Food Distribution Research Society

Journal of Food Distribution Research
Volume 56, Issue 2, pp. 33–53

What Makes Consumers More Likely to Take Home and Eat Leftovers after Dining Out?

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Abstract

Restaurant customers can decrease waste by taking their uneaten food home in a to-go box or doggy bag for later consumption. We estimate the probability that a customer will take home and eat their leftovers using logistic regression. Data on 687 customers were collected via an online survey. Results indicate that meal price, type of food, gender, age, and employment status affect a consumer's likelihood of taking home and consuming their restaurant leftovers. This paper is among the few that examine how often customers use or waste their restaurant leftovers once they are taken home.

Keywords: doggy bags, food waste, plate waste, restaurants, restaurant leftovers

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Introduction

With more than 1 billion tons of food wasted annually (United Nations, 2021), food waste has become a global problem (Heng and House, 2022). Food waste is also increasingly acknowledged as a substantial concern in the United States, where more than one-third of the harvested food supply goes unconsumed (Buzby, Wells, and Hyman, 2014; Dsouza et al., 2023). Most of this loss (61%) is happening at the household level (Dsouza et al., 2023; Zhao et al., 2023). Other major contributors to food waste in the United States are the food service and hospitality industries, which contribute 26% and 12% of the total waste, respectively (Dhir et al., 2020; Zhao et al., 2023). Several reasons, including improper storage and/or preparation of food, food being prepared yet never served, and food left uneaten by customers, explain the degree of food loss in these sectors (Engström and Carlsson-Kanyama, 2004). The economic impact of this loss has been estimated at approximately $25 billion per year (Huang, Ma, and Wang, 2021).

The food service and hospitality industries have implemented various strategies to tackle the issue of food waste. For example, many restaurants serve smaller portion sizes, utilize software for inventory management, and ensure proper food supply management so that fresh food is served before spoiling (Blum, 2020). While these actions are helpful, a substantial part of the responsibility for managing food waste also rests with restaurant customers. These customers can reduce waste by requesting a to-go box or doggy bag with the leftovers to take home and consume later. Waste generated when diners do not choose this option is known as "plate waste" and accounts for 20% to 40% of waste at the restaurant level (Bloom, 2011; Blum, 2020). The social acceptability of doggy bags varies from region to region; for instance, the practice of taking leftovers home is uncommon in parts of Europe, such as France (Sirieix, Lála, and Kocmanová, 2017) and Italy (Coldiretti, 2017), but is more accepted in the United Kingdom (Giorgi, 2013).

Several factors that increase the likelihood of an individual asking for a doggy bag have been identified in previous research, including (i) if the consumer felt comfortable around the people with whom they were dining, (ii) if the restaurant server initiated the idea, or (iii) if there was enough food remaining to justify taking it home (Hamerman, Rudell, and Martins, 2017; Mirosa, Liu, and Mirosa, 2018). On the other hand, customers trying to impress those with whom they were dining were less likely to take home leftovers (Hamerman, Rudell, and Martins, 2017). Many people view taking home leftovers as a responsible, positive action, yet they may refrain from doing so because of perceived social shame (Sirieix, Lála, and Kocmanová, 2017) or may take uneaten food home as a result of feeling guilty for not doing so (Talwar et al., 2021).

Additionally, scholars have sought to identify ways in which restaurants can increase consumer uptake of leftovers. For instance, Van Herpen et al. (2021) assessed how changing the structure from "opt-in" to "opt-out" could enable more customers to keep uneaten food and found that customers were more likely to take home leftovers when a doggy bag was given to them by default rather than when they were required to make a special request to take home uneaten food. Although taking home restaurant leftovers is a step in the right direction for reducing plate waste, it does not sufficiently reduce waste; individuals must eat the food they take home rather than throwing it out later for progress to occur. One study from Scotland showed that more than 90% of food taken

home is eaten or used (recycled) (Zero Waste Scotland, 2014), though other research suggests that it is less common (Roe, Qi, and Apolzan, 2020).

A common theme in this literature is that women are more prone to not leaving uneaten food at restaurants (Vizzoto et al., 2021; Cerrah and Yigitoglu, 2022). As a result, women are often more likely to ask for a doggy bag (Mirosa, Liu, and Mirosa, 2018). Although some studies illustrate that income and age are not statistically significant factors in the decision to keep leftovers (i.e., Hamerman, Rudell, and Martins, 2017; Vizzoto et al., 2021), divergences do exist (i.e., Cerrah and Yigitoglu, 2022), so further investigation of these factors is warranted. Ambrosius and Gilderbloom (2015) indicate that urban residence can be associated with more environmentally conscious behaviors. Hamerman, Rudell, and Martins (2017) found that those who are more environmentally conscious and live in urban areas are more likely to take home leftovers.

The studies mentioned above took place in New Zealand, Italy, Turkey, France, the Czech Republic, and Scotland, among others (Zero Waste Scotland, 2014; Sirieix, Lála, and Kocmanová, 2017; Mirosa, Liu, and Mirosa 2018; Vizzoto et al., 2021; Cerrah and Yigitoglu, 2022). To the best of our knowledge, limited research exists from the United States regarding the impact of demographic characteristics, lifestyle preferences, or food type on a person's likelihood of taking home leftovers and consuming them at a later time. With the understanding that the uptake of leftovers is highly variable region by region, the present study will examine these impacts for Southeastern U.S. restaurant consumers.

We seek to better understand how common it is for consumers in this region to take home their leftovers and eat them later. Our study has two specific objectives: (i) estimate the relationship among demographic characteristics (i.e., gender, age, education, etc.) and lifestyle characteristic (i.e., living in an urban versus rural area, being vegan/vegetarian, recycling, etc.) and the probability of taking home restaurant leftovers and consuming them later; and (ii) estimate whether consumers are more prone to taking home specific types of restaurant food (i.e., Is steak more desirable than salad as a leftover?). Data regarding plate waste habits and characteristics of American consumers who take home their restaurant leftovers can be very beneficial in identifying ways to further reduce food waste in restaurants.

Methods and Data

Survey Design

The data for this study are obtained from a larger survey focusing on food waste that, in addition to capturing consumers' preferences for taking home and eating leftovers after dining out, also examined household decision makers' evaluation of visually imperfect vegetables.[1] Vegetables

[1] The survey was conducted by (University Anonymized University) per Institutional Board Approved Protocol IRB2021-0459

are the most often wasted food group (Wang et al., 2017; Roe, Qi, and Apolzan, 2020) and thus merit more investigation in the food waste literature.

The survey instrument was distributed by Qualtrics XM. To test the survey, two pilots were distributed to consumers with different demographics (age, income, origin, household location), with 40 respondents per pilot. Online distribution of the final questionnaire was preferred over other alternatives considering that the overwhelming majority (approximately 90%) of households in the study area have access to the internet (U.S. Census Bureau, 2021). Survey respondents were residents of the seven Southeastern U.S. states (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee).

Several steps were utilized to guarantee the veracity of the responses. For instance, a crosscheck of zip codes and state of residence was completed, and incorrect observations were dropped from the sample. Data validation tools provided by Qualtrics, such as Qualtrics Bot Detection (using Google's reCAPTCHA v3 technology), were enabled to determine the probability that responses were generated by bots. In addition to this method, Qualtrics' RelevantID technology assessed if the same respondent repeatedly took the survey or if a response was fraudulent. Responses with high Bot Detection or RelevantID scores were dropped from the sample. Qualtrics technology was also used to identify "speeders" (respondents whose survey completion time was over 2 standard deviations from the median completion time) taking the survey as they may have been motivated to complete it as quickly as possible to claim the incentive, reducing the quality of responses. In this study, no respondents were flagged as "speeders."

The survey had 808 total responses, but 34 respondents did not answer questions regarding restaurant food that were required for this study and were therefore not included in our sample. Further, one response was removed from the sample because of the respondent's answer regarding year of birth. Additional responses were removed if they did not have an entry for the variables of interest in the final model, bringing the total number of responses used to 687. The average respondent took approximately 16 minutes to complete the survey.

Respondents were only allowed to progress in the survey if they were from one of the seven Southeastern states, were over the age of 18, were the primary grocery shopper in their home, and if they bought vegetables every month. Eligible survey participants then answered a series of questions regarding (i) their dining preferences and habits, (ii) lifestyle characteristics, (iii) whether they took home their restaurant leftovers or left them behind, (iv) what they did with those leftovers, and (v) demographic characteristics.[2] All survey questions were either multiple choice, free response textbox, or sliding scale-style questions.

Demographic Characteristics of Survey Participants

The demographic characteristics of our sample and a comparison with the 2021 American Community Survey (ACS) are presented in Table 1. The age of respondents matches the age

[2] See survey questions in the appendix.

distribution across states from the ACS, and the percentage of respondents identifying as white versus other races follows the ACS. Education levels, income, and employment status percentages are also close approximates of the ACS's values. More than 50% of respondents reported an income lower than $50,000 per year, whereas only 6% reported an income higher than $150,000. In our sample, there are more female respondents (73.4%) than male respondents. This difference is justifiable given that women are more often the primary grocery shoppers in a household (Saphores and Xu, 2021). The higher proportion of female respondents is also beneficial for this study considering that restaurants recognize the importance of better understanding women's behavior regarding restaurant preferences (Jones, 2018). Overall, we can reasonably assume that our survey sample reflects the population of the survey region.

Table 1. Summary of Demographic Variables

Variable	Survey Data (n = 687)	American Community Survey
Gender		
Male/other	26.6%	48.9%
Female	73.4%	51.1%
Age (years) [c]	39.1	39.6
Race[d]		
White	59.5%	59.6%
Other	40.5%	40.4%
Education[e]		
High school, GED, or less	29.4%	38.6%
Some college (but no degree), associate's, technical school	40.0%	29.0%
Bachelor's, graduate, or professional degree	30.6%	32.4%
Income		
Less than $25,000	22.9%	19.9%
$25,000–$49,999	29.5%	22.4%
$50,000–$74,999	19.4%	18.3%
$75,000–$99,999	13.1%	12.8%
$100,000–$149,999	9.2%	14.2%
$150,000 or more	6.0%	12.4%
Employment[f]		
Employed or student	69.3%	57.0%
Unemployed, retired, disabled	30.7%	43.0%
Married/living with partner	53.7%	N/A[b]
Own home	57.2%	N/A
Household 3+	54.7%	N/A

Table 1 (cont.)

Variable	Survey Data (n = 687)	American Community Survey
State		N/A
Alabama	9.5%	
Florida	31.3%	
Georgia	18.2%	
Mississippi	4.5%	
North Carolina	16.0%	
South Carolina	8.4%	
Tennessee	12.1%	
Children under 18 in home		N/A
0	59.0%	
1	19.8%	
2	12.2%	
3+	9.0%	

Notes: [a]American Community Survey 1-Year Estimates. Statistics were aggregated for states included in our survey: Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee.
[b]The "NA" is included in the table because ACS does not include all demographic variables from the present study.
[c]The value for ACS is the average value of each state's median age.
[d]The American Community Survey allows respondents to record that they are one race, two races, or more. Our survey allowed only one race to be selected. The value for ACS is the number for "Race alone or in combination with one or more other races." Our survey did not allow respondents to select more than one race.
[e]ACS records education level for individuals over the age of 25. The summary statistic for our survey is for those 18 and older.
[f]ACS records employment for those over 16 years of age, whereas our survey only includes results from those 18 and older. "Employed" in our survey included those working part time, full time, or students. "Unemployed" includes those who specified that they are disabled, retired, or unemployed when asked their employment status.

Table 2 outlines summary statistics of food-related survey questions. The majority of respondents indicated that they dine out once or more per month, in line with other results of American dining habits (SWNS News, 2024). Approximately 20% of survey participants left their uneaten food at the restaurant after their most recent restaurant meal. More than 85% of respondents (87.3%) ate home-cooked meals at least three times a week and used rather than discarded the leftovers from their home-cooked meals. Lastly, 13.5% of respondents identify as either vegan or vegetarian.

Table 2. Summary of Restaurant and Food-Related Questions

Variable	Survey Data (n = 687)
Dine out once or more/month	86.8%
Took leftovers	81.0%
Last meal cost $30 or less	83.1%
Cook 3+ meals at home per week	87.3%
Eat home-cooked leftovers	84.7%
Recycle	70.7%
Vegan	13.5%

Figure 1 incorporates a visual representation of survey respondents' answers to major questions on our survey.

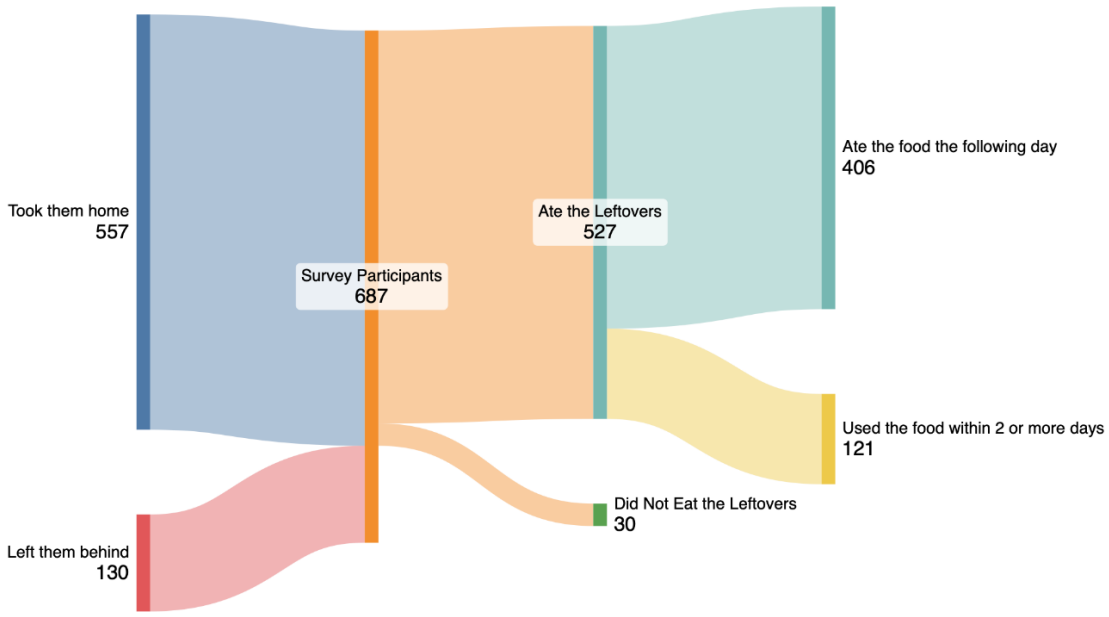

Figure 1. Sankey Chart of Leftover Food Consumption Pattern

The food categories with the highest number of respondents indicating they took leftovers home are pasta (36.5%[3]), followed by pizza (36.1%) and steak (24.9%). On the other hand, the food categories with the lowest number of respondents reporting they consumed leftovers were fast food (14.6%) and "other" food (4.8%). Of the 81% who took their leftovers home, 94.54% ate or used them for other purposes. Respondents to the survey specified whether they used the food

[3] Participants were able to choose more than one food that was part of their leftovers. This allowance implies that percentages do not total 100%.

within one day, within two or more days, or to feed a pet; the overwhelming majority (77%) used the food within one day.

Empirical Strategy

The goal of our study includes gaining insight into a consumer's action between two alternatives. Logistic regression was therefore identified as an appropriate method for modelling our data. Specifically, the dependent variable equals 1 if the consumer took home their leftover food on their previous visit to a restaurant and ate it later, and 0 if the consumer did not take their leftovers home.[4] To test for different specifications, we estimated several logistic regression models, each with a different set of covariates. We discuss these variables in more detail in the Results section.[5]

Set I included as explanatory variables gender (dummy variable equals 1 if female, 0 otherwise), price (dummy variable equals 1 if the meal cost was more than $30, and 0 otherwise), and food type[6] that was uneaten (1 if the food was present as a leftover, 0 if not).

Set II included all variables from Set I in addition to age in years (a continuous variable), ethnicity (dummy variable equals 1 if respondent self-reported to be white, 0 otherwise), education ("12 years or less," "13–15 years," or "16+ years"), income (continuous variable), employment (to capture employment, employment status categories were assigned as "employed" for those employed full time, part time, or selected as a student, and the remaining categories were assigned as "unemployed"), children (0 if no children, 1 otherwise), household size (number of people), marital status, and income. The categorical income variable was transformed into a continuous variable by selecting the center value of each category as the income.

Set III added lifestyle preferences to the variables used in Set I and Set II, including whether the consumer was vegan or vegetarian (a binary variable for categories "vegan or vegetarian" or "not vegan or vegetarian"), if they participated in agritourism, if they cooked at home more than three times a week, and whether they ate leftovers from home-cooked meals.

Set IV includes all previous sets and adds a variable indicating if the respondent lived in an urban area (a dummy variable equal to 1 if the respondent's zip code had a population density[7] greater than 100 people per square mile, and 0 if population density was less than 100 per square mile).

[4] The logistic regression was run in R. We used the glm function from the "stats" package (R Core Team, 2022). Marginal effects were estimated from the logitmfx function in the "mfx" package (Fernihough, 2019). Code and data are available upon request.

[5] All variables included in each model are show in Table A1 in the Appendix.

[6] Food type options were pizza, steak, pasta, burger, seafood, salad, regional food (Indian, Thai, Chinese, etc.), dessert, fast food (McDonalds, Wendy's, Burger King, etc.), and Other.

[7] Population density was determined using the R package "zipcodeR" (Rozzi, 2021), which sources population data from the 2020 U.S. Census. The population of a zip code was divided by the area in square miles of the zip code to form the population density.

Results

Based on the Akaike Information Criterion (AIC) as well as a likelihood ratio test, the selected model included all sets of variables described above.[8] The model shows that accounting for the additional variables, such as lifestyle characteristics (being vegan/vegetarian, recycling, living in an urban area), is essential when characterizing the consumer's decision regarding taking home and eating leftovers later. In this model, 15 out of 34 variables are statistically significant and are included in Table 3. The discussion in this paper will focus on the marginal effects.[9] Marginal effects from the logistic regression aid in the interpretation of results, but the values of the marginal effects themselves are only meaningful in terms of magnitude.

Table 3. Coefficients and Marginal Effects of Statistically Significant Variables on Whether a Consumer Takes Home and Eats Restaurant Leftovers

Variable	Coeff. (S.E.)	Marginal Effects
Gender: female	0.656***	0.093***
	(0.235)	(0.033)
Ethnicity: white	0.413*	0.059*
	(0.225)	(0.032)
Age	-0.017*	-0.002**
	(0.009)	(0.001)
Employment: non-employed	0.484*	0.069*
	(0.274)	(0.039)
Florida	-0.848*	-0.104**
	(0.444)	(0.049)
North Carolina	-1.086**	-0.141**
	(0.474)	(0.056)
Tennessee	-1.263***	-0.170***
	(0.483)	(0.061)
Had salad as a leftover	-0.835***	-0.119***
	(0.259)	(0.036)
Had regional food as leftover	0.592**	0.084**
	-0.835***	-0.119***
Average price of leftovers: > $30	0.860***	0.122***
	(0.315)	(0.044)
Participated in agritourism	-1.322***	-0.188***
	(0.295)	(0.040)
Eat home-cooked leftovers	1.631***	0.231***
	(0.273)	(0.035)
Cook 3+ meals at home per week	0.575*	0.082**
	(0.295)	(0.042)

[8] All models estimated and AIC and likelihood ratio tests can be obtained upon request.
[9] Marginal effects here refer to the partial effect. It is calculated after determining the average of the observations.

Table 3 (cont.)

Variable	Coeff. (S.E.)	Marginal Effects
Vegan or vegetarian	-0.706**	-0.100**
	(0.297)	(0.042)
Live in urban zip code	0.797***	0.113***
	(0.294)	(0.041)

Notes: Standard errors listed in parenthesis. All state marginal effects are in comparison to the baseline state, Alabama. "Regional food" was described to survey participants as "Indian, Thai, Chinese, etc."
Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

We find that among the demographic characteristics examined, gender, ethnicity, age, employment status, urban residency, and state of residence are statistically significant. Among lifestyle characteristics, eating home-cooked leftovers, participating in agritourism, choosing to be vegan or vegetarian, and recycling are statistically significant. Those who eat leftovers at home or participate in agritourism are more likely to take home restaurant leftovers, whereas those who are vegan or vegetarian are less likely to take them home.

Regarding our second objective (estimate whether consumers are more prone to taking home specific types of restaurant food), we find that those who had a more expensive restaurant meal or had leftover regional food are more likely to take them home. "Regional food" was described to survey participants as "Indian, Thai, Chinese, etc." On the other hand, we find that those who had salad are less likely to save it for later consumption.

We did not find a statistically significant effect of income on the likelihood of taking home a doggy bag. This result mirrors the findings of Vizzoto et al. (2021) and Hamerman, Rudell, and Martins (2017). We also find that those who self-reported "white" as their ethnicity are more likely to take home and consume leftover food. Women are 9.3 percentage points more likely than men to take home their restaurant leftovers, holding all else constant. This result is consistent with Mirosa, Liu, and Mirosa (2018) and corroborates the findings of Vizzoto et al. (2021) and Cerrah and Yigitoglu (2022), who reported that women are more prone to eating less. Thus, because they eat less food than men due to larger portion sizes, they tend to take home uneaten food more often.

The result for age indicates that older consumers are less likely to take home leftovers. Specifically, each additional year of age is associated with a 0.2 percentage point decrease in the likelihood of taking home leftovers (holding all else constant). Our results suggest that there was no discernible difference between a person's probability of taking home leftovers if they had different levels of education. Employment status, on the other hand, was significant. We find that unemployed consumers are more likely to take home leftovers.

Respondents from Florida, North Carolina, or Tennessee are less likely compared to those from Alabama (the base state) to take home uneaten food, which indicates regional differences in behavior. A similar phenomenon is seen in the studies mentioned previously that were conducted in different countries (Giorgi, 2013; Coldiretti, 2017; Sirieix, Lála, and Kocmanová, 2017). Thus, local customs and norms affect the likelihood of consuming uneaten food.

Respondents living in an urban zip code are also more likely to take home leftovers. This statistically significant marginal effect might be attributed to those who live in more densely populated zones who are more aware of the massive amount of food waste produced in their area. Therefore, they are more motivated to contribute less to the waste in general.

Among the lifestyle characteristics, a person's status as a vegan/vegetarian, whether they recycle, whether they cook meals at home, whether they eat home-cooked leftovers, and whether they participate in agritourism are included in the model. We find that those who identify as vegan or vegetarian are less likely to take home leftovers. The marginal effects associated with recycling behavior and cooking at home three or more times a week were insignificant. On the other hand, those who eat home-cooked leftovers are more likely to take home restaurant leftovers than those who do not.

Because restaurant type can be defined in many ways, we created two factors capturing differences: the price of the meal and the type of food. Therefore, we asked customers the type of food left uneaten at their most recent restaurant meal and the average price of food per person.

Regarding type of food, salad and food described as "regional food" were two variables that had a statistically significant influence on a consumer's likelihood of taking home a doggy bag. No other food types had statistically significant results. Consumers who had not eaten an entire salad are less likely to take home leftovers, but leftover regional food is more attractive to saving and eating later. Salad tends to be a less attractive food one or two days after being left uneaten. Because of that we hypothesized that consumers refrain from taking home a leftover salad. One with dressing could be even less attractive as a leftover, but serving dressings on the side could solve this issue.

Regarding meal price, consumers with a meal costing greater than $30 are more likely to take home their leftovers. Holding all else constant, consumers who eat more expensive meals have a predicted probability of taking them home that is 12.2 percentage points higher than those with a less expensive meal. This small price marginal effect on the likelihood of taking home a doggy bag indicates that consumers who eat more expensive food are more likely to take leftovers home, likely because restaurant goers perceive more expensive food as worth saving.

Discussion

Our results reveal interesting patterns. First, we find some connection between a person's residency and the likelihood of taking home leftovers—those from urban areas, as well as those from certain states, are more likely to take home their leftovers. Hypothetically, a person living in Alabama has a predicted probability of 0.85 of taking home and eating leftovers. A person with all the same characteristics[10] as the one from Alabama, with the only difference being that they reside in Florida, has a predicted probability of 0.75 of taking home and eating restaurant leftovers. Further, identical consumers from urban versus rural areas have predicted probabilities of 0.78 and

[10] Characteristics of the hypothetical consumers in this section were chosen based on attributes of the average respondent to the survey.

0.65, respectively, meaning that those in rural areas are less likely to take home and eat their leftovers.

A second pattern that was revealed is that vegans and vegetarians, as well as those who take home salad as a leftover, are less likely to take leftovers home. The predicted probabilities of vegan/vegetarian and non-vegan/non-vegetarian consumers taking home and using their restaurant leftovers are 0.66 and 0.78, respectively. The probabilities for those who did or did not have salad as a leftover are 0.65 and 0.79, respectively.

In our survey sample, 35.5% of vegans/vegetarians had a salad as their last restaurant leftover meal. Only 15.3% of those who are not vegan/vegetarian had salad as a leftover. Therefore, a potential explanation for why vegans and vegetarians are less likely to take home leftovers is that one of the major foods they consume (i.e., salad) is less desirable as a leftover. A day-old salad may be less appealing than a day-old hamburger or pasta, for example, so taking home an uneaten portion may be less expected. Leafy greens from salads have a short shelf life compared with other foods, which may cause consumers to find them less appealing or viable as leftovers.

In addition to the less appealing characteristics of leftover salads, they can be harmful to dogs, as well. The term "doggy bag" derives from feeding leftovers to dogs, which is a common practice for some customers. While typical salad bases, such as lettuce, are technically safe for dogs to consume, others such as kale and spinach can be quite harmful to canines (Lotz, 2022). Additionally, common salad ingredients, such as avocados, almonds, onions, grapes, raisins, dairy products, and macadamia nuts are harmful to dogs (AKC Staff, 2018). Consumers intending to feed leftovers to their dogs will, therefore, be less inclined to take home uneaten salads.

The third pattern that emerges from our analysis relates to food cost. While a respondent's income had no detectable influence on their likelihood of taking home leftovers, we found that a higher priced restaurant meal increases the likelihood of a consumer taking home uneaten food. Furthermore, those who are unemployed are more likely to take home higher priced leftovers These results are in line with the common perception that higher priced meals are more worthy of saving for later. Also, consumers who are unemployed may have less access to food and thus are more likely to save uneaten higher priced meals. Another factor is that higher priced meals may potentially contain more food and therefore produce more leftovers. A person who paid more than $30 for their meal and is unemployed has a predicted probability of 0.85 that they will take home and use their restaurant leftovers. In contrast, a person who spent less than $30 on their meal and is employed has a probability of 0.74.

We also found that the probabilities of taking home restaurant leftovers and consuming them change with the combination of these characteristics. Consider two people who are identical in every way measured on this survey: They are the same age, both are male, and their other characteristics are the same. If person A lives in an urban area, is not vegan, and does not have salad as a leftover, their predicted probability of taking home their restaurant leftovers is 0.82. If person B does not live in an urban area, is vegan, and has salad as a leftover, their predicted

probability of taking home their restaurant leftovers is only 0.40. The substantial difference is due only to where they live, what they ordered, and their status as either vegan or non-vegan.

Conclusion

Like most of the nations around the globe, food waste is a substantial problem in the United States. While most food waste happens at the household level, restaurants contribute significantly to the food lost each year. A high percentage of this food loss can be attributed to consumers leaving uneaten food and not taking it home for later consumption. There is a wide margin of research possibilities in this area, and this study expands the literature related to consumer behavior and restaurant leftovers. The objectives of our study were to (i) estimate the relationship between demographic characteristics (i.e., gender, age, education, etc.) and lifestyle characteristics (i.e., living in an urban versus rural area, being vegan/vegetarian, recycling, etc.) and the probability of taking home restaurant leftovers and consuming them later; and (ii) estimate whether consumers are more prone to taking home specific types of restaurant food (i.e., Is steak more desirable than salad as a leftover?).

Our survey results indicate that more than 81% of restaurant goers took home leftovers from the most recent time they had extra food at the end of a restaurant meal, and 94.54% ate or used the uneaten food. This result should prompt retail establishments to assess their portion sizes. There is potential for less revenue loss for restaurants that serve a more balanced variety of food to consumers. Toward this goal, many restaurants have implemented better inventory management, reduced portion sizes, and so on, but the results indicate that more can be done. Actions like these can decrease financial loss in the retail sector as well as contribute to less food waste. In addition to restaurant managers, consumers can play a pivotal role in reducing food waste at restaurants. This study aims to shed light on this issue.

We find that gender, living in an urban area, and, in some cases, state of residence comprise the most vital indicators of a person's probability of taking home their restaurant leftovers. Those who eat leftovers at home or participate in agritourism are more likely to take leftovers home from a restaurant, whereas those who are vegan/vegetarian are less likely to take home leftovers. We find that those who had a more expensive restaurant meal are likely to take home leftovers, and those who had salad are less likely to take it home.

Better understanding restaurant consumers contributes to reduced food waste. For example, this research could be used by restaurants specializing in vegan/vegetarian dishes or restaurants with a typically older clientele to identify that their patrons are more prone to wasting leftovers. Those restaurants could, then, take extra measures to reduce waste and encourage their customers to do so as well.

This research also has some limitations. First and foremost, this is research based solely on a survey. Answers to surveys are self-reported, so there is always a possibility that they will remember their restaurant visits slightly incorrectly or will fail to give a truly accurate estimate of measures such as how often they eat out. Future research regarding restaurant plate waste could

include questions regarding time of day or year leftovers are more often taken, as consumers may be more likely to save uneaten food when they are not worried about spoilage in hot weather. Consumers' concerns with food safety may prevent them from taking home leftovers if they are aware that they will be unable to appropriately refrigerate or store the food before it spoils. Additionally, future studies should investigate if restaurant goers are less likely to take their leftovers home if they have to attend an event following their meal. In other words, those with engagements after their meal may find taking leftovers home less viable as they would not have the ability to safely store the leftover food. The style of restaurant food could also affect whether leftovers were taken. The frequency of feeding leftovers to pets could also be more thoroughly investigated. Mode of travel, travel time, and whether the restaurant visit was the sole purpose of the trip could help to further establish reasons for or against taking leftovers home. Finally, future work including an observational study of a physical restaurant could be beneficial in verifying validity of self-reported surveys on taking home or leaving leftovers.

This research focuses on the Southeastern United States. While the responses are likely closely in line with what others from around the United States would report regarding their restaurant habits, it is possible that the results from this study are not representative of other regions of the United States. Although our survey was not distributed across America, it is a great first step toward building a foundation of understanding around this topic in the United States.

Acknowledgment

This work was supported by the USDA National Institute of Food and Agriculture, the Organic Transitions Program (Award Number: 2021-51106-35495).

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Appendix

Survey Instrument

The restaurant-related questions were addressed in the following way: "*Last time you had left-overs at a restaurant, did you: 1. Took them home in a box; or 2. Leave them behind at the restaurant"*(this response is referred to as "leftover action" for the remainder of the paper), "*At the last time you had left-overs at a restaurant, what was the average price per person you paid for food?*" (This response is referred to as "Average Price"), What did you do with the leftovers? (options for response: *"I did not eat (forgot I had them), I ate it the following day, I ate it in the next 2 or more days, and Other (for example, feed my pet)."* "*In the last month, how many times did you dine out?"* (referred to as "Dine-Out Frequency hereafter), and finally "*What type of food was the left-over [at your last restaurant meal]"* to which respondents could choose multiple answers from pizza, steak, pasta, burger, seafood, salad, regional food, dessert, fast food, or "other." For our purposes, "regional food" was described to survey participants as "Indian, Thai, Chinese, etc."

Demographic-related questions were addressed as follows:

- What is your gender? 1. Male, 2. Female, 3. Non-binary / third gender 4. Prefer not to say
- At the last time you had left-overs at a restaurant, what was the average price per person you paid for food? 1. Between $10 and $20 dollars 2. Between $20 and $30 dollars 3. Between $30 and $40 dollars 4. Between $40 and $50 dollars 5. More than $50 dollars
- What is your year of birth? (open text box)
- What ethnicity do you most identify with? 1. White 2. Black or African American 3. American Indian or Alaska Native 4. Asian 5. Native Hawaiian or Pacific Islander 6. Hispanic or Latino or Spanish Origin of any race 7. Other
- What is the highest level of education you have completed? 1. *Some high school or less 2. High school diploma or GED 3. Some college, but no degree 4. Associates or technical degree 5. Bachelor's degree 6. Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.) 7. Prefer not to say*
- What was your total household income before taxes during the past 12 months? *1. Less than $25,000 2. $25,000-$49,999 3. $50,000-$74,999 4. $75,000-$99,999 5. $100,000-$149,999 6. $150,000 or more 7. Prefer not to say*
- *Which of the following categories best describes your employment status? 1. Employed full time 2. Employed part time 3. Unemployed 4. Retired 5. Student 6. Disabled 7. How many children under 18 live with you? (open text box)*
- *How many people are currently living in your household? 1. Myself only 2. Myself + 1 3. Myself + 2 4. Myself + 3 5. Myself + 4 6. Myself + more than 4*
- *What is your current marital status? 1. Married 2. Living with a partner 3. Widowed 4. Divorced/Separated 5. Never been married*
- *Which state do you currently reside in? 1. Alabama 2. Florida 3. Georgia 4. Mississippi 5. North Carolina 6. South Carolina 7. Tennesse 8. Other*
- *Do you own your primary residence? 1. Yes 2. No 3. Prefer not to say*

- *What type of food was the left-over? 1. Pizza 2. Steak 3. Pasta 4. Burger 5. Seafood 6. Salad 7. Regional food (Indian, Thai, Chinese, etc.) 8. Dessert 9. Fast-food (McDonald's, Wendy, Burger King, etc.) 10. Other 11. In the last month, how many times did you dine out? 12. None 13. Between 1 and 5 times 14. Between 5 and 10 times 15. More than 10 times*
- *Do you recycle? Yes/No*
- *Are you vegan or vegetarian? Yes/No*
- *Have you done agro-tourism in the last year? Yes/No*
- *Do you cook dinner at home more than 3 times a week? Yes/No*
- *What is your five-digit zip code? (free response text box)*

Table A1. Estimation of the Final Model and Marginal Effects

Variable	Coeff. (S.E.)	Marginal Effects
Gender: female	0.656***	0.093***
	(0.235)	(0.033)
Average price of leftovers: > $30	0.860***	0.122***
	(0.315)	(0.044)
Had pizza as leftover	-0.060	-0.008
	(0.230)	(0.033)
Had steak as leftover	-0.189	-0.027
	(0.246)	(0.035)
Had pasta as leftover	0.273	0.039
	(0.227)	(0.032)
Had burger as leftover	-0.120	-0.017
	(0.258)	(0.037)
Had seafood as leftover	0.235	0.033
	(0.278)	(0.039)
Had salad as leftover	-0.835***	-0.119***
	(0.259)	(0.036)
Had regional food[1] as leftover	0.592**	0.084**
	(0.301)	(0.042)
Had dessert as leftover	-0.152	-0.022
	(0.307)	(0.044)
Had fast food as leftover	-0.192	-0.027
	(0.296)	(0.042)
Had other food as leftover	-0.521	-0.074
	(0.475)	(0.067)
Age	-0.017*	-0.002**
	(0.009)	(0.001)
Ethnicity: white	0.413*	0.059*
	(0.225)	(0.032)
Education: some college/associate's degree/technical school[2]	0.164	0.023
	(0.263)	(0.037)

Table A.1 (cont)

Variable	Coeff. (S.E.)	Marginal Effects
Education: bachelor's/graduate	0.354	0.050
degree/professional degree	(0.311)	(0.044)
Income	-0.002	-0.001
	(0.004)	(< 0.001)
Employment: non-employed	0.484*	0.069*
	(0.274)	(0.039)
Children	-0.028	-0.004
	(0.108)	(0.015)
Household size: 3 or more	0.027	0.004
	(0.251)	(0.036)
Marital status: not living with a partner	0.099	0.014
	(0.232)	(0.033)
State: Florida[3]	-0.848*	-0.104**
	(0.444)	(0.049)
State: Georgia	-0.753	-0.090*
	(0.477)	(0.054)
State: Mississippi	0.659	0.055
	(0.716)	(0.057)
State: North Carolina	-1.086**	-0.141**
	(0.474)	(0.056)
State: South Carolina	-0.579	-0.067
	(0.541)	(0.062)
State: Tennessee	-1.263***	-0.170***
	(0.483)	(0.061)
Home owned	0.213	0.030
	(0.237)	(0.034)
Vegan or vegetarian	-0.706**	-0.100**
	(0.297)	(0.042)
Participated in agritourism	-1.322***	-0.188***
	(0.295)	(0.040)
Recycle	0.027	0.004
	(0.250)	(0.035)
Eat home-cooked leftovers	1.631***	0.231***
	(0.273)	(0.035)
Cook 3+ meals at home per week	0.575*	0.082**
	(0.295)	(0.042)
Live in urban[4] zip code	0.797***	0.113***
	(0.294)	(0.041)
Constant	-0.631	
	(0.726)	

Table A1 (cont.)

Variable	Coeff. (S.E.)	Marginal Effects
Observations		687
Log likelihood		-305.734
Akaike Inf. Crit.		681.468

Note: Standard errors are in parentheses.