Guiding Your Plate Towards Sustainability: How Visual Food Guides Influence Food Waste

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Executive Summary

This study aimed to explore whether visual food guides could reduce food waste in UBC dining halls by helping students better understand portion sizes. Our research question was: Can visual food guides reduce food waste in university dining settings?

We implemented a two-condition, between-subjects design. One group was exposed to visual food guide posters in the dining hall, while the other group (control) had no such guide. We collected data on food waste weight and observed behaviors for four weeks.

The results showed a 17.5% reduction in food waste in the experimental group compared to the control group, though this difference was not statistically significant. However, we found significant differences of 25% in observed food waste behaviors, suggesting that visual guides effectively influenced student's food choices and waste reduction.

Our findings suggest that simple visual interventions can have a positive impact on food waste reduction, even though more research may be needed for larger-scale changes. This study provides valuable insights into how behavioral nudges can promote sustainable eating practices in campus dining environments.

Introduction

Food waste has become a significant challenge for all-access dining halls at the University of British Columbia, a concerning trend given the university's goal of fostering a more sustainable future for its students. Additionally, excessive food waste presents an economic concern, as it results in the loss of valuable resources and the inefficient use of staff efforts. To address these issues, several behavioural interventions, including nudges, have been implemented to encourage food waste reduction across different dining settings. Nudges are interventions designed to promote desired actions in people by minimizing friction (Luo et al., 2023). They change people's behaviours in predictable ways without restricting options or altering financial incentives (Thaler and Sunstein, 2008). In particular, visual nudges are subtle cues, such as images or symbols, designed to influence behavior and decision-making (Das & Dumortier, 2024).

A growing body of research supports the effectiveness of visual nudges in buffet-style dining settings. For instance, Zhu and Liu (2024) found that visual cues promoting awareness of portion sizes effectively lowered food waste in buffet-style restaurants. Similarly, Schäufele-Elbers et al. (2024) highlighted the effectiveness of visual information nudges in reducing food waste by raising awareness of sustainable practices and encouraging guests to minimize waste. A meta-analysis by Zang et al. (2023) further supported these findings, revealing a moderate reduction in food waste when buffet restaurants implemented information-based nudges. These results suggest that educating individuals on portion sizes can be a potent strategy for lowering food waste. In line with this, Balzaretti et al. (2020) demonstrated that educating primary school students about portion sizes and encouraging them to serve only what they can consume significantly reduced food waste. Collectively, these studies underline the potential of visual cues and educational strategies in promoting more sustainable eating behaviors.

Despite the considerable research on the effectiveness of information nudges and educational interventions in self-serve dining environments, there is a notable gap in studies exploring the impact of visual representations of portion allocation on a plate. One such representation is the Food Guide Plate from Health Canada (2025), which uses a visual image of a plate to educate consumers about healthy portion sizes. This tool provides clear, concise visual information that could be particularly useful in guiding students toward more appropriate portioning habits.

According to Chang (2022), consumers often overestimate the amount of food they can consume. This tendency is reflected in feedback from UBC dining hall staff and managers, who have noted that many first-year students struggle to properly judge how to allocate food on their plates. Given these challenges, introducing a visual plate guide as a nudging strategy could help students more accurately judge portion sizes, potentially leading to reduced plate waste. Therefore, visual nudges providing clear and informative visual cues about portion sizes offer a promising approach to reducing food waste in dining halls. By helping students better understand portioning, these interventions could contribute to both environmental sustainability and more efficient resource use within UBC's dining facilities.

Research Question

To fill the knowledge gaps in our literature review, the research team questioned whether the existence of visual food guides would affect the food waste in a UBC dining hall.

Hypothesis

We hypothesize that posting a visual food guide poster will result in a reduction of food waste in UBC dining halls compared to a baseline with no changes to the dining hall environment.

Methods

Participants

Participants were diners who visited the Gather dining hall at Place Vanier during lunch (10:30 AM-3:30 PM) and dinner (3:30 PM-10:00 PM) for four weeks in March 2025. While no demographic information about the participants was collected, customers at this dining hall consisted of UBC students, restaurant personnel, and other diners. We presumed that the majority of the participants were approximately 18 to 19 years old as the dining hall mainly serves first-year students with meal plans. We conducted a G*Power analysis using a minimum effect size Cohen's $d = 0.20$, $\alpha = 0.05$, power = 0.80, which yielded a minimum requirement of $n = 394$ participants per condition. A total of $N = 4240$ diners were recorded during the observation period at Gather dining hall, with $n = 2120$ participants per condition.

Conditions

Our research adopted a two-condition between-subjects design, with the independent variable being the visual food guide poster. The control condition took place over two weeks from March 3rd to March 13th. During this period, no visual nudges or interventions were implemented,

establishing a baseline for our study. The experimental condition lasted from March 14th to March 26th and involved the posting of posters of different sizes in the Gather dining hall. 208 posters were posted in the dining hall, including walls and the napkin holders on each table. Our posters featured a picture of a plate with the recommended food balance in the center, surrounded by slogans such as "Smart Portions = Less Waste" (Figure 3). The posters were designed to relate to the study and its hypotheses by providing helpful advice to diners in a concise manner using simple language. Furthermore, four variations of the poster were created to ensure dietary inclusivity.

Measures

Our dependent variable was operationalized as food waste behavior among UBC students in the dining halls. We used two measures to evaluate student food waste behaviors. Quantitative data was measured by dividing the total food waste weight per day by the total amount of transactions per day. The weight data and transaction data were collected from Gather over the four-week study period. The dining hall provided us with the total weight of the organic bins in kilograms and the number of transactions at the end of each business day. To support our quantitative data, qualitative data was collected using a Likert-like behaviour observation rating scale (Cruz et al., 2024, Figure 2) to score how much food was left on each diner's plate. The scale ranges from 0 to 5 (0 = "no food waste", 1 = "unavoidable food waste", 2 = "cleaning plate", 3 = "minimal food waste", 4 = "moderate food waste", 5 = "excessive food waste"). Inter-Rater Agreement was assessed using the Intraclass Correlation Coefficient (ICC) to measure the degree of agreement between two observers to validate the reliability of the scale (Table 5).

Procedure

Food waste weight (kg) data collection

The daily food waste in kilograms and the number of transactions were collected from the Gather dining hall records each day. A total of 28 data points were collected over four weeks, with 14 data points collected for the control period and 14 for the experimental period. This data included breakfast, lunch, and dinner from March 3rd to March 26th. The data was divided by the total transactions per day to provide the total food waste weight per person.

Observational data collection

During the observation period, two observers rated diners' food waste over 2-hour periods each day. The observation was conducted from the dining area of the Gather dining hall, where the observers had a direct view of the organic waste bins. Since the organic bins are located near the exit of the dining hall, high levels of foot traffic occasionally blocked the observers' view of the participants. To ensure the confidentiality and validity of the experiment, random selection was used to observe the food waste behavior of students. The two observers ensured that the same participant was selected for each observation before independently rating them.

Results

Measured food waste weight (kg)

In the control condition, diners discarded an average of 0.097 kg of food per meal (SD = 0.043), while in the poster condition, the average was 0.080 kg (SD = 0.039), representing a 17.5% reduction in food waste (Table 6). Assumption checks (Table 8, 9) confirmed that the data were approximately normally distributed ($p > .05$) and that the variances were equal (Levene's test: $F = 0.47$, $p = .496$). An independent samples t-test was therefore used to assess group differences. The t-test results revealed no statistically significant difference between the conditions, $t(58) = 1.31$, $p = .193$ (Table 7). However, the effect size was moderate (Cohen's $d = 0.45$), suggesting the intervention may still have practical significance despite the lack of statistical significance. Although measured food waste (kg) showed a reduction aligned with the hypothesis, this difference did not reach statistical significance and does not support our alternative hypothesis.

Observed food waste behaviour

To assess the effect of the poster intervention on observed food waste behavior, we conducted descriptive analyses for each condition (Table 1). Observational data revealed that participants in the poster condition exhibited lower food waste behavior scores ($M = 1.67$, $SD = 0.55$) compared to those in the no-poster condition ($M = 2.23$, $SD = 0.62$), indicating a 25% decrease in food waste behaviour among dining hall patrons. Before conducting inferential tests, we conducted assumption checks using the Shapiro-Wilk test (Table 3) and Levene's test (Table 4). The data significantly deviated from normality ($p < .05$), and although Levene's test indicated equal variances ($p > .05$), the normality violation led us to conduct a Mann-Whitney U test instead of an independent sample t-test. The Mann-Whitney U test (Table 2) revealed a statistically significant difference between the two conditions, $U = 173.5$, $p < .05$, with a small to medium effect size ($r = 0.263$). These findings suggest that the poster intervention was effective in reducing observed food waste behaviors. Inter-rater reliability for behavioral coding was good (ICC = 0.861), confirming consistent scoring among observers. Observed food waste showed a significant reduction aligned with the hypothesis, which supports our alternative hypothesis.

Discussion

Our study results showed that the experimental group exposed to the visual food guide poster reduced food waste (kg per transaction) by approximately 17.53% compared to the control group, based on dining hall food waste data. However, this difference was not statistically significant, suggesting that visual cues may or may not have influenced food waste behavior. In contrast, our observational data revealed a 25% decrease in food waste behaviors (e.g., over-serving or discarding large portions) in the experimental group. This indicates that visual portion size guides can help students better assess how much food to take, reducing the likelihood of waste at an individual level. The difference in statistical significance between the two results may be explained by the type and volume of data collected. While the food waste weight data were limited to 28 days, potentially reducing the power to detect a significant effect, the observational data

included 4,240 data points, offering a much larger sample size and allowing for a clearer detection of behavioral changes.

Implications

These findings have meaningful implications for sustainability efforts in university dining contexts. Although the reduction in food waste weight was not statistically significant, the notable behavioral changes observed suggest that visual interventions can play an important role in shaping student's food-related decisions. This supports and extends previous studies by showing that even low-cost, passive strategies, such as redesigning plate and bowl sizes, or targeted educational campaigns, can lead to measurable changes in behavior. Ultimately, this research encourages institutions to adopt a multifaceted, data-informed approach to food waste reduction, and it opens pathways for future studies to explore long-term impacts, scalability, and the role of design and placement in maximizing the visibility and influence of such nudges. These findings align with previous research showing that portion size education can impact food waste in buffet settings. Our study builds on this by applying it in a real-world university dining context. The discrepancy between food weight data and observed behaviors may be due to consistently discarded food items, oversized self-serve bowls, and the presence of napkins and inedible remnants contributed to overall waste, potentially diluting the measurable impact of the intervention.

During our observations, several key patterns in food waste were noted. A significant portion of the waste consisted of napkins and unavoidable food remnants. Additionally, during each observation period, similar food items were observed to be consistently discarded by nearly every student. Furthermore, the bowls used in the self-serve area were noticeably larger than those in other sections, which may lead students to take more food than they can consume, further contributing to food waste. Finally, Gather Dining Hall appears to offer less variety and fewer choices compared to other dining halls, which may result in students not finding meals that align with their preferences, thereby increasing the likelihood of food waste.

Limitations

One of the major limitations of this study related to confounding variables. Food waste may be affected by confounding variables such as menu changes, the quality of the day's food, and individual taste preferences. Individual taste preferences can lead to different levels of waste, as can the lack of quality in dishes. Additionally, a main limitation of our study was the limited time frame in which the study was conducted. Furthermore, the Hawthorne effect was another factor that should not be neglected. As our observation seat was close to the sorting bin, subjects may have sensed that they were being recorded and changed their behaviour. Finally, the measurement for the weight and volume of food waste was not entirely accurate during the observation period. Incorrect food sorting and napkin waste were all included in the collected data, which subjected our data to a margin of error. To account for these limitations, future experiments could extend the observation period to assess whether visual cues need a longer time to take effect. Additionally, field experiments with hidden observers are needed to reduce the impact of the Hawthorne effect. Finally, technology-based data collection, such as automated waste measurements, can be used to eliminate human error in weight recording.

Recommendations

Based on our study, we recommend several strategies to reduce food waste in UBC dining halls. First, implement visual nudges like the Healthy Plate poster across all halls to promote consistent, positive eating behaviors. Given the positive impact on student behavior, scaling up this intervention is advisable. It is recommended that they be placed in high-visibility locations, such as entry points, serving areas, and waste bins, and be consistently maintained, not just temporarily. Second, explore additional low-cost nudges such as smaller plates or more customizable portion sizes to better match student needs. Third, increase food diversity at Gather Dining Hall by offering more vegetarian, vegan, and culturally inclusive options, helping students find meals they are more likely to eat. Additionally, keep messaging positive and non-judgmental, focusing on collective impact rather than individual responsibility to encourage participation. Lastly, introduce a weekly feedback survey to identify unpopular dishes and guide menu adjustments, ensuring meals better align with student preferences and reduce overall waste.

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Appendix

Figure 1a. Mean difference for the observation data.

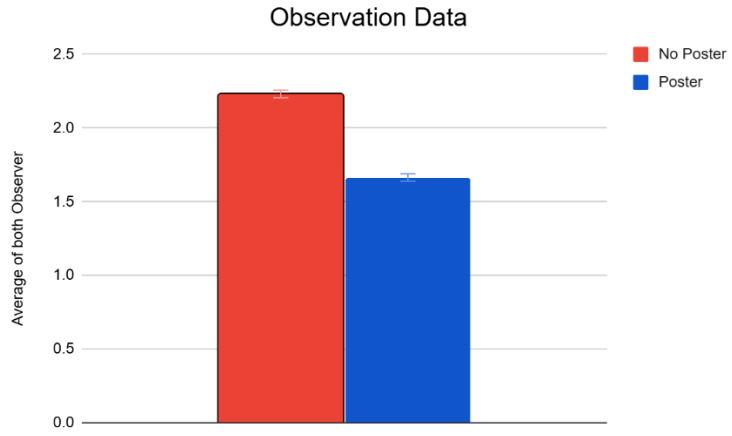

Figure 1b. Mean difference for the food waste weight data.

Table 1. Observation data descriptive statistics.

	Average of both Observer	
	No Poster	Poster
Valid	2120	2120
Missing	0	0
Median	2.000	1.500
Mean	2.232	1.665
Std. Error of Mean	0.026	0.025
Std. Deviation	1.183	1.144

Table 2. Observation Data Mann-Whitney U Test.

	U	df	p	Rank-Biserial Correlation	SE Rank-Biserial Correlation
Average of both Observer	$2.839\times10^{+6}$		< .001	0.263	0.018

Note. For the Mann-Whitney test, effect size is given by the rank biserial correlation.

Note. Mann-Whitney U test.

Table 3. Observation Data Assumption Checks using the Shapiro-Wilk test.

Test of Normality (Shapiro-Wilk)

Residuals	W	p
Average of both Observer	0.975	< .001

Note. Significant results suggest a deviation from normality.

Table 4. Observation Data Assumption Checks using the Levene's test.

Test of Equality of Variances (Levene's)

	F	df_1	df_2	p
Average of both Observer	3.296	1	4238	0.070

Table 5. Observation Data Intraclass Correlation.

Intraclass Correlation

Type	Point Estimate	Lower 95% CI	Upper 95% CI
ICC1,1	0.861	0.853	0.868

Note. 4240 subjects and 2 raters/measurements. ICC type as referenced by Shrout & Fleiss (1979).

Table 6. Food Waste Data Per Transaction Descriptive Statistics

Descriptive Statistics

	Food Waste per Transaction (kg per person)	
	No Poster	Poster
Valid	14	14
Missing	0	0
Median	0.098	0.088
Mean	0.097	0.080
Std. Error of Mean	0.010	0.010
Std. Deviation	0.039	0.037

Table 7. Food Waste Data Per Transaction Independent Samples T-Test

Independent Samples T-Test

	t	df	p
Food Waste per Transaction (kg per person)	1.180	26	0.249

Note. Student's t-test.

Table 8. Food Waste Data Per Transaction Assumption Check using the Shaprio-Wilk test.

Test of Normality (Shapiro-Wilk)

Residuals	W	p
Food Waste per Transaction (kg per person)	0.950	0.193

Note. Significant results suggest a deviation from normality.

Table 9. Food Waste Data Per Transaction Assumption Check using the Leven's test.

Test of Equality of Variances (Levene's)

	F	df_1	df_2	p
Food Waste per Transaction (kg per person)	0.043	1	26	0.837

Figure 2. Visual representation of the Food Waste Behaviour Observation Scale. Reprinted from Cruz, E. et al., (2024).

Figure 3. Posters including visual representation of portion sizes and showing four dietary variations.

Team contribution

Thea Elias: Assigned each group member tasks and kept track of internal deadlines; helped organize team meetings; conducted literature review and researched past studies; edited all sections of proposal, slide presentation, and final report; participated in weekly observational data collection; presented findings to teaching team; helped set up posters in dining hall; integrated feedback received from the teaching team.

Peter Chan: Developed and organized the presentation script and slides, ensuring the presentation remained within an 8-minute timeframe; participated in observational data collection over 6 days; and assisted in setting up posters in the dining hall; Editing Final report sections of Executive Summary and Recommendation; and proactively reached out to other groups working on different topics to collaborate by sharing slides and statistics, ensuring our project was clearly structured and understandable for audiences unfamiliar with our study.

Qinhao Wang: Designed the food waste observation rating scale, participated in weekly data collection, created presentation slides and assisted with presentation practice, wrote the final report results, and actively attended group meetings and in-person lectures to receive feedback from the professor and teaching assistant.

Xiaotong Yang: Final Report: Research question and hypothesis, participation and condition; Making slides: editing the research question and research hypothesis; engaged in making two version posters; Participated in collecting data every week; helped with setting up posters in the dining hall; helped with cutting the poster; engaged in every group meeting; helped with organize the slides.

Zoe Zhao: Making 2 sizes posters; helped with cutting posters; data observation every Tuesday, Wednesday and Thursday; adjusting PPT models and created slides of implication and limitation part, finally revising the ppt and also assisted with presentation practice; discussion part in final report, engaged in each meeting and sometimes provided useful insights; actively communicated with teammates to process each projects.

Rhythm Kaur Saluja: Research Project Proposal: Statistics, methods, poster design, Presentation: Statistics, results, methods, additional observations, recommendations, writing presentation script, answering questions at the end of the presentation, Final Report: Executive summary, statistics, results, discussion, implications, observations, Project Meetings: Coordinating meetings, ensuring preparation, Additional: Dining hall observation data collection, putting up posters for the experimental condition, communication with clients/professor/TA, organizing team meetings, submitting all the assignments on time.

Shuaixin Qiu: Participated in data collection in two weeks; Participated in each group meetings; Making presentation slides for participants and measures part; Final report for measures and procedures; Given suggestions about posters, presentation and final report.