listed variables statistically significant (all $ps < .001$) except for descriptive norms, which were not significant in predicting intentions to reduce food waste while on vacation.

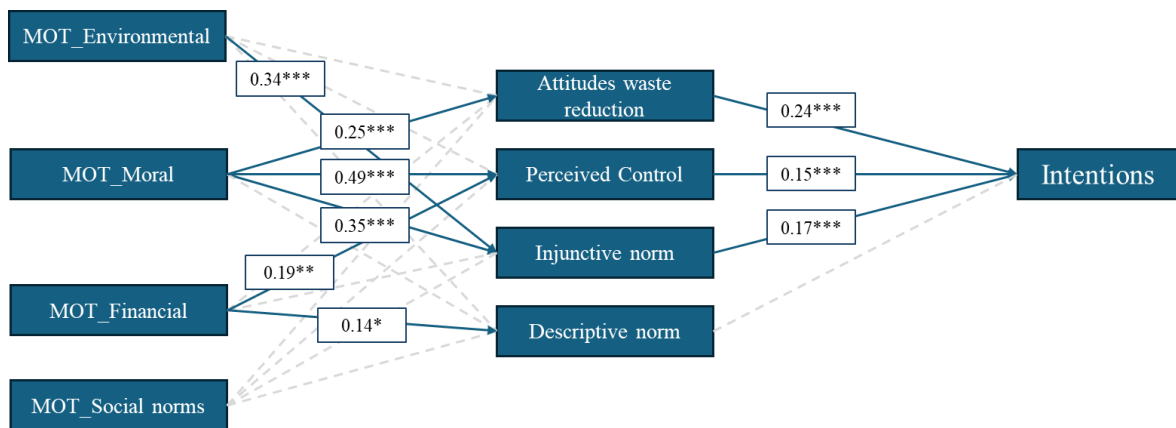
That is, it doesn't matter what they think other campers do, although perceived waste mindfulness among other campers was quite low, suggesting that participants assume others are not particularly mindful of waste in that context, in motivating their intentions to reduce waste. The injunctive norm, however, is different, because it's who matters to them, whether they approve or disapprove, that does influence their intention to reduce waste.

2. In a second path analysis, the four motivation subscales (Ribbers *et al.*, 2023) were added as antecedents of the TPB components; in the tested model, attitudes, social norms, and perceived behavioural control are thus treated as mediators of motivations (i.e., reasons for non-wasting food) on intentions. The four Motivation to Avoid Food Waste (MAFW) scales were included as predictors of behavioural antecedents, as their wording conceptualises them more as beliefs. According to Ajzen (1991; 2002), attitudes, subjective norms, and perceived behavioural control are determined by the underlying beliefs that underpin them.

Below is the model (see Figure 5.11) with the explained variance and fitness indices. The MAFW scale items, in their operationalisation (e.g., “Food waste is not right because it depletes resources for future generations”), fundamentally represent beliefs about food waste across different domains. Accordingly, in the presented model, the MAFW scales are incorporated into the TPB framework as antecedents of the intention predictors – namely attitudes, perceived behavioural control, and social norms – since established research views these predictors as outcomes of their corresponding underlying beliefs (Ajzen, 1991).

Figure 5.11

Model of TPB plus additional predictors



Note. $X^2 = 377.8$ ($df=30$), $p<.001$. CFI=.97, TLI=.78, RMSEA=.10, and SRMR=.03. $R^2=.36$ for intentions, .13 for attitudes, .22 for perceived behavioural control, .24 for injunctive norm, and .05 for descriptive norm. Coefficients are unstandardised (b) values.

Several significant indirect effects emerged from the mediation analyses (Table 5.9). Only significant effects are reported. For a complete table of results, see the Appendix.

Table 5.9

Indirect effects of the model

Description	Estimate	SE	95% Confidence Intervals		β	z	p
MOT_Environmental \Rightarrow Injunctive norm \Rightarrow Intentions	0.06	0.02	0.02	0.10	0.072	2.78	.01
MOT_Moral \Rightarrow Attitudes reduction \Rightarrow Intentions	0.06	0.02	0.02	0.11	0.073	2.72	.01

MOT_Moral ⇒ PBC ⇒ Intentions	0.07	0.02	0.03	0.12	0.087	3.03	.00
MOT_Moral ⇒ Injunctive norm ⇒ Intentions	0.06	0.02	0.02	0.10	0.071	2.70	.01
MOT_Financial ⇒ PBC ⇒ Intentions	0.03	0.01	0.01	0.05	0.05	2.48	.01

Environmental motivation exhibited a significant indirect effect on intentions through injunctive norms, suggesting that participants with stronger environmental motivations perceived stronger social expectations to reduce food waste, which in turn predicted higher intentions to do so.

Moral motivation displayed multiple significant indirect effects. Specifically, moral motivation influenced intentions via attitudes toward food waste reduction, perceived behavioural control, and injunctive norms. These results suggest that moral considerations are associated with more positive attitudes, a stronger sense of control, and greater perceived social approval regarding food waste reduction, which together enhance behavioural intentions. Moral motivation also affects attitudes towards reducing food waste, and in the specific context of a vacation. The fact that the economic motivation subscale of the Ribbers *et al.* (2023) scale predicts the descriptive norm can be interpreted as follows: it's possible that people who associate food waste with a waste of money may project their own belief and attribute the same motivation to other campers. Therefore, the more I believe that food waste is a waste of money, the more I will believe that other people also try to reduce it as much as possible.

Finally, financial motivation showed a significant indirect effect on intentions through perceived behavioural control, indicating that participants who viewed food waste as an economic issue also perceived themselves as more capable of reducing it, which subsequently strengthened their intentions.

DISCUSSION

This on-field experimental study aimed to investigate how different motivational messages regarding the economic and environmental impacts of food waste can influence food waste in a leisure setting.

The sample considered in this study presents characteristics of particular interest for several reasons. First, data collection took place in a leisure context, a setting rarely investigated in the literature on pro-environmental behaviours, which traditionally focuses on everyday or educational environments. Second, the sample exhibits high average levels in several relevant psychological variables, including awareness of the consequences of food waste, positive attitudes toward its prevention, motivations to avoid it, and perceived behavioural control. Participants were primarily adults and older adults, with a strong orientation toward sustainable behaviours.

Another notable feature of the sample is its multinational composition, including both Italian and non-Italian participants. This allowed us to observe significant differences between national groups in their motivations and attitudes toward food waste, highlighting the importance of considering nationality in the design of interventions.

Despite the interventions implemented, the absence of significant effects from the experimental manipulation can be largely attributed to these sample characteristics. A ceiling effect may have occurred, as participants already reported very high levels on the target variables, leaving little room for further improvement. Moreover, the type of intervention used – a brief informational message – may not have been intense or long-lasting enough to produce measurable changes in a highly sensitised sample. In this sense, the study design itself may have limited the emergence of differences between groups. This also aligns with the mere-exposure effect (Bornstein & Craver-Lemley, 2022; Zajonc, 1968), whereby repeated exposure to sustainability-related messages inside the camping site could have influenced participants independently of the intervention's content.

Awareness of food waste consequences was found to have a significant positive effect on intentions to reduce waste (Chun T'ing *et al.*, 2021; Melnyk *et al.*, 2025), although ecological consciousness did not show the same effect (Chun T'ing *et al.*, 2021). Interestingly, participants reported, on average, low levels of descriptive norms, meaning they did not strongly believe that other campers were making an effort to reduce food

waste. However, their intentions and attitudes toward waste reduction were very high. This suggests that a moral licensing effect – typically triggered when individuals compare themselves to others or observe virtuous behaviour from ingroup members (Effron & Conway, 2015; Lasarov & Hoffmann, 2020) – might not have occurred in this context.

Participants may simply be consistently attentive and virtuous in their behaviours, or it may indicate that behaviour in this context does not easily change. The behavioural variable included in our model is therefore a proxy for past behaviour, capturing what participants actually did in the preceding days. For some, this reflects routines in their usual domestic context, while for others, it reflects behaviour already adapted to the vacation context, and for some, a combination of both.

Regarding motivational measures, the Ribbers’ scale proved informative overall. However, the social norm subscale, although it shows good reliability, does not correlate with any of the other variables in the model and fails to predict social norms—neither the descriptive norm nor, as expected, the injunctive norm (for the wording of the scale items in the MAFW, see Appendix). In contrast, moral and environmental motivation subscales were particularly relevant, consistent with previous literature (Ribbers *et al.*, 2023, 2024). A meta-analytic review has also noted a publication bias related to moral licensing (Blanken *et al.*, 2015), which may partly explain the inconsistent findings in this domain.

Finally, the trends observed in this study suggest that single-wave designs can capture initial patterns but may underestimate changes over time. Future research could explore these effects further through longitudinal designs or follow-up questionnaires, ideally integrating different messages, prompts, or nudges and accounting for participants’ characteristics, motivations, and capacities to act.

GENERAL DISCUSSION

Both studies used three experimental groups to test how different informational messages on the impact of food waste might influence attitudes, waste-related behaviours, and motivations. In both cases, however, this did not occur. That is, there were no significant differences between the groups, although Study 6 showed a very interesting trend consistent with the hypotheses (namely, that information about environmental impact increased environmental motivations, while financial information increased economic motivation), which could be further explored in a future longitudinal study.

The Motivation to Avoid Food Waste (MAFW) scales prove to be particularly important, showing significant correlations with many TPB measures and with awareness of the importance of food waste. They capture different reasons and, therefore, potential levers for promoting anti-waste behaviours. The findings reported in both study 5 and study 6 are consistent with the existing literature, particularly in that the moral and environmental motivation subscales appear especially relevant, as also reported in previous studies (Ribbers *et al.*, 2023, 2024).

These interventions, especially the longitudinal ones in which simply participating and receiving informational and motivational nudges, regardless of their specific content, provide valuable knowledge, are important for the design of future studies on food waste reduction across different contexts. The results can also offer valuable insights for sustainability research more broadly. In this regard, the differences between nationalities observed in Study 6 further highlight the importance of personalising interventions. Future research should therefore integrate longitudinal designs, nudge-based interventions, and specifically consider participants' nationalities, motivations, as well as their opportunities and abilities.

6

GENERAL DISCUSSION

Food waste represents a significant global issue with serious environmental, economic, social, and ethical implications. It contributes to the depletion of natural resources while food inequity persists, exacerbating existing disparities in access to adequate nutrition. Moreover, food waste is a major source of greenhouse gas emissions, intensifying its environmental impact. This challenge is expected to become increasingly critical as the global population continues to rise, and it therefore requires immediate action.

This thesis investigated food waste across various life contexts and tested different intervention methods to reduce food waste and associated behaviours. Studies 1 and 2 highlighted how food waste, despite often being investigated from an individual and family perspective, conceals issues of a more global nature. They highlighted issues of responsibility and accountability, the role of institutions and their communication on the matter, as well as broader concerns, such as environmental and social issues. Studies 3, 4, 5, and 6 explored different methodologies to interventions aimed at reducing food waste at home (Studies 3, 4, and 5) and in a vacation context (Study 6). Specifically, Studies 3 and 4 used implementation intentions and coping intentions exercises to implement a waste reduction strategy, while Studies 5 and 6 utilised motivational beliefs that drive waste avoidance to educate participants through informational nudges or messages about the economic, environmental, and social impacts of food waste, leveraging these beliefs and aiming to increase awareness among participants.

The main insights of the thesis are presented below.

Perception of food waste. Food waste is generally perceived as a domestic and familiar issue, closely tied to everyday life and household habits. However, when participants are asked directly through interviews or surveys, they often link it to broader systemic problems at environmental, social, and economic levels, such as industrial food

production, pollution, and overconsumption. Whether this reflects self-presentation bias or genuine beliefs, all studies show that food waste is seen as wrong and to be avoided whenever possible. Its perceived importance is primarily social and moral, rooted in feelings of injustice and inequity, but also connected to environmental and economic concerns, often shaped by family teachings and cultural values related to respect for food. Across all presented studies, samples reported highly negative mean attitudes toward food waste, highly positive attitudes toward reducing household and non-household food waste, and positive attitudes toward using preventive behaviours to minimise personal food waste. This reveals a shared perception that food waste should be avoided and that reducing it represents a desirable goal.

The perception of food waste as an environmental issue yields complex results. In Study 1, interviews revealed that participants did not spontaneously associate food waste with environmental problems; their initial thoughts focused on food inequity and everyday experiences. When prompted, however, most recognised a strong link between food waste and environmental degradation, viewing it as part of a wider system of overproduction and excessive consumption. Still, it was not always seen as an urgent environmental priority.

Different measures of food waste. This thesis employed several approaches to comprehensively capture food waste. Measures included self-reported food waste behaviours, a composite variable representing the frequency of habits that lead to waste, such as overpreparing food, overeating, or allowing food to spoil, and a measure of preventive behaviours that reflects the frequency of actions aimed at reducing waste, such as reusing leftovers or planning meals in advance.

This multidimensional approach allowed for a more nuanced understanding of food waste, encompassing both behaviours that generate waste and strategies intended to prevent it. The studies together offered an integrated view of the practical challenges, obstacles, and motivations linked to food waste, as well as the techniques used to manage and reduce it in everyday domestic life.

Although food waste was assessed through different variables across studies, these measures behaved in remarkably similar ways. This is a remarkable insight, because what really matters isn't how waste is operationalised, but the mechanisms behind it. Study 4 presents the same extended TPB model with different dependent variables. The discrepancy in the explained variance across those models is readily attributable to

differences in specificity between the intention measures and those for food waste and habits. Beyond this, general intentions to reduce food waste had a significant effect on both measures of food waste habits, potentially demonstrating a spillover effect between the specific preventive goal chosen as a tool to reduce food waste, and all other food waste-leading habits.

Emotions. Across all studies, emotions emerged as a key factor in shaping attitudes and intentions related to food waste, although their role varied depending on how they were conceptualised and measured. In Study 4 with implementation intentions, emotions were framed as anticipated feelings of success or failure in achieving the behavioural goal. In this case, positive anticipated emotions such as satisfaction and pride successfully predict intentions to reduce food waste, both before and after the intervention. In contrast, in Studies 2 and 5, which examined food waste in relation to broader contexts and motivations to avoid food waste, negative emotions were the main predictors of behavioural intentions, while positive emotions showed no significant effect, supporting previous literature (Attiq, Chu, *et al.*, 2021; Attiq, Danish Habib, *et al.*, 2021; Chakraborty & Mattila, 2025; Fazal-e-Hasan *et al.*, 2024; Floriano, 2024; Lau *et al.*, 2024; Russell *et al.*, 2017). This difference likely reflects distinct framings: when the focus is on moral or social values, negative emotions become more salient, whereas in goal-oriented contexts, positive anticipated emotions may play a stronger motivational role. These results raise a fundamental point in the debate on emotions in the literature (Saman Attiq *et al.*, 2021; Russell *et al.*, 2017), suggesting that the type of emotion that has the greatest influence depends on the context and the goal.

In the qualitative interviews, participants frequently expressed sadness, guilt, and frustration toward the broader system in which food waste occurs, often accompanied by disillusionment with institutions and a sense of helplessness in addressing the environmental and social consequences of waste. Guilt, in particular, appeared as a recurring theme across both qualitative and quantitative studies. In Study 1, participants described guilt mainly in relation to social concerns, such as the awareness that some people do not have enough to eat. Study 2 confirmed this trend, showing that guilt related both to food waste and to broader environmental issues (*eco-guilt*) had a significant positive effect on intentions to reduce food waste, both general and specific. Eco-guilt was less explicitly mentioned in participants' discourse, yet many displayed worry and frustration about the environmental crisis, indicating an underlying awareness of its relevance.

The crucial role of guilt aligns with previous research on food waste (Saman Attiq *et al.*, 2021; S. Attiq, Chu, *et al.*, 2021; Chakraborty & Mattila, 2025; Floriano, 2024; Lau *et al.*, 2024). However, although guilt and negative emotions more broadly predict behavioural intentions, this does not imply that they constitute the most effective basis for interventions. Explicitly eliciting guilt or other negative emotions to promote behavioural change, thereby relying on extrinsic rather than intrinsic motivation, may have counterproductive effects and potentially undermine the desired outcome on the long run (Chakraborty & Mattila, 2025; Russell *et al.*, 2017).

Perception of injustice. The feeling of injustice occupies an intermediate position between belief and emotion. As shown in Studies 1 and 2, it is conceptually and empirically connected to other emotional responses, such as moral disgust, anger, and sadness, yet it appears to be perceived as more abstract and distant from individuals' daily behaviours. Participants often recognised the injustice inherent in food waste, particularly in light of global food inequity, but did not always relate this perception directly to their own actions.

This belief often relies on the low perception of control in re-establishing this balance. In other words, they believe that the food they waste will not directly affect people in need, and that avoiding waste would not benefit them in any way.

Social norms. Across all studies, social norms emerged as important but nuanced predictors of intentions and behaviours related to food waste. Participants generally perceived that others made limited or inconsistent efforts to reduce waste, a perception also reflected in the qualitative interviews. Injunctive norms, or what people believe others think they should do, appeared to exert a stronger influence than descriptive norms, which reflect perceptions of what others actually do. In other words, perceived social expectations mattered more than observed behaviour.

This distinction may depend on a self-presentation bias. Asking participants to report others' behaviour could elicit a desire to show themselves as someone who does not care about conforming and who thinks and acts independently from others. In reality, however, observing others following or violating norms can have a stronger and often unacknowledged impact on individual actions (Cialdini *et al.*, 1990; Lindenberg *et al.*, 2021). Given the recognised influence of descriptive norms on pro-environmental behaviour, this discrepancy underscores the importance of research designs that more accurately capture social interactions.

The household environment is particularly relevant for understanding the influence of social norms. Many participants reported that managing food within a household involves balancing different preferences, routines, and habits, which can create tension or inconsistency in waste reduction efforts. Future research could examine these interpersonal dynamics by measuring the behaviours of several household members and analysing how they influence one another over time. Network analysis represents a promising approach for this purpose, as it allows researchers to follow multiple individuals longitudinally and model how their interactions affect food waste-related behaviour within a shared social context.

The influence of social norms on behaviour depends on the type of behaviour investigated and, as we saw, it is fundamentally tied to morality when addressing food waste. A promising avenue for future research would be to examine moral norms as both predictors of intentions and of actual food waste-reduction behaviour, and as a key lever to foster waste-reduction strategies.

Evaluating existing theories and models.

Theory of Planned Behaviour (Ajzen, 1991) and the Model of Goal-Directed Behaviour (Perugini & Bagozzi, 2001). The TPB is generally confirmed as a valid model across all studies in the food waste domain. Attitudes, social norms, and perceived behavioural control significantly predict intentions to reduce food waste in the domestic context and, in some cases, even directly predict food waste behaviours.

Study 4 confirmed the validity of anticipated emotions and past behaviour as additional predictors of intentions and behaviours related to food waste reduction. These two variables are part of the Theory of Goal-Directed Behaviour (MGB), which represents a proposed extension of the TPB model. The additional variance explained by these variables further supports their predictive power and key role. The TPB, integrated with the MGB framework, serves as a strong baseline model to which additional predictors can be incorporated, such as perceptions of injustice and motivations to avoid food waste, as shown in Studies 2 and 5.

Nudge theory (Thaler & Sunstein, 2008). The relative importance of nudges appears to rely partly on their informational content. In the studies presented here, nudges and informative messages did not produce significant differences between groups.

Nevertheless, simply participating in a study and receiving informational or motivational nudges can provide participants with useful knowledge and awareness, thereby supporting engagement in the goal of reducing food waste. As recently investigated in Prelez and colleagues (2023), future research should try to combine multiple methods of intervention to increase the chances of tackling food waste and its related behaviours. For example, investigating educative nudges that present information on the economic, moral and environmental consequences of food waste in combination with implementation intentions technique or other intervention strategies.

Motivations to Avoid Food Waste scale (Ribbers et al., 2023). The MAFW scale proved particularly important, showing significant correlations with several TPB measures and with awareness of the importance of food waste. They capture different motivations and, therefore, potential levers for promoting anti-waste behaviours. In Study 2, economic motivations dominated intentions to reduce food waste, while pro-environmental self-identity showed no predictive power, unlike eco-guilt, underscoring emotions' key role over self-identity. In contrast, Studies 5 and 6 highlighted environmental motives as second only to moral ones in driving avoidance, even if individuals do not always instinctively frame food waste as an environmental issue. Ecological concerns thus play a pivotal, increasingly influential role in shaping attitudes and behaviours. Nationality-based differences (Study 6) align with existing literature and warrant further exploration. Future research could examine demographic variations in motivational drivers (e.g., Barker et al., 2021).

Implementation intentions and coping intentions. Implementation intentions and coping intentions did not produce significant effects. In either study, no statistically significant differences emerged among the three groups on the measured variables after randomisation. These non-significant results may be attributed to the small sample size and the study design for Study 3, but not for Study 4.

Study 4, with a longitudinal design and an adequate sample size, also allowed participants to select their preferred anti-waste strategy as a goal during the experiment. Personalising the goal to be implemented could have potentially increased their engagement.

Combining the methods of implementation intentions and coping intentions with the ***Motivation-Opportunity-Ability framework (Atkins & Michie, 2013)*** may help reduce the gap between intentions and behaviours. As intended in the MOA framework,

behaviours depend on the motivation, opportunity, and ability to achieve the goal. A more robust longitudinal design with continuous engagement and integration of MOA and implementation intentions could increase effectiveness in promoting food waste reduction.

Longitudinal studies. Studies 4 and 5 were longitudinal, and in both cases, the specific conditions or group assignments did not appear to drive differences. Simply participating in a study about food waste and engaging in an activity aimed at actively reducing it – through implementation intentions in study 4 and continuous nudges in study 5 – helped participants maintain their goals over time.

Perceived behavioural control was closely related to successful outcomes, consistent with prior evidence that self-efficacy is a key determinant of behaviour change (Vaughan-Johnston & Jacobson, 2020; Warner & French, 2022; Wieber *et al.*, 2010) Goal commitment also emerged as a critical factor influencing both behavioural outcomes and perceived behavioural control. The intensity of participants' commitment and engagement appears central to intervention success, underscoring the need for interventions to align with participants' real objectives. Social influence also played a role, with injunctive norms consistently affecting behaviour, suggesting that future longitudinal interventions could leverage social expectations and collaboration to enhance adherence.

Policy implications. The roles of institutions and collective responsibility emerge as central to addressing food waste, as highlighted in both Study 1 and Study 2. Participants consistently emphasised that this issue cannot be tackled by individuals or families alone, and that collective action is necessary. Participants generally expressed dissatisfaction with how institutions handle food waste, citing insufficient communication and insufficient information.

In Study 2, responsibility is attributed to both individual citizens and larger companies and institutions, reflecting a dual perspective. On one hand, participants acknowledge that each person has a duty to act and that coordinated efforts can produce a meaningful impact. On the other hand, there is recognition that an individual's responsibility and potential impact are not equivalent to those of multinational corporations or coalitions of states.

Food injustice is perceived as a central issue in the context of food waste in Study 1. In Study 2, however, individual responsibility showed little or no predictive effect on

general or specific intentions to reduce food waste. Similarly, pro-environmental self-identity, institutional trust, and perceptions of food injustice did not significantly predict behavioural intentions at the household level. This does not indicate a lack of interest but may reflect a matter of proximity. Household food waste addresses immediate, local behaviour, whereas institutions and systemic injustice operate on a broader scale that may seem less directly connected to individual actions. The distinction between general and specific intentions suggests that variables such as institutional trust, self-identity, and perceptions of injustice may influence overall attitudes and awareness, but their impact on concrete, household-level actions is limited.

Policies should also take into account the environmental aspect of the problem. As we have seen, this is a theme that emerges and is connected to food waste, and it will increasingly become a pressing issue. Communication and initiatives against waste could also leverage this aspect, considering not only the individual dimension but also global environmental health.

Limits and future research. Several limitations of this research should be acknowledged, along with directions for future studies.

Two main limitations of this research arise at the participant level. One concerns the potential influence of social desirability on self-reported behaviours. For example, the discrepancy between food-waste guilt and eco-guilt, together with high levels of pro-environmental self-identity, suggests that participants may have inferred the study's focus and responded accordingly. This limitation is common in research on pro-environmental behaviour and other topics susceptible to social desirability (Milfont, 2009). The literature also reports a tendency for individuals to underreport food waste behaviours, often indicating lower levels of waste than those observed in reality (van der Werf *et al.*, 2020). Future studies should incorporate experimental conditions where social desirability competes with other drivers, such as incentives or conflicting values. Understanding the motivational values of food waste is increasing, showing not only why people waste but also why they aim to avoid it. (Ribbers *et al.*, 2023, 2024). The other issue is that recruiting participants with low initial interest remains challenging, as many preventive behaviours are already frequently performed, leaving little room for improvement and possibly explaining the non-significant results.

A further issue concerns the definition of food waste itself. Study 1 revealed that participants often lack a clear distinction between food waste and food loss, which may affect how they respond to questions about the food system, ethics, and environmental impacts. Future studies should clarify this distinction to ensure accurate interpretation and analysis.

In addition, the social issue of food injustice, involving both overconsumption in some areas and scarcity in others, is central to this research but remains underexplored in socio-psychological literature. Ethical dilemmas between individual well-being and the community are important to consider (Chang, 2019).

More broadly, food-related behaviours are inherently complex, shaped by multiple internal and external factors (Bhattacharya *et al.*, 2021; Rosas *et al.*, 2021a). Food waste is no exception, involving pragmatic, economic, educational, and ecological dimensions. Recognising this complexity is essential for designing effective interventions that leverage diverse motivations, including ethical, environmental, and social factors.

Finally, longitudinal studies, such as studies 4 and 5, show the value of repeated engagement, although the effects are not always strong and differences between groups are not statistically significant. In study 5, a clear trend suggests that extended or intensified interventions could help transform behaviours into short-term goals or habits (Hassan *et al.*, 2016). Strategies to enhance intervention impact may include diaries, repeated exercises, or sharing reused meals with peers. Using consistent prompts or ecological momentary assessment could further improve outcomes. Attention to goal personalisation, motivational factors, social factors, and repeated engagement can enhance the effectiveness of behavioural interventions aimed at reducing food waste.

Critical take on food waste

Technically speaking, all food that begins its life in production but ends up neither consumed nor used in any form is considered “lost” or “wasted.” These are not the same. Food losses refer to products that are grown or raised but become unusable during the production chain because they are damaged, contaminated, or otherwise rendered unsellable, inedible, or unfit even for alternative uses such as animal feed. Food waste, on the other hand, refers to edible food that, once produced, is not consumed for some reason. The term applies to the final stages of the supply chain, including retail and final consumption, as well as households, businesses, restaurants, markets, supermarkets, schools, and so forth.

In my view, the real problem is that we fail to consider the overall impact of food production and to view “waste” as encompassing both what is lost and what is discarded. If improper crop maintenance results in the loss of tons of grapes, why should that not be considered a massive waste? The issue is not merely semantic. When we examine the literature, promotional campaigns, and anti-waste initiatives, we see that the focus is consistently placed on individual consumers, on the single person who, while just one drop in an ocean, is held responsible for changing the tide. But asking one person or even one group to shoulder the weight of the entire planet leads nowhere. Some people will internalise a deep sense of guilt, becoming anxious over every small decision they make. Others will ignore or downplay the environmental issue entirely, since thinking about catastrophic consequences offers no path to relief.

This hyper-responsibilisation of the individual has so far yielded no meaningful results and will never foster anything constructive for society as a whole. This is not to say that the individual bears no responsibility, but that their responsibility must remain proportional to their power. It must also be clearly communicated that responsibility can be measured: throwing away an apple is not the same as mismanaging a ton of apples during transport. Similarly, a spoiled chicken breast in a household cannot compare to the responsibility of an industrial farm forced to cull thousands of birds due to poor hygiene or viral outbreaks.

In other words, one’s sense of guilt should be proportional to one’s means, necessities, and the real consequences of one’s actions.

A professor at Wageningen University in the Netherlands once proposed a solution to the problem of categorising food losses and their impact: to call everything

“waste.” I, however, believe the opposite makes more sense; let us call it all “loss.” Whether it occurs at the beginning of the supply chain or when a consumer throws away a spoiled apple, it is a loss. The word *waste* suggests carelessness. *Loss*, on the other hand, carries far less weight. It evokes mourning, not judgment. Sadness, not guilt.

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APPENDIX

STUDY 1

Outline of the interviews:

Sociodemographic data. Age, gender, region of residence, education level, household composition.

Experiences. What comes to mind when I say "food waste"? Are there any wasteful behaviours that you engage in? Or even that someone close to you engages in? When does this happen? Are there any preventative behaviours that you engage in, or do you use to avoid waste? Are there any activities or tools that you think can help reduce food waste? And, on the other hand, are there any things or situations that can hinder it? For example, if you live with someone, does this make it easier or harder for you? (Work, commitments, where you shop, etc.). Who takes care of/manages the food at home? Who does the shopping and cooking? Other places, besides the home, such as restaurants, cafeterias, etc., where you might waste food?

Motivations and Values. What are the motivations that might lead to throwing away still-consumable food, or instead to wanting to reuse it? Health hazard/disgust for certain types of leftovers? Is avoiding food waste important to your family or to the people around you? Is an abundance of food important to you? For example, at family dinners or on special occasions, does food acquire an important value in terms of sharing and quantity?

Environmental Issues and Responsibility. Is food waste a problem? Both at the individual and global levels. What consequences can it have? Both at the individual and global levels. Are the consequences the same for everyone, or do some people suffer the consequences more than others? Do you feel directly or indirectly responsible? In your opinion, who is responsible for the problem? Who can fix it? Or who is right to take action? Is waste an issue you connect to the climate emergency? Among environmental problems, do you perceive it as an urgent/priority issue? What is most important to you? How often do you think about it, and how does it make you feel? Does it influence how you perceive the future? Is it something that worries you?

Communication. Do you think it's a topic that's being discussed? How is it discussed? How is top-down communication (e.g., institutions, schools, mainstream media)? As a citizen, what would you like Italian and/or global institutions to do to

combat the problem of food waste? What would give you hope for the future and trust in institutions? Do you know of any initiatives that promote waste reduction?

STUDY 2

Table A.1

Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Attitudes	—															
2. Social norms	.27*	—														
3. PAE	-.06	.06	—													
4. NAE	.26*	.16*	-	—												
5. Eco-guilt	.04	-.03	-.06	.29*	—											
6. Food waste guilt	.32*	.22*	.03	.40*	.11	—										
7. PESI	.23*	.35*	.08	.25*	-.10	.37*	—									
8. Responsibility	.28*	.24*	.14*	.37*	.08	.47*	.47*	—								
9. Institution trust	.12	.20*	.11	.16*	.07	.03	.19*	.21*	—							
10. Food Injustice	.16*	.11	-.06	.19*	.22*	.23*	.13*	.18*	.01	—						
11. PBC	.34*	.33*	.13*	.14*	-	.31*	.40*	.40*	.15	.07	—					
12. Prev habits	.13*	.30*	.12*	.17*	-	.24*	.41*	.25*	.13	.09	.35*	—				
13. Waste habits	-	-	-.07	.05	.22*	-	-	-	.04	-.08	-	-	—			
14. Intentions	.25*	.28*		.50*	0.12	.38*	.36*	.44*	.13	.30*	.40*	.36*	.20*	—		
15. Intentions (prev)	.39*	.41*	-.02	.33*	.15*	.33*	.21*	.30*	.12	.18*	.22*	.26*	-.06	.45*	—	
16. Intentions (waste)	.16*	.12*	.05	.24*	.19*	.20*	-.09	-.09	-.09	-.09	-.07	.06	-	-.06	.50*	—

Table A.2

Path analysis results

Model Tests			
Label	X ²	df	p
User Model	39.0	22	0.014
Baseline Model	1142.0	120	<.001

Fit Indices

AIC	BIC	adj. BIC	SRMR	RMSEA	RMSEA 95% CI		RMS EA <i>p</i>
					Lower	Upper	
8422	8892	8480	0.034	0.053	0.024	0.080	0.399

CFI	TLI	RNI	GFI	adj. GFI	pars. GFI
0.983	0.910	0.983	0.999	0.996	0.145

R-squared

Variable	R ²	95% Confidence Intervals		Wald X ²	df	<i>p</i>
		Lower	Upper			
Intentions	0.501	0.414	0.581	277.1	13	<.001
Intentions (preventive)	0.212	0.131	0.301	75.2	3	<.001
Intentions (waste)	0.115	0.053	0.193	36.8	3	<.001

Parameter Estimates

Dep	Pred	Estimate	SE	95% Confidence Intervals		β	<i>z</i>	<i>p</i>
				Lower	Upper			
Intentions	Attitudes	0.19717	0.0588	0.08188	0.3125	0.16724	33.520	<.001
Intentions	Social norms	0.17788	0.0471	0.08562	0.2701	0.18364	37.789	<.001
Intentions	PBC	0.14175	0.0537	0.03648	0.2470	0.14215	26.390	0.008
Intentions	PAE	0.02770	0.0417	-0.05399	0.1094	0.03141	0.6646	0.506
Intentions	NAE	0.25762	0.0448	0.16976	0.3455	0.31850	57.472	<.001
Intentions	Past behaviour (preventive)	0.18083	0.0638	0.05580	0.3059	0.14073	28.348	0.005
Intentions	Past behaviour (waste)	0.02906	0.0756	-0.11904	0.1772	0.01926	0.3845	0.701
Intentions	Food guilt	0.01079	0.0525	-0.09219	0.1138	0.01105	0.2053	0.837
Intentions	PESI	-0.00368	0.0577	-0.11668	0.1093	-0.00344	-	0.949
Intentions	Food Injustice	0.19855	0.0622	0.07672	0.3204	0.14494	31.941	0.001
Intentions	Responsib.	0.08592	0.0464	-0.00496	0.1768	0.10329	18.530	0.064
Intentions	Institution Trust	-0.05298	0.0575	-0.16563	0.0597	-0.04207	-	0.357
Intentions	Eco-guilt	0.02483	0.0408	-0.05520	0.1049	0.02972	0.9218	0.543
Intention (preventive)	Intentions	0.25297	0.0378	0.17880	0.3271	0.39972	66.845	<.001
Intentions (preventive)	PBC	0.00617	0.0377	-0.06770	0.0800	0.00978	0.1638	0.870
Intentions (preventive)	Past behaviour (preventive)	0.09696	0.0436	0.01151	0.1824	0.11923	22.239	0.026
Intentions (waste)	Intentions	0.21434	0.0446	0.12696	0.3017	0.29659	48.076	<.001
Intentions (waste)	PBC	-0.00998	0.0472	-0.10254	0.0826	-0.01385	-	0.833
Intentions (waste)	Past behaviour (waste)	-0.14059	0.0615	-0.26105	-0.0201	-0.12895	0.2113	0.022

Description	Estimate	SE	C.I. Lower	C.I. Upper	β	<i>z</i>	<i>p</i>
Attitudes ⇒ Intentions ⇒ Intentions (preventive)	0.050	0.017	0.017	0.083	0.067	2.996	0.003

Attitudes ⇒ Intentions ⇒ Intentions (waste)	0.042	0.015	0.012	0.072	0.050	2.750	0.006
Social norms ⇒ Intentions ⇒ Intentions (preventive)	0.045	0.014	0.018	0.072	0.073	3.290	0.001
Social norms ⇒ Intentions ⇒ Intentions (waste)	0.038	0.013	0.013	0.063	0.054	2.971	0.003
PBC ⇒ Intentions ⇒ Intentions (preventive)	0.036	0.015	0.007	0.064	0.057	2.455	0.014
PBC ⇒ Intentions ⇒ Intentions (waste)	0.030	0.013	0.005	0.056	0.042	2.313	0.021
PAE ⇒ Intentions ⇒ Intentions (preventive)	0.007	0.011	-0.014	0.028	0.013	0.661	0.508
PAE ⇒ Intentions ⇒ Intentions (waste)	0.006	0.009	-0.012	0.024	0.009	0.658	0.510
NAE ⇒ Intentions ⇒ Intentions (preventive)	0.065	0.015	0.036	0.094	0.127	4.358	<.001
NAE ⇒ Intentions ⇒ Intentions (waste)	0.055	0.015	0.026	0.085	0.094	3.688	<.001
Past behaviour (preventive) ⇒ Intentions ⇒ Intentions (preventive)	0.046	0.018	0.011	0.080	0.056	2.610	0.009
Past behaviour (preventive) ⇒ Intentions ⇒ Intentions (waste)	0.039	0.016	0.008	0.070	0.042	2.442	0.015
Past behaviour (waste) ⇒ Intentions ⇒ Intentions (preventive)	0.007	0.019	-0.030	0.045	0.008	0.384	0.701
Past behaviour (waste) ⇒ Intentions ⇒ Intentions (waste)	0.006	0.016	-0.026	0.038	0.006	0.383	0.701
Food guilt ⇒ Intentions ⇒ Intentions (preventive)	0.003	0.013	-0.023	0.029	0.004	0.205	0.837
Food guilt ⇒ Intentions ⇒ Intentions (waste)	0.002	0.011	-0.020	0.024	0.003	0.205	0.837
PESI ⇒ Intentions ⇒ Intentions (preventive)	-0.001	0.015	-0.030	0.028	-0.001	-	0.949
PESI ⇒ Intentions ⇒ Intentions (waste)	-0.001	0.012	-0.025	0.023	-0.001	-	0.949
Food Injustice ⇒ Intentions ⇒ Intentions (preventive)	0.050	0.017	0.016	0.084	0.058	2.882	0.004
Food Injustice ⇒ Intentions ⇒ Intentions (waste)	0.043	0.016	0.011	0.074	0.043	2.660	0.008
Responsibility ⇒ Intentions ⇒ Intentions (preventive)	0.022	0.012	-0.002	0.046	0.041	1.786	0.074
Responsibility ⇒ Intentions ⇒ Intentions (waste)	0.018	0.011	-0.002	0.039	0.031	1.729	0.084
InstitutionTrust ⇒ Intentions ⇒ Intentions (preventive)	-0.013	0.015	-0.042	0.015	-0.017	-	0.361
InstitutionTrust ⇒ Intentions ⇒ Intentions (waste)	-0.011	0.013	-0.036	0.013	-0.012	-	0.365
Eco-guilt ⇒ Intentions ⇒ Intentions (preventive)	0.006	0.010	-0.014	0.027	0.012	0.606	0.545
Eco-guilt ⇒ Intentions ⇒ Intentions (waste)	0.005	0.009	-0.012	0.023	0.009	0.603	0.546

STUDY 3

Food waste management. 2 items on food and food waste management in the household (“I consider managing food within my family a waste of time and energy”, $M = 3.76$, $SD = 0.920$ and “I find it easy to manage food within my family unit”, $M = 3.41$, $SD = 1.110$) on a 5-point Likert scale (1 = Completely disagree, 5 = Completely agree).

Table A.3

Descriptive statistics of shopping habits

Item	N	Mean	SD
Make small purchases, but more frequently	86	2.80	1.08
Make large purchases, but less frequently	86	3.27	1.03
Buy in large quantities	86	2.83	0.95
Buy in small quantities	86	3.12	1.01
Make unplanned purchases outside the shopping list	86	3.17	0.91
Generally, how many times do you go grocery shopping in a two-week period?	86	3.17	0.91

Table A.4

Descriptive statistics of coping planning strategies items

Item	N	Media	SD
<i>I've made a detailed plan on...</i>			
...what to do if something interferes with my plans.	29	3.10	1.15
...how to deal with possible setbacks.	29	2.93	1.10
...what to do in difficult situations, to act according to my intentions.	29	2.93	1.10
...what good opportunities to seize.	29	3.55	1.18
...when I need to be especially careful to avoid mistakes.	29	3.48	0.95

Table A.5*Correlation matrix*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Responsibility	—															
2. Environmental awareness	.13	—														
3. Importance	.10	.30 **	—													
4. Management 1	.22 *	.14	.25 *	—												
5. Management 2	-	-.30	-.12	-	—											
6. PAE	.13			.33 **		—										
7. NAE	.18	.46 ***	.10	.18	.07	—										
8. Attitudes towards shopping list	.16	.24 *	.05	.31 **	-.04	.62 ***	—									
9. Attitudes towards food waste reduction	-	.32 **	.06	.14	.19	.39 ***	.47 ***	—								
10. Social norms	.00	.28 *	.09	.01	.31 **	.49 ***	.35 **	.69 ***	—							
11. PBC	.16	.16	.09	-	.18	.29 **	.22	.31 **	.25 *	—						
12. Coping strategies	.06	.23 *	.19	-	.32 **	.16	.20	.32 **	.22	.50 ***	—					
13. Intentions	-	.18	.20	.24	.03	.36	.47	.12	.09	.25	.16	—				
14. Preventive behaviors	.21	.26 *	.28 **	.23 *	-.03	.42 ***	.41 ***	.42 ***	.28 *	.56 ***	.50 ***	.59 ***	—			
15. Food waste behaviors	.13	.28 **	.26 *	.21	.07	.17	.27	.24 *	.04	.23 *	.39 ***	.20	.33 **	—		
16. Goal commitment	.05	-.11	-.06	.23 *	-	-.21	-.04	-.11	-	-	-.18	-.25	-.15	-	—	
	.31 **	.23 *	.42 ***	.25 *	-.12	.50 ***	.48 ***	.26 *	.31 **	.26 *	.24 *	.65 ***	.54 ***	.17	-	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

STUDY 4

Additional sociodemographic characteristics of the sample. Regarding city size, 99 participants lived in towns with fewer than 30,000 inhabitants, 70 in cities with 30,001–100,000 inhabitants, 23 in cities with 100,001–250,000 inhabitants, and 59 in cities with more than 250,000 inhabitants. In terms of education, 5 participants held a middle school diploma or less, 111 held a high school diploma, 72 held a bachelor’s degree, 48 held a master’s degree, and 15 held a PhD or a specialisation/master’s degree. Regarding household composition, 33 participants lived alone, 59 with 2 people, 77 with 3 people, 61 with 4 people, and 21 with 5 or more people. Concerning occupation, 73 were students, 26 were both students and workers, 34 were independent workers, 86 were employees, 30 were unemployed, and 2 were retired. Economic strain was reported as follows: 20 participants made ends meet with great difficulty, 95 with some difficulty, 112 somewhat easily, and 24 very easily. Most participants reported being omnivores (n = 208), while 21 identified as flexitarians, 4 as pescatarians, 13 as vegetarians, and 5 as vegans.

Table A.6 reports the follow-up questions recorded at T2 that were not included in the main analyses and were used as an indicator of the study's efficacy.

Table A.6
Follow-up questions recorded at T2

Reference	Variable name	Example item	Number of items	Response scale
Ad hoc	Frequency strategy	<i>Over the past two weeks, how many times did you {SelectedChoices}?</i>	1	Integer values
Ah hoc	Facilitators/barriers	<i>Think about some factors that may have helped or hindered you in achieving your goal to ({SelectedChoices}) over the past two weeks. E.g. Do the activity together with others, time to dedicate, mood...</i>	9	1 = Ostacled, 5 = Facilitated
<i>Perceived efficacy of the behavioural goal (strategy), the study, and the exercises</i>				
Ad hoc	Efficacy strategy	<i>Please think about how useful these aspects have been for you in managing food at home and reducing food waste: {SelectedChoices}</i>	1	1 = Not at all useful, 5 = Extremely useful
Ad hoc	Efficacy participation	<i>Please think about how useful these aspects have been for you in managing food at home and</i>	1	

reducing food waste: Having participated in this study

Ad hoc	Efficacy awareness	"Participating in this study made me reflect on my food management habits / on the issue of food waste."	1	
Ad hoc	Efficacy i.i.	"Thinking in advance about how to achieve my goal with the proposed exercises helped me a lot in managing food at home and avoiding waste"	1	1 = Not at all, 5 = Totally
Ad hoc	Efficacy coping	"Thinking in advance about the obstacles and how to address them with the proposed exercises helped me a lot in managing food at home and avoiding waste"	1	

Note. The measures presented here were less central to the thesis topics; therefore, they have been excluded from the analyses. *Efficacy i.i.* and *Efficacy coping* refer to the exercises that participants in the experimental conditions completed at T1. If they did not complete those exercises, they had to answer: "I had no exercise".

Figure A.1

Portions to grams from van Herpen and colleagues (2019)

Product category	Answer option 1	Answer option 2	Answer option 3	Answer option 4	Answer option 5
Fresh vegetables and salads	25	75	150	250	350
Non-fresh vegetables	25	75	150	250	350
Fresh fruit	25	50	100	300	500
Non-fresh fruit	20	40	80	240	400
Potatoes	25	75	150	250	350
Potato products	25	88	375	750	1125
Pasta	25	75	150	250	350
Rice and remaining grains	25	75	150	250	350
Beans, lentils, chickpeas, et cetera	25	75	150	250	350
Meat	75	150	375	675	900
Meat substitute	45	90	225	405	540
Fish	75	150	375	675	900
Bread toppings	10	20	50	90	120
Bread	18	35	400	800	1200
Cereals	10	40	250	500	1000
Yoghurt, custard, et cetera	38	150	500	1000	2000
Cheese	5	10	20	45	60
Eggs	30	60	150	270	360
Soups / curry	38	150	500	1000	1500
Sauce	10	30	90	225	675
Candy / cookies / bars	10	20	50	90	120
Crisps / nuts	10	20	50	90	120
Non-alcoholic beverages	68	250	500	1000	1500
Alcoholic beverages	75	300	500	1000	1500

Estimates are based on online information available from the Dutch food and nutrition centre (voedingscentrum.nl), a major Dutch retailer (ah.nl), two platforms dedicated to weight loss / healthy eating (wijvallenaf.nl and smakelijketenzonderzout), supplemented with own measurements.

Table A.7*Post Hoc Comparisons for Goal commitment*

Comparison		Mean Difference	SE	df	t	<i>p</i> _{Tukey}
2	- 3	-73.5	123.8	246	-0.594	.93
	- 4	31.4	120.1	246	0.262	.99
	- 5	97.6	123.1	246	0.792	.86
3	- 4	105.0	49.5	246	2.119	.15
	- 5	171.1	56.5	246	3.028	.01
4	- 5	66.1	47.9	246	1.381	.51

Table A.8
Complete correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1. Economic status	.																				
2. Env. Awareness PRE	-.02	.																			
3. Env. Awareness POST	-.05	.31***	.																		
4. Importance PRE	-.05	.81***	.13*	.																	
5. Importance POST	-.70	.15*	.38***	.29***	.																
6. Preventive behaviours PRE	-.16*	.14*	.21**	.17**	.19**	.															
7. Preventive behaviours POST	-.09	.17*	.21**	.14*	.22***	.70***	.														
8. Waste behaviours PRE	.08	-.08	-.13*	-.05	-.13*	-.20**	-.19**	.													
9. Waste behaviours POST	.12	-.24***	.21**	.15*	.17*	.27***	.21**	.60***	.												
10. PAE	-.06	.17**	.23***	.16*	.22***	.31***	.37***	-.00	-.13*	.											
11. NAE	-.13*	.04	.12	.03	.13*	.30***	.36***	.06	-.10	.57***	.										
12. Attitudes goal	.15*	.21***	.26***	.19**	.32***	.35***	.39***	-.18**	.27***	.48***	.38***	.									
13. Attitudes food waste	.19**	.23***	.34***	.25***	.34***	.37***	.40***	.13*	.31***	.50***	.32***	.75***	.								
14. Social norms	.10	.15*	.21**	.10	.18**	.16*	.20**	-.17**	.15*	.31***	.24***	.23***	.16**	.							
15. PBC PRE	-.03	.15*	.21**	.17**	.32***	.28***	.28***	-.27***	.31***	.38***	.21***	.48***	.43***	.29***	.						
16. PBC POST	-.02	.11	.16*	.13*	.32***	.24***	.31***	-.28***	.35***	.23***	.12	.38***	.35***	.25***	.62***	.					
17. Goal commitment	-.08	.13*	.11	.17**	.15*	.34***	.37***	-.16*	.20**	.43***	.25***	.39***	.37***	.27***	.40***	.48***	.				
18. Efficacy strategy	-.05	.12	.22***	.13*	.24***	.31***	.37***	-.11	.17**	.33***	.23***	.40***	.28***	.27***	.39***	.46***	.27***	.			
19. Intentions PRE	-.17**	.23***	.26***	.23***	.34***	.23***	.33***	-.17**	.24***	.48***	.27***	.46***	.44***	.28***	.47***	.40***	.53***	.33***	.		
20. Intentions POST	-.08	.19**	.28***	.20**	.38***	.37***	.36***	-.20**	.34***	.43***	.25***	.48***	.46***	.27***	.48***	.59***	.42***	.53***	.51***	.	

Path analyses

Table A.9
Model A

Parameter Estimates

Dep	Pred	Estimate	SE	95% Confidence Intervals		β	z	p
				Lower	Upper			
Intentions.POST	Intentions.PRE	0.6051	0.0675	0.47284	0.7373	0.5074	8.969	<.001
Intentions.PRE	Attitudes.waste	0.0495	0.0633	-0.07449	0.1735	0.0546	0.782	0.434
Intentions.PRE	Attitudes.goal	0.0700	0.0617	-0.05090	0.1909	0.0799	1.135	0.256
Intentions.PRE	Inj_norm	0.0739	0.0327	0.00985	0.1379	0.1229	2.261	0.024
Intentions.PRE	Desc_norm	-0.0313	0.0238	-0.07800	0.0154	-0.0681	-1.313	0.189
Intentions.PRE	PBC.PRE	0.1184	0.0446	0.03102	0.2058	0.1473	2.656	0.008
Intentions.PRE	PAE	0.1191	0.0457	0.02954	0.2088	0.1772	2.606	0.009
Intentions.PRE	NAE	-0.0137	0.0311	-0.07462	0.0472	-0.0251	-0.441	0.659
Intentions.PRE	Goal Commitment	0.2523	0.0334	0.18685	0.3178	0.4177	7.552	<.001

Description	Estimate	SE	Lower	Upper	β	z	p
Goal Commitment \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.030	0.038	-0.045	0.105	0.028	0.779	0.436
PBC.PRE \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.042	0.038	-0.031	0.116	0.041	1.126	0.260
Attitudes.waste \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.045	0.020	0.005	0.085	0.062	2.193	0.028
Attitudes.goal \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	-0.019	0.015	-0.047	0.010	-0.035	-1.299	0.194
Inj_norm \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.072	0.028	0.017	0.127	0.075	2.546	0.011
Desc_norm \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.072	0.029	0.016	0.129	0.090	2.502	0.012
PAE \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	-0.008	0.019	-0.045	0.029	-0.013	-0.441	0.659
NAE \Rightarrow Intentions.PRE \Rightarrow Intentions.POST	0.153	0.026	0.101	0.204	0.212	5.777	<.001

Table A.10
Model B

Parameter Estimates

Dep	Pred	Estimate	SE	95% Confidence Intervals		β	z	p
				Lower	Upper			
Intentions PRE	Attitudes waste	0.04351	0.0604	-0.07493	0.1619	0.0511	0.720	0.472
Intentions PRE	Attitudes goal	0.07961	0.0602	-0.03829	0.1975	0.0957	1.323	0.186
Intentions PRE	Injunctive norm	0.07554	0.0310	0.01484	0.1362	0.1291	2.439	0.015
Intentions PRE	Descriptive norm	-0.02932	0.0233	-0.07504	0.0164	-	-	0.209
Intentions PRE	PBC PRE	0.12828	0.0434	0.04313	0.2134	0.1605	2.953	0.003
Intentions PRE	PAE	0.08821	0.0413	0.00734	0.1691	0.1354	2.138	0.033
Intentions PRE	NAE	-0.00825	0.0301	-0.06715	0.0507	-	-	0.784
Intentions PRE	Goal Commitment	0.26078	0.0323	0.19754	0.3240	0.4270	8.081	<.001
Food Waste POST	Intentions PRE	-	464.808	-	-	-	-	0.003
		14.015.971		23.126.035	490.591	0.1873	3.015	

Description	Estimate	SE	C.I. Lower	C.I. Upper	β	z	p
Attitudes.waste ⇒ Intentions.PRE ⇒ Food Waste POST	-6.098	8.708	-23.165	10.969	-0.010	-0.700	0.484
Attitudes.goal ⇒ Intentions.PRE ⇒ Food Waste POST	-11.158	9.207	-29.203	6.888	-0.018	-1.212	0.226
Inj_norm ⇒ Intentions.PRE ⇒ Food Waste POST	-10.588	5.583	-21.531	0.355	-0.024	-1.896	0.058
Desc_norm ⇒ Intentions.PRE ⇒ Food Waste POST	4.109	3.542	-2.833	11.052	0.012	1.160	0.246
PBC.PRE ⇒ Intentions.PRE ⇒ Food Waste POST	-17.980	8.523	-34.684	-1.276	-0.030	-2.110	0.035
PAE ⇒ Intentions.PRE ⇒ Food Waste POST	-12.363	7.089	-26.257	1.531	-0.025	-1.744	0.081
NAE ⇒ Intentions.PRE ⇒ Food Waste POST	1.156	4.229	-7.133	9.445	0.003	0.273	0.785
Goal Commitment ⇒ Intentions.PRE ⇒ Food Waste POST	-36.551	12.938	-61.909	-11.194	-0.080	-2.825	0.005

Note. Defined parameters. C.I. = 95% Confidence Intervals.

Table A.11
Model C

Parameter Estimates

Dep	Pred	Estimate	SE	95% Confidence Intervals		β	z	p
				Lower	Upper			
Intentions.PRE	Goal Commitment	0.2523	0.0334	0.18685	0.3178	0.4177	7.552	<.001
Intentions.PRE	Inj_norm	0.0739	0.0327	0.00985	0.1379	0.1229	2.261	0.024
Intentions.PRE	Desc_norm	-0.0313	0.0238	-	0.0154	-	-	0.189
Intentions.PRE	PAE	0.1191	0.0457	0.02954	0.2088	0.1772	2.606	0.009
Intentions.PRE	NAE	-0.0137	0.0311	-	0.0472	-	-	0.659
Intentions.PRE	Attitudes.goal	0.0700	0.0617	-	0.1909	0.0799	1.135	0.256
Intentions.PRE	Attitudes.waste	0.0495	0.0633	-	0.1735	0.0546	0.782	0.434
Intentions.PRE	PBC.PRE	0.1184	0.0446	0.03102	0.2058	0.1473	2.656	0.008
Prev.habits.POST	Intentions.PRE	0.3849	0.0734	0.24101	0.5287	0.3255	5.244	<.001
Waste.habits.POST	Intentions.PRE	-0.2747	0.0741	-	-	-	-	<.001
				0.41998	0.1295	0.2365	3.707	

Description	Estimate	SE	C.I. Lower	C.I. Upper	β	z	p
Goal Commitment ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.097	0.023	0.053	0.141	0.136	4.307	<.001
Goal Commitment ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.069	0.021	-0.110	-0.028	-0.099	-3.328	<.001
Inj_norm ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.028	0.014	0.002	0.055	0.040	2.076	0.038
Inj_norm ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.020	0.011	-0.041	0.000	-0.029	-1.931	0.054
Desc_norm ⇒ Intentions.PRE ⇒ Prev.habits.POST	-0.012	0.009	-0.031	0.006	-0.022	-1.273	0.203
Desc_norm ⇒ Intentions.PRE ⇒ Waste.habits.POST	0.009	0.007	-0.005	0.022	0.016	1.237	0.216
PAE ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.046	0.020	0.007	0.084	0.058	2.334	0.020
PAE ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.033	0.015	-0.063	-0.003	-0.042	-2.132	0.033
NAE ⇒ Intentions.PRE ⇒ Prev.habits.POST	-0.005	0.012	-0.029	0.018	-0.008	-0.440	0.660
NAE ⇒ Intentions.PRE ⇒ Waste.habits.POST	0.004	0.009	-0.013	0.021	0.006	0.438	0.661

Attitudes.goal ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.027	0.024	-0.021	0.075	0.026	1.109	0.267
Attitudes.goal ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.019	0.018	-0.054	0.016	-0.019	-1.085	0.278
Attitudes.waste ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.019	0.025	-0.029	0.067	0.018	0.774	0.439
Attitudes.waste ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.014	0.018	-0.048	0.021	-0.013	-0.765	0.444
PBC.PRE ⇒ Intentions.PRE ⇒ Prev.habits.POST	0.046	0.019	0.008	0.083	0.048	2.369	0.018
PBC.PRE ⇒ Intentions.PRE ⇒ Waste.habits.POST	-0.033	0.015	-0.062	-0.003	-0.035	-2.159	0.031

Note. Defined parameters. C.I. = 95% Confidence Intervals.

STUDY 5

Additional sociodemographic data. The majority resided in the North-West of Italy (110 participants, 88.0%), followed by the North-East (8 participants, 6.4%), the Centre (3 participants, 2.4%), the South (1 participant, 0.8%), the Islands (1 participant, 0.8%), and 2 participants (1.6%) reported living in Germany. Regarding city size, 65 participants (52.0%) lived in towns with fewer than 30,000 inhabitants, 31 (24.8%) in cities with 30,001-100,000 inhabitants, 6 (4.8%) in cities with 100,001-250,000 inhabitants, and 23 (18.4%) in cities with more than 250,000 inhabitants. In terms of educational attainment, 61 participants (48.8%) had a high school diploma, 34 (27.2%) held a bachelor's degree, 23 (18.4%) a master's degree, and 7 (5.6%) a post-degree qualification or doctorate. Regarding occupation, 61 participants (48.8%) were students, 31 (24.8%) were both students and workers, 20 (16.0%) were dependent workers, 7 (5.6%) were independent workers, 5 (4.0%) were unemployed, and 1 participant (0.8%) was retired. The average household size was 3.09 persons (SD = 1.10), with 9 participants (7.2%) living alone, 30 (24.0%) in two-person households, 40 (32.0%) in three-person households, 33 (26.4%) in four-person households, and 13 (10.4%) in households of five or more people. Most participants reported a relatively stable economic situation, with 68 participants (54.4%) indicating they made ends meet "somewhat easily," 28 (22.4%) "very easily," 28 (22.4%) "with some difficulty," and 1 participant (0.8%) "with great difficulty." Political orientation was measured on a 7-point Likert scale (1 = Far left to 7 = Far right), with a mean score of 3.75 (SD = 2.26). Regarding dietary habits, the majority

were omnivores (100 participants, 80.0%), followed by flexitarians (10 participants, 8.0%), vegetarians (11 participants, 8.8%), pescatarians (3 participants, 2.4%), and 1 vegan participant (0.8%).

Table A.12

The motivation to avoid food waste (MAFW) scale from Ribbers and colleagues (2023)

Factor	Items
Environmental	1. Food waste leads to excess pollution caused by the production, distribution and disposal of food
	2. Wasting food leads to overproduction that damages our environment
	3. Wasting food is a waste of the energy and labor that went into the production of it
	4. I try to avoid food waste because of the environmental impact of food packaging
	5. Food waste has huge economic consequences for society
	6. Food waste is not fair because it depletes resources for future generations
Moral	7. When food is wasted, some animals suffered unnecessarily
	8. Food waste is not acceptable because it can be avoided by saving and eating leftovers
	9. Wasting food is unnecessary because the food can be reused, frozen or better portioned instead of wasted
	10. I try to avoid food waste because food should not be taken for granted
	11. Wasting food is disrespectful to poor people in this country
Financial	12. Wasting food is a shame because I could have saved the money
	13. Wasting food worries me because I could have spent the money on other things
	14. I try to avoid food waste because I worked hard to earn the money I paid the food with
	15. Wasting food is a waste of my money
Social norm	16. I avoid food waste because I don't want other people to think I'm greedy
	17. I don't want to waste food because I'm afraid other people will think that I'm ungrateful
	18. I avoid wasting food because I'm afraid people will think I'm flaunting my wealth
	19. I try not to waste food because otherwise people will think that I'm unable to run my household properly

<i>Factor</i>	<i>Items</i>
	20. <i>I try to avoid food waste because I worry that people think that I'm a wasteful person</i>
	21. <i>I refrain from wasting food because I fear that people think I don't care about food waste problems</i>

Nudge – Economic treatment

“Food waste is a topic that has been discussed for years in institutional circles due to its weight and its economic, environmental and social consequences. Reducing food waste and food insecurity are one of the objectives of the 2030 Agenda for Sustainable Development, a “shared agenda” of the United Nations that aims to guarantee a better life for everyone, as well as for the planet we live on. During this research, we want to focus our attention on one aspect of food waste in particular: the ECONOMIC aspect.”

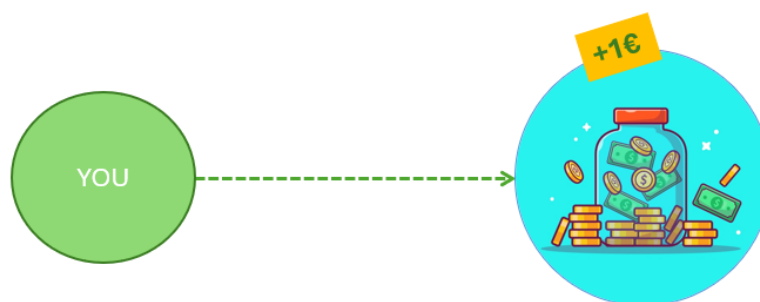
Day 1: *Food waste has a considerable economic cost. Each Italian citizen wastes approximately 81 grams of food per day and 566 grams of food per week, which in a year corresponds to approximately €126 (Waste Watcher, Spreco Zero survey of 2023). This means that approximately 4.8 billion euros per year are thrown away (in the garbage) in Italy alone.*

Day 2: *Food waste has a considerable economic cost. Globally, about 1/3 of food is wasted. This corresponds to about 1.30 billion tons, around 870 billion euros per year.*

Day 3: *Figure X.*

Figure A.2

Motivational nudge for the economic treatment



"Keep going! Your effort today is a saving tomorrow! Remember that food waste is an economic waste for you, for your community and for the entire world."

Nudge – Environmental treatment

"Food waste is a topic that has been discussed for years in institutional circles due to its weight and its economic, environmental and social consequences. Reducing food waste and food insecurity are one of the objectives of the 2030 Agenda for Sustainable Development, a "shared agenda" of the United Nations that aims to guarantee a better life for everyone, as well as for the planet we live on. During this research, we want to focus our attention on one aspect of food waste in particular: the ENVIRONMENTAL aspect."

Day 1: *Food waste has a considerable environmental and ecological cost. Each Italian citizen wastes approximately 81 grams of food per day, 566 per week and around 30kg per year (Waste Watcher, 2023 Zero Waste survey). This means that approximately 13 million tons of CO₂ per year are dispersed into the environment in Italy alone.*

Day 2: *Food waste has a considerable environmental and ecological cost. Globally, about 1/3 of food is wasted. This corresponds to about 3.3 billion tons of CO₂ dispersed into the environment. We are talking about about 8 - 10% of global greenhouse gas emissions (Food Waste Index Report 2021, United Nations Programme).*

Day 3: *Figure X.*

Figure A.3

Motivational nudge for the environmental treatment



*“Keep up the good work! Your effort today protects the environment!
Remember that food waste harms the nature of your community
and the planet.”*

Nudge – Moral treatment

“Food waste is a topic that has been discussed for years in institutional circles due to its weight and its economic, environmental and social consequences. Reducing food waste and food insecurity are one of the objectives of the 2030 Agenda for Sustainable Development, a “shared agenda” of the United Nations that aims to guarantee a better life for everyone, as well as for the planet we live on. During this research, we want to focus our attention on one aspect of food waste in particular: the aspect of SOCIAL INJUSTICE.”

Day 1: *Food waste has a considerable cost in terms of social (in)justice. Each Italian citizen wastes approximately 81 grams of food per day and 566 grams of food per week and around 30kg per year (Waste Watcher, Spreco Zero survey of 2023), while approximately 3 million people are in a situation of food insecurity.*

Day 2: *Food waste has a considerable cost in terms of social (in)justice. Globally, about 1/3 of all food that passes the production chain is wasted, while 343 million people are in a situation of severe food insecurity.*

Day 3: *Figure X.*

Figure A.4

Motivational nudge for the social treatment



*“Your effort today is a step forward in achieving food equality!
Remember that food waste doesn’t just hurt you or your community,
it hurts everyone!”*

Author’s note

This research was conducted and funded within the PNRR Project ONFOODS. Artificial intelligence-based tools such as Scopus AI (for literature review) and ChatGPT, Perplexity AI and Grammarly (for linguistic and stylistic refinement) were utilized in the preparation of this dissertation.



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