Nudging Towards Sustainability: The Effect of Highlighting Low-Carbon Food on Menus to Influence Consumer Food Choice

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Executive Summary

This study explored whether highlighting low-carbon food items on a restaurant menu can influence consumers to choose more climate-friendly food. Drawing on nudge theory, the intervention tested the impact of two visual nudges, a bracket around menu item names on the menu board and standee displays of the selected items. Data on food sales from a Chinese restaurant called DaBao were collected and compared during a two-week baseline (no intervention) and a two-week intervention period. Two bao and dim sum options were chosen as low-carbon based on the ingredients' greenhouse gas emissions. 3,781 transactions were analyzed using a chi-square test that revealed a statistically significant decrease in low-carbon food items ordered during the intervention ($\chi^2 = 5.85$, p = 0.0156), rejecting the hypothesis that menu highlighting influences consumer behavior for highlighted items. However, the effect of the intervention was marginal (Cramer's V = 0.0393). Limitations such as the unrecorded dim sum combo orders and the lack of comparison to a no-intervention control site may have been contributing factors to the ineffectiveness of our intervention to promote climate-conscious eating. Future studies should further examine the cognitive processes underlying such impacts and compare single versus repeated interventions to optimize behavioral outcomes.

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Introduction

As the world moves to combat climate change, a focus on reducing emissions in the food sector is needed. In 2018, emissions from the global food production reached around 13.7 billion metric tons of carbon dioxide equivalent, equivalent to 26% of global greenhouse gas emissions (Poore & Nemencek, 2018). However, there is the potential for an up to 44% reduction in carbon emissions from the food sector using demand-side measures (IPCC, 2023).

One promising demand-side measure for shifting food consumption towards more climate-friendly options is nudges, which are changes in the presentation or incentive of an option without limiting choices (Luo et al., 2023). According to Luo et al. (2023), nudges leverage cognitive processes–such as attention, effort, and motivation–to encourage or hinder particular behaviours, in our case, climate-friendly food choices. Examples of nudges to promote climate-friendly food choices have included changing the order of menu items to emphasize low-emission options (Franchini et al., 2023), providing information on the carbon footprint of items through labels and posters (Slapø & Karevold, 2019), and setting low-emission ingredient options for a dish as the automatic or default option (Betz et al., 2022). Overall, these studies demonstrate that nudges can encourage climate-friendly food choices.

Despite the consensus that nudges are generally effective, more insight is needed on understanding the potential of a synergistic effect between multiple nudges in the domain of climate-friendly food choice (Pandey et al., 2023; Livingston et al., 2021). This potential for synergy is evident through the success of using multiple promotional materials in other domains, such as promoting support for a COVID-19 pass for international travel (Sotis et al., 2021) and reminding participants about behaviours to follow while preparing food at home (Koch et al., 2024). Therefore, our study aims to address these gaps by designing an intervention that adds two visual elements as nudges and examining whether these elements can increase consumers' choice of climate-friendly foods.

Research Question

How does highlighting low-carbon foods on menus influence consumer food choice?

Hypothesis

Compared to a baseline period with no intervention, highlighting low-carbon food options visually using standee menus and brackets in the intervention period will increase sales of these items compared to non-highlighted, non-low-carbon foods.

Methods

Participants

A total of 200 participants was initially targeted based on a power analysis for a chi-square test, with an alpha value of 0.05 and a power of 80, using an estimated minimum effect size w of 0.2 based on the literature review. The total amount of items sold in DaBao was 2165 during the baseline period and 1616 during the intervention period, adding up to a total of 3781. The participant demographic was all customers at DaBao during the 4 week period of the experiment.

Conditions

There were four conditions in our study, based on our independent variable, food carbon type (low-carbon vs. non-low-carbon), and the two different time periods examined (baseline vs. intervention). These conditions were observed over a 14-day baseline period (pre-intervention) and a 14-day intervention period (post-intervention). Low-carbon foods were selected based on which menu items showed the lowest Greenhouse Gas (GHG) Emissions per kg of food product, using a graph sourced from data in Poore & Nemencek (2018; fig. 1). The focus was placed on the bao and dim sum options, including low-carbon meat options to ensure customers made choices based on the carbon footprint of foods rather than whether they were vegetarian/vegan-only. Based on GHG emissions data, we selected Mini Chicken and Mini Vegan as low-carbon bao items, and Ha Gow Shrimp Dumpling and Vegan Mushroom Dumpling as low-carbon dim sum items. The remaining bao and dim sum items were selected for the non-low-carbon condition (fig. 2).

The independent variable was operationalized by highlighting low-carbon items using standee menus that featured only low-carbon food and a bracket around the food names on the main wall menu to distinguish them from other options. In the baseline period, both low-carbon (N = 542) and non-low-carbon (N = 1623) foods were not shown on standee menus nor framed by brackets. In the intervention period, names of the low-carbon foods (N = 350) were shown on standee menus placed around DaBao and framed with brackets on a large overhead menu, while non-low-carbon foods (N = 1266) were not shown on standee menus or framed with brackets.

Measures

The dependent variable in this study was the net quantity of sales for highlighted, low-carbon food items and non-highlighted, non-low-carbon food items during the baseline and intervention periods. This was operationalized using the gross quantity of sales in both low-carbon and non-low-carbon dim sum and bao items, using a sales report summary provided by SEEDS for both the baseline and intervention periods. The proportion of low-carbon sales per period was also calculated by dividing the number of low-carbon foods sold during the baseline/intervention period by the total number (i.e. both low-carbon and non-low-carbon) of foods sold during the baseline/intervention period.

Procedure

The intervention was implemented by placing 4 standee menus with the selected low-carbon foods around DaBao, a Chinese fast-food restaurant located at UBC in the IKB library. The standees were placed near the entrances and the cashiers. Additionally, paper brackets were placed around the names of the selected low-carbon food items to highlight them on the restaurant's menu board (fig. 5). Data collection took place from February 24th until March 31st. The baseline period was from February 24th to March 13th, and the intervention period was from March 18th to March 31st; both periods were 2-week (14 day) periods, adding up to a total of 4 weeks (28 days). Data on the number of food items sold was collected using sales summary sheets of all food items sold at Da Bao across both the baseline and intervention periods, provided by the UBC SEEDS Staff. We specifically focused on the total sales of bao and dim sum items and on comparing sales between the intervention and baseline periods.

One challenge faced in this study was that a green border design for highlighting items on the large overhead menu (fig. 4) originally designed for the intervention had to be discarded; as a result, the current bracket design was used as a substitute. There was also a challenge in tracking participants due to the sales data only showing total items sold of each item. Another issue involved difficulties in obtaining consistent photos for the standee menu, which resulted in the absence of images for the low-carbon food items.

Results

There were a total of 542 low-carbon items (Expected Value: 510.76, Chi-Square Statistic: 1.91) and 1623 non-low-carbon items (Expected Value: 1654.24, Chi-Square Statistic: 0.59) sold at DaBao during the baseline period. In comparison, there were a total of 350 low-carbon items (Expected Value: 381.24, Chi-Square Statistic: 2.56) and 1266 of the non-low-carbon items (Expected Value: 1234.76, Chi-Square Statistic: 0.79) sold during the intervention period (table 1). These values represent a decrease in the absolute quantity of both low-carbon and non-low-carbon food sold during the intervention period. Importantly, the proportion of low-carbon food sold between the baseline and intervention periods also decreased; low-carbon foods represented 25% of total sales in the baseline period, but only 21.7% of total sales in the intervention period. In contrast, the proportion of non-low-carbon food sales increased from making up 75% of sales in the baseline period to 78.3% of sales in the intervention period.

Because the data contains two categorical variables with count data, A chi-square analysis was performed to determine whether the intervention had a significant effect on low-carbon food sales and to assess the strength of that impact. The results were a chi-square (X^2) of 5.8514, a p-value of 0.0156, and 1 degree of freedom; Cramer's V, a measure of the effect size for the chi-square test, was calculated to be 0.0393. Given an alpha level of $\alpha = 0.05$, these values indicate that the intervention had a significant but marginal impact on low-carbon food sales at DaBao. However, the decrease, rather than increase, in the absolute quantity and proportion of low carbon food sold during the intervention period indicates that our hypothesis is not supported.

Discussion

The results showed there was not an increase in the consumption of low-carbon food items during the intervention, which leads us to reject our hypothesis and claim that highlighting low-carbon foods by using separate standee menus and brackets on a large menu board did not increase how often they were purchased. Considering the previous literature on nudges, this was not the expected result. However, this result does not necessarily suggest that nudges are ineffective; the small effect size suggests that limitations may have played an important role.

We also found that overall food sales decreased during our intervention period compared to the baseline period. While this effect could be due to our intervention, it is unlikely due to our marginal effect size. Instead, this change could be due to alternative explanations, such as people going to campus less often as the school year comes to a close.

Limitations

A major limitation in this study is the data that were used for analysis. The dim sum combo accounted for 90% of all dim sum sales, but it was not included in the analysis since there was nothing in place to track whether the combo contained low-carbon or non-low-carbon foods. In the future, this information can be recorded to help with understanding the data. Another concern for this study is the menu changes from DaBao, specifically the addition and removal of dishes (including low-carbon items), and the effect that had on the data received. These menu changes may have affected sales and made our analysis less accurate.

Another limitation is that the conditions were minimal. There was no condition with only one nudge, nor a simultaneous comparison condition. This means it is unclear if a single nudge would have done worse, the same, or better. This is important, since nudges are aimed at getting people's attention, and having multiple nudges might mean they are competing with each other for attention. Having no simultaneous control site where the intervention was not implemented introduces vulnerability to changing attitudes and external campaigns around climate-friendly food choices. Having more control conditions would be beneficial to future studies.

Additionally, no insight into cognitive processes was gained from the experiment. This limits our ability to understand why the intervention did not work and advise on other designs for nudge interventions. Further work into the cognitive processes of nudges (both on their own and combined) could reveal important information on this topic.

Implications

Despite previous studies that demonstrate the effectiveness of nudges, this study shows that nudges are not always effective. Although it is unclear why the interventions did not

increase sales of highlighted items, it shows that nudges have to be thoughtfully implemented and might not work as intended everywhere.

It is possible that our intervention did not work because it was not the only influence on the cognitive processes it aimed to leverage. Our intervention would have to compete for attention with the larger menu, food displays, and other advertising or promotional material. Motivation, especially around climate-friendly food, is also influenced by many factors before the customer arrives at the restaurant. Multiple nudges might even compete with each other, including other nudges from outside our intervention. It is also possible that the intervention was effective in changing the contents of the dim sum menu, and we would not know. Further work on multiple nudges in the food sector should be aware of these possible pitfalls.

All these possibilities can be considered for future study to better understand how multiple nudges affect climate-friendly food choice. Future studies can compare the use of multiple interventions to the use of a single intervention for increasing low-carbon food options. Additionally, considering the impact of cognitive processes by utilizing techniques to measure them would contribute to a more concrete understanding of the causal mechanisms behind the effectiveness (or ineffectiveness) of nudges.

Recommendations for Clients

Despite challenges encountered during the study, several recommendations have emerged that could inform future research and enhance efforts to increase low-carbon food purchases at UBC.

For future SEEDS studies that seek to replicate this experiment's design, it is recommended to use the original green border design that may generate a possible increase in effect size.

Additionally, improvements in quality management are essential. Staff training aimed at ensuring consistent service quality is critical, particularly in mitigating negative emotional interactions that may inhibit customers from taking the time to consider low-carbon food options. Additionally, food quality must be actively monitored. Observations during the study revealed that the freshness of vegetable-based meals deteriorated rapidly, potentially impacting their appeal. Recommended strategies include implementing regular quality checks during service hours or preparing smaller batches in anticipation of peak periods.

Furthermore, incorporating a brief verbal prompt promoting low-carbon food options during customer interaction, such as immediately after a greeting, may enhance customer awareness and bring sustainable choices to the forefront of their decision-making process, thus alleviating decision fatigue. For the sustainable nudges for low-carbon products, employee education and training regarding low-carbon options are essential.

To implement these nudges from the employee, visual images may aid its process for both the employee and customer. The absence of visual aids in the store environment may lessen customer engagement with low-carbon food products. The addition of appealing, well-designed

images could improve customers' ability to make mindful, environmentally conscious choices. Visual representation serves both to reduce cognitive load and to enhance the salience of sustainable consumption behaviors.

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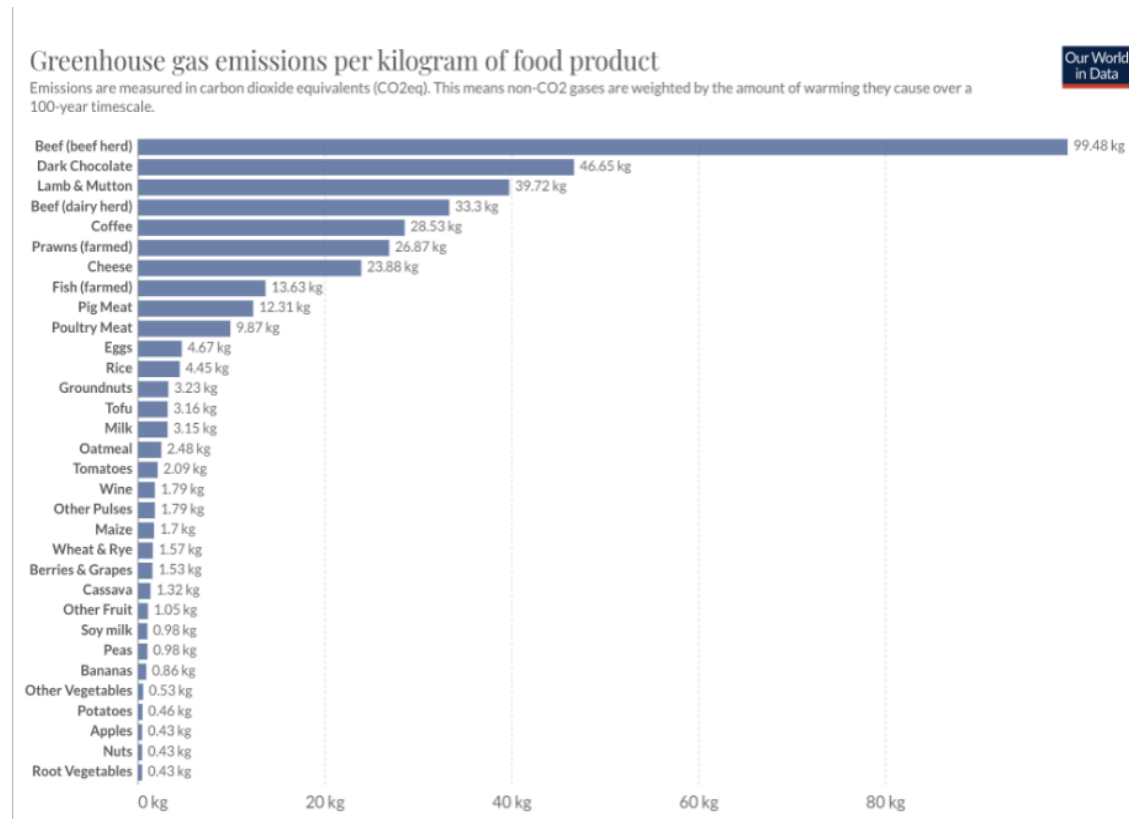
Appendix

Greenhouse gas emissions per kilogram of food product

Emissions are measured in carbon dioxide equivalents (CO2eq). This means non-CO2 gases are weighted by the amount of warming they cause over a 100-year timescale.

Fig. 1. The GHG Emissions graphs used to determine low-carbon foods.

	Baseline Period	**Intervention Period**	**Row Total**
Low-Carbon Foods	542 (510.76) [1.91]	350 (381.24) [2.56]	892
Non-Low-Carbon Foods	1623 (1654.24) [0.59]	1266 (1234.76) [0.79]	2889
Column Total	2165	1616	Grand Total: 3781

Table 1. Data on the gross quantity of sales in each condition. Numbers in round brackets indicate the expected number of sales if the intervention had no impact; numbers in square brackets indicate the chi-square value for each condition.
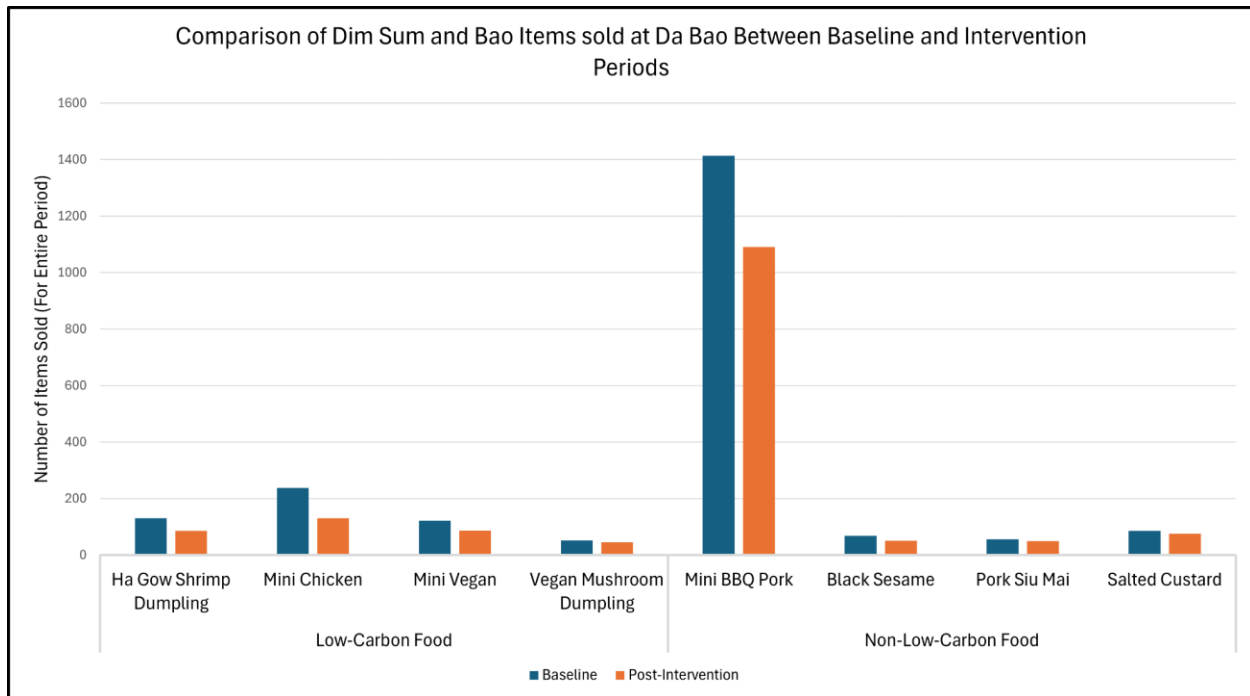
Fig. 2. Comparison of items across baseline and intervention periods.

Experimental Materials

Fig. 3. Designs of the interventions that were used, the bracket (left) and standee menu (right)

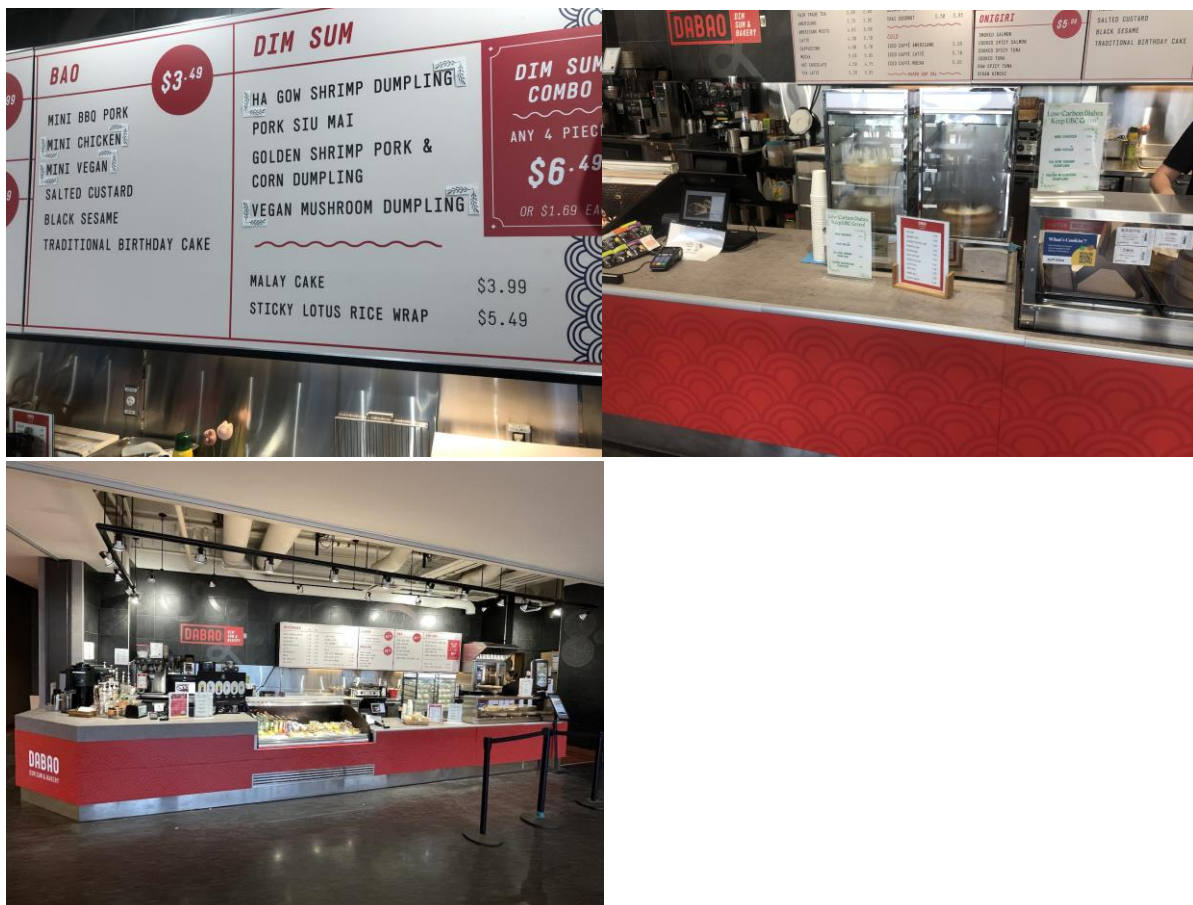Fig. 4. The original border design before using the bracket design.

Fig. 5. Pictures of the interventions in place at Dabao

Team Member Contributions

Breanna McNeilly

Contributed to the methods section in the proposal, presentation, and final report. In the final report worked on participants and procedure specifically. Created slides for all methods sections on the presentation (participants, conditions, and measures) while adding more detailed notes for the speaker and helped in creating the final slide. Wrote part of the methods in the proposal and helped in editing it down to one page for the submission. Helped find papers to use for the literature review. Attended all meetings with the prof excluding the stats meeting and attended all group meetings.

Mika Takane

Contributed to communication on site with the manager, with measurements of the menu board, and the intervention installation. Creating the rough draft of the menu poster and the original full border line design later carried on with a new developed design. Completed the data entry of raw sales data into Excel documents for the statistical analysis for optimising the Chi-squared test. Participated in the presentation speech for the result section while writing the script, and made a slide and summary of the discussion and recommendation section. Also completed the full recommendation section and part of the discussion section.

Albert Lin

Contributed to much of the background literature section of the project proposal and reviewed portions of each section of the final proposal. Was present for almost every meeting with the professor and TA. Created the slides for the background literature/introduction and most of the results sections of the presentation. Wrote part of the introduction & results sections on the final report and contributed significantly to editing the rest of the report. Organized when group meetings would occur.

Nghi Le

Contributed by helping Logan put together the materials for the intervention and designing the finalized version of the intervention itself, in other words, the standee menu design. Came up with the group name and researched an article to help with background literature. Worked collaboratively with Breanna on creating the presentation slides and editing the title, research question, and hypothesis slides. Worked on the executive summary, research question, and hypothesis sections of the final report and worked on the project title, background literature, research question, and hypothesis of the proposal. Also attended all group meetings.

Logan Hoff

Contributed ideas for the experiment and its implementation. Helped lead and focus group meetings. Communicated with teaching staff and Seeds staff during in-person meetings. Received and put up materials for the intervention. Worked collaboratively to complete

background literature and discussion for the proposal, presentation, and final report. Spoke during the presentation, including answering questions.

Aidan Conrad

Contributed to the statistical analysis portion of the proposal, presentation, and the final paper. Ensured that I was available for group meetings and ready to contribute at all times. Performed the formatting and statistical analysis of the data in order to determine whether our results were significant and whether our hypothesis had been supported by the data and communicated the results and any updates on the data analysis to the rest of the team to help with coordination and communication.

Jerrin Chu

Contributed to the methods portion of the proposal, presentation, and the final paper. Played an active role in keeping group meetings and the timeline organized, and ensured that all members were on the same page on the scope of the project. Served as the main point of contact with the teaching staff and SEEDS clients. One of the presenters during the presentation proofread the final paper and contributed significantly to the editing process.