Gender, Age, and Peer Influence on Food Incentives in Schools*

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1 Introduction

In this paper, we will provide a deeper analysis and reproduction of the paper, *Incentives and Unintended Consequences: Spillover Effects in Food Choice* (Angelucci et al. 2019). Replications of Table 1, Figure 2 and 3 were also completed from the raw data in which the original paper is based. The original study was conducted on 1631 students from various elementary schools in a low-income neighborhood in Chicago, IL, from kindergarten to grade 8. The purpose of the study was to determine whether there were spillover effects of students making decisions based on their peers' decisions as well as the incentives given to their peers. The study consisted of two stages. In the first stage (G1), each student was given a card from a deck which offered the choice of cookies or grapes, where the grapes sometimes came with a prize as an incentive to be chosen. In the second stage (G2), each student was given the opportunity to change their choice of food based on the initial decisions of their peers. Students were sat in tables of sizes up to 10 students, in which the proportion of cards in the deck that contained incentivized grapes were 0%, 50%, or 100%. Furthermore, some tables were designated as public treatment, in which students were able to see the incentive status of their peers, and some tables were designated as private treatment, in which students were unable to see the incentive status of their peers.

The remainder of this paper is structured as follows. In Section 2, we compile the subset of data that strictly includes the students that took part in the public treatment study and not the private treatment study. Students were offered more information to advise their final decisions by being able to see the incentive status of their peers. In Section 3, we dive deeper

*Code and data are available at: https://github.com/SamanthaBarfoot/food-incentive-analysis.git The Social Science Reproduction DOI is: https://doi.org/10.48152/ssrp-s4sw-c494

into analyzing possible factors that may influence a student's final food choice in stage G2. We leverage `ggplot2` by creating bar graphs to represent the grouped data for the various factors that were analyzed. Finally, in Section 4, we summarize our results and also identify other factors or biases that may have affected the results, on a qualitative or quantitative level.

The graphs and tables in this paper were created in R Studio using R (R Core Team 2023) and the analysis in a Quarto document. The analysis was conducted with the use of the `ggplot` (Wickham 2016), `tiddyverse` (Wickham et al. 2019), `knitr` (Xie 2021), `kableExtra` (Zhu, Travison, and Tsai 2024), and `dyplr` (Wickham et al. 2023) packages. The replications of the original graphs and tables were completed with the `semiPar` (Wand 2018), `janitor` (Firke 2023), `tiddyverse` (Wickham et al. 2019), `knitr` (Xie 2021), `tibble` (Müller and Wickham 2023), and `kableExtra` (Zhu, Travison, and Tsai 2024) packages.

2 Data

The original study data included 1631 students, in which the incentive status, public or private, table size, table incentive proportion, sex, race, eligibility for free lunches, and food choices for both stages G1 and G2 was compiled for each student. By filtering out the original data to only show students who participated in the public treatment, the sample size reduces from 1631 students to 883 students, representing roughly 54% of the original sample size. Table 1 summarizes all the students at public treatment tables, with a subset of columns displayed representing some of the factors to be analyzed in Section 3. Comments regarding data cleaning methods are mentioned in Section 4.

We separated each student into 4 subgroups, based on the following criteria:

- Public and 0% of the card deck is incentivized,
- Public and 50% of the card deck is incentivized where the student is not incentivized,
- Public and 50% of the card deck is incentivized where the student is incentivized, and
- Public and 100% of the card deck is incentivized.

In the Table 1, the results are generally consistent across the 4 subgroups, in which there is low variance among the values in the various columns. This more-or-less even distribution of the races, genders and grades of students across tables of varying incentive levels speaks to the efficacy of the randomness that was intended in the original study. In the next section, we will dive into analyzing the correlation of several individual factors and the choices made in stage G2.

Table 1: Summary statistics for the four different public observation: 0% of the card deck is incentivized, 50% of the card deck is incentivized where the student is not incentivized, 50% of the card deck is incentivized where the student is incentivized, and 100% of the card deck is incentivized

Group	Observations	Table Size	Percent of boys	Grade	Black	Hispanic	Free Lunch
Public-0	268	6.51	0.47	4.07	0.34	0.58	0.8
Public-50-no incentive	238	6.42	0.47	3.68	0.39	0.48	0.8
Public-50-incentive	206	6.51	0.47	3.69	0.37	0.49	0.8
Public-100-incentive	171	5.98	0.49	3.83	0.39	0.56	0.8
Total	883	6.39	0.47	3.83	0.37	0.53	0.8

3 Results

To determine whether there is a certain characteristic in students that might influence the decision made in stage G2, particularly their grade, gender, or their eligibility for free lunches, bar graphs were created that group the public student's data based on each of the chosen factors.

To begin our analysis, we created a graph, Figure 1, of the frequency of students that either switched their final food choice or kept the same food choice, grouped by the grade of the student. Grade 0 represents students in kindergarten. Figure 1 gives an overview of the public data across all levels of table incentivises, in which students were able to make their final choice based on their peers' initial choices and incentive statuses.

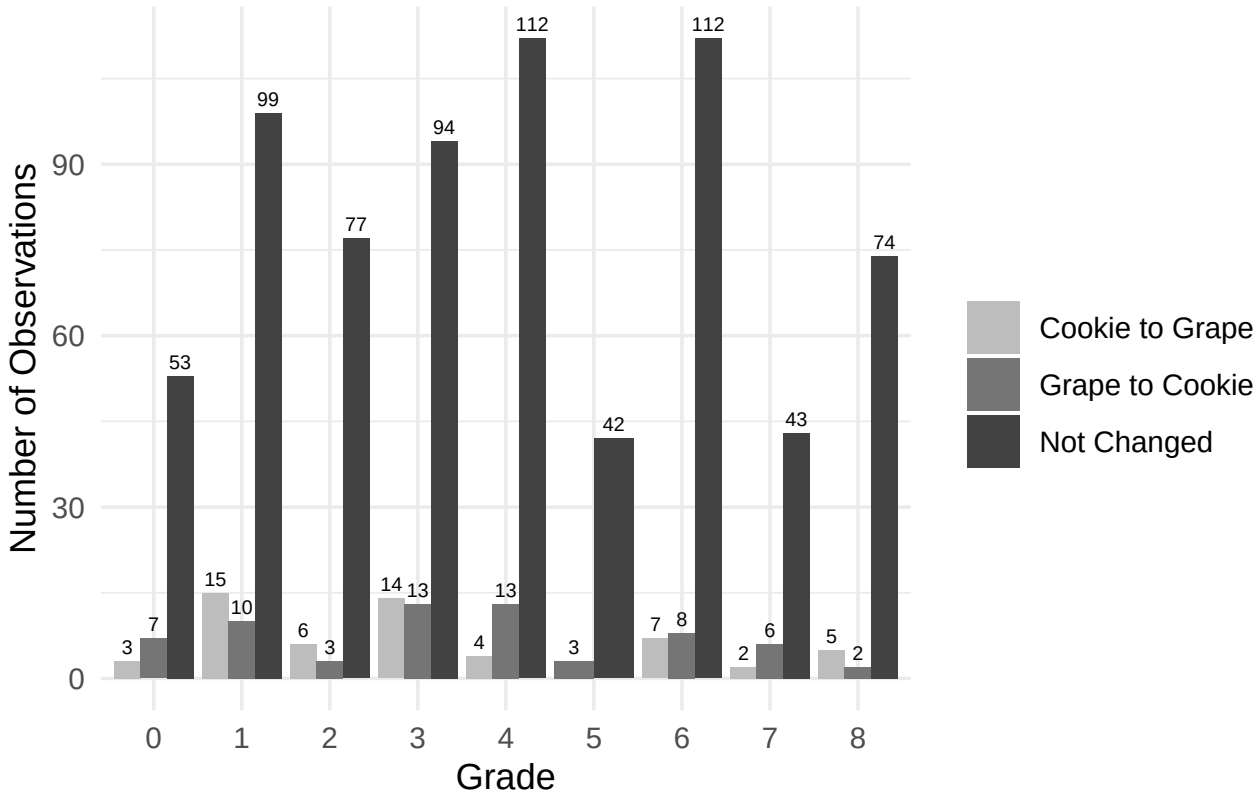

Figure 1: Students food choices from stage G1 to G2 comparing grape to cookie, cookie to grape, or no change.

It is evident that when aggregating all the public tables, including the incentivized and non-incentivized students, that the majority of students across each grade kept their initial food choice as their final food choice. Additionally, the number of students that switched from one food to the other was approximately even for both scenarios (56 switched from Cookie to Grape, 66 switched from Grape to Cookie).

To analyze the individual factors and observe their effect on incentivized students choosing grapes or cookies as their final choice, we compared all incentivized students who kept grapes as their final choice with whether or not the students were eligible for free lunches. This can be seen in Figure 2.

We can see in Figure 2 that the proportion of students choosing the incentivized grapes that are eligible for free lunches is 94%. We can compare this to the expected value of 86% since the proportion of all students in public tables whom are eligible for free lunches is 0.86 as shown in Table 1.

We can also examine the proportion of incentivized students that chose grapes compared to cookies, grouped by grade in Figure 3.

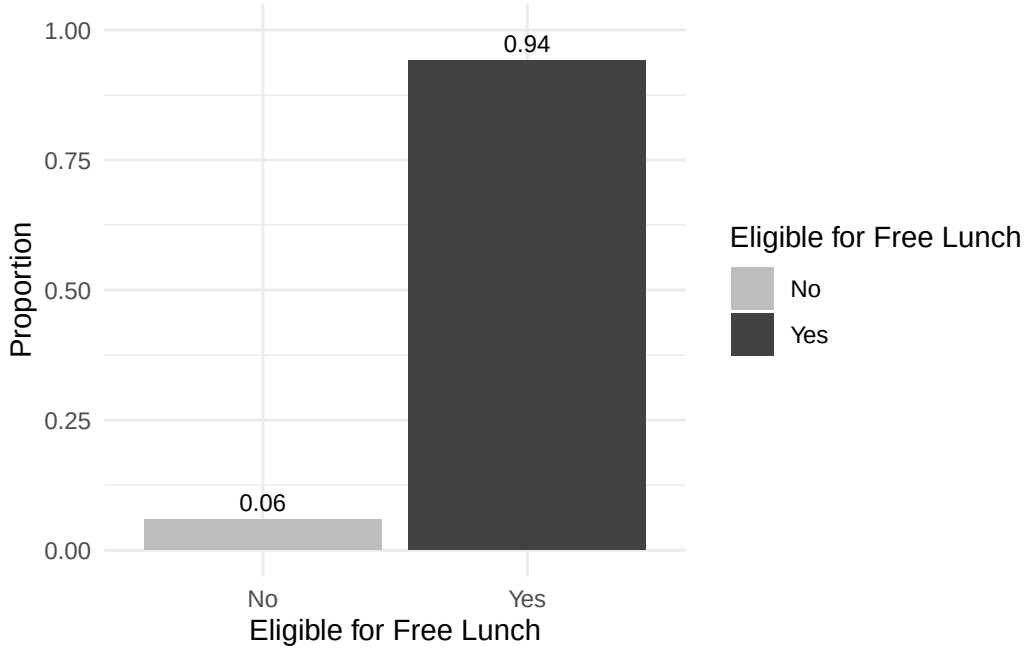

Figure 2: Comparing incentivized students choosing grapes if they are eligible or not eligable for the free lunch program

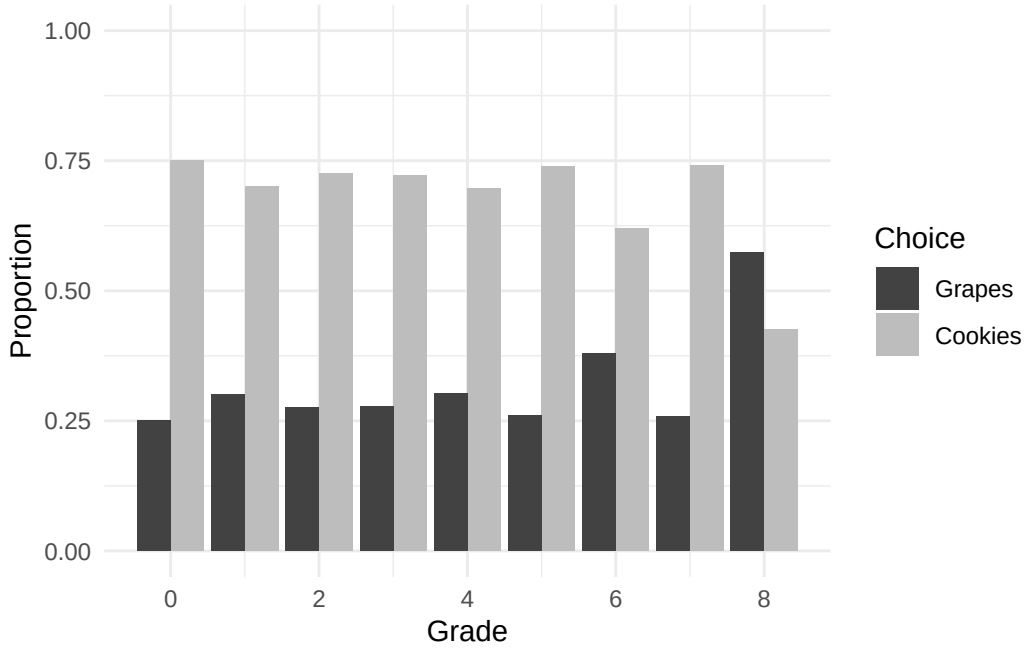

Figure 3: Comparing incentivized students choosing grapes or cookies by the students grade

We observe that from kindergarten to grade 8, the proportion of students choosing cookies in the final stage is around 60-75%, with the majority of grades being closer to 75%. However, for students in grade 8, the proportion of students choosing cookies was less than the proportion of students choosing the incentivized grapes, as only roughly 40% of students chose the cookies. This is a considerable drop compared to all of the lower grades. This may indicate that the older students are more inclined to choose the food option which also gives them the opportunity to win a prize, and that they are less influenced by the food option itself.

Finally, Figure 4 compares the food choices of boys and girls students who were incentivized to choose between grapes and cookies. It appears that there is not much difference between boys and girls when it comes to their choices between grapes and cookies. Both genders have a slight preference for grapes and the percentage of students who choose grapes or cookies is almost the same for both genders. From our Figure 4 analysis, summary statistics were calculated, which indicate that, on average, around 31% of boys and 35% of girls chose grapes as their final food option, while approximately 69% of boys and 65% of girls chose cookies. These statistics highlight the balanced distribution of food choices among genders within the incentivized students, suggesting that there is limited gender-based influence on decision-making in this context. In conclusion, it appears that isolating based on gender has the least variance or impact on the final food choice among incentivized students compared to the other factors analyzed.

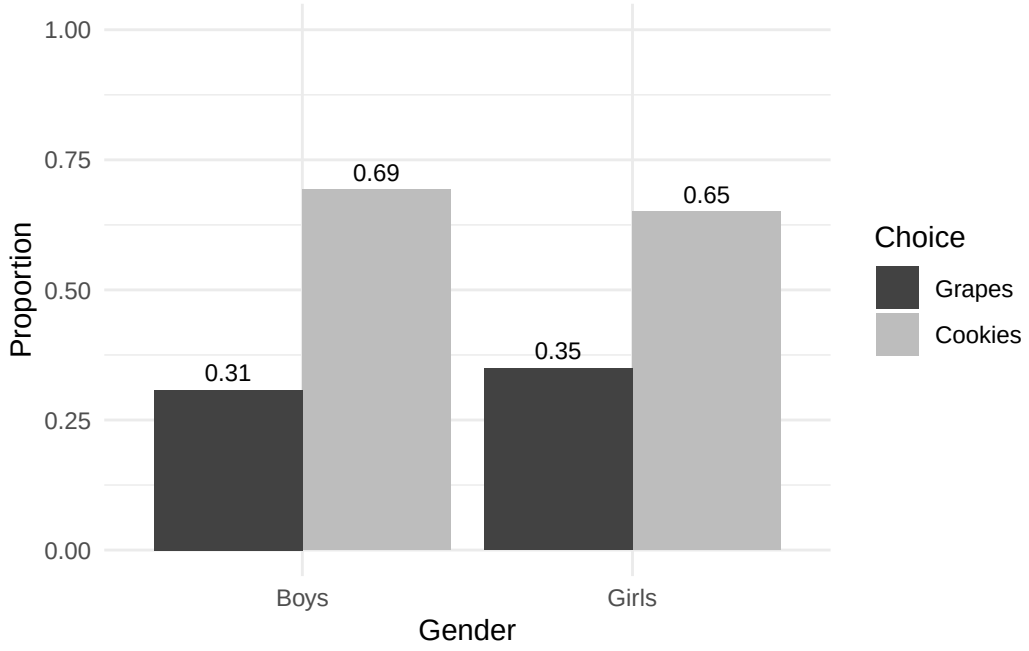

Figure 4: Comparing incentivized students choosing grapes or cookies by the students gender

We will now also create two grouped bar graphs which show the progression of the students' food choices from stage 1 to stage 2; first for public, non-incentivized students, then followed

by a graph for public, incentivized students.

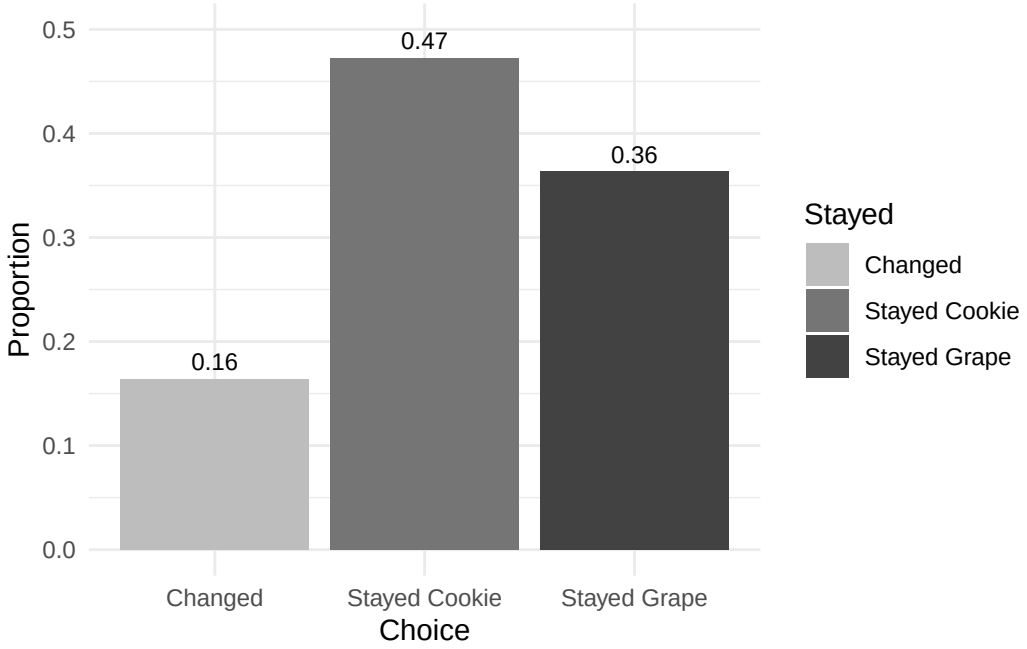

Figure 5: Comparing the proportion of students in the public group who recieved no incentive and whether or not they stayed with their initil choice of cookie or grape or if they switched.

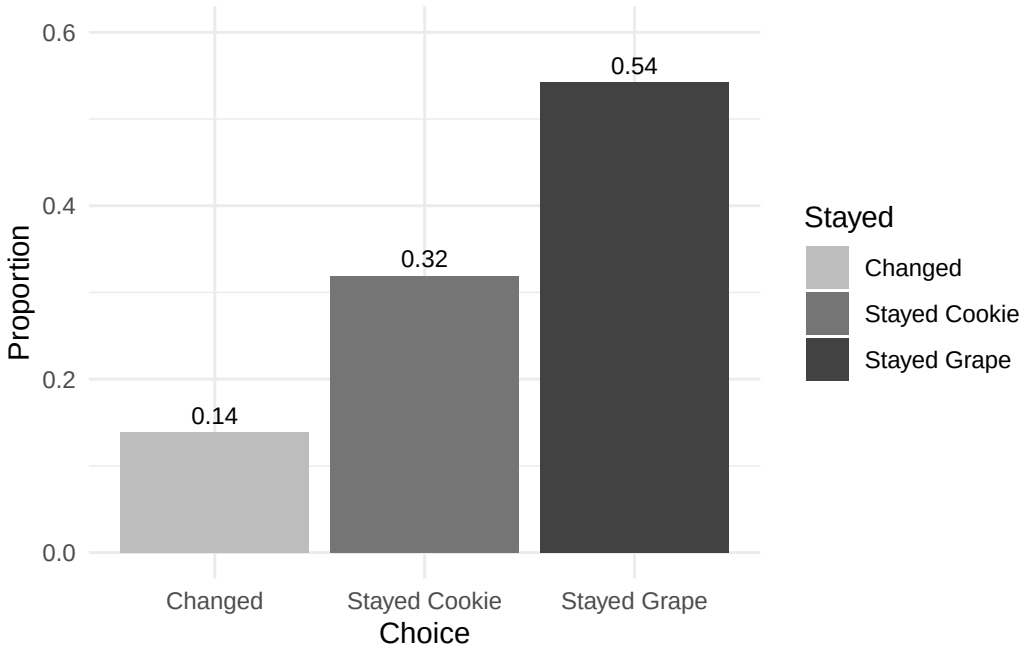

Figure 6: Comparing the proportion of students in the public group who recieved an incentive and whether or not they stayed with their initil choice of cookie or grape or if they switched.

We view from these two graphs that the impact of incentivization leads to a higher proportion of students who choose the grapes in the final stage compared to the cookies. We will discuss this further in the discussion section.

4 Discussion

4.1 Gender, Age, and Free Lunch Eligibility Influences on Food Choice

This paper replicated and reproduced certain aspects of the paper *Incentives and Unintended Consequences: Spillover Effects in Food Choice* (Angelucci et al. 2019). Figure 2 and Figure 3 were replicated using the original raw data provided in the replication package as well as Table 1. We discussed the original study and how they conducted their research as well as their original conclusions.

The purpose of our paper was to analyze the influence that age, gender, and free lunch eligibility may have had on a student's food choice in a public setting where other peers' choices and incentive status were visible to all students at the table. Incentive status plays an important role in affecting each student's food choice decision, as the possibility to win a prize is offered to an incentivized student when that student chooses grapes. The results of these individual

analyses are mentioned in the Results section. To begin the discussion of our analyses, we will first look at the results for Figure 2, in which the impact of free lunch eligibility on incentivized students' food choices is analyzed.

In Figure 2, we observed that the proportion of all incentivized students with free lunch eligibility who chose the grapes was 94%. This amount exceeded the expected proportion of 86%, which is the proportion of all students with free lunch eligibility who participated in the public setting. One assumption for this higher weighting in students with free lunch eligibility choosing the incentivized grapes, is that these students represent the lowest-income demographic of the student body, which is already located in a low-income neighborhood in Chicago. For students who already receive free lunches from the school on a daily basis, the difference in taste or nutritional value between the cookies and grapes may take a backseat to the appeal of potentially winning a prize, simply by choosing the grapes over the cookies.

Next, we discuss the results for Figure 3, in which the impact of grade on incentivized students' food choices is analyzed.

In Figure 3, we can observe that most students from kindergarten to grade 7 selected cookies as their food choice in the final stage of the study. Meanwhile, students in the oldest age group, the grade 8 students, were the only age group to have more students select grapes as their food choice. As well, the grade 6 students had the second highest proportion of grapes chosen after the grade 8 students. This might imply that either the oldest students were more influenced by the potential of winning a prize, or simply value the nutritional aspect of the grapes over the cookies, separate from the prospect of winning a prize. Additionally, the kindergarten students had the lowest proportion of students selecting cookies as their food choice. The grade 8 students also had one of the largest percentages of the age groups where the students did not change their food choice at 91%. Whereas, the younger grades had more students choosing to switch their food choices. Only 84% of kindergarteners, 79% of 1st graders, and 77% of 3rd graders kept their initial choice.

Finally, we discuss the results for Figure 4, in which the impact of gender on incentivized students' food choices is analyzed.

In Figure 4, we noticed that gender did not play nearly as much of a role in food choice as grade or free lunch eligibility did. There was very little difference between the tendencies of grape or cookie choice between the boys and the girls, evident in the fact that 31% of boys chose the incentivized grapes and 35% of girls chose the incentivized grapes. In the experiment, the frequency of public/private setting, incentivized levels, and distribution of incentiveness was completely randomized for all students, regardless of their gender or other identifying characteristics. Students were able to choose, to some degree, which other students would sit at their table. It is likely that for the most part, boys would choose their male friends to sit with them, and girls would choose their female friends to sit with them. Thus, the tendencies of students who made their decisions based on incentive status, personal preference, and perhaps peer pressure from their friends, would have been structurally similar for both boys and girls.

In summary, we analyzed the final food choices of public, incentivized students by their free lunch eligibility, grade, and gender. For free lunch eligibility, there was some significance observed in the proportion of incentivized students choosing grapes (94% eligible for free lunches), compared to the expected amount of 86% students being eligible for free lunches. For grade, there was some significance observed in the grade 8 students choosing grapes at a much higher rate compared to all previous grades, along with the grade 6 students choosing grapes at the second highest proportion relative to their grade, implying some correlation between maturity (or simply older age) and the choice of incentivized grapes. Finally, for gender, there was no significance observed in the tendencies of boys and girls choosing the incentivized grapes.

4.2 Progression of Non-incentivized Student Food Choices

To analyze the potential influences of incentivization on students' final food choices from a less granular or more general overview, we will discuss the results for Figure 5, in which we categorized all non-incentivized students based on the progression of their food choice from stage 1 to stage 2. There were three groups that these non-incentivized students were binned to: 1) Students who changed from cookie to grape or grape to cookie, 2) Students who stayed with cookies, and 3) Students who stayed with grapes.

This graph is important because this data includes only students who didn't have the opportunity to win a prize regardless of their food choice, which meant that students chose the food that they wanted to eat separate from any incentive. Figure 5 indicates that almost half of these students (47%) chose cookies from the start and stayed with their decision. This was 11% higher than the proportion of students that stuck with their choice of grapes. As a contrast, only 16% of public, non-incentivized students changed their decision after viewing the food choices of other students at their tables. This may be due to the students having a change of appetite, or due to seeing their friends/peers choosing a different food which influenced them to change their choice. Note, that these three percentages add up to 99% due to individual rounding.

4.3 Progression of Incentivized Student Food Choices

We now discuss the results for Figure 6, in which we categorized all incentivized students based on the progression of their food choice from stage 1 to stage 2. Similar to Figure 5, there were three groups that these incentivized students were binned to: 1) Students who changed from cookie to grape or grape to cookie, 2) Students who stayed with cookies, and 3) Students who stayed with grapes.

This graph is equally as important to consider as Figure 5 because this data includes only public, incentivized students who had the opportunity to win a prize by choosing the incentivized grapes instead of the cookies. Figure 6 indicates that more than half of these students

(54%) chose grapes from the start and stayed with their decision,which was 22% higher than the proportion of students sticking with their choice of cookies.

As a comparison to the previous discussion point, we are able to see the impact of incentivization more clearly on students' final decision to stay with the incentivized grapes compared to staying with the non-incentivized cookies. This graph also shows that only 14% of students made a change after seeing what food their peers chose. This proportion is even lower than observed in Figure 5 where 16% of students changed their food choice, meaning that incentivized students were slightly more likely to stay with their initial decision. As these students already had to weigh the benefits of choosing the incentivized grapes in the initial stage before even viewing their peers' choices, and also weigh these benefits with their personal preference for grapes and cookies, it is conceivable that they would be more confident in maintaining their initial food choice.

4.4 Weaknesses and next steps

Speak about any holes in our analysis or perhaps the original study. One point worth mentioning may be the fact that the study was undertaken in a low-income neighborhood in Chicago. When introducing the incentive factor in the public treatment, the spillover effect may be magnified as these elementary students may be more influenced to alter their final food choice and choose the incentivized grapes, compared to students surveyed in more affluent neighborhoods who may not be as swayed by the option of a prize.

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