UNIVERSIDADE FEDERAL DA GRANDE DOURADOS
FACULDADE DE ADMINISTRAÇÃO, CIÊNCIAS CONTÁBEIS E ECONOMIA
PROGRAMA DE PÓS-GRADUAÇÃO EM AGRONEGÓCIOS

NUDGES PARA A REDUÇÃO DO DESPERDÍCIO DE ALIMENTOS NAS RESIDÊNCIAS

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Aos seis dias do mês de março do ano de dois mil e vinte e três, às oito horas, em sessão pública, realizou-se na Universidade Federal da Grande Dourados, a Defesa de Tese de Doutorado intitulada **"NUDGES PARA A REDUÇÃO DO DESPERDÍCIO DE ALIMENTOS DENTRO DAS RESIDÊNCIAS"**, apresentada pelo doutorando Gabriel Jäger Ramos, do Programa de Pós-Graduação em Agronegócios, à Banca Examinadora constituída pelos membros: Prof. Dr. João Augusto Rossi Borges/UFGD (presidente/orientador), Prof. Dr. Paulo Henrique de Oliveira Hoeckel /UFGD (membro titular interno), Prof. Dr. Gustavo Porpino de Araújo/EMBRAPA (membro titular externo), Prof.ª Dr.ª Márcia Dutra de Barcellos/UFRGS (membro titular externo) e Prof. Dr. Cristian Rogerio Foguesatto/UFG (membro titular externo). Iniciados os trabalhos, a presidência deu a conhecer ao candidato e aos integrantes da banca as normas a serem observadas na apresentação da Tese. Após o candidato ter apresentado a sua Tese, os componentes da Banca Examinadora fizeram suas arguições. Terminada a Defesa, a Banca Examinadora, em sessão secreta, passou aos trabalhos de julgamento, tendo sido o candidato considerado **aprovado**. O Presidente da Banca atesta a participação dos membros que estiveram presentes de forma remota, conforme declarações anexas. Nada mais havendo a tratar, lavrou-se a presente ata, que vai assinada pelos membros da Comissão Examinadora.

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“Não critique, auxilie. Veja com bondade e ouça com lógica.”

André Luiz

DEDICATÓRIA

Dedico essa tese às pessoas que passam fome ao redor do mundo. Aos mais de 50% da população brasileira que vive com algum nível de insegurança alimentar. Aos 33 milhões de brasileiros que passam fome atualmente. Que essa pesquisa, nem que seja minimamente, possa contribuir para que nos guiemos rumo a um futuro sem fome, no qual todos tenham o básico para se alimentar.

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SUMÁRIO

NUDGES PARA A REDUÇÃO DO DESPERDÍCIO DE ALIMENTOS NAS RESIDÊNCIAS

RESUMO - As práticas de gerenciamento de alimentos são possíveis causas de desperdício alimentos nas residências. Portanto, a forma como as pessoas realizam a gestão de alimentos, como comprar e cozinhar, afeta a quantidade de alimentos que desperdiçam. Visando a redução do desperdício de alimentos nas residências, os nudges podem ser usados para influenciar as pessoas a mudarem seu comportamento em vários domínios. Nudges são intervenções que normalmente são de baixo custo e tem a capacidade de mudar o comportamento das pessoas alterando a arquitetura de escolha, incluindo locais privados, como residências. Tais intervenções podem ser direcionadas a diferentes fases do processo de gerenciamento dos alimentos nas residências, como a prevenção da compra excessiva de alimentos e a prevenção do preparo de alimentos em excesso. No entanto, são necessários insights sobre a eficácia dos nudges direcionados a essas duas fases especificamente. Assim, o objetivo desta pesquisa foi testar nudges para reduzir o desperdício de alimentos em 80 residências da cidade de Dourados, no estado de Mato Grosso do Sul, direcionados a duas fases diferentes do processo de gerenciamento de alimentos das residências (compra e preparo), enquanto mensurou diretamente o desperdício de alimentos nas residências participantes. Além disso, como as pessoas tendem a se tornar mais conscientes devido ao acompanhamento preciso do desperdício de alimentos em suas residências, foram avaliados os efeitos da mensuração do desperdício de alimentos ao longo do tempo na quantidade desperdiçada. Para avaliar a efetividade dos nudges, foi realizada uma Análise de Variância (ANOVA) de Medidas Repetidas. Os resultados da ANOVA de medidas repetidas mostraram que, embora os nudges não tenham tido qualquer efeito no desperdício de alimentos dos participantes, houve uma diferença significativa no desperdício de alimentos das residências participantes após a intervenção em comparação com o período pré-intervenção. Essa diferença parece acontecer porque, quando as pessoas mensuram o desperdício de alimentos ao longo do tempo, tendem a reduzi-lo. Resultado semelhante foi encontrado por um modelo de regressão linear e uma modelagem multinível de dois níveis. Além disso, visto que a vulnerabilidade dos métodos de auto-relato para a mensuração de desperdício de alimentos tem sido questionada na literatura, realizou-se comparações entre o desperdício de alimentos auto-relatado subjetivo e o desperdício de alimentos objetivo. Os resultados de tabulações cruzadas e de uma ANOVA fatorial indicaram que os participantes não conseguiram relatar com precisão o desperdício de alimentos de suas residências pelo método de auto-relato, e, portanto, tal método pode não ser confiável para mensurar o desperdício de alimentos nas residências.

Palavras-chave: Economia comportamental, intervenções comportamentais, métodos de mensuração de desperdício de alimentos nas residências, gestão do agronegócio, tomada de decisão.

NUDGES FOR HOUSEHOLD FOOD WASTE REDUCTION

ABSTRACT – Food management practices are possible causes of household food waste. Hence, how people manage food management practices, such as buying and cooking, impacts how much food they waste. To influence people's behavior, aiming for food waste reduction, nudges can be used to change people's behavior in a variety of domains, including food waste at the household level. Nudges are interventions that have powerful and low-cost characteristics, as well as a capacity of changing people's behavior by altering choice architecture, including private places such as households. Such interventions can be aimed at different phases of the household food management process as the prevention of overbuying and the prevention of overcooking. Insights, however, are needed on the effectiveness of nudges targeting these two different phases. Hence, the objective of this study was to test nudges aimed at two different phases of the household food management process (cooking and purchasing) while directly measuring the participant's household food waste. Furthermore, because people tend to become more conscientious because of precisely keeping track of their food waste, the effects of measuring household food waste on participants' household food waste over time were assessed. To check the effectiveness of the nudges, a Repeated Measures ANOVA was performed. Repeated measures ANOVA's results showed that, although the nudges did not have any effect on participants' food waste, there was a significant difference in the participant's food waste post-intervention compared to the pre-intervention period. This difference seemed to happen because when people keep measuring their food waste over time, they tend to reduce it. This result was also found by a Linear Regression model and a Two-Level Mixed Model. Additionally, because self-reported food waste measurement methods has been questioned in the literature, comparisons between subjective self-reported food waste and objective food waste were performed. Results of cross-tabulations and a univariate ANOVA indicated that the participants could not accurately self-report their household food waste and therefore this measurement method might not be reliable for measuring household food waste.

Keywords: Behavioral economics, Behavioral interventions, Household food waste measurement methods, Agribusiness management, Decision-making.

LISTAS DE ABREVIATURAS

ANOVA	Análise de variância
FAO	Food and Agriculture Organization of the United Nations
FW	Food waste
GHG	Greenhouse gas
HER	Home energy report
IBGE	Instituto Brasileiro de Geografia e Estatística
PEK	Peak energy report
UN	United Nations
UNEP	The United Nations Environment Program
UK	United Kingdom
WRAP	Waste and Resources Action Program

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1 INTRODUCTION

In 2015, the United Nations (UN) adopted the 2030 Agenda for Sustainable Development, with 17 objectives to end poverty, protect the planet and ensure prosperity for all (United Nations, 2015). Food waste is related to those objectives, particularly to “Zero Hunger and Sustainable Agriculture”, which makes the topic a challenge to tackle all over the world. A staggering 931 million tons of the total food production in the world is wasted (UNEP, 2021). This fact not only brings risks to the world’s food security but also has negative impacts on the environment due to greenhouse gas emissions (GHG), freshwater use, cropland, fertilizer use, and economic losses (Gustavsson et al., 2011; Kummu et al., 2012).

While food waste is common in more than 1 billion people’s lives, food insecurity is a reality for too many others (Lundqvist et al., 2010; Kosseva, 2013). Therefore, food waste is not just an economic and social issue, it goes beyond, being also an ethical issue (Hebrok & Boks, 2017). Thus, it has become essential to move to a more sustainable and equitable food system (Vieira et al., 2021).

One of the possible solutions to increase food availability could justly be through food waste reduction (Foley et al., 2011; Kummu et al., 2012; FAO, 2013). Food waste occurs in all supply chain points, however, most of the food waste occurs in households (UNEP, 2021). Data on household food waste show that each person wastes around 85kg per year in France, 50 kg in the Netherlands, 134 kg in South Africa, 84 kg in Ghana, 102 kg in Australia, 150 kg in China, 64 kg in Japan, 79 kg in Canada and 59 kg in the USA (UNEP, 2021). A similar situation occurs in Brazil. Although about 10 million people are suffering from food insecurity (IBGE, 2020), each Brazilian household wastes around 128.8 kg of food per year (Porpino et al., 2018) and each person wastes 60 kg of food per year (Araujo et al., 2018). Furthermore, it is expected that food waste increases in the next 25 years worldwide due to economic and population growth (Chen et al., 2017).

It is known that people’s behavior is the reason for the occurrence of food waste in households. Hence, food waste behavior at the household level is

related to a food waste journey, composed from different factors such as psychological factors, norms, situational factors, demographic factors, and household food management routines (see Figure 1) (Principato et al., 2021).

Figure 1 - The wasteful behavior

Psychological Factors	Norms	Situational Factors	Demographic factors
• Attitudes • Perceived behavioral control • FW Knowledge • FW involvement • Habits, emotions	• Social norms • Personal norms	• Level of urbanization • Perception of the amount of litter	• Age • Level of education • Household composition • Gender • Income

HOUSEHOLD FOOD WASTE JOURNEY				
Planning	**In-store**	**Pre-consumption**	**Consumption**	**Disposition**
• Lack of planning • Lack of fridge checking • Lack of a shopping list • Lack of meal planning • Lack of communication among household members	• Overprovisioning of food • Impulsive purchase • Presence of children • Marketing strategies • Visual merchandise • Too large package size • Lack of shopping in different shopping facilities and local markets	STORAGE • Sub-optimal storage • Lack of freezing food • Misinterpretation of expiration dates • Food freshness fear • Food safety fear • Lack of sensory skills COOKING • Sub-optimal culinary skills • Cooking or serving too much food • Inability to cook leftovers into new meals • Rely on ready-made, convenience food	• Do not eat leftovers • Lack of proper storage of leftovers • Food preferences	• Do not separate kitchen waste

WASTEFUL BEHAVIOR

*FW = Food Waste; *Food freshness fear is when people are afraid of the food not being fresh enough; *Food safety fear is when people are afraid of the food not being safe enough to eat.

Source: Principato et al., 2021.

Given all the factors that influence the behavior of people to waste food, the development of strategies aiming at food waste reduction at the household level is challenging. According to Hebrok & Boks (2017), one of the possible ways to develop an intervention for influencing people's behavior is to use nudges.

Nudges have been used to change a set of people's behaviors and it was presented in the book "Nudge – Improving Decisions About Health, Wealth and Happiness" (Thaler & Sunstein, 2008). Since the book's release, nudges have been developed and tested, and the results have been encouraging.

According to Thaler & Sunstein (2008), a “nudge” is any aspect of choice architecture that changes people’s behavior in predictable ways, without forbidding any options or significantly altering their economic incentives. Besides, the incentives must be cheap, easy to avoid, and not mandatory. Nudges are usually low-cost and have the capacity of changing the individual’s behavior including private places, such as households (Jagau & Vyrastekova, 2017).

Given the evidence of nudges to change people’s behavior in a variety of domains, governments have created specific departments to develop nudge-based interventions to influence individuals. For instance, in the United Kingdom ‘the Behavioral Sciences team’ (Nudge Unit) and in the United States ‘the White House Behavioral and Social Sciences team’. Some examples of nudges applied by these teams are nudges to increase vaccine uptake, to make people pay their taxes on time, and to encourage people to acquire retirement security (Social and behavioral Sciences Team, 2016; The UK Institute for Government, 2020). A possible explanation for the wide use of nudges in policies is its low or no cost (Sunstein, 2014).

As examples of nudges Goldberg & Gunasti (2007), in a study conducted in the United States, showed that the nudge ‘place fruits instead of candies close to the supermarket’s cashiers’ influenced people to buy more fruits. Kallbekken & Saelen (2013), in an experiment conducted in restaurants of a hotel chain in Norway, showed that the nudge ‘reduction from 24cm to 21cm of the size of the plate’ reduced about 15% of food waste at those restaurants. In another study conducted in Germany, Momsen & Stoerk (2014) showed that a default option changing nudge increased by 44.6% the number of individuals that opted for purchasing a renewable energy provision instead of a conventional one. In England, Shearer et al. (2017), showed that the use of the nudge ‘sticker prompts’ increased by 20.7% of the food waste captured for recycling.

One of the most recently explored types of nudges is the “green nudges”, which are nudges toward environmental sustainability. For instance, to change the default source of energy option for a green energy source option, studies have shown that people are more likely to choose the green option when this is the default. Another example is the use of social norms to inform people how

much their neighbors are saving energy to promote energy use reduction by social influence (Schubert, 2017).

However, most of the green nudges target energy consumption and conservation (Schubert, 2017). Despite the evidence that nudges can modify people's behavior in a variety of domains, there is a scarcity of research testing nudges for household food waste reduction (Kameke & Fischer, 2018).

Given the scarcity of studies, I have explored the literature for other behavioral interventions aimed at household food waste reduction. Few studies reported successful interventions. For instance, presenting people with the quantity and the average household waste of food, as well as the social impacts of food waste, influence them to reduce their food waste (van der Werf et al., 2021). Wharton et al. (2021) also showed that interventions to educate and inform people were effective in reducing food waste. Van Dooren et al. (2020) indicated that facilitating good food management practices, by providing manners of correctly measuring portions of rice or pasta for cooking the right quantity without leftovers reduced food waste.

Prior research has also looked at the effectiveness of a combination of several interventions (Stöckli., 2018), such as using emotional appeals or pointing out the value of food and the social impacts of food waste (Septianto et al., 2020; van der Werf et al., 2019) and at the effectiveness of targeting one specific phase of the household food management process (e.g., cooking, purchasing, storage, or consumption) (van Dooren, 2020). Yet, insights are lacking in comparing interventions targeting different phases of the food management process, for example, cooking and purchasing.

Considering prior research and the studies present above, this study tackles three main gaps in the literature: (1) it took a period relatively longer for intervention inside households, compared to other similar studies (Reynolds et al.; 2019). This longer period of intervention can minimize reactions that can camouflage participants' real food waste (Quested et al., 2020); (2) At the same time, a longer period of intervention provides opportunities for assessing the effects of measuring household food waste on food waste behavior. The assessment of measuring food waste on food waste behavior is important

because many consumers are unaware of the amount of food that they waste and its implications (Soma et al., 2020), and as they start measuring, it may increase their awareness and lead to changes in waste behavior (Langley et al., 2010; Sharp et al., 2010). To the best of our knowledge, there are no similar studies that tested the effect of measurement over time.

Finally, (3) there are different ways to measure food waste at the household level, including objective and subjective measurements. To check if a household food waste reduction intervention is effective, the food waste measurement is essential. However, self-report methods might be biased, which difficult the assessment of an intervention's effectiveness. Thus, comparisons between households' objective food waste and self-reported subjective food waste are important to provide new insights about people's capacity of accurately self-report their household food waste.

Based on the above, the general objective of this study was to test nudges aimed at two different phases of the household food management process (cooking and purchasing) while directly measuring the participant's household food waste. In addition to testing nudges, the effects of measurement of household food waste over time were assessed, because people tend to become more conscientious as a result of precisely keeping track of their food waste (Ammann et al., 2021).

Furthermore, as a secondary objective, comparisons between subjective self-reported food waste and the participant's actual food waste were performed to check how accurate the participants are when self-reporting their food waste using subjective scales. In next section I present explanation and a literature review regarding important topics of this study, which are about behavioral economics, nudges, planning (cooking and purchasing) as a driver for household food waste, awareness and behavioral reactivity, and food waste measurement methods.

2 LITERATURE REVIEW

This section contains the literature background that supports this study. The section is divided into five subsections: The first and second subsections are named Behavioral economics and Nudge, and both provide the theoretical background that supports the development of the interventions applied in this study. The third subsection is named Planning as a driver of household food waste, where I explain the role of planning for household food waste reduction and why I target this phase of the household food management process in the empirical experiment. The fourth subsection is named Food waste measurement methods, and it describes the existent measurement methods, their advantages, and disadvantages, as well as why the measurement method used in this study was chosen. The last subsection is named Awareness and behavioral reactivity, where I justify the investigation of the effect of measuring food waste on food waste behavior over time.

2.1 BEHAVIORAL ECONOMICS

Human behavior is complex. Hence, for creating interventions that result in behavior changes, it is required a solid understanding of how people behave in different situations (Lehner et al., 2015). Regarding the complexity of human behavior, economics has developed models to predict and explain how people behave. Thus, behavioral economics has challenged some standard economic assumptions, which is the focus of this study.

A common assumption in traditional economic models, to predict people's decisions, is that they make rational choices and behave in rational ways. However, behavioral economics seeks to refute these common assumptions (Ariely, 2008). The rational assumptions about human behavior were first questioned in the 1950s – 1970s, by cognitive and psychologist scientists (Simon, 1957; Tversky & Kahneman, 1974). They proposed that instead of full rationality, people have bounded rationality, are subject to behavioral biases, rarely make

deliberate choices, and rely on mental shortcuts and habits to make their decisions.

Based on their findings, a ‘new’ economics research agenda has emerged, named behavioral economics. Models based on behavioral economics help to better explain why individuals often make decisions that deviate from desirable objectives and behaviors. This is possible because behavioral economics relaxes some assumptions of traditional economics models (e.g., full rationality); instead, models are based on the findings of different fields of social sciences, like economics, psychology, cognitive psychology, ecological psychology, social psychology, sociology and even anthropology (Rehman, 2017). Hence, the incorporation of findings from different scientific fields makes behavioral economics models much more realistic than standard economics.

One of the theories created based on the idea that people have bounded rationality, against the assumptions of the traditional economy, is the theory of two systems of thinking, created by Daniel Kahneman (2011). The two systems of thinking are System 1 and System 2.

In general, the System 1 thinking process is based on heuristics, is intuitive, biased, associative, and automatic. System 2 thinking process is based on rules, analytical, flexible, and slow (Lin et al., 2017). Examples of tasks carried out by System 1 are to recognize an object, understand simple sentences, or fear a disease. Regarding System 2, the examples are searching your memory to find the name of a person, checking the validity of a complex argument, or counting the occurrences of a letter in a text (Alba-Juez, 2021).

Heuristics are generalizations that help simplify judgements in situations of complexity or uncertainty and rely on past experiences, shared cultural knowledge, trust in certain authorities or expertise, and subjective impressions (Petersen et al., 2022). One heuristic example is when people assess the probability of an event by the degree to which instances are available in memory (Arnott and Gao, 2019), which make the decision-making process easier and might lead to cognitive biases. Cognitive biases are systematic errors that repeat predictably, in particular circumstances, when people are processing and

interpreting information, as a result of the brain trying to simplify the information processing (Kahneman, 2011 Evans and Stanovich, 2013; Lin et al., 2017).

For Kahneman (2011), the biases cannot always be avoided, and System 2 is too slow and inefficient to function as System 1's substitute. As a result, the best that can be done is to learn and recognize situations in which mistakes are probable and make more efforts to avoid significant mistakes when decisions will result in significant impacts. Following behavioral economics' insights about people's decision-making process, nudges have been used to improve decisions when System 1 is in control of the decision.

2.2 NUDGE

For Thaler & Sunstein (2008) nudges work because they correct behavioral biases and human behavior faults when the decision situation does not support the use of cognitive effort. Thus, choice architecture is related to the informational or physical structure of the environment, which influences the way people's choices are made.

However, nudging is not about manipulating or limiting people's choices in order of doing good or help. Nudging is about gently pushing people (Verschragen, 2017). For Thaler & Sunstein (2008) nudges are libertarian paternalistic because, although they push people in a rational direction, they still preserve their freedom of choice.

According to Lehner et al. (2015), there are four main types of nudges:

1- Simplification and framing of information, which is based on the idea that not only the amount or accessibility of information matters but how information is presented, fitting the decision-making process of individuals.
2- Changes to the physical environment: the physical environment has a significant impact on an individual's choices. Therefore, specific planned changes in this environment will influence them to make better choices.

3- Changes to the default policy: people tend to stay inert, take the path of least resistance, and prefer not to act unless they have to. Based on that, people are influenced by defaults.
4- The use of social norms: simply for the fact that humans are social beings, social norms strongly influence human behavior.

Initially, to have a better idea about nudges applied for changing behaviors inside households, I searched in the literature examples of the application of the above-mentioned nudges in studies that tested their capacity for behavioral change specifically at the household level. This step was taken to gather insights that would further provide information to develop the nudges for household food waste reduction tested in this study. These examples are presented in Figure 2.

Figure 2 - Nudges applied for behavior change in households

AUTHORS	STUDY'S OBJECTIVE	INTERVENTION	NUDGE TYPE
van Dooren. et al. (2020)	To perform an intervention on cooking the right amount of pasta and rice.	Subjects were given a measuring cup called the Eetmaatje.	Simplification and change to the physical environment
Henry. et al., (2019)	To estimate the causal effect of an electronic Home Energy Report (HER) program on residential electricity consumption.	Delivering customized HERs*	The use of social norms and simplification.
Otaki. et al., (2019)	To investigate the efficacy of historical self-comparison as a water demand management tool.	Intervention groups received the water droplet illustrations	Simplification and framing of information
Brandon. et al. (2018)	To investigate the response of households to social nudges on electricity consumption during peak load events.	Delivering of HERs* and PERs**	The use of social norms
Torres and Carlsson, (2018)	To investigate the spillover effects of a social information campaign aimed at encouraging residential water savings.	Delivering water consumption reports	The use of social norms
Gillingham and Tsvetanov, (2018)	To examine the effect of information provision on the completion of scheduled energy	Sending a personalized notecard, mailed to the individual's address 14 days before the	The use of social norms

	assessment visits.	scheduled assessment visit.	
Linder. et al. (2018)	To test whether an information intervention can be effective in promoting the recycling of food waste in an urban area.	Delivering leaflets guided by insights from nudging and community-based social marketing.	The use of social norms; Simplification and framing of information
Sudarshan (2016)	To investigate whether the response of households to peer comparisons on electricity consumption	Providing households information on the average electricity consumption of their peers, relative to their own.	The use of social norms
Shearer. et al., (2016)	To investigate the effectiveness of using stickers as a visual prompt to encourage the separate collection of household food waste for recycling	A sticker prompt was affixed to the lids of refuse bins.	Simplification and framing of information; Changes to the physical environment
Guerassimoff and Thomas (2015)	To assess whether nudge marketing service could increase users' commitment to efficient energy use habits.	To develop and apply a loyalty program using web interfaces.	Simplification and framing of information
Luoto., et al., (2014)	To examine whether nudges can increase water treatment among poor households	To give water treatment products and use inside-home posters as reminders for the use of the products.	Simplification and framing of information; Changes to the physical environment

Figure 2 shows that most of the studies tested nudges for changing people's behavior concerning water and energy use. Besides, most of the studies used nudges based on social norms. Now, I detail the studies above that focused on household food waste reduction and recycling.

A study conducted by van Dooren et al. (2020) tested a nudge for household food waste reduction. The nudge was based on simplification and reminding people by providing a measuring cup for cooking the right amount of pasta and rice. Their results showed evidence that the measuring cup intervention increased the number of households using the right amount of rice and pasta for cooking, reducing food waste.

Regarding food waste recycling, Linder et al. (2018) used a social norm and framing of information nudges to stimulate people to collect their household

food waste for recycling. The nudges were based on delivering leaflets that were created based on environmental psychology and behavioral economics insights. Their results supported that the leaflets increased the recycling of food waste in the area of the experiment and the difference between the control (who did not receive the leaflets) and the treatment group (households that received the leaflets as a nudge) persisted and was significant even 8 months after the information was handed out.

Also focusing on food waste recycling, Shearer et al. (2016) created a nudge based on the framing of information and changes to the physical environment, by using sticker prompts inside the households to stimulate food waste recycling. The study reached 64.284 households that participated in the experiment between the control and treatment groups, which took a period of up to 16 weeks. Results showed that there was an increase of 20.74% in the average food waste captured for recycling from the treatment group compared to the control group, which did not receive the nudge.

Other studies tested nudges to change behavior for better water and electricity use in households. For instance, Henry et al. (2019) used a social norm nudge by delivering Home Energy Reports (a report that shows how was the households' energy consumption in the past month) to approximately 9.000 households during a year. Using this nudge, households reduced their energy consumption by 2.9%.

Brandon et al. (2018) used two similar nudges based on social norms, in an experiment with 42.100 households, delivering Home Energy Reports and Peak Energy Reports. With this intervention, they found that both nudges could reduce peak load electricity consumption by 2% to 4% when applied in insolation and by 7% when applied in combination. Also, using social norms nudges, Torres and Carlsson (2018), conducted an experiment with 1857 households to encourage residential water saving. Their results indicate that the applied nudge reduced water use by up to 6.8%. Otaki et al. (2019), used a nudge based on simplification and framing of information, by simply changing the colors of water droplets, from blue to yellow or red, in historical water consumption feedback that households received by e-mail. With this intervention, done in 633 households,

between control and treatment groups, over 24 weeks, they observed that water consumption declined in the treatment group.

Finally, there was only one study that focused on water treatment. Luoto et al. (2014) used nudges based on simplification and framing of information, as well as changes to the physical environment, to increase water treatment among poor households. The nudges consisted in using positively framed and contrast-framed messages, as well as a poster, to be hung in the participants' homes as a reminder. Their study covered 400 compounds, which are collections of 6-20 households. Their results showed that the intervention was effective in increasing water treatment in the participants' households.

Considering all nudge interventions described above, there is evidence that a well-developed nudge can be useful for behavior change. From the literature presented above, the framing of information nudge, developed by Shearer et al. (2016), inspired the nudges developed for this study because they used nudges similar of what was tested in this study. Since this study focused specifically on the purchasing and cooking phases of the household food management process, next, the role of planning in reducing food waste is explored.

2.3 PLANNING AS A DRIVER OF HOUSEHOLD FOOD WASTE (PURCHASING AND COOKING)

As presented in the section 2.2, nudges targeting planning phases of the household food management process (Shearer et al., 2016; van Dooren et al., 2020), could be adapted for food waste reduction. Because planning has been promising in reducing food waste, I developed two interventions to encourage participants to plan either their food purchasing or their cooking.

Food waste behavior can be triggered during different stages of the household food management process (i.e., planning, in-store, pre-consumption, consumption, and disposition; Principato et al., 2021). Moreover, incorrect behaviors are performed in each of these stages. For instance, regarding the "in-store" stage, bad shopping routines such as buying more than is needed or not

planning the grocery shopping, are related to food waste generation (Mondejar-Jimenez et al., 2016). Regarding consumption, differences in preferences and habits are known to increase the generation of leftovers, increasing food waste (Principato et al., 2021). Regarding disposal, individuals who do not compost or recycle food (i.e., leftovers from consumption or cooking) tend to throw more food away (Secondi et al., 2015). Next, I detail food waste behavior regarding purchasing and cooking, the focus of this study.

Food waste generated from purchasing is related to how people behave when buying food, for example, if they buy food impulsively or have an attraction to special offers (Principato et al., 2021). Furthermore, when people buy more than they need, it increases the food's likelihood of spoilage (Quested et al., 2013). Previous literature has indicated several strategies that might reduce food overbuying. These strategies include good shopping habits such as the use of shopping lists or checking the food levels before shopping (Principato et al., 2022; Farr-Wharton et al., 2014). Such strategies might be effective because they help consumers to not be susceptible to marketing promotions and impulsive buying (Ponis et al., 2017).

Cooking is related to how people process their food products. Previous literature has indicated that when people cook more than they need or do not have the proper skills to make good use of leftovers (van Geffen et al., 2020), there is an increase in the amount of food waste. As such, strategies that improve people's cooking skills might reduce food waste (van Geffen et al., 2016). This is because better cooking skills can increase the use of leftovers in the preparation of new meals, help consumers avoid that food burned while cooking, or help them prevent cooking more than is needed (Williams et al., 2012; Evans, 2011; Principato et al., 2021). Previous studies have shown successful intervention examples, such as providing a way to measure the exact amount of food needed for cooking (van Dooren et al., 2020) or through educational interventions that improve consumers' dealing with leftovers and edibility judgment (Marian et al., 2022).

In conclusion, a lack of practice in cooking and planning meals or planning food purchasing is likely to increase over-acquisition and might cause food

disposal (Aschemann-Witzel et al., 2019). Therefore, planning beforehand for food purchasing, preparation and serving, and management of leftovers, enables people to avoid food waste.

Indeed, planning is the key behavior to contributing to the prevention of food waste (Ferro et al., 2022), which is why this study's interventions were developed around helping consumers to plan their food purchasing and cooking. In the next section, I explore the implications of food waste awareness and behavioral reactivity when measuring participants' household food waste.

2.4 AWARENESS AND BEHAVIORAL REACTIVITY

In this study, I have assessed if the measurement of household food waste over time affects the participants' food waste behavior. As theoretical background for this, I will discuss the concept of behavioral reactivity and household food waste awareness.

A challenge in testing behavioral interventions to reduce food waste in households is how to measure household food waste. Self-report measures of household food waste, such as diaries and surveys, tend to be more time-saving and cost-efficient for researchers than direct measures such as food waste weighting or composition analysis. However, direct measures might not be precise due to participants' concerns over social desirability (Amann et al., 2021), and they lead to underreporting (van Herpen et al., 2019; Quested et al., 2020).

To minimize the lack of accuracy, I adopt the use of kitchen scales. I hoped that by using kitchen scales participants would self-report their household food waste more precisely, compared to other available measuring methods (e.g., diaries or surveys based on estimated amounts), which usually involve some dose of subjectivity. However, the measurement itself can still affect actual food waste. As such, the method used to measure food waste in this study presents an opportunity to check if this happens.

The literature shows that when individuals are faced with their behavior, such as having to report their food waste precisely, they tend to become more aware of their habits, which in our study, might lead to food waste reduction

(Amann et al., 2021; Koivupuro et al., 2012; Langley et al., 2010). This phenomenon is known as “behavioral reactivity” and different academic fields have investigated it. To avoid misunderstandings about the behavioral reactivity concept, Trafton and Gifford (2008) presented the following definition: behavioral reactivity is the intensity of an automatized/habitual behavioral response when an opportunity to obtain positive or negative reinforcement is identified. In the context of this study, behavioral reactivity is basically people wasting less during the measurement period of their participation in the study compared to what they wasted beforehand (Quested et al., 2020).

Behavioral reactivity might occur for different reasons such as a rise in the salience of food waste, which makes people put more effort into ‘doing the right thing’ and reducing their food waste (Quested et al., 2020). Another reason for behavioral reactivity is that people modify their behavior to minimize the burden of undertaking the food waste measurement exercise. One example of this behavior modification is a delay in clearing out the fridge until the measurement period finishes (Quested et al., 2020). However, since this study’s period of measurement is sufficiently long (see details in the section 3), the delay in clearing out the fridge is less likely. Furthermore, in the context of this study, the behavior reactivity suggests that if a behavior change happens during the measurement period, it will go back to usual, once the reinforcement is gone.

On the other hand, assuming that the measurement itself might affect food waste because people tend to become more aware of their habits and thus reduce their food waste, the introduction of the measurement routine could alter people’s habits, since a new routine might take around 66 days on average to become a habit (Lally et al., 2010). Furthermore, this would mean that the new behavior would persist after the study period.

Because of the above, beyond testing nudges to reduce household food waste, I assessed the effects of measurement of household food waste over time, on the participant’s behavior. This allowed me to examine whether the reported food waste diminishes during the study period, also for people who are not exposed to any intervention. To limit the possibility that people would delay certain behaviors, such as clearing out the fridge, during the study, I chose a

relatively long measurement period. In the next section, I explore food waste measurement methods, which is an essential step to test any intervention, including nudges.

2.5 FOOD WASTE MEASUREMENTS METHODS

According to Herpen et al. (2019), to better understand the drivers of food waste, it needs to be measured reliably and validly. However, establishing a valid estimation of the extent of food waste remains a major challenge (Elimelech, Ayalon, & Ert, 2018; Parfitt et al., 2010), due to the lack of standardized methods to quantify household food waste (Herpen et al., 2019; Porpino, 2016).

There are several methods of measuring household food waste, such as self-report in a diary, self-report survey or interview, waste-composition analysis, self-collection in provided containers and photographs, and in-home observations (Herpen et al., 2019). To understand the advantages and disadvantages of each method, Herpen et al. (2019), presented four criteria. These criteria are (1) the degree to which estimates of food waste can be biased; (2) the effort required of respondents; (3) the effort and costs for the researcher; and (4) the ability of the method to provide information about different states of food waste. Next, I detailed different methods for measuring household food waste.

2.5.1 Diary

Diary is the method used to measure household food waste by making the respondents report the type and the amount of food they waste at their homes for a determined period of time (Herpen et al., 2019). Previous studies have asked the respondents to measure the weight of the food wasted or describe the amount of food wasted in units; for instance, three oranges or two slices of toast. Additionally, participants were asked to include the state of the food (fresh, cooked, ready to consume when purchased, etc.) and reasons for the disposal (inedible, looked bad, left on the plate, etc.) (Katajajuuri et al., 2014; Ventour, 2008).

This method has some disadvantages, such as it requires high effort from the respondent, which creates difficulty for recruiting participants, besides, it demands close interaction with households. Moreover, the diary method can motivate individuals to change their behavior since the method is a constant reminder of food waste. Also, the method carries a risk of self-selection and poor data quality (Langley et al., 2010; Sharp et al., 2010).

2.5.2 Self-report survey / Interview

In this method, participants answer questions reporting the amount and frequency of food waste without the use of a diary or other instruments. Various measures have been used within this method such as absolute or frequency measures, visually-based measures, and proportional waste measures (Herpen et al., 2018; Parizeau et al., 2015; Ventour, 2008).

According to Herpen et al., (2019), the advantages of this method are the easiness of collecting data at a relatively low cost for the researcher and requires low effort from the respondent. On the other hand, people are more inclined to give socially desirable answers. Moreover, when using surveys, the measurement draws upon the individual's memory, which can be faulty.

2.5.3 Waste-composition analysis

This method can be applied without changing people’s behavior and requires no effort from the respondent because, in waste-composition analysis, the household’s food waste is collected, physically separated, weighed, and categorized (Herpen et al., 2019). Yet, to accurately measure household food waste weight and composition, it has to be recorded as closely as possible to the point that food goes to the waste stream (Elimelech, Ayalon, & Ert, 2018; Langley et al., 2010).

However, this method is costly and requires specific knowledge and significant time from the researcher, besides the difficulty for distinguish the waste between food being thrown out before use, partly used, or as leftovers. On other

hand, due to this method not relying on self-reporting, it is not dependent upon respondents' memory or subject to social desirability (Herpen et al., 2019).

2.5.4 Self-collection in provided containers

This method can be applied by providing the participants with specific containers, where they will dispose of their food waste, which will be collected by the researcher at regular times. Thus, this method can provide an overall measurement of the grams of food waste.

The effort required from the researcher is substantial due to the regular collection of food waste. However, for the participant, a low effort is required since they only have to dispose of their waste in the provided containers instead of their regular bins (Herpen., 2019). According to Herpen et al. (2019), the habit of disposing of food waste in regular bins and the concerns over social desirability might lead to underreporting.

2.5.5 Photographs and in-home observation

This method demands from the participants to photograph the food they dispose of. Despite of low effort required by the participants, due to the easiness of the use of mobile cameras, and because of the time consumed by the coding of these photos, this method can lead to high costs of data handling and difficulty of applying it to large samples (Herpen et al., 2019). Since this method has not been used often, little is known about potential biases, both due to underreporting and due to incorrect coding (Herpen et al., 2019).

Given the above-mentioned issues, it might be effective to combine different measurement methods. Indeed, for Herpen et al. (2019), kitchen caddies combined with photographs and in-home observations seem to be more accurate than self-reported methods.

Based on the necessity to standardize quantification across different countries as a means of tracking the achievement of its Sustainable Development Goal 12.3, the United Nations Environment Program has suggested using waste

composition analysis, and direct measurement in households via scales, or diaries (Vieira et al., 2021). With this in mind, this study used combined measurement methods to more accurately assess the effects of the nudges and the effects of measurement over time, as well as to provide better data to compare objective and subjective household food waste (see details in section 3).

3 MATERIALS AND METHODS

3.1 SAMPLING, AND RECRUITMENT

Based on the theoretical background presented in section 2 I developed and tested two nudges in a field experiment. An online invitation was circulated by e-mail and social media (Facebook, Instagram and WhatsApp) to recruit participants. Using this strategy, 92 participants were recruited, however, nine dropped out of the experiment and three were excluded because they did not report any food waste measurement in the pre-or post-intervention period. Hence, the sample size comprised 80 participants, who were representing their households. The selected participants were all located in the city of Dourados (population of 225,500 people) in Brazil.

3.2 SURVEY

After the participants' selection, a survey (Appendix 1) was applied to collect demographic information, including gender, age, household composition (lives alone or shared household, family with only adults and family with children) the highest level of education in the household (until completed high school, bachelor's degree, master's degree, and Ph.D.), how many daily meals were made in the household (1 or 2, 3 or more) and the number of people in the household (1, 2, 3, 4, 5 or more), as well as dichotomous questions such as if the household composts or recycles food, if the participant believes to have in mind

the right amount of food stored at home when purchasing food, and if the participant has the habit of using shopping lists. This survey also checked if the participant's household had the required characteristics for the experiment, which was that at least one weekly meal must be eaten at home.

Besides demographic information, I decided to add in the survey, two questions to check how much food waste the participants believe to generate and to compare the answers to the participants' actual food waste measured by scales. The first question was: "How much food no consumed, do you believe it is wasted in general in your household?" The scale used to measure it had the options: "Quite a lot", "A reasonable amount", "Some", "A small amount", "Hardly any" and "None". This scale was adapted from the report "Down the Drain" (WRAP, 2009).

The second question was: "How many kilos of food do you believe is wasted in your household per month?" The scale used in this question had the options "Less than 1 kg", "From 1 kg to 5kg", "More than 5 kg to 10 kg", and "More than 10 kg".

The purpose of these two questions was, first, to check what is the correspondent in kilos for participants, when they report their food waste from "quite a lot" to "none". Second, to compare if the actual households' food waste measured by the scales is similar to the subjective self-reported food waste. The variable representing the household's actual food waste was each participant's average food waste per month. After receiving the survey, participants were contacted via social media and received the "Participant's Guide" (Appendix 2), containing all the information they needed to complete the study.

3.3 EXPERIMENT DESIGN

The 80 participating households were randomly distributed into 3 groups. The groups are the control group (22 participants), the "purchasing" group (28 participants), and the "cooking" group (30 participants). The treatments were applied after 91 days from the beginning of the measurement period. The purchasing group received an intervention focused on preventing food

overbuying, the cooking group received an intervention focused on preventing food overcooking and the control group did not receive any intervention.

In the purchasing group, the participants received the “Food Savior Kit”. This kit aimed to create participants’ commitment and prevent food overbuying. It was composed of a decorative framed picture to be hung in the participant’s kitchen, indicating five tips for household food waste reduction focused on food overbuying, and a fridge magnet containing information about food waste and food overbuying. As I have seen in the literature review that households with shopping lists waste less, I included a notepad for shopping lists in the kit. In the cooking group, participants also received the “Food Savior Kit”, in which the decorative framed picture and the fridge magnet were modified to provide tips to prevent food overcooking. Besides, the cooking group did not receive the shopping lists because the interventions for the cooking group were not targeting food purchasing. The control group only provided their food waste measurements. Pictures of the content of the kits are in Appendix 3.

The measurement kits, nudges materials, and the final collection of note lists were done through personal visits to the participant’s home. This enabled me to achieve high response rates, as well as good understanding and collaboration from the participants, thus ensuring high data quality. As the home visits needed to be scheduled across multiple days, the exact day when the experiment started, when the intervention was provided, and when the experiment finished differed from one person to another. Thus, the exact length of the pre-and post-intervention periods varied among the participants.

3.4 FOOD WASTE MEASUREMENT METHOD

The measurement of food waste lasted for an average period of 166 days. The participants received a measurement package, containing a 2.7L trash bin, trash bags, personalized note lists, and a digital kitchen scale with a capacity of measuring weight from 0 kg to 10 kg. In the given trash bin, they had to discard all the food they would normally discard in regular bins. In this study, the food given to pets or used for composting was not considered in the food waste

measurement. The researcher delivered all the measurement packages to each household and explained personally how the participants should use them.

The explanation given to the participants was the following: they had to discard only the avoidable food waste. In this study, avoidable food waste is the food that had been edible before disposal (e.g., slices of bread, apples, meat) that could have been consumed if it had been better portioned, managed, stored, and/or prepared (Koivupuro et al., 2012). Avoidable food waste also includes acceptable food items that are not eaten due to consumer preferences, such as bread crusts and jacket potato skins (Principato et al., 2018).

Every time the trash bin was filled or if participants felt the necessity to empty it, they had to turn on the scale, put the trash bin on it, check the bin's weight, and note it on the note list, as well as the date and hour of the discard. Only after this procedure, the trash bin could be cleared out, replacing its trash bag with another given trash bag, and thus, repeating the procedure. The participants were also informed that the note lists would be collected monthly by the researcher.

Participants' food waste was recorded immediately after they had delivered the note lists. It was added in a spreadsheet how much food waste each participant had and how many measurements they made each month. This allowed us to calculate the average food waste per day by dividing their food waste in kilos by the days they were in the experiment, pre-and post-intervention, as well as create a difference score (average food waste per day before the intervention minus average food waste per day after intervention).

3.5 DATA ANALYSIS

The data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were used to check the minimum, maximum, means, and standard deviation of the measurement period pre-and post-intervention, the average number of measurements pre-and post-intervention, the average food waste per day pre-and post-intervention, the average food waste per week and the difference score of average food waste per day.

3.5.1 To assess the effect of the nudges on participants' behavior

Prior to the main analysis, Chi-Square and Fisher's Exact tests were performed for nominal and ordinal variables to check whether the groups differed in any demographics (gender, number of meals eaten at home, the highest level of education in the household, household composition, number of people in the household, if the household does compost or food recycling, if the participant believes to have in mind the right amount of food stored at home when purchasing food, and if the participant has the habit of using shopping lists). Additionally, a Variance Analysis (ANOVA) was performed to check whether the groups differed in age and the average food waste per day in the pre-intervention period and thus were comparable. No significant differences among the groups were found for any of these tests. Results of the Chi-Square, Fisher's Exact tests, and ANOVA are presented in Appendix 4.

Next, Repeated Measures ANOVA was performed using the average food waste per day pre-intervention and average food waste per day post-intervention as the within-subjects variables, and the condition (control, purchasing, and cooking) as the between-subjects factor, to achieve three goals: to check the pre-intervention versus post-intervention main effect to see if there is a behavioral change over time, to check the interaction with treatments to see if my interventions were successful in reducing food waste and to check the treatments main effect.

Additionally, I wanted to check if my findings held when including covariates in the model. Therefore, a Linear Regression was performed to check if the condition that the participants are in (control, purchasing, or cooking group) could significantly predict the participants' difference score of average food waste per day (pre- minus post-intervention), controlling for demographic variables (gender, number of meals at home, highest level of education in the household, household composition) and dummy coded independent variables (if the household does compost or food recycling; if the participant believes to have in mind the right amount of food stored at home when purchasing food; if the

participant has the habit of using shopping lists and control group). All these variables are presented in Table 1.

Table 1 - Description of variables used in the analysis

Variable	Description
Difference Score of Average Food Waste per Day	The average food waste per day recorded by the participants before the intervention minus the average food waste per day recorded after the intervention.
Number of meals at home	Dummy for the number of meals eaten in the household per day. There were two categories: 0 = one or two meals; 1 = three or more meals.
Household Size	The number of people living in the household, measured in five categories and used as a numerical variable.
The highest level of education in the household	The highest level of education among the members of the household, measured in four categories: Until completed high school, Bachelor's Degree, Master's Degree, and Ph.D., used as a numeric variable.
Household Composition	Two dummy-coded variables (0/1) for the composition of the household for "family with only adults" and "family with children". "Lives alone or shared household" was the reference category.
Gender	Dummy for the gender of the household's participant: 0 = male and 1 = female.
If the participant believes to have in mind the right amount of food stored at home when purchasing food	Dummy for the belief of the participant regarding having in mind the right amount of food stored at home when buying food: 0 = No and 1 = Yes.
If the participant does compost or food recycling	Dummy for the fact that the participant does compost or recycles food, with two categories: 0 = No and 1 = Yes.
If the participant has the habit of using shopping lists	Dummy for the fact that the participant has the habit of using a shopping list: 0 = No and 1 = Yes.
Purchasing group	Dummy for the purchasing group variable, coded as 1 for the participants who were in the purchasing group and coded as 0 for the participants who were in a different group. The control group was used as the reference category.
Cooking group	Dummy for the cooking group variable, coded as 1 for the participants who were in the purchasing group and coded as 0 for the participants who were in a different group. The control group was used as the reference category.

3.5.2 To assess the effects of measurement over time

To check if the measurement would affect the participants' behavior over time, another Linear Regression was performed using the participants' difference score of average food waste per day pre- minus post-intervention as the dependent variable, and the number of measurements that the participants recorded, and average food waste per measurement as independent variables (r = .153), controlling for demographic variables. Besides the Linear Regression, a Two-Level Mixed Model was performed to check the average food waste per week (DV) over 18 weeks of the experiment. It was selected a period of 18 weeks from the measurement period, because from the 19th week to the 25th, the last week of the study period, the sample size started to reduce substantially.

It was expected that food waste would become more salient for participants who record their food waste more often (i.e., a higher number of measurements) and for participants who record higher amounts of food waste on average. If one or both of these variables indeed affects the difference between pre-and post-intervention food waste, this would provide further insight into the process through which waste measurement affects food waste amount.

3.5.3 To compare objective and subjective household food waste

To achieve our secondary objective, three cross-tabulations were done. With the first cross-tabulation, I wanted to check if the household food waste reported by the participants using a subjective scale per month was accurate compared to their actual food waste measured by the kitchen scales.

In the second cross-tabulation, I wanted to check the equivalence in kilos measured with the kitchen scales, compared to the participants subjective self-reported household food waste in general, using the scales from "none" to "quite a lot" and thus, assess if this subjective scale could be a reliable method for measuring household food waste. Finally, with the third cross-tabulation, I wanted to check the equivalence of self-reported kilos per month of food waste compared to the subjective self-reported household food waste in general.

Pearson correlations were performed to check the correlations between the variables average food waste per month, self-reported food waste per month,

and self-reported food waste in general, in each cross-tabulation. To check if the subjective scales' categories statistically significantly differed ($p < 0.05$) among them, a univariate ANOVA was performed using the average food waste per month as the dependent variable and the subjective self-reported food waste per month and the subjective self-reported food waste in general as factors (IVs).

4 RESULTS

4.1 DESCRIPTIVE RESULTS

The demographic characteristics of the sample are presented in Table 2. The sample was composed mostly of women (75%). This is an overrepresentation compared to the national statistics: women represent 51.1% of the population; (Brazilian Institute for Geography and Statistics: IBGE, 2021). This probably occurred due to women's larger involvement in household food management. The sample was more educated compared to the average Brazilian population. Regarding the highest level of education, most of the participants had a bachelor's degree (38.8%) and 20% had a Ph.D., while only 17.4% of the Brazilian population have a bachelor's degree (IBGE, 2021). This is probably a result of the sampling technique used in this study.

Comparing the sample to the Brazilian population, families composed of adults with or without children (72.6%) resemble the proportion in the Brazilian population (68.2%). Regarding other household compositions, it was not possible to compare with the Brazilian context due to the different characterization of household composition in the country. Regarding the number of people in the household, the sample overrepresented the Brazilian population concerning households with 2 people (33.8%) and slightly overrepresented the Brazilian population regarding households composed of only one person (20%) (IBGE, 2021). However, the sample underrepresented households with five people or more (8.8%), compared to the Brazilian population (12.5%) (IBGE, 2021). Regarding age, the minimum age of the sample was 21 years old and the maximum was 67 years old ($M = 37.64$; $S.D = 10.59$).

Table 2 - Demographic characteristics of the sample.

	Study's Percentage (%)
Gender	
Male	25
Female	75
Number of meals eaten at home per day	
1 or 2	31.3
3 or more	68.8
Highest level of education in the household	
High school or less	20
Bachelor's degree	38.8
Master's degree	21.3
PhD	20
Household composition	
Lives alone or shared household	27.5
Family, only adults	41.3
Family with children	31.3
Number of people in the household	
1	20
2	33.8
3	18.8
4	18.8
5 or more	8.8

Table 3 presents details about food waste measurements. The average post-intervention measurement period was 30.59 days shorter than the pre-intervention period (93.10 days). The average number of measurements per week has not changed between the pre-intervention (M = 1.64; SD = 1.39) and the post-intervention period (M = 1.60; SD = 1.37) ($t(79) = -.618$, $p < .538$), which indicates that there was no participant fatigue in keeping up with measuring food waste. The overall mean of the average food waste per day has reduced from 101.73 grams in the pre-intervention period to 86.37 grams in the post-intervention period (-15.09%).

Table 3 - Details regarding food waste measurements.

	Minimum	Maximum	Mean	S.D.
Measurement Period Pre-intervention (days)	80	112	93.10	6.48
Measurement Period Post-intervention (days)	5	87	62.51	15.08
Average Number of Measurements Per Week Pre-intervention	0.20	6.70	1.64	1.39
Average Number of Measurements Per Week Post-intervention	0.20	6.91	1.60	1.37
Average Food Waste per Day Pre-intervention (grams)	2.95	369.43	101.73	92.85

Average Food Waste per Day Post-intervention (grams)	2.39	463.31	86.37	84.73
Average Food Waste per Week (18 weeks) (grams)	0.12	960.00	93.61	116.09
Difference Score of Average Food Waste Per Day (grams)	-150.79	197.25	15.35	57.17

4.2 DID THE NUDGES INFLUENCE FOOD WASTE REDUCTION?

The Repeated Measures ANOVA results showed that there was a statistically significant difference in the average food waste per day over time between the pre-and post-intervention period ($F(1, 77) = .5.978$, $p < .017$; $\eta^2_p = .072$). The Repeated Measures ANOVA also showed that there was not a statistically significant interaction between the measurement period pre-and post-intervention and the treatment groups (control, purchasing, and cooking) ($F(2, 77) = 1.039$, $p = .359$; $\eta^2_p = .026$) and that there was no main effect among the groups ($F(2, 77) = .857$, $p = .428$; $\eta^2_p = .022$). These results suggest that the nudges did not have any effect on the participants' food waste, however, the reduction in participants' average food waste per day in the post-intervention period (from 101.73 grams on average in the pre-intervention period, to 86.37 grams in average in the post-intervention period) (Table 3), was significant and was not caused by the nudges.

To further explore whether the nudges have any effect on participants' household food waste, a Linear Regression (model 1 in Table 4) was performed to predict the participants' difference score of the average food waste per day pre-minus post-intervention based on which condition they are in (control, purchasing, or cooking group). A non-significant regression equation was found ($F(12, 67) = 1.228$, $p < .283$) with an R^2 of .180. Results showed that the condition, in which the participants are in, did not significantly predict the difference score of the average food waste per day pre- minus post-intervention. Based on the model's Variance Inflation Factor values, no collinearity was found among the model's predictors.

Table 4 - Linear Regression results (model 1)

					95% Confidence Interval

	B	t-value	p-value	Lower Bound	Upper Bound
(Constant)	30.83	.808	.422	-45.34	107.01
Female	2.15	.138	.890	-28.97	33.29
Age	.770	1.161	.250	-.554	2.09
How many meals are made at home per day	-9.94	-.689	.493	-38.74	18.86
Highest level of education in the household	-6.94	-1.061	.292	-19.99	6.11
Family, only adults	5.98	.317	.752	-31.63	43.59
Family with children	38.74	1.493	.140	-13.04	90.53
Number of people in the household	-4.75	-.599	.551	-20.57	11,06
Does compost or food recycling	-3.60	-.236	.814	-34.05	26,84
Believes to have in mind the right amount of food stored at home when shopping for food	-16.81	-1.126	.264	-46.61	12.98
Has the habit of using shopping lists	-10.31	-.684	.497	-40.41	19.79
Purchasing Group	-15.50	-.930	.356	-48.79	17.78
Cooking Group	3.65	.220	.827	-29.49	36.79

4.3 THE MERE MEASUREMENT EFFECT

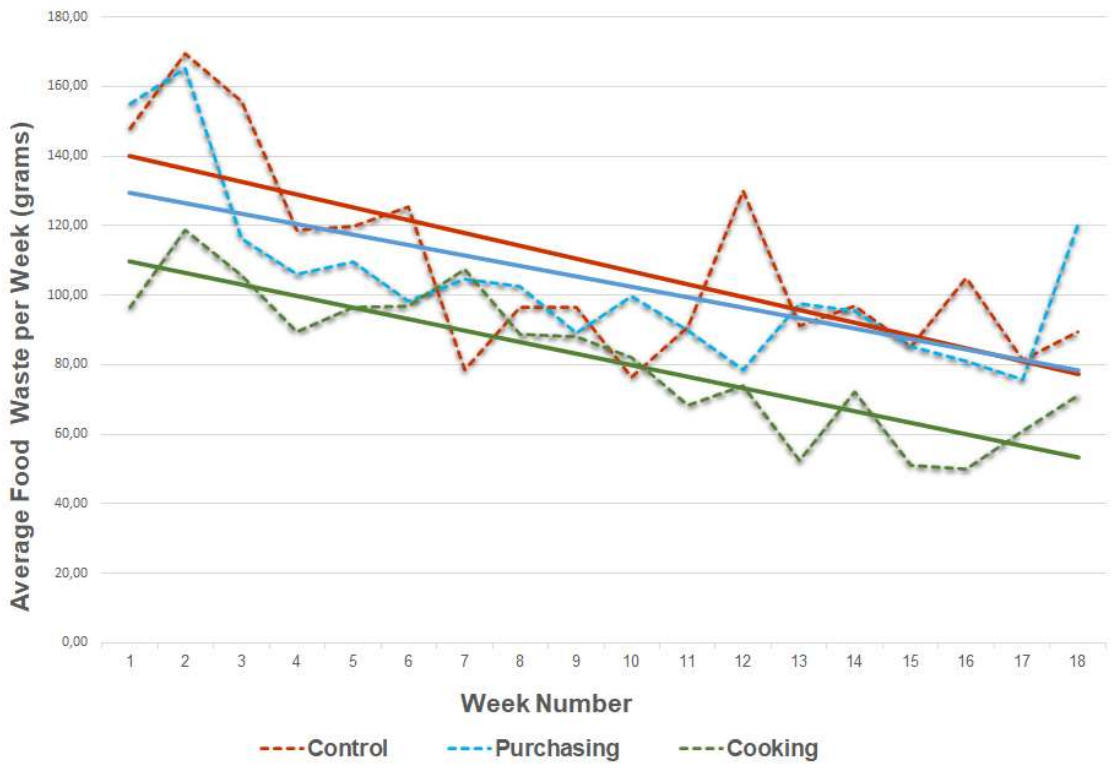
Another Linear Regression (model 2 in Table 5) was performed to check how the measurement affected the participants' behavior over time by predicting the participants' difference score of the average food waste per day pre- minus post-intervention, based on the number of measurements that the participants recorded and the average food waste per measurement. A non-statistically significant regression equation was found ($F(4, 75) = 2.001$, $p < .103$) with an R^2 of .096. However, results showed that the average food waste per measurement could significantly predict the difference score of food waste per day pre- minus post-intervention ($B = .471$, $p < .027$). No collinearity was found among the model's predictors.

Table 5 - Linear Regression results (model 2)

				95% Confidence Interval	
	B	t-value	p-value	Lower Bound	Upper Bound
(Constant)	7.86	.439	.662	-27.84	43.57
Purchasing Group	-18.06	-1.127	.263	-49.99	13.86
Cooking Group	2.05	.129	.897	-29.55	33.66
Number of measurements	.471	2.26	.027	.056	.886
Average food waste per measurement	-.009	-.422	.674	-.049	.032

Therefore, results indicated that the mere measurement of food waste had an effect: food waste was less in the post-intervention period than in the pre-intervention period for all groups, including the control group, and individuals who provided measurements more often had a larger decrease in food waste. If measurement affects food waste amounts, I would expect there to be a decrease in the amount of food waste over the weeks of measurement (i.e., irrespective of the pre- versus post-intervention periods). To explore this, a Two-Level Mixed Model was performed to check the average food waste per week over 18 weeks of the experiment with the period (week number) as the independent variable. Results of our Two-Level Mixed Model showed that there is a linear fixed effect for food waste reduction over time (B = -1.56, S.E = .211, $p < .000$) (Figure 3). This further confirms the existence of a mere measurement effect in the data.

Figure 3 - The linear tendency of household food waste over 18 weeks of study period



4.4 COMPARISONS BETWEEN OBJECTIVE AND SUBJECTIVE HOUSEHOLD FOOD WASTE

4.4.1 Comparisons by cross-tabulations

Two cross-tabulations were performed: to check if the household food waste reported by the participants using a subjective scale per month was accurate compared to their actual food waste measured by the kitchen scales and, to check what is the equivalence in kilos when the participants subjectively reported their household food waste using the scales from “none” to “quite a lot” and thus, assess if subjective scales can be a reliable method for measuring household food waste. These results are shown in Table 6 and Table 7.

Table 6 - Average food waste per month compared to subjective self-reported food waste per month

Subjective self-reported food waste per month	Mean (kg)	N	Std. deviation	Minimum (kg)	Maximum (kg)
Less than 1 kg	1.631	19	1.917	0.116	8.096
From 1 kg to 5 kg	2.522	46	1.919	0.129	7.863
More than 5 kg to 10 kg	2.899	12	2.643	0.518	8.921
More than 10 kg	5.131	3	4.305	0.559	9.106
Total	2.465	80	2.202	0.116	9.106

In Table 6, results indicate that most of the participants have “a good idea” about how much food they waste per month. This is because they reported waste from 1 kg to 5 kg per month and their food waste measured with the scales was 2.5 kg on average. Furthermore, there were a smaller number of participants who believe to waste more than they actually do, which is the case of some participants that reported wasting more than 10 kg, as well as others who believe to waste less than they actually do, the case of some participants that reported wasting less than 1 kg. The Pearson correlation between subjective self-reported food waste per month and the average food waste per month indicated a weak correlation between the variables ($r = 0.289$, $p < 0.01$; $r^2 = 0.08$). A possible

explanation for this correlation's result is that subjective scales might not capture actual food waste measured in scales.

Table 7 - Average food waste per month compared to subjective self-reported food waste in general.

Subjective self-reported food waste per month	Mean (kg)	N	Std. deviation	Minimum (kg)	Maximum (kg)
None	0.692	3	0.737	0.140	1.529
Hardly any	1.531	17	1.877	0.116	8.096
A small amount	2.595	21	1.745	0.256	6.660
Some	1.791	14	0.978	0.270	3.298
A reasonable amount	3.493	18	3.114	0.518	9.106
Quite a lot	3.802	7	2.024	0.489	6.489
Total	2.464	80	2.201	0.116	9.106

In Table 7, results indicate that participants who believe to have no waste, still generate some food waste. This is because when participants reported wasting no food, they were actually wasting 692 grams on average. However, when the participants reported their food waste from "Hardly Any" to "Quite a lot" their average food waste increased, except when participants reported wasting "Some" food. The Pearson correlation between subjective self-reported food waste in general and the average food waste per month indicated a weak correlation ($r = 0.344$, $p < 0.01$; $r^2 = 0.11$), which supports the hypothesis that subjective scales might not capture actual food waste.

To check what is the equivalence of average kilos per month for participants when they reported wasting food from "none" to "quite a lot", another cross tabulation was performed crossing participants' answers of subjective self-reported food waste in kilos per month and the subjective self-reported food waste in general (Table 8).

Table 8 - Self-reported subjective food waste crossing food waste in general x food waste per month in kilos.

	None	Hardly Any	A small amount	Some	A reasonable amount	Quite a lot	Total
Less than 1 kg	66.7%	58.8%	23.8%	7.1%	5.6%		23.8%

From 1 kg to 5 kg	33.3%	41.2%	**66.7%**	**57.1%**	**61.1%**	**71.4%**	57.5%
More than 5 kg to 10			9.5%	35.7%	22.2%	14.3%	15%
More than 10 kg					11.1%	14.3%	3.8%
Total	100%	100%	100%	100%	100%	100	100%

In Table 8, results show that most of the participants reported wasting from 1 kg to 5 kg, however, the subjective meaning of 1kg to 5 kg differs from “a small amount” up to “quite a lot”. The Pearson correlation between these two variables indicated a moderate correlation ($r = 0.519$, $p < 0.01$; $r^2 = 0.26$).

The three correlation results above support the idea that the participants could not precisely relate the subjective scales with kilograms, which might make participants look for neutral or socially acceptable answers. Furthermore, the meaning in kilos of subjective amounts of food waste seems to differ from one person to another. The moderate correlation between the two subjective food waste scales suggests that our subjective scales for measuring food waste are indeed more related to each other than the actual food waste measured per month.

4.4.2 Comparisons by univariate ANOVA

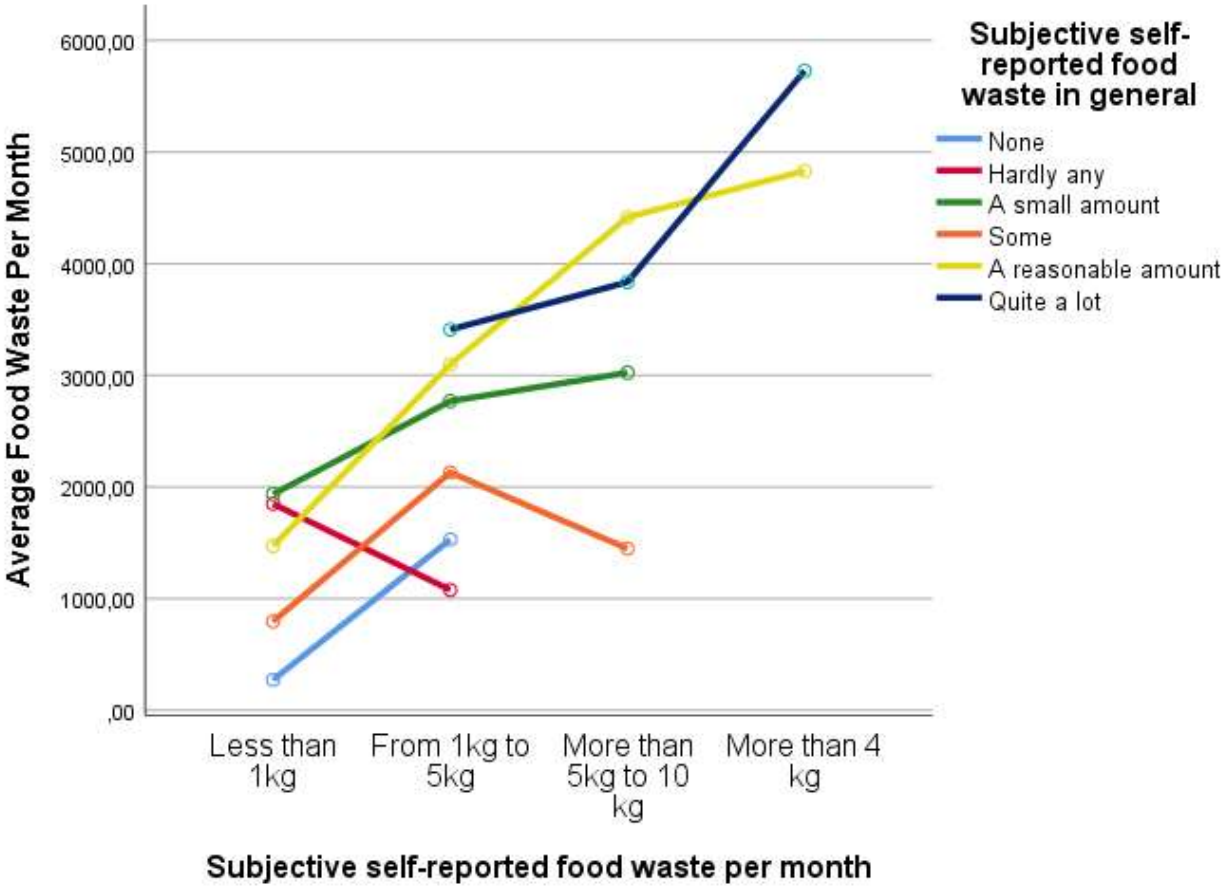
Since the subjective scales used to self-report measure food waste, were not strongly correlated to the participant’s actual average food waste per month, I wanted to test if the categories of both subjective scales statistically differed from each other in the means of average food waste per month. Because of this, a univariate ANOVA (6x4) was performed. The results showed that there was a non-statistically significant difference among the categories of subjective self-reported food waste in general ($F(5, 63) = .850$, $p < .520$; $\eta^2_p = .063$) and subjective self-reported food waste per month ($F(3, 63) = 1.052$, $p < .376$; $\eta^2_p = .048$) regarding the average food waste per month measured with the scales, as well as for the interaction between these two self-reported food waste scales ($F(8, 63) = .413$, $p < .909$; $\eta^2_p = .050$).

Figure 5 shows that the category “a reasonable amount” varies along different means of household food waste, from less than 2kg per month to almost

5kg per month, as well as along the four categories of subjective food waste per month scale. Similar distribution appears in the other categories of self-reported food waste in general, varying across different means of food waste per month and the different self-reported food waste per month categories.

Thus, Figure 4 graphically represents the lack of significant statistical difference in average food waste per month for both subjective self-reported food waste scales. These results endorse the idea that self-reported subjective scales might not be a precise method for measuring household food waste.

Figure 4 - Estimated marginal means for average food waste per month and subjective food waste in general



5 DISCUSSION AND CONCLUDING COMMENTS

The general objective of this study was to test nudges aimed at two different phases of the household food management process (cooking and purchasing) while directly measuring the participant's household food waste. In addition, the effects of measurement of household food waste over time were assessed, and as a secondary objective, comparisons between subjective self-reported food waste and the participant's actual food waste were performed. Next, it is discussed the results for each of this study's objectives: the effects of the nudges tested in this study, the effect of measuring household food waste over time, and results from the comparisons between objective and subjective household food waste.

5.1 NUDGES

The objective was to test two nudges to reduce household food waste in two different groups. The interventions were developed targeting the planning stage of the household food management process, specifically the phases of purchasing and cooking. The nudges were tested among households of Dourados in Brazil. The results showed that nudges were not effective in reducing household food waste.

Other studies were successful in testing behavioral interventions like nudges inside households, reaching behavioral change (van Dooren et al., 2020; Shearer et al., 2017). These studies have focused on facilitating a behavior rather than changing it to a new one, which might explain why their nudges were effective.

For instance, Shearer et al. 2017, aimed to encourage food waste recycling rather than reduce it, by using sticker prompts. Also, to facilitate a behavior, van Dooren et al. 2020, aimed to help consumers to cook the right portions of rice and pasta. Indeed, previous research has indicated that facilitating a behavior or increasing people's ability to change is more acceptable than trying to directly change their behavior (Van Geffen et al., 2016; Simões et al., 2022). According

to Van Geffern et al., 2016, motivation, opportunity, and ability to engage in food waste prevention can predict consumer food waste generation.

Regarding nudges' effectiveness, Martens et al. 2021, after analyzing over 400 studies, reported that a nudge is an effective and applicable tool for behavior change. However, Maier et al. 2022, have pointed out that nudges' effect sizes might have not been strong enough as presented by Martens et al., 2021. Additionally, van Dooren et al., 2020, highlighted that, to change habitual behaviors, it is necessary to take the strength of habits into account, as well as the difficulty of establishing new ones and breaking existing ones.

Furthermore, people tend to make only small, easy, and simple changes regarding behavioral changes. When behavioral change actions impact people's lifestyles or are complex to execute, they are postponed (Umpfenbach 2014). This difficulty in behavior change might explain the lack of strength of nudges' effect sizes.

Based on the above, the nudges tested in this study might have not been effective because they focused on directly changing food waste behavior, which required the establishment of new habits instead of facilitating the required behavior. Differently from the studies above that successfully tested nudges, it might be the case that the nudges tested in this study did not increase participants' ability to change or motivated them to prevent food waste.

Considering the difficulty of establishing new habits from habitual behaviors, based on the insights of Lin et al. 2017, I hypothesized that nudges in this study might not have had a significant effect due to two other possible explanations. First, since I created this study's nudges based on the System 1 and System 2 decision-making process theory, and if we consider that the two systems interact with each other, then, interventions created for influence behaviors originated from the System 1 decision-making process, would not be designed properly and thus, would not be effective.

Second, if we consider that the two systems do not interact (Lin et al., 2017), we would have to be sure that the sub-optimal behaviors that we wanted to change are exclusively driven by System 1 processes. Thus, this approach would not be adequate to capture the complexities of the decision-making process

operation, and consequently, our interventions would not have the required strength to change the participant's behavior.

Another reason why this study's nudges did not influence people's behavior may be that they were not adequately developed for the participants' cultural settings because this study's nudges were inspired by nudges developed in different cultural settings. Porpino et al. 2016, have presented the role of different cultural settings in the way how people deal with food and their food habits. It is important the development of studies that beyond testing household food waste reduction intervention in different cultural settings, also brings more concrete information about the drivers for household food waste, taking into account the specific cultural setting of the studied population, as well as their household food waste habits and data, especially in developing countries where the household food waste data is not so accurate and reliable, but still as relevant as in developed countries (UNEP, 2021).

5.2 THE MEASUREMENT EFFECT

Despite the above, there is a key finding regarding the measurement period of the experiment. The results confirmed a household food waste reduction over time in the treatment groups, which was not caused by the nudges applied, as well as in the control group. The results showed that the number of measurements that the participants weight their food waste could significantly predict their household food waste as well as a linear tendency for household food waste reduction over time while routinely measuring food waste.

In other words, I observed a measurement effect towards food waste reduction. This result brings up new questions, such as: Was this food waste reduction caused by behavioral reactivity due to people facing their food waste when measuring it? Or was the food waste reduction caused because people got more aware of their habits and consequently, the introduction of a new routine (food waste measurement) influenced people in other to develop a new habit of reducing food waste? These questions open new avenues for future research

that can further test the effects of household food waste measurement and its causes. The insights below bring ideas for new research.

Regarding this study, the average food waste per week has reduced throughout the measurement period weeks. This result suggests that the measurement routine might have caused a behavior reactivity (Quested et al., 2020) that led to a household food waste reduction, creating a behavior change. Additionally, the measurement period was sufficiently long to make people build a new habit of measuring household food waste (Lally et al., 2010).

Even if there is a behavior change during the study period, to confirm if this change would remain after the study period and confirm a new habit creation, a new study should be conducted. Although people got aware of their household food waste, in the longer term, they could not overcome their previous household food management routine and lifestyle (van Dooren et al., 2020).

Aydin and Yildirim, 2021, showed that moral attitudes are vital for food waste generation. In my study, people may have behavioral reacted to the measurement routine due to their moral attitudes (i.e., think that wasting food is unethical when there are people in hunger or believe that wasting food is environmentally wrong, etc). However, even if people become aware of their food waste, there are other determinants of their household food waste behavior.

Regarding other determinants of household food waste behavior, the perceived behavior control seems to have significant relevance for household food waste behavior changing (Visschers et al., 2016). If we consider that the behavioral reactivity, caused by the measurement routine, can be useful for household food waste, allied to provoke behavioral reactivity, consumers must be convinced that their behavior can be changed, as well as perceive that they have control over their household food waste generation (Stancu et al., 2016; van Dooren et al., 2020). Based on the above, it is important to find manners of not only developing people's awareness of household food waste but also providing ways to facilitate and maintain behavior-changing by simplifying and developing new solutions that will make people perceive their behavior change to be possible.

5.3 SUBJECTIVE SCALES VERSUS OBJECTIVE MEASUREMENTS

Researchers have been recommending using direct measurements (i.e., collection, and weighting) for quantifying food waste because the reliability of self-reported data has been questioned in several studies (Whybrow et al., 2016; van der Werf et al., 2019; Quested et al., 2020). Regarding the secondary objective of this study, comparisons were done to verify how accurate participants are when self-reporting food waste using subjective scales compared to their actual food waste measured by kitchen scales.

In my study, the subjective self-reported food waste in general and per month were compared to participants' household food waste weighted in kitchen scales. From the food waste data measured by the kitchen scales, the participants' average food waste per month was calculated, to be compared to their self-reported answers. Results showed that participants were not accurate regarding their actual food waste, because their self-reported answers statistically differed from their actual food waste measured with the kitchen scales, which brings more evidence for the self-reported measurements' vulnerability, pointed out by other researchers, as mentioned above.

A similar study conducted by Cropley et al., 2022, tested a new tool called Wastogram consisting of in-home food waste measurements using scales and photographs. In this study, self-reported food waste was compared to the Wastogram tool, regarding the capacity to predict bin audits. Results showed that the in-home food waste measurements were accurate and could strongly predict bin audits. These results support our findings of self-reported food waste reported by surveys, to be vulnerable regarding accuracy.

Based on the comparisons between subjective self-reported food waste and the actual food waste measured with the kitchen scales, there is evidence that the subjective scale of food waste in general used in our study, adapted from WRAP (2009), as well as the subjective scale of food waste per month created by the authors, used to measure self-reported food waste, might not be a reliable measuring method. These results suggest that, when measuring food waste using a self-reported method, it is necessary to provide a scale structured with

information enough to reduce the participant's lack of precision caused by subjectivity.

On the other hand, when choosing a direct measurement method as used in this study, one concern regarding in-home food waste measurements, is the burden of undertaking the food waste measurement exercise (Quested et al., 2020), which can make people under-report their household food waste by not keeping the new measurement routine. In our study of 166 days of measurement, participants did not present evidence of fatigue by undertaking the measurement routine.

Another concern is the risk of underreporting due to social desirability and behavioral reactivity. Since most of the studies were conducted in a short measurement period (Silvennoinen et al., 2014; Wharton et al., 2021; Cropley et al., 2022), we choose a long measurement period to undermine possible disadvantages of the measurement method. Additionally, our study used an innovative way of measuring household food waste, similar to the Wastogram (Cropley et al., 2022).

Based on the above, these results suggest that in-home measurements, by providing scales for people to measure their food waste, can be a reliable and promising way of measuring household food waste for further research, mostly because of three key points: (1) it has the potential of not causing participant's fatigue due to possibly contribute for a new habit formation by introducing the measurement in people's household routine; (2) it can be as accurate as the people's actual household food waste; (3) it minimizes participants and researchers efforts, required by other household food waste measurement methods (van Herpen, 2019), as well as the cost of a more accurate method as the composition analysis.

5.4 IMPLICATIONS FOR PUBLIC POLICIES

The Covid-19 pandemic has increased food insecurity and raised debates regarding hunger in Brazil (Vieira et al., 2021). Due to the increase in hunger and to reduce food loss and waste, in June 2020, the Brazilian government, sanctioned bill number 14.016 (Brasil, 2020), regarding food waste and food

donation for human consumption. This legislation is an example of a public effort to reduce food waste and cope with food insecurity. However, as other bill projects in Brazil, this legislation has mostly looked at the food waste that occurs before the food reaches the households. Indeed, households are a difficult point of intervention, but, since most of the food waste happens inside households, public policies should also be targeted in this direction as well.

The mere measurement effect found in this study provides insights for policymakers to develop public policies for household food waste reduction. Based on this, one of the ways of targeting public policies for household food waste reduction could be the creation of an organic waste collection system, because, in Brazil, the households' organic waste public collection is almost nonexistent. Since tracking or measuring household food waste can lead to food waste reduction due to behavioral reactivity, the creation of an organic waste collection system could influence people's food waste behavior by altering their household food management routine, leading toward food waste reduction.

An organic waste collection system could also provide opportunities for the development of ways for tracking amounts of household food waste and encourage household food waste reduction, through taxes discounts or by simply informing people how much food waste they are generating (social norms), or how much money they are wasting while wasting food (financial attitudes), or how many people their food waste could feed in their city (personal attitudes). Additionally, the development of an organic waste collection system could improve household food waste research in Brazil, by providing reliable data and waste composition analysis opportunities.

Since, the ability to change, motivation, and opportunity are key factors for people's engagement in food waste prevention, this could be explored by policymakers. Propaganda and prevention programs that focus on motivating food waste prevention could be a simple and valid method to increase society's engagement in food waste prevention.

Furthermore, people need to perceive the capacity of behavior change as well as the benefits of doing that, not only environmentally but personally. Because of people's lack of ability to behavior changing and the necessity of

opportunities for doing that, connecting households with stakeholders able to redirect food surplus or food waste for food recycling could improve people's ability to change by providing solutions like a different destination to their food waste, instead the waste bin. That could also improve food waste reduction, as well as provide opportunities for new business models that could play an important role in minimizing food waste, and at the same time, economically contributes to local communities and municipalities.

5.5 LIMITATIONS

This study had two main limitations that should be considered in future research. First, a reliable method for measuring household food waste is still under debate in the literature. The measurement method used in this study tried to minimize the underestimation of self-reported methods by providing weight scales for the participants, however, the action of keep measuring relied upon the participants, which was not the ideal scenario for household food waste measurement. On the other hand, it has allowed the assessment of the measurement effects. Future studies should develop manners for better controlling participants' measurement routines.

Second, our sample could not represent the Brazilian population because it was not large enough and was more educated, which mines our study's power of generalization of our findings. That might have occurred because the study's recruitment was done by social media (e.g., social media might have delivered the recruitment invitation to people connected to the universities, who probably study or have studied there and thus, are more educated than other groups of the population. Other reason is that a study with a bigger sample require more funding and staff due to people's involvement with the research. These facts were also a limitation for this study.

In future research, broader recruitment should be done, to reach people with a more heterogenous demographic background. Finally, it is important that future studies deep into testing measurement methods, not only to find the gold standard method of household food waste measurement but also looking for

measurement effects since that, in the case of this study, it has appeared to be relevant for food waste reduction.

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Appendix 1 - Questionário para início do estudo

1- Qual o seu nome completo?

2- Qual a sua idade?

3- Quantas refeições são feitas na residência por dia?

- 1
- 2
- 3 ou mais

4- Qual o maior nível educacional dentro da sua residência?

- Nenhum ou até o ensino básico completo
- Ensino médio incompleto
- Ensino médio completo
- Superior incompleto
- Superior completo
- Mestrado
- Doutorado

5- Como é composta sua residência?

- Moro sozinho(a)
- Residência compartilhada
- Família, somente adultos
- Família com criança(s)
- Outro:_____

6- Quantas pessoas moram na residência?

- 1
- 2
- 3
- 4
- 5 ou mais

7- Você faz compostagem ou reciclagem de alimentos em sua residência?
   - o Sim
   - o Não

8- Você acredita que tem em mente a quantidade certa de alimentos armazenados em sua residência, no momento em que vai ao mercado?
   - o Sim
   - o Não

9- Você tem o hábito de usar uma lista de compras quando vai ao mercado para comprar alimentos?
   - o Sim
   - o Não

10- Em sua residência, quanto de alimento não consumido, você diria que é jogado fora no geral?
   - o Bastante
   - o Uma quantidade razoável
   - o Um pouco
   - o Uma pequena quantidade
   - o Quase nada
   - o Nada

11- Em uma escala de 1 a 5. O quanto você acredita saber sobre desperdício de alimentos?

Pouco conhecimento 1 2 3 4 5 Muito conhecimento

12- Em uma escala de 1 a 5. O quanto você se sente capacitado em evitar o desperdício de alimentos em sua residência?

Pouco capaz 1 2 3 4 5 Muito capaz

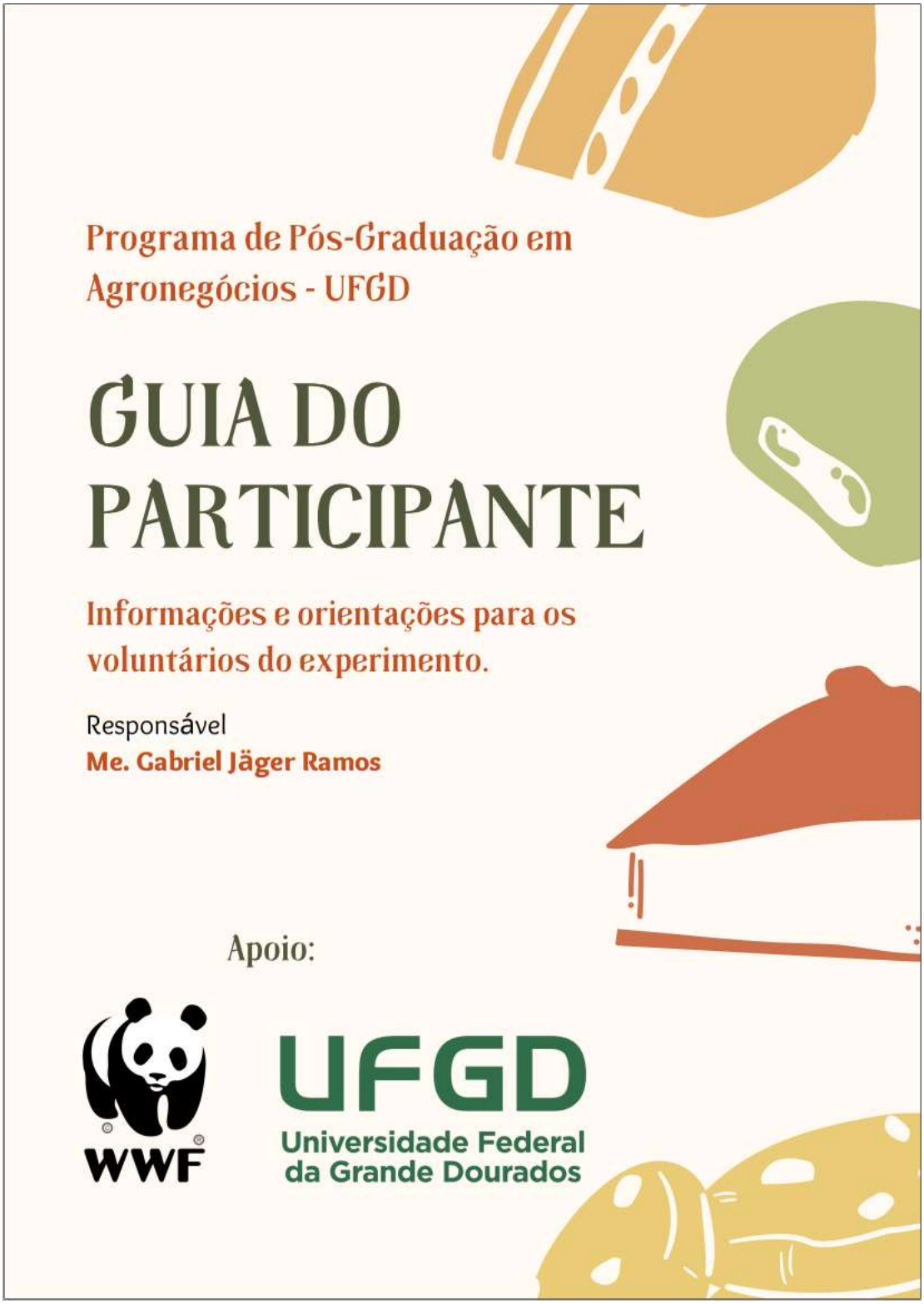
13- Quantos quilos de alimentos você acredita que são desperdiçados em sua residência por mês?

- Menos de 1 kg
- De 1kg a 5kg
- Mais que 5kg até 10kg
- Mais que 10kg

14- O quanto você apoia a criação de políticas públicas para a redução do desperdício de alimentos dentro da sua e demais residências?

Não apoio 1 2 3 4 5 Apoio totalmente

Appendix 2 - The participant's guide



Muito obrigado por ser um voluntário em nossa pesquisa!

Neste guia você encontrará orientações de como você deverá proceder durante o experimento. Leia com atenção e caso ainda tenha dúvidas, entre em contato com o responsável pela pesquisa. Através dos seguintes meios:

(67) 9 9921-2971

gabrieljagerramos1@gmail.com

OS MATERIAIS QUE VOU RECEBER COMO PARTICIPANTE

Nesta pesquisa você nos ajudara a medir o lixo de alimentos descartados nos domicílios. Para isso, você receberá listas de anotação de peso, uma balança eletrônica com uma lixeira acoplada e sacos de lixo, para serem usados dentro da sua casa:

BLOCOS COM LISTAS PARA ANOTAÇÃO DE PESO

OS MATERIAIS QUE VOU RECEBER COMO PARTICIPANTE

SACOS DE LIXO

BALANÇA COM LIXEIRA

COMO USAR OS MATERIAIS PARA A PESQUISA?

A seguir você encontra instruções de como utilizar os materiais fornecidos:

01

SACOS DE LIXO

Você receberá sacos de lixos específicos para serem usados na lixeira que você receberá com a balança. Você só poderá trocar esse saco de lixo após encher a lixeira com os alimentos descartados.

OBS: Você não poderá utilizar na lixeira recebida, outro saco de lixo diferente desse que será dado a você.

02

PARA QUE SERVE A BALANÇA COM A LIXEIRA?

Toda vez que você for descartar um alimento no lixo, você deverá descartar esse alimento na lixeira acoplada à balança.

Quando essa lixeira encher, antes de esvaziá-la e trocar o saco de lixo, você deverá ligar a sua balança, ver o peso e fazer as anotações nas listas de anotações fornecidas. Só após fazer as anotações, você poderá descartar os sacos de lixo como preferir.

03

LISTA PARA ANOTAÇÃO DE PESO

Sempre que você encher a lixeira recebida, você deverá anotar o peso dado na balança, além de anotar a data e a hora a qual mediu esse peso. Essas listas serão coletadas semanalmente pelo pesquisador.

QUAIS ALIMENTOS DEVO DESCARTAR NESSA LIXEIRA?

Você deverá inserir na lixeira que você receberá com a balança, apenas os alimentos considerados **EVITAVEIS**. É importante diferenciar o que é evitável e o que não é evitável:

ALIMENTOS EVITÁVEIS

Alimentos e bebidas que estão em perfeitas condições de serem consumidos, porém acabam sendo rejeitados ou jogados fora.

Situações aonde o alimento ainda é considerado evitável:

- Se estragou na armazenagem
- Se passou do prazo de validade
- Se não está fresco
- Se estragou na geladeira
- Se sobrou após uma refeição
- Sobras do preparo da refeição
- Alimentos requentados
- Alimentos considerados "feios"

***Todos esses alimentos deverão ser descartados na lixeira que você receberá.**

ALIMENTOS NÃO-EVITÁVEIS

Resíduos de alimentos que não são comestíveis em circunstâncias normais. **Esses alimentos não irão para a lixeira que você recebeu!** Por exemplo:

- Ossos
- Peles de animais
- Cascas de ovos
- Cascas não comestíveis de frutas (Abacaxi, Laranja, Banana).
- Borra de café
- Bolsas de chá

***OBS: Qualquer dúvida sobre se um alimento deve ou não ser descartado na lixeira que você receberá, por favor entre em contato com o pesquisador e tire sua dúvida.**

ORIENTAÇÕES FINAIS

Antes do início dessa pesquisa, você receberá um vídeo online, para lhe orientar exatamente como realizar as tarefas explicadas neste folheto. Também serão repassadas algumas orientações adicionais neste vídeo ilustrativo.

Obrigado pela sua participação!

Sua participação nesta pesquisa é muito importante para o avanço da ciência brasileira!

Programa de Pós-Graduação em Agronegócios
Pesquisa de Doutorado

Apoio:

UFGD
Universidade Federal da Grande Dourados

WWF

PPGAgronegócios
UFGD

Appendix 3 - Modelos dos nudges do experimento

Quadro decorativo Tipo 1 (Food Overbuying Prevention)

Quadro decorativo Tipo 2 (Food Overcooking Prevention)

Imã de geladeira tipo 1 (Food Overbuying Prevention)

Imã de geladeira tipo 2 (Food Overcooking Prevention)

Lista de compras

Lista de anotação

Appendix 4 – Socio-demographic and background characteristics in each of the conditions

	Control group (n = 22)	Purchase intervention (*n* = 28)	Cooking intervention (*n* = 30)	Test statistic	*p*-value
Gender					
% male	3.8	10	11.3	χ^2 (2) = 2.11	.349
% female	23.8	25	26.3		
Number of meals at home					
% 1 or 2	10	8.8	12.5	χ^2 (2) = 0.83	.658
% 3 or more	17.5	26.3	25		
Education*					
% High school or incomplete graduation	5	6.3	8.8		
% Graduated	11.3	11.3	16.3	χ^2 (6) = 3.38	.760
% Master's degree	3.8	10	7.5		
% Ph.D.	7.5	7.5	5		
Household composition					
% Lives alone or shared household	5	10	12.5		
% Family, only adults	11.3	13.8	16.3	χ^2 (4) = 2.40	.662
% Family with children	11.3	11.3	8.3		
Household size					
% 1 person	3.8	7.5	8.8		
% 2 people	8.8	10	15	χ^2 (8) = 5.72	.679
% 3 people	5	8.8	5		
% 4 people	5	7.5	6.3		
% 5 people or more	5	1.3	2.5		
Does compost or recycle food					
% Yes	8.8	11.3	5	χ^2 (2) = 3.49	.175
% No	18.8	23.8	32.5		
Believes to have in mind the right amount of food stored at home when shopping for food					
% Yes	20	25	27.5	χ^2 (2) = 0.03	.987
% No	7.5	10	10		

Has the habit of using shopping lists					
% Yes	21.3	22.5	28.7	χ^2 (2) = 1.46	.482
% No	6.3	12.5	8.8		
Note: *The highest level of education in the household					

ANOVA results for:

The average food waste per day pre-intervention among the groups: (F(2, 77) = .496; p < .611).

Age among the groups: (F(2, 77) = 1.041; p < .358).