BETTER POLICY LAB FINAL REPORT

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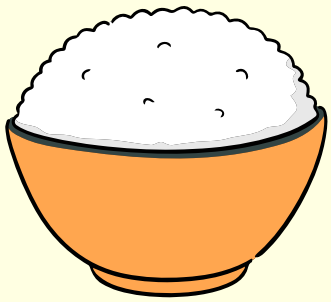

"What's Your Rice Level?"

Reducing Rice Waste Among Customers at NUS Eateries

BETTER POLICY LAB

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1

Introduction

In 2019, the average Singaporean wasted two bowls of rice per day. Altogether, it accounted for 744 million *kg* of food waste that year![1]

Singapore's food waste problem has been growing. Over the last decade, estimates indicate a 20% increase in the food waste generated[1]. This trend implies a host of downstream problems in waste disposal, food security, and increased environmental burden[1].

Recent developments in food waste treatment, such as the use of anaerobic digesters, are promising for mitigating the risks of food waste[2]. Nonetheless, preventive strategies to reduce food waste are also needed on top of mitigation strategies in dealing with the problem.

Based on our preliminary observations at canteens in the National University of Singapore (NUS), we found that most of the food waste from consumers comprises rice and noodles. This indicates that addressing consumers' carbohydrate portions is crucial to reduce their food waste. Hence, we focus on rice waste in our study.

Specifically on rice waste, we found that **most consumers finish their rice, but the few (~20%) who did not finish their rice, waste a significant amount.** This highlights the need to remind consumers who need less rice, to order less rice.

Figure 1: *Varying amounts of food waste left over by NUS canteen-goers.*

Figure 2 *Bubble Tea Sugar Level Chart by Koi, a major bubble tea franchise. Retrieved from https://foursquare.com/v/koi-caf%C3%A9/555ac3a9498e63ff91a1cda2/photos. Copyright 2017 by KOI Thé.*

To nudge people to order less rice, we found that we could learn from bubble tea stalls.

We drew inspiration from the menu cards used by bubble tea stalls to present different sugar levels for their drinks (see Figure 2). Despite the long queues in their stalls, bubble tea stalls have the standard practice of asking customers about their desired sugar level. Due to these practices, it has become the norm for customers to refer to the menu cards by their own initiative to request their desired sugar level.

Hence, we wondered, "Could we apply the same menu card-and-asking strategy at rice-selling stalls to reduce consumer rice waste?"

We designed our own menu cards to help customers select an appropriate rice portion that they can finish. A pilot survey of our menu card designs revealed that the most effective design was minimalistic, showing two rice levels and a clear message: “Let Us Know What Rice Level!”

We tested our menu card at NUS eateries and **found that the menu card made customers twice as likely to order less or no rice**. We also found a **significant increase in the number of “Less Rice” orders at stalls with the menu card**. This shows that our menu card intervention can help customers order rice levels that they *can* finish.

We hope that this report not only contributes useful insights on consumer food waste behaviour, but also demonstrates the potential for our menu card to be used at hawker centres and food courts across the country.

2

Designing our Intervention

We conducted preliminary observations in NUS canteens to understand the reasons why customers waste rice. We then designed a suitable intervention, in the form of a menu card to tackle the issue.

Figure 3: *Our final menu card cut-outs*

Why did NUS canteen-goers waste rice?

From our observations, we identified key factors that prevent consumers from adjusting their rice portions and consequently lead to their rice wastage:

1. **Default bias**
   Customers often take the default rice portion given even when it is too much for them, as they might not realise that they could ask for less.

2. **Limited mental resources**
   When customers are queuing up for their food, they forget to ask for less rice.

3. **Mental accounting**
   As compared to side dishes like meat and vegetables, rice is a food item that has low value for the consumers, hence they are more willing to waste their rice, when they feel full.

We brainstormed ways to address one or more of these diagnoses through our intervention, particularly when testing possible menu card designs (see Box 1).

Previous attempts to reduce rice waste using posters

Prior to our study, there had been an attempt to reduce customer rice waste through the use of posters (Figure 4). However, we noticed two key limitations of this intervention:

1. The poster was placed in a non-salient position.
2. Stall owners do not actively refer to the posters in a timely manner. This causes the poster to fade into the background

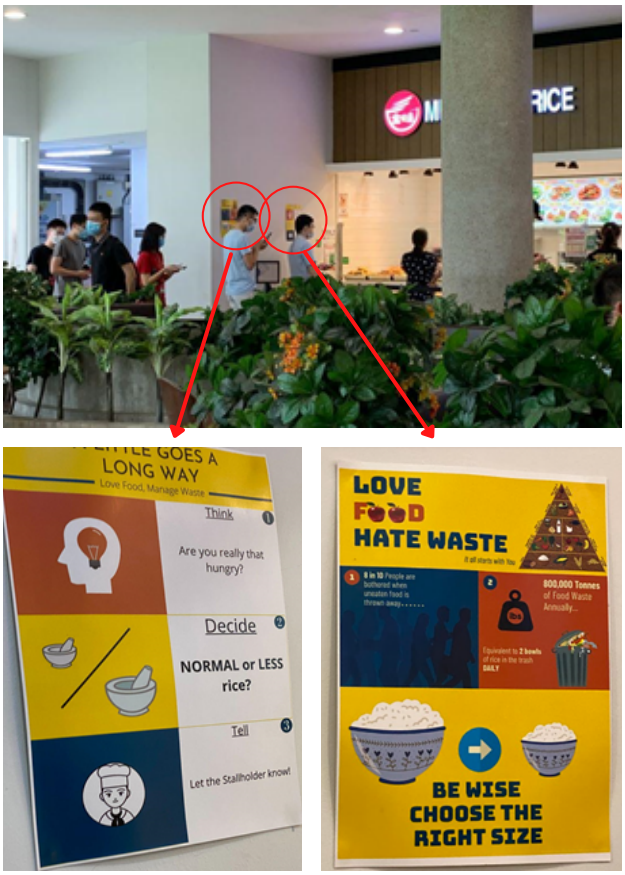


Figure 4 *Previous poster attempts at Food Clique, which is one of the canteens in NUS.*

Other consideration: Why not change the default rice portion?

We thought of changing the default portion as a potential intervention method. It was promising as it would reduce the effort needed by both stallholders and customers in thinking and communicating about different rice levels.

However, we found some potential issues which limit the feasibility of implementing this intervention. Our primary consideration involves the harm that both the customers and stallholders could experience. Customers might feel unhappy if they notice that stallholders have started to give them less rice while charging for the same amount. This could lead to significant harm to the stallholders business. Moreover, standardising the amount of rice or the equipment used for scooping smaller default rice portions may be logistically challenging.

Our Final Decision:
Using a Rice Level Menu Card

We adapted bubble tea menu cards for rice levels, to facilitate customers' requests for adjusting their rice level.

We had key reasons why we decided on using menu cards in the end. One, it could facilitate consumers' initiative to ask for less, rather than force a lower portion upon them. Second, a visual persuasive text on the menu card could be incorporated for messaging purposes or to encourage interaction between stallholders and customers.

Our team conducted a pilot survey where respondents viewed four prototype designs, ranked them, and gave quantitative and qualitative feedback on them (see Box 1). We chose the winning design and refined it.

Our final menu card design has the following characteristics:

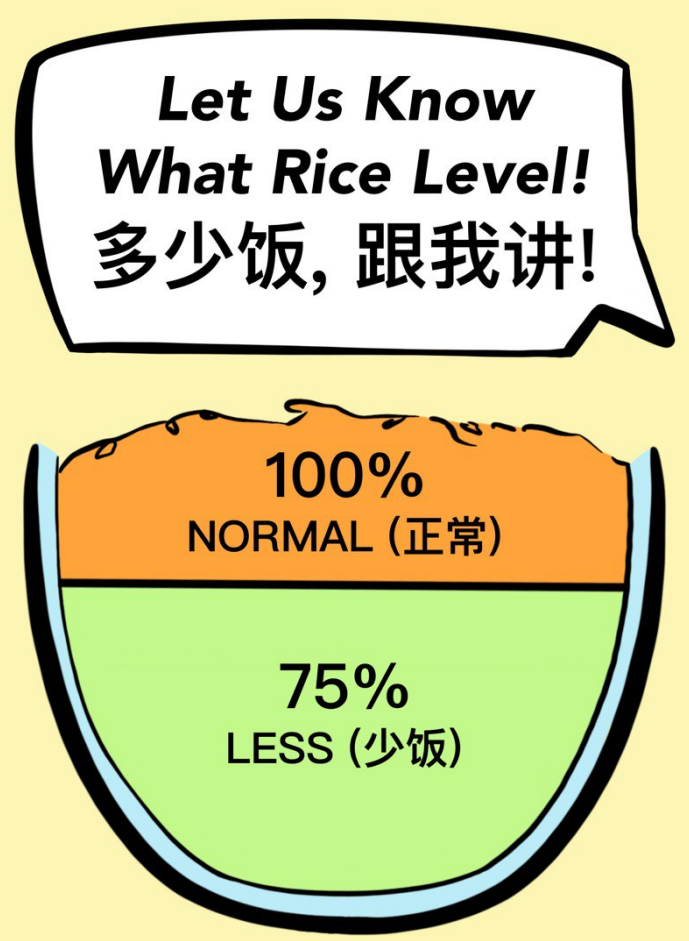


Figure 5 *Our final menu card design.*

1. An illustrated bowl of rice, with two blocks of bright colour that indicate a different rice portion option respectively—"Less Rice" (75%) and "Normal Rice" (100%). We chose to only include these two options to cue customers towards lower rice, although we did not intend to restrict customers to only these two options in practice.

2. The text "Tell Us What Rice Level!" is printed above the illustrated bowl of rice, as a direct cue for customers to voice their desired rice portion.

3. A Chinese translation of the English text that mimics the common manner of communication used when ordering at the mixed rice stall.

Box 1: Menu card prototype designs in our pilot study

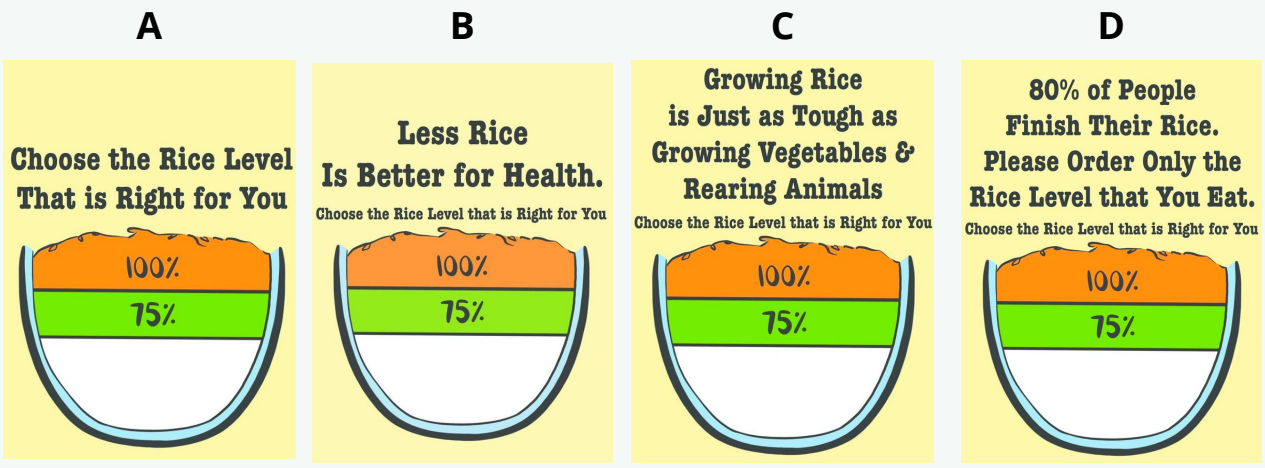


Figure 6 *Menu card prototype designs viewed by respondents in our pilot survey. From left: (A) Poster without additional messaging, (B)poster with health benefit messaging, (C) poster with mental accounting messaging, and (D) poster with social norm messaging respectively.*

When respondents viewed all four prototypes together, the minimal design without any additional messaging (Design A in Figure 6) was ranked as the best by more than half (23 out of 43), and in the top two by three quarters (32 out of 43) of the respondents.

Respondents who viewed this prototype by itself also reported wanting the lowest rice level on average, at 76.6% of the normal rice level.

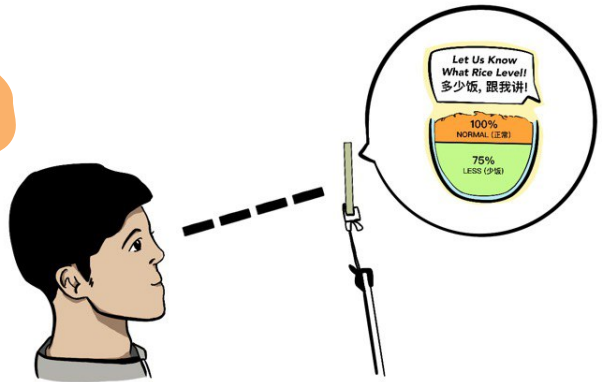
Due to the strong preference for the minimalist design among respondents. we maintained this minimalism in our final menu card (Figure 5).

Of additional note is that respondents reported that the social norm design (Design D in Figure 6) was the most likely to change their rice ordering behaviour. However, they also commented that additional messaging can appear as too wordy. Future designs that intend to incorporate the social norm or other types of messaging should stay clear and concise.

Our Strategy:
See, Ask, Order

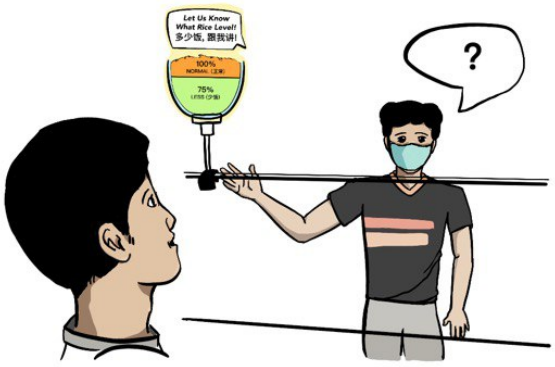
To avoid the pitfalls of previous posters, we placed our menu card in a salient position in the line of sight of customers (see Figure 8). We encouraged stall owners to give timely cues to customers, by actively asking customers to choose a rice portion. We hoped that this would increase the effect of the intervention. The flowchart below (Figure 7) illustrates the ordering process that we envisioned.

1



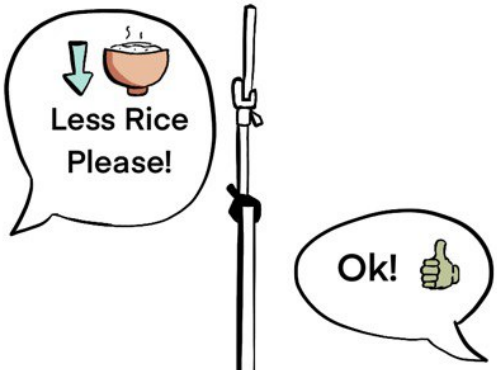
As customers approach the start of the queue, they will see the menu card and begin considering their desired rice level.

2



At the customer's turn to order, the stallholder gestures to the menu card and asks for the customer's desired rice level.

3



Finally, customers will tell the stallholder their desired rice level, order sides, and make payment at the counter.

Figure 7 *Flowchart illustrating the ordering process with our menu card installed.*

a

b

Figure 8 *Images of our menu cards (circled in red) installed at the mixed rice stalls at the intervention canteens of Food Clique (8a) and Technoedge (8b).*

3

Testing

We tested our menu card intervention at the mixed vegetable rice ("mixed rice") stalls of four different canteens within NUS. We chose mixed rice stalls as they generally see a much higher number of customers relative to other stalls within the canteens.

Since our project was carried out amid the COVID-19 pandemic, NUS eateries were selected from the beginning to buffer the possibility of pandemic constraints at external locations.

Our main measure was the individual rice orders of customers ("No Rice", "Less Rice", "Normal Rice" or "More Rice"). From 12.00pm to 1.30pm across three weeks, for three days each week, we stood by the mixed rice stalls at each of the four eateries (Fine Food, Food Clique, Frontier, Technoedge) to record every individual customer's rice order.

A secondary measure, rice waste amount, was collected from 12.00pm to 1.30pm every weekday across these three weeks. We enlisted the help of cleaning staff at the canteens to help us collect and weigh the rice waste.

However, we deemed it our secondary measure for two reasons. One, we could not directly assess the reliability of collection by the cleaning staff. Two, the majority of our samples took away their food, and we could not account for their wastage.

The compliance of stallholders in referring to the menu card and/or directly asking customers about their desired rice portion was also recorded.

Our data collection extended over three weeks (Figure 9). The first week was for baseline data collection, when all the mixed rice stalls were operating business-as-usual, without our intervention. For the next two weeks, the mixed rice stalls at two of the eateries received our menu card intervention (Food Clique and Technoedge) while the other two did not (Fine Food and Frontier).

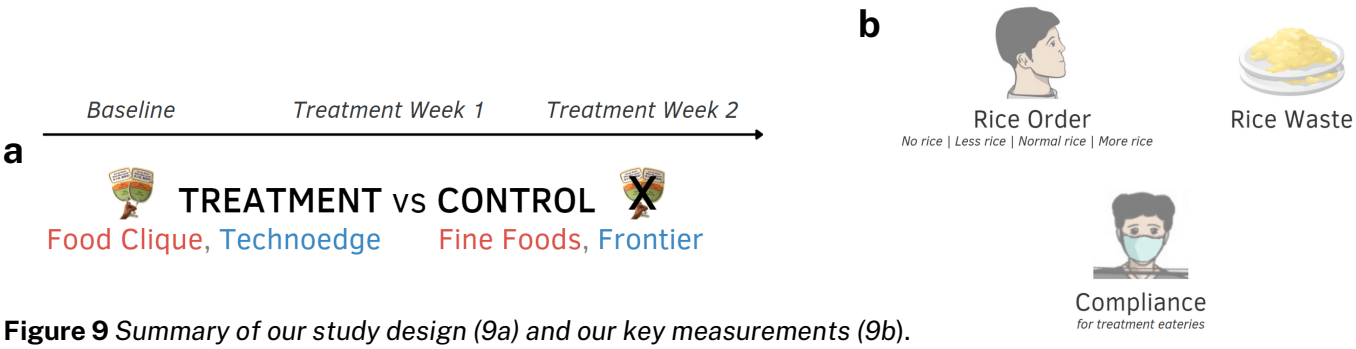


Figure 9 *Summary of our study design (9a) and our key measurements (9b).*

4

Findings

Our analysis of over 4000 customers across the three weeks of study revealed significant factors that affected their rice level orders:

1. **Menu card**
   When the menu card was present, customers were 2x as likely to order less or no rice.

2. **Takeaway**
   Customers who choose to takeaway are 1.2x as likely to order normal or more rice

3. **Gender**
   Males were 3x as likely to order normal or more rice.

Rice orders

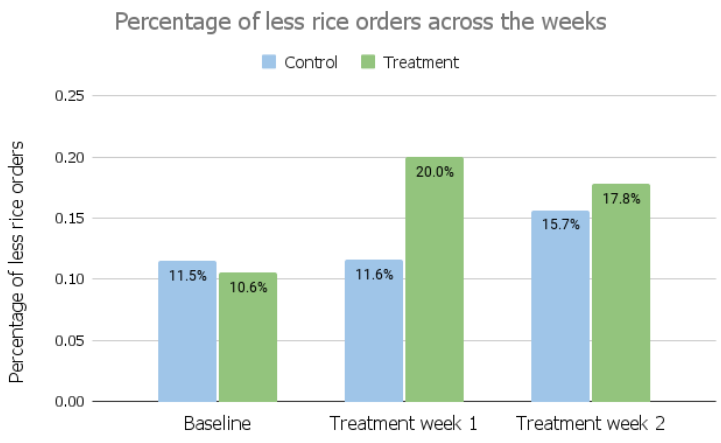


Figure 10 *Graph showing percentage of less rice orders at treatment and control eateries across the three weeks.*

As seen in Figure 10, the percentage of less rice orders increased in the treatment eateries during the treatment weeks as compared to the baseline, and this increase was larger than the natural increase seen in the control eateries.

From this, we infer that our intervention made a sizeable number of customers more aware and willing to request for smaller rice portions.

Rice waste

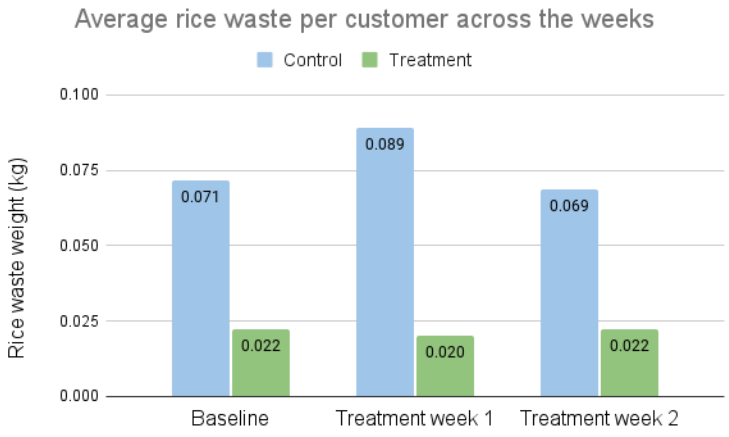


Figure 11 *Graph showing amount of rice waste at treatment and control eateries across the three weeks.*

We found that the average weight of rice waste produced per customer did not change much in our treatment eateries when the menu card was introduced (Figure 11). The weight remained around 20g per customer, or about 10% of a normal rice portion. While this sounds quite little, every bit of waste from each customer would accumulate to a lot.

Stallholder compliance rate

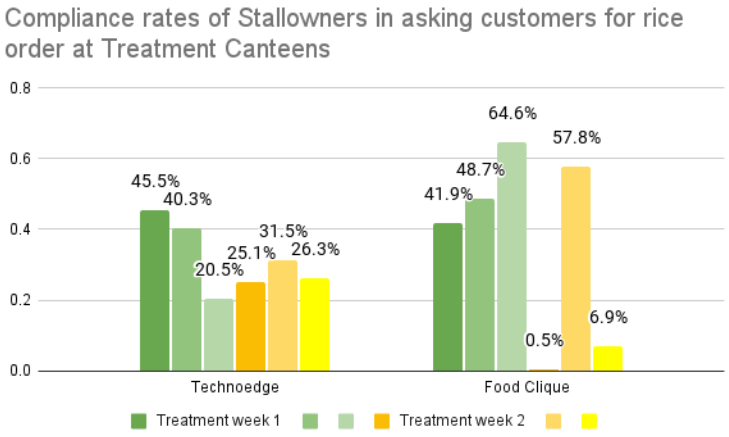


Figure 12 *Graph showing stallholder compliance rate in asking customers for rice orders at treatment condition canteens*

Both the Technoedge and Food Clique mixed rice stallholders had similar initial compliance rates in referring customers to the menu card and directly asking about desired rice portions. However, compliance rates fluctuated across the two treatment weeks due to contextual factors.

Building rapport with the stallholders at Food Clique corresponded to an increasing trend in compliance. There was less ability to build rapport with the stallholders at Technoedge, which corresponded to a decreasing trend instead.

Compliance at Food Clique also dropped drastically on two of the three days in Treatment Week 2, due to the introduction of a new staff member.

5

Recommendations

Based on both the successes and challenges of our project, we have a few recommendations to make for future studies or implementation of similar menu cards:

Recommendation 1:
Buying-in stallholders to participate in the initiative

The mixed rice stallholders were resistant towards taking up our intervention initially. We interviewed them to understand why, and found some common themes (see Figure 13).

First, all the stallholders mentioned that the active component of asking the customer about their desired rice portion is adding more work to their already busy routine during peak hours.

Second, some stallholders believe that most of the customers who want to adjust their rice level already ask them. They also believe that it is the customer's responsibility to tell them the

Figure 13 *Quotes from stall holders on why they were resistant to our intervention*

amount of rice that they want.

Third, stallholders also argued that this is an unconventional practice beyond their existing way of doing things, which makes them feel like it is not necessary.

To persuade stallholders about the importance of taking up new initiatives like ours, we discovered that building rapport goes a long way.

One way we can effectively persuade them would be by explaining the potential benefits for them through informal conversations. The experience of one of our team members, who was attached to the intervention canteen Food Clique, supports this.

She had a meal with the stallholders during non-peak hours and explained that our intervention could help them to reduce the amount of rice they need to prepare daily. Following this, our team observed a corresponding increase in compliance rate to the intervention at Food Clique when the stallholders she engaged with were working.

Recommendation 2:

Test the menu card-asking strategy for a longer period and outside of NUS.

We believe that our intervention has to be tested further to ascertain its effects.

Our study was conducted for a brief period of time, which made it difficult to rule out natural fluctuations in the behaviour of customers that order at the mixed rice stalls.

Furthermore, the result of our intervention may be attributable to novelty effects. A longer-term study would help to check if the effect of the intervention diminishes over time.

Testing in hawker centres and food courts outside of NUS is also crucial. NUS canteens may have different customer demographics, management, and food waste problems compared to outside locations. Studies of the intervention at outside locations will provide more insight into how to improve the intervention.

Recommendation 3:
Make it easier for cleaning staff in collecting rice waste

Cleaning staff at the NUS canteens faced difficulties separating rice waste from the mixed rice stalls from other rice selling stalls. This affected the reliability of our secondary measure (rice waste weight) and made it hard for us to see the tangible impact of our intervention.

To circumvent this, we propose that our intervention be implemented to all other rice-selling stalls within the eatery. This would minimise the need to separate rice waste from particular stalls. A bonus is that this would allow the study to assess the intervention's effectiveness in a larger sample and beyond mixed rice stalls.

6 Conclusion

To sum up, our menu card increases less rice orders by customers. Our study demonstrates the potential for using menu cards to remind and prompt customers to tell stallholders how much rice they want. The menu card-asking strategy has great potential to be scaled up, due its low cost.

That said, the biggest challenge in implementing it is the buy-in of stallholders. Convincing them that their effort to ask customers benefits not only the environment, but also themselves, will go a long way to improve the rice waste situation.

At the end of the day we hope to create a norm where consumers are more conscientious about choosing appropriate rice portions for themselves.

References:

1. Ministry of Sustainability and the Environment (2021). Food Waste. Retrieved from https://www.towardszerowaste.gov.sg/foodwaste/
2. Ministry of Sustainability and the Environment (2021). Written Reply to Parliamentary Question on Food Sustainability Habits by Ms Grace Fu, Minister for Sustainability and the Environment. Retrieved from https://www.mse.gov.sg/resource-room/category/2021-02-24-written-reply-to-pq-on-food-sustainability-habits/
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Technical Annex

This annex summarises the empirical element of the trial. It provides detail on our design considerations and the statistical analysis through which we obtained our results.

Quasi-randomised control trial

Our initial cluster randomised control trial (RCT) design was to match the eateries according to demographic similarities, such that the eateries with similar demographics would each be randomly allocated to either control or treatment. However, there were limitations posed by the eateries that prevented us from fully randomising whether each eatery received the control or treatment condition. During our preliminary observations, we noticed that Fine Food had the fewest customers– about a third of the customer volume in the other 3 eateries (Figure 1). We also realised that the rice wastage came mainly from the 20% of customers. If Fine Food were randomly allocated to the treatment condition, it might be too small a sample size to capture those 20% of customers. Consequently, it would be difficult for us to detect any effect our menu card intervention had on the rice orders and rice wastage. As having significant power was important for us to draw more accurate conclusions about the population, we deliberately chose Food Clique as our treatment eatery instead of randomly choosing between Food Clique and Fine Food.

Location	Week 10	Week 8	Week 9
Fine Foods	182	156	176
Food Clique	519	426	469
Frontier	443	461	393
Technoedge	516	449	525

Figure 14 *Sample sizes across the three weeks. Week 8 is for the baseline measurement. Weeks 9 and 10 are treatment weeks 1 and 2 respectively.*

Mixed effects model

We use a mixed effects model because we have a hierarchy of levels. At the top level, we have the eateries. At the lower level, we have customer rice orders within each eatery. The lower level measurements that are within the same upper level unit are correlated, because of two possible reasons: a) each upper level unit has various aspects that affect all of its lower level measurements similarly, and b) the lower level measurements are repeated measures of the same customers over time, and each customer would have consistent rice orders. For example, stall holder factors such as their agreeableness to ask customers for their rice order and their style of asking customers would affect all customers in an eatery similarly. Customer-specific factors, such as their hunger, their agreeableness to specify their rice order, and the stall holder's decision to ask some customers but not others, would also affect all rice order measurements for each customer. The treatment (i.e. menu card intervention) was applied randomly to the upper level units (i.e. the eateries), so the random variable was the eatery. The fixed variables were the presence of the menu card, whether customers chose to takeaway and customer gender.

```
Call:
mixed_model(fixed = Rice2level ~ Menucardb + Conditionb + Takeawayb +
    Genderb + UTown + Week + Dayb + Genderb * Conditionb + Conditionb *
    Menucardb, random = ~1 | FoodCourtID, data = MSEdata, family = binomial())

Data Descriptives:
Number of Observations: 4715
Number of Groups: 4

Model:
 family: binomial
 link: logit

Fit statistics:
   log.Lik      AIC      BIC
 -2238.874 4499.748 4492.998

Random effects covariance matrix:
              StdDev
(Intercept) 0.1814614

Fixed effects:
                        Estimate Std.Err z-value  p-value
(Intercept)               1.2508  0.5806  2.1545 0.031202
Menucardb1               -0.7611  0.1503 -5.0631  < 1e-04
Conditionb1              -0.9044  1.1980 -0.7550 0.450278
Takeawayb1                0.1854  0.0760  2.4398 0.014694
Genderb1                  1.0496  0.0816 12.8628  < 1e-04
UTown1                    0.2750  0.2030  1.3549 0.175462
Week                     -0.0368  0.0652 -0.5646 0.572330
Dayb                     -0.0328  0.0227 -1.4436 0.148844
Conditionb1:Genderb1      0.0077  0.2233  0.0345 0.972497
Menucardb1:Conditionb1    1.4665  1.1960  1.2261 0.220156

Integration:
method: adaptive Gauss-Hermite quadrature rule
quadrature points: 11

Optimization:
method: hybrid EM and quasi-Newton
converged: TRUE
```

Figure 15
R output for mixed effects model showing the predictors of customers' rice orders.
Output: Rice2level = Whether customer orders normal/more rice.
Input: Menucardb1 = Presence of menu card, Conditionb1 = Whether stall holder asks the customer, Takeawayb1 = Whether customer takeaways, Genderb1 = Male(1), Female(0), UTown1 = Whether the eatery is situated in UTown, Week = Week of study, Dayb = Day of the week, Conditionb1:Genderb1 = Interaction variable of whether stall holder asks and gender, Menucardb1:Conditionb1 = Interaction variable of presence of menu card and whether stall holder asks.
Random variable: FoodCourtID = Eatery

The model provides the log odds of ordering normal/more rice given one unit increase in the predictor (binary) variables. To interpret the odds of ordering normal/more rice for a specific predictor, take the exponential of the respective coefficient. For example, taking the exponential of the takeaway coefficient gives 1.20, which is interpreted as "customers who choose to takeaway are 1.2 times more likely to order normal/ more rice".

To interpret the odds of ordering less/no rice for a specific predictor, take the inverse exponential of the respective coefficient. For example, taking the inverse exponential of the menu card coefficient gives 2.14, which is interpreted as "when the menu card was present, customers were twice as likely to order less/ no rice".