

Is there a decrease in food waste in a male high school cafeteria setting when students are offered incentives to eat their food?

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ABSTRACT

There appears to be an alarming amount of food waste among first world countries. This is especially true in school cafeterias in the United States. This food waste creates a double track of negative effects: the resources required to produce it and the effort required to dispose of it. A possible solution to reduce food waste in male teenagers is to create a positive reinforcement for eating their whole meal. This study determined the effect of offering an incentive as an intervention in a high school cafeteria setting to decrease individual food waste among high school students. Seventy four male high school students were studied under a control phase in which normal levels of individual food waste were assessed and under an experimental phase, in which a cookie was given if all the food was consumed. The incentive resulted in a 64.5% reduction in individual food waste in the high school cafeteria. This strategy could be implemented in similar settings to help decrease food waste.

Introduction

A whopping 40% of food produced around the globe will end up, sooner or later, in a landfill or wasteland (Stuart, 2012). This includes about 20% that is lost throughout the supply chain from harvest to supermarket and the other 20% is lost from food that is simply not eaten and thrown away (Papargyropoulou et al, 2014). The incredibly alarming rate of inefficiency and unsustainability of our food waste does not stop there. First world countries produce four times as much food as they need. Partially due to the fact that our brains are quite simply very bad at sizing up our meals (Chandon, 2016) and we prefer a certain aesthetic of the food and desire to only eat “good looking food” (Stuart, 2012). Around half of vegetables and fruits are thrown away because of how they look, whether it is a deformity or “weird look” (Stuart, 2012).

This selective eating preference combined with the food waste in supermarkets and restaurants end up not only being much more economically expensive but also environmentally unsustainable. An analytical review conducted by the Departments of Economics, Business Management, and Law at the University of Bari Aldo Moro in Italy analyzed the global warming effects that food waste created (Amicarelli, 2021). This review focused on the “double track” of food waste, which refers to the two cycles of food waste that cause climate change, (1) the use of resources to create the food, and (2) the disposal of it (Amicarelli, 2021). The double track effect is devastating in terms of the usage and effects of resources. In order to produce food, large quantities of water are needed, fertilizer for crops is utilized which can cause algae blooms and negative environmental effects, and greenhouse gasses such as carbon from vehicles and methane from cows are produced. To dispose of the food waste, trucks and landfills create fossil fuels and greenhouse gas pollutants. It has been estimated that China single handedly created 38 million tons of carbon dioxide only from the disposal of food waste (Liu et al, 2021). To offset this amount of carbon, a total of 250 million trees would need to be planted. Therefore, food waste is a loss-loss scenario, everytime, for the environment.

Fortunately, food waste reduction efforts have been introduced all around the world with food banks and

movements to eat “ugly vegetables” (Environmental Protection Agency, 2021). Unfortunately, food waste levels still remain alarming in the United States (US) schools. Not only is this bad for the environment but it is costly and inefficient. Schools waste an estimated 530,000 tons of food each year or around 40 pounds per student in the US, which costs \$1.7 billion nationwide, the equivalent of \$9.3 million worth of food being thrown out everyday (Gingerella, 2019). In addition, the US is far behind other first world countries, accounting for a higher rate of food waste in US school cafeterias compared to European school cafeterias, as evidenced in a study conducted by researchers from the University of Bologna and later reviewed by Dr. Christina Costello, an expert of Industrial Ecology from Penn State. That study found that schools in Sweden wasted 23% of food served, in Italy and Spain it was from 20-30%, while the US had around 50% of food served wasted (Mulhollem, 2021)

Due to this growing problem, several studies have experimented on how to reduce food waste in school cafeterias. One study found a decrease in food waste of a cafeteria when farmers were brought to talk to the school children about their job, which made the children more aware of the problem. Placing signs warning of “Only get what you can eat” were also found to be effective (Nargi, 2019). Another study did a review of 300 interventions to reduce food waste and found that the most effective strategies were informational or nutritional guidelines campaigns, with around 30% food waste reduction each, and plate interventions with around 50% reduction (Reynolds et al, 2019). The plate-size interventions consisted of limiting the number of plates available and actually reducing the size of the plate (Kerameas et al, 2015); this intervention was effective due to the simple human nature of Unit Bias, or the innate desire to eat a complete unit, in this case one plate of food. Another study conducted in Italy found that the food service provider, and repetition of the menu were the main causes of food waste in the overall cafeteria (Boschini 2019).

All these studies have been for the most part effective at pinpointing and reducing food waste in a whole cafeteria system. Very few, however, focused on the food waste generated individually. One experiment motivated participants to reduce their individual food waste by showing them signs and pictures of the negative effects of food waste and inducing guilt (Reynolds et al, 2019). Although this was effective, no studies to this date have experimented with positive motivation. Therefore, a study that investigates the effects of offering positive motivation for male teenagers for eating their food in a school cafeteria could provide insightful results.

Studies have shown that offering positive reinforcements through rewards and incentives tend to be more effective at motivating teenagers as compared to adults who tend to respond more to threats and a possible negative reprimand (Palminteri et al, 2016). Also, positive reinforcement has been found to be better at creating and building motivation in students, while negative consequences such as punishments were better at maintaining motivation (Faud et al, 2021). Therefore, a research experiment that aims to create motivation to eat all of the food and that focuses purely on positive reinforcement may be more effective, but research is needed to test this hypothesis.

Recent scientific research also suggests that women tend to think more about the negative consequences of throwing food away and creating food waste (Cantaragiu, 2019). Even though it is estimated that men and women have about the same amount of food waste, the reasons for food waste differ. For example, women produce more food waste when shopping and cooking, because they buy and cook more than is needed (Nguyen, 2021). Men however, produce more food waste by not consuming all the food in their plate since they feel less guilty about throwing it away (Cantaragiu, 2019). In a cafeteria setting, since the students are only getting served, it is more likely that males will throw away more food and therefore create more food waste. Therefore, a research experiment that focuses on male teenagers, who are more likely to be negligent towards the negative effects of food waste and tend to be less guilty about it than women, would provide a more clear result.

The proposed research experiment would answer the following gap of knowledge: Is there a decrease in food waste in a male high school cafeteria setting when students are offered incentives to eat their food? The hypothesis is that incentives will motivate male teenagers to eat all their food and reduce the overall individual food waste in a cafeteria. This question can be answered through an experimental case study.

Research Design and Methodology

General Design

This was an intervention study to determine the effects of an incentive to reduce individual food waste in male students in a high school cafeteria setting that utilizes an “all you can eat” salad bar and a main serving line for the entree. The study was approved by the Institutional Review Board of the school.

Population

The participants in this study consisted of 16-18 year old high school male students from a private catholic school. There were no criteria for exclusion based on weight, demographics, or exercise.

Sample

The goal of the sample was to recruit 70-80 participants, as this is a convenient and feasible sample for the researcher. This sample would allow for dropouts and for lack of participation.

Recruitment

Male high school students were recruited by sending several emails and messages to the entire junior and senior class. The emails contained vague instructions and the chance to win monetary and edible prizes for their participation. The messages never mentioned how a participant could win the prizes or the hypothesis or the purpose of the study. Those interested in participating were asked to sign up via an online airtable sign up sheet, which asked for basic information such as name and phone number.

Exposure or Intervention

The intervention of the study was an incentive provided to the participants for consuming all their food. The type of incentive was determined via a pilot survey among a small sample of male students from the same high school to explore their perception on the most effective incentive to reduce the amount of food wasted in the cafeteria. It was found that a small dessert or candy would prove to be most motivating. Individually packed Oreo cookie bags were used as the incentive, which were generously donated by the Mondelez company. The donation was sufficient to last throughout the experimental period and it allowed for the incentive to remain constant.

Outcome variable

The outcome variable was the amount of food wasted. This was measured by weighing all the foods, including plates from all participants at the end of the school lunch in a large plastic bag. Cups and any liquids were not included since it would skew the result due to their heavy weight. Participants were asked to turn in their plates (regardless of what they ate) in the study bag. This study bag was situated in a specific corner of the cafeteria controlled by the researcher during data collection. Participants were not allowed to throw the food anywhere else and volunteers helped supervise that all the food was being placed in the study bag. The study bag was measured at the end of each meal in duplicates using an analog luggage type of scale in pounds. The total weight was used to calculate total waste per day and also the average waste per participant by dividing the total weight by the number of participants that provided their food waste every day. Food waste from all participants was measured for 4 consecutive days during each phase, as described below.

Procedures

The study consisted of two phases. The control (first phase) and the experimental (second phase). Each phase consisted of 4 days of measurements. Since the menu cycle varies every 4 weeks or roughly every 20 school days, the second phase was completed 4 weeks after, during the same menu cycle to reduce variability between phases. Participants were sent instructions about the study via a group chat and were asked to sign-in with the researcher in the cafeteria every day to record who came each day of data collection.

- Phase 1: participants were instructed to throw away all their food waste, regardless of what they ate, in the study bag. No other information was provided. This phase served as the control phase as the students were blinded about the procedures for the second phase. Empty plates and full plates alike were included in the waste measurement to guarantee uniformity and a valid result. Therefore, the participants were explicitly told that they had to bring their empty plates if they had eaten all of their food.
- Phase 2: the procedures were similar but an incentive (an Oreo cookie) was given to those participants that had no food waste, or an empty plate. Participants were informed that eating all of their food earned them the incentive. The researcher confirmed that the participant consumed all the food before providing the incentive; volunteers helped monitor this process. Similar to phase I, participants were required to place in the study bag their plate (with or without food) at the end of each meal.

Compensation

At the end of Phase 1, the participants that completed all 4 days were entered into a raffle to win two \$20 bills or a \$25 dollar Amazon gift card. This ensured that participants would participate in the intervention throughout the first 4 days of Phase 1. No compensation was given in Phase 2, only the incentives for consuming all their food.

Materials

The materials required for the experiment included a large trash bag, a scale to measure the food wasted, an iPad to record participants, the Oreo cookies, and cash or gift cards.

Statistical analysis

To determine the effects of the intervention on food waste, a student t-test was done to compare the average food waste weight under the control phase and the average food waste under the experimental phase. The analyses were done using a TI-84 plus graphing calculator and the significance was determined at $p < 0.05$.

Limitations

An important limitation is cheating by the participant in Phase 2, such as hiding uneaten food somewhere else, giving their food to a friend, and any other type of action where the food was not eaten by the participant. If the researcher found participants cheating, their food waste was not accounted for that day. However, the cafeteria setting was always very busy and loud, and there could be participants that were not caught. Therefore, there will always be a margin of error. To account for this, the researcher sent a quick post experiment anonymous survey at the end of the study that included two very simple questions. The survey asked if the participant had “cheated” and if so how many days.

Results

A total of 74 male high school students volunteered to participate; from this, 35-40 actively participated in the intervention. In Phase 1, the average food wasted per individual was 0.48 lb, while in Phase 2, it was 0.17 lb (T-test Z score = 7; $p < 0.001$) (Table 1). This resulted in an average of 64% reduction in food waste throughout the 4 days in Phase 2. It can be concluded that the result is statistically significant.

Table 1. Average Individual Waste per Participant (lbs) in Phase 1 vs Phase 2 of the Cafeteria Intervention per Day

Menu Day	Phase 1	Phase 2	Difference
Day 1	0.536	0.257	0.279
Day 2	0.452	0.141	0.311
Day 3	0.472	0.138	0.334
Day 4	0.440	0.149	0.291
Mean	0.475 (SD=0.043)	0.1713 (SD=0.054)	0.304 (SD=0.024)

Note. The total average difference was divided by the total average weight of Phase 1 to find the 64% reduction.

The anonymous survey completed by participants at the end to explore cheating during the study found that 20% of participants cheated at one point of the experiment. This is around 7-8 participants in the whole duration of the intervention. Out of the 20% that cheated, 50% admitted that they only cheated on one occasion out of the 4 days and 30% admitted cheating twice. As mentioned before this was understood to be a limitation that would affect the result of the intervention. However, due to the large effect found in the reduction of total food wasted, the researcher can confidently say that the true result would still be statistically significant.

Discussion

This experimental case study is the first study to our knowledge to test if a positive incentive decreases individual food waste in a male high school cafeteria setting that utilizes an “all you can eat” setting. The study showed that the incentive significantly decreased the individual food waste by 64.5% compared to the control phase.

This result may be explained by the motivation created by the incentive and also by the awareness that the attainment of incentives created among the participants. Previous research has determined that teenagers respond better to rewards rather than a punishment (Palminteri et al, 2016). The Oreo cookie may have provided enough positive motivation for the students to finish their food, despite being full or not necessarily liking their food. In other words, the incentive would have created enough motivation for the participant to overcome previous obstacles that impeded them from finishing their food, resulting in food waste. The results of this study adds to the body of literature and fulfills a gap of knowledge in current research.

Also, it is possible that the intervention created awareness in the individual as a secondary effect, which in turn made the participant realize that it is easier to get the incentive if they serve themselves less food. This is due to the participant logically thinking that if they get less they have to eat less but also through the concept of unit bias and segmentation effect, in which an individual is more likely to finish a single unit of food rather than several smaller ones (Kerameas et al, 2015). Depending on the size of the unit an individual is likely to eat more or less. A smaller

plate will prompt the individual to eat less, and the fewer plates an individual gets, the easier it is to finish their food (Kerameas et al, 2015). Therefore due to the awareness the incentive creates, the participants will get less plates or smaller plates which in turn makes it easier for the participants to eat all of their food and attain the incentive.

Fulfillment of Gap in Research

To our knowledge, this experiment is the first to test the use of positive incentives, such as cookies, to decrease the food waste generated by an individual. As stated in the introduction, no study before had utilized positive incentives, much less an edible reward, as an intervention for reducing food waste. Rather, most studies conducted thus far have focused on warning and educating individuals about the dangers of food waste (Reynolds et al, 2019). They created a personal awareness of the individual and the quantity they were eating through education. The difference being that this study created personal awareness of the individual through the motivation to gain the incentive. In other studies, consequences and possible repercussions were used to motivate individuals to eat their food, exactly the opposite of this experiment (Reynolds et al, 2019)(Nguyen, 2021).

Limitations

Any experimental study, especially those conducted by a high school student, will have certain limitations. As mentioned previously this study was liable to cheating, such as hiding the food not eaten or throwing it away somewhere else to receive the incentive. A total of 20% of the participants admitted that they cheated 1 or 2 times during the study. This behavior can be more likely explained by deindividuation, which explains that an individual is more likely to break the rules when they are in the comfort of a group setting. The individual knows they will not get punished and will cut or cheat under the protection of a large group (Nikerson, 2021). Since there were no additional consequences for cheating other than not receiving the incentive if caught, some participants were not discouraged to cheat. Another explanation for cheating throughout the study is simply to attain a personal gain or to avoid a negative evaluation. A study determined that lying behavior in an individual was typically due either to achieve personal gain or to avoid a negative evaluation. In this study it is probable that a reason for the cheating could have been that the individual did not want to have a negative evaluation, in the form of not receiving the incentive, and cheated in order to avoid it (McArthur et al, 2022).

If this study were to be implemented long-term, it is important to note that there could be over saturation of incentives. This is extremely hard to prevent since the students can see and are aware of the cafeteria setup and layout. Interval variable distributions do typically tend to be effective but the participant would realize during the lunch period therefore losing its “surprise” and by default its purpose. On the other hand, a consistent application, or a constant fixed ratio will cause the saturation of the incentive and the loss of its value (Yukl et al, 1972).

Conclusion

In conclusion, this study was successful in demonstrating that offering a positive incentive in a male high school cafeteria setting reduced individual food waste by about 64.5%. Therefore, the hypothesis was proven right. These results may be explained by the motivation that the incentive created and the awareness it generated leading to the reduction in food waste and success of the experiment. The researcher also concluded that there will always be attempts of cheating by the participant which is driven by deindividuation, self-gain, and avoidance of possible repercussions or negative views. In the end, the results of this experiment can and should be applied to school cafeterias across the country to reduce food waste and combat its double track negative environmental effects. The results would also increase efficiency in the school cafeteria system and allow for money to be redistributed to more adequate places. This experiment successfully addressed the gap of knowledge and should be used to achieve a better, more clean world.

Implications

The results of this experimental study can be translated into other similar schools in the US with a similar setting, such as having an “all you can eat” cafeteria, to help decrease individual food waste using incentives. This in turn could reduce the cost of food and create a more efficient and environmentally friendly cafeteria setting. Schools can potentially implement a reward system and successfully decrease their food waste which would potentially save resources and money, in addition to being more environmentally friendly. Systems that can be implemented are special places to “cash in” the student's empty plate in exchange for an incentive.

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