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The Power of Peer Pressure: Incorporating Social Comparison Into Traditional Anti-Food Waste Campaigns and its Potential Effects on College Campuses

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Abstract

Food waste is a major contributor to climate change, one of the most pressing environmental challenges of our time. Addressing this problem would not only protect the environment, but it would also save trillions of dollars and help to reduce the staggering number of people in the world today who are chronically malnourished. This paper focuses on the potential of using behavioral economic theory, particularly the concept of "nudging" in addressing the problem of food waste. Existing literature on nudges and food waste mainly focuses on how feedback and manipulating plate size can reduce food waste. Another proven approach to "nudging" is the use of social influence. Thus, my proposed experiment will investigate the question: could incorporating social comparisons into traditional anti-food waste feedback campaigns have a significant effect on the amount of food waste, particularly in university dining halls? The study will take place in the four "all-you-care-to-eat" dining halls at Penn. The participants will be students who are enrolled in a university meal plan and choose to eat at those dining halls during the five week period in which this experiment will take place. Materials will include separate food waste only trash bins for each of the dining halls, scales to measure the food waste, a device to count how many students eat at the dining hall each day, preliminary and post-experiment surveys, and posters for each of the four treatment conditions. Expected results are based on existing literature in behavioral economics and psychology.

Keywords

food waste, nudge, behavioral economics, environmental policy, social influence

Disciplines

Behavioral Economics | Environmental Policy | Food Studies | Public Policy

THE POWER OF PEER PRESSURE: INCORPORATING SOCIAL COMPARISON INTO TRADITIONAL ANTI-FOOD WASTE CAMPAIGNS & ITS POTENTIAL EFFECTS ON COLLEGE CAMPUSES

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ABSTRACT

Food waste is a major contributor to climate change, one of the most pressing environmental challenges of our time. Addressing this problem would not only protect the environment, but it would also save trillions of dollars and help to reduce the staggering number of people in the world today who are chronically malnourished. This paper focuses on the potential of using behavioral economic theory, particularly the concept of "nudging" in addressing the problem of food waste. Existing literature on nudges and food waste mainly focuses on how feedback and manipulating plate size can reduce food waste. Another proven approach to "nudging" is the use of social influence. Thus, my proposed experiment will investigate the question: could incorporating social comparisons into traditional anti-food waste feedback campaigns have a significant effect on the amount of food waste, particularly in university dining halls? The study will take place in the four "all-you-care-to-eat" dining halls at Penn. The participants will be students who are enrolled in a university meal plan and choose to eat at those dining halls during the five week period in which this experiment will take place. Materials will include separate food waste only trash bins for each of the dining halls, scales to measure the food waste, a device to count how many students eat at the dining hall each day, preliminary and post-experiment surveys, and posters for each of the four treatment conditions. Expected results are based on existing literature in behavioral economics and psychology.

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INTRODUCTION

Fighting the effects of climate change is one of the most pressing issues facing not only the United States, but the entire international community today. However, policies to address climate change are debated in the media and in legislatures, one key contributor is often left out or overlooked: food waste. In *Food Foolish: The Hidden Connection Between Food Waste, Hunger, and Climate Change*, John M. Mandyck and Eric B. Schultz explain that the embodied carbon dioxide emissions of food waste alone represent 3.3 billion metric tons (Mandyck and Schultz 2015, 3). This number encapsulates everything from the energy used in the agricultural process, the energy used to power processing and packaging facilities, and so on. The authors later add, "if food waste were a country by itself, it would be the third largest emitter of greenhouse gases behind China and the United States (Mandyck and Schultz 2015, 3). Further, according to the United States' Environmental Protection Agency, each year in the United States, approximately 31% of the total food supply, or the equivalent of 133 billion pounds, is wasted ("America's Food Waste Problem" 2016). This food waste contributes to the 18% of methane emissions that comes from landfills. In fact, in 2010 food waste accounted for 13.9% of municipal solid waste, surpassed only by paper (Getty and Thiagarajah 2013). According to the United Nations Environment Programme's Regional Office of North America, organic waste is the second largest component of landfills, which are the largest source of methane emissions, which are 21 times more powerful in causing climate change than carbon dioxide (UNEP 2015).

Not only does food waste contribute significantly to climate change, but it also poses a serious drain on resources. For example, agriculture consumes 70 percent of global water withdrawals (Mandyck and Schultz 2015, 78). According to a report issued by the United

Nations in 2015, the global water demand will increase by fifty-five percent in the next fifteen years, meaning that if this issue is not addressed, only sixty percent of the world's water needs will be met in 2030 (Mandyck and Schultz 2015, 75). Mandyck and Schultz illustrate how much food waste and water shortages are connected with the startling facts that it takes 5.4 gallons of water to produce a head of broccoli, 3.3 gallons to grow a single tomato and almost a half-gallon to grow one strawberry (Mandyck and Schultz 2015, 79).

In addition to its environmental and social costs, food waste has a great economic cost as well. In 2014, the Food and Agricultural Organization (FAO) of the United Nations, released the findings of the first full cost-analysis on food waste. They found the cost to be a staggering $1 trillion dollars. This number did not take into account the costs of water scarcity, soil erosion, and greenhouse gas emissions, nor did it take into account the costs of people being displaced from their homes or living with hunger (Mandyck and Schultz 2015, 91). The true cost estimated by the FAO was actually 2.5 times greater than the cost of wasted food alone, again, which they estimated to be one trillion dollars.

Taking serious measures to reduce food waste would not only greatly benefit the environment and save trillions, but it would also mean more food for the more than eight hundred million people who are chronically undernourished. In addition, more than two billion suffer from micronutrient deficiencies known as hidden hunger, and more than one hundred million children under the age of five are underweight (Mandyck and Schultz 2015, 9).

Unfortunately, environmental issues are often especially difficult to solve by nature of the interests involved. That is, when it comes to the taking care of the environment, benefits are disbursed among the population while the costs are either concentrated on a certain industry, motivating those with vested interests to mobilize, or disbursed, which does not easily mobilize

people. In political science terms, these two categories of policy are called entrepreneurial politics or majoritarian politics (Wilson 1973). Entrepreneurial politics describes policy areas in which the costs are concentrated and the benefits are disbursed. One only has to look to the political infeasibility of a carbon tax to see that because the benefits of this policy are disbursed among the population while the costs fall on specific, powerful industries, it would take a "policy entrepreneur" to mobilize people for this cause if it is ever to become a reality. On the other hand, some environmental issues could be considered "majoritarian politics." Majoritarian politics refers to policies that have both diffuse costs and diffuse benefits (Wilson 1973).

As a result, environmental issues are depicted by Garrett Hardin's famous "Tragedy of the Commons" analogy. Hardin explains that the environment is a shared space with limited resources in which people are motivated by self-interest to use the resources available. Since no one particular individual faces the consequences of their actions, in this case resource depletion and the degradation of the environment, everyone continues their detrimental behavior. Thus, environmental policy issues can be seen as a collective action problem or prisoner's dilemma. That is, everyone would benefit from working together to reach a common goal, protecting and conserving the environment and natural resources, but everyone also benefits from defecting and pursuing their own short-term, self-interested goals, for example profiting economically from exploiting natural resources. Another key factor is that when it comes to environmental policy, benefits are not only disbursed among the population, but also they are not immediate benefits, but future benefits. Given that people tend to discount future rewards, a phenomena in behavioral economics known as "present bias," they are less likely to go out of their way to achieve these rewards (Thaler and Sunstein 2008, 75). Since behavioral economics, unlike traditional economic theory, can account for this bias, it is a particularly useful tool in tackling food waste

as well as other environmental policy issues.

LITERATURE REVIEW

NUDGES

In *Nudge: Improving Decisions About Health, Wealth, and Happiness*, Richard Thaler and Cass Sunstein describe the potential of their "new movement," which they call "libertarian paternalism," to improve various aspects of life and society. From helping people save for retirement to saving the planet, Thaler and Sunstein claim to have found a solution. They begin with a premise that has been well established by behavioral economics and psychology: humans are not, in fact, the perfectly rational decision-makers that traditional economic theory assumes them to be. Instead, the human brain processes information using two different systems: the automatic system and the reflective system. The automatic system is used all the time; it is intuitive and does not involve extensive reflection or deliberation. The reflective system, on the other hand, is more deliberate and thoughtful. This is the type of thinking involved in deciding which university to attend or writing an essay (Thaler and Sunstein 2009, 20). Since people do not have time to use their reflective system when making most of their daily decisions, people often use shortcuts, or heuristics, which can result in various "blunders" as Thaler and Sunstein call them. These blunders are also known as present bias, status quo bias, loss aversion, and so on. Given that humans are not the perfectly rational decision-makers of traditional economic theory, the authors argue that choice environments should be designed to "nudge" people into making objectively better decisions.

They call this concept *libertarian paternalism*. The idea is that this movement is libertarian because it does not actually restrict one's ability to choose or the number of options

available. However, it is also paternalistic in its claim that "it is legitimate for choice architects to try to influence people's behavior in order to make their lives longer, healthier, and better" (Thaler and Sunstein 2009, 5). The authors believe nudges can be utilized in both the private sector and in public policy. In fact, they assert that many of their most important applications are those that can be used in public policy and the law. Moreover, the authors claim that since nudges usually cost very little and do not actually restrict the freedom to choose, both sides of the political aisle should see the appeal and potential of incorporating nudges into public policy.

One particular area of public policy in which Thaler and Sunstein believe nudges can be effective is environmental policy. Nudges that attempt to help people make choices that are better for the environment are referred to throughout behavioral economics literature as "green nudges". Thaler and Sunstein argue that nudges are preferable to the more traditional methods of environmental regulation, such as command-and-control or market-based policies, because they are more economically efficient and less heavy-handed on the part of the government. That is, in a command-and-control type of regulation, the government may require polluters to meet a certain standard or to install a specific type of technology to reduce emissions. This is the image that may come to mind when one thinks of typical environmental regulation or the Environmental Protection Agency. Another way policy-makers may attempt to reduce pollution is through market-based regulations, such as taxes or subsidies. This method provides more freedom of choice in meeting standards than a command-and-control policy typically would. However, the authors claim that both of these methods are too intrusive and additionally, less economically efficient when compared to nudges.

Thaler and Sunstein cite two factors that make creating and enforcing effective environmental policy difficult: 1) incentives are not properly aligned and 2) there is a lack of

feedback and information when it comes to decisions that impact the environment (Thaler and Sunstein 2009, 187). Therefore, providing better feedback and information may be an effective way to nudge people into making more environmentally friendly decisions. For example, the authors suggest the creation of a public Greenhouse Gas Inventory (GGI), which would require the biggest CO2 emitters to disclose their emissions to the public, could help fight climate change. As opposed to requiring the biggest CO2 emitters to buy and install a specific type of technology to reduce emissions, the creation of this inventory would not impose a significant cost on emitters. Instead, it would incentivize polluters to create innovative solutions and reduce emissions on their own in order to avoid being at the top of the GGI. Another example of a green nudge cited in this chapter is Clive Thompson's energy conserving orb (Thaler and Sunstein 2009, 196). In 2007, Thompson created a desktop orb that provided visual and immediate feedback regarding energy usage. The orb is designed to glow red when energy consumption is high and green when consumption is modest. Within weeks, customers using the orb showed a reduction in energy usage (Thaler and Sunstein 2009, 196).

In "Behavioral Environmental Economics: Promises and Challenges," Rachel Croson and Nicholas Treich discuss the many ways Thaler and Sunstein's Nudge is being used to address various environmental problems. Croson and Treich note the recent focus of attention on nudges in public policy. For example, in 2009, President Obama signed a memorandum meant to "clarify the role of the behavioral sciences in informing regulatory policy" (Croson and Treich 2014, 337). Further, Obama appointed Cass Sunstein to serve as administrator of the Office of Information and Regulatory Affairs (OIRA) from 2009 to 2012. Likewise, around this time Prime Minister of the United Kingdom, David Cameron created the "Behavioral Insights Team" aka "the nudge unit" (Croson and Treich 2014, 337). In addition, the European Commission has

launched research programs on nudges and public policy. Croson and Treich attribute the political success of nudges to their low cost, the fact that they are easy to understand and equally applied to everyone, their testability, and their empirical performance (Croson and Treich 2014, 337). The authors then go on to explain prominent types of nudges, such as default options and related schemes and social comparisons. Croson and Treich mention one example of a food waste nudge, the 2013 experiment conducted by Kallbekken and Saelen.

FOOD WASTE

Kallbekkan and Saelen's study contains a field experiment, in which they alter two different variables of interest, and a complementary observational study. In both treatments of the field experiment, the authors are testing whether or not there is a significant reduction of food waste produced by hotel guests at an all-you-can-eat breakfast buffet. In the first treatment, the authors test the hypothesis that reducing plate size will reduce the amount of food waste generated. They cite Sobal and Wansink's 2007 finding that "plate shape and size delineate norms for appropriate amounts of food to eat at a meal" (Sobal and Wansink 2007). They also cite Van Ittersum and Wansink's 2012 finding that big bowls lead to over-serving and small bowls lead to underserving; this led them to the conclusion that large plates may not only provide a social cue, but may also create a visual illusion that contributes to people's tendency to over-serve when given a large plate (Van Ittersum and Wansink 2012). Finally, the authors cite Freedman and Brochado's 2010 study, which found that increased portion size leads to increased food intake and increased food waste (Freedman and Brochado 2010). These three studies were crucial in the author's formation of their hypothesis that reducing plate size, by only 3cm, should reduce food waste generated. In the second treatment, a sign was placed above the buffet encouraging guests to visit the buffet multiple times instead of taking a lot of food at once. Both

of the treatments proved to be significant in reducing the amount of food waste generated at the hotel buffet.

The authors claim that the findings of this study could be easily transferred to schools, hospitals, prisons, or essentially anywhere with buffet style dining (Kallbekken and Saelen 2013, 327). In addition, these two changes cost very little; reducing plate size may actually save costs in the long run and printing a few simple posters is almost a negligible cost for a hotel or similar institution. Further, these changes were not found to negatively influence customer satisfaction. As a result, the authors conclude that their findings suggest, "using simple nudges to reduce food waste might represent a very fruitful approach to achieving significant greenhouse gas emission reductions" (Kallbekken and Saelen 2013, 327).

The 2010 Freedman and Brochado study cited by Kallebekken and Saelen primarily sought to determine whether or not giving college freshman a smaller portion of French fries would reduce their intake, but it also looked at the effects of reducing portion size on the amount of food production and waste. The authors found that as portion size decreased from 88g to 44g, so did total French fry production, consumption, both in total and per person, and plate waste. When the portion size was 88g, total waste was approximately 6, 168 plus or minus 265 grams of food. When portion size was decreased to 44g, this number was reduced to 4, 242 plus or minus 90 grams of food wasted (Freedman and Brochado 2010). This finding shows how something as simple as reducing portion size in a college cafeteria can significantly reduce the amount of food waste generated.

In 2012, Koert van Ittersum and Brian Wansink published "Plate Size and Color Suggestibility: The Delboeuf Illusion's Bias on Serving and Eating Behavior" in the Journal of Consumer Research. This study, which was also cited by Kallbekken and Saelen, presents four

main contributions to the existing literature on the effects of plate size on food consumption, and by extension, waste. This work 1) proposes the Delboeuf illusion "as a neglected but possible explanation for the link between the size of dinnerware and serving biases," 2) it "extends the Delboeuf illusion from the perceptual to the behavioral domain, thereby helping refute the notion that there are separate visual pathways for perception and action that prevent visual illusions from having behavioral consequences," 3) it proposes that there is a greater chance consumers will be influenced by this illusion if they are "distracted, unaware, or uneducated" and 4) it shows how color contrast between the food, the dinnerware, and the tablecloth influences the Delboeuf illusion (Van Ittersum and Wansink 2012, 216). The authors conduct five different studies, which eventually led them to these four main conclusions; each study looked at the effects of the illusion in combination with other factors, such as dinnerware and food color and education, on serving behavior.

The authors conclude that "attention and education may reduce the over serving (underserving) biases associated with serving on larger (smaller) bowls and plates. Furthermore, while reducing the color contrast between the dinnerware and its background may help reduce over- and underserving biases, increasing the color contrast between the food and the dinnerware actually may accomplish this as well" (Van Ittersum and Wansink 2012, 225). Given the results found in other studies, that reducing portion size reduced both intake and plate waste, the results of this study are important in that they show how educating about the Delboeuf illusion and reducing the color contrast between dinnerware and its background could be used to reduce the over-serving bias when large plates are used, thus reducing the amount of waste produced.

In 2013, Van Ittersum and Wansink published another study titled "Portion Size Me: Plate Induced Consumption Norms and Win-Win Solutions for Reducing Food Intake and

Waste." In this study, again it was found that plate size influences how much people serve, consume, and waste. The authors conclude that the size of the dinnerware must be serving as an anchor for how much food should be served and consumed; they contribute this again to the Delboeuf illusion. In this study, the authors observed diners in a Chinese Buffet restaurant. There were two different plate options, one small and one large. Not surprisingly, they found that those who chose the larger plate served themselves 52% more food than those who selected the smaller plate and wasted 135.2% more than those with smaller plates (Van Ittersum and Wansink 2013, 322). In order to address the possible issue that arises with letting participants choose their own plate, the authors argue, "People with larger appetites might have taken larger plates, but they should have also eaten a higher percentage of what they took. Because this was not the case, it may be that the effects of self-selection may be weaker than the effects of large plates" (Van Ittersum and Wansink 2013, 322).

In their general discussion of their experiment and opportunities for further research, the authors point out three research questions which could further develop their theory: first, "How does the diameter of the verge ring (the point where a plate or bowl's interior surface goes from flat to sloped) influence serving and perceptions?"; second, "Does the diameter band on the lip of a bowl or plate bias perceptions?"; and third, "Which designs or colors of a plate or bowls ridge influence size estimations?" (Van Ittersum and Wansink 2013, 331). They summarize the importance of their findings by concluding, "We eat off of plates and out of bowls without thinking how their size proportionately influences how much we serve and eat. Yet the basic implications this has for waistlines, food waste, and wallets are of substantial importance to managers, policymakers, health professionals, and consumers" (Van Ittersum and Wansink 2013, 331).

In addition to reducing plate size, other methods have proven to be effective nudges when it comes to reducing food waste. One example can be found in Getty and Thiagarajah's study, "Impact on Plate Waste of Switching from a Tray to a Trayless Delivery System in a University Dining Hall and Employee Response to the Switch." They found that getting rid of the trays in a university buffet-style dining hall reduced waste produced a significant reduction in solid waste, 0.81oz per patron, to be exact (Getty and Thiagarajah 2013). Applying this number to the average 500 patrons per meal present in the dining hall, this would mean saving 400 ounces or 25 pounds of solid food per meal; Given that there are typically nine meals per week served in the dining halls, this change would result in 225 pounds less of solid waste in a week. With minimal employee concerns, this study seems to show that this small change, taking away the trays in a dining hall could significantly reduce the amount of food waste produced. Given the amount of buffet-style dining halls at universities across the United States (Penn alone has four of them!), this could be a very significant environmental improvement.

Another very simple nudge was proven to be effective in reducing food waste at a university: simple, written feedback presented to students on posters. In the study "Written Messages Improve Edible Food Waste Behaviors in a University Dining Facility," Kelly Whitehair et al. test whether or not a "simple message-type intervention that requires little sustained administrative support" can effectively change food waste behavior in a university dining facility. As the authors highlight, nearly 54 billion pounds of food is wasted annually by commercial and retail food operators, including university dining facilities (Whitehair et al. 2013). Whitehair cites a study by J.E. Peterson et al. in which exposing dormitory residents to real-time visual feedback and incentives effectively reduced the amount of energy used by said dormitory residents as evidence that messaging and feedback campaigns have successfully

increased sustainable or environmentally-friendly behavior among individuals—in these studies, college students.

Whitehair and her colleagues provided students with a questionnaire to get an understanding of their attitudes toward food waste and sustainability. Then, they monitored the amount of food waste in the dining hall for two weeks without any interventions present, they call this period the baseline period. During the third week of the study, a "prompt-type intervention" was installed. During the fifth week, a feedback-based message was incorporated. During the last week of the study all interventions were removed, but food waste data was still collected. The first intervention was a simple message stating, "Eat what you take, don't waste food" (Whitehair et al 2013). The second intervention provided more detailed information about food waste.

The authors found that after the initial prompt-type intervention, food waste decreased by 15% on average. However, the second, more detailed feedback-based intervention did not significantly reduce the amount of food waste any further. This study shows that a simple, low cost intervention like a poster saying "don't waste food" can significantly reduce the amount of food wasted in a setting such as a dining hall at a university. It is also important to note what this study disproves: that a more quantitative type of feedback does not reduce waste any more than a very simple message. The authors seem to believe this is the case because these messages remind students of their own personal beliefs regarding the environment and sustainability. Increasing the salience of this issue seems to be enough to change students' behavior when it comes to food waste.

SOCIAL PRESSURE

In "The Constructive, Destructive, and Reconstructive Power of Social Norms," Schultz

et al (2007) explore the "boomerang effect," which has been found in normative messaging field experiments and they test a way to correct for this boomerang effect. The boomerang effect refers to the phenomena that occurs in field experiments in which people who are performing better than the norm adjust their behavior to the norm. For example, in this 2007 study Schultz et al conducted a field experiment in which they used normative messages to promote energy conservation. As they predicted, the normative messaging provoked a decrease in energy usage from households who had previously been using too much energy and the boomerang effect in households that were actually more efficient than the norm. However, they found that adding a social aspect to the messaging (ie approval or disapproval) effectively eliminated the boomerang effect. That is, for people who were originally consuming less energy than their neighbors, adding a positive emoticon to indicate social approval resulted in these households maintaining their original low rate of energy consumption rather than increasing their energy consumption to meet the norm.

In 2008, Alan S. Gerber et al conducted a field experiment in which they examined how social pressure could be used to impact voter turnout in the United States. Gerber and his colleagues conducted an experiment in which they sent various mailings to approximately 80,000 households in Michigan during a campaign season. The mailings each primed voters to think of their civic duty to vote, but they varied in level of extrinsic or social pressure. For example, one group received a mailing that only reminded them that voting is their civic duty. Another group was told that researchers would be studying their voter turnout using public records, the third group was given the voter turnout record of all eligible voters in their household, and the fourth group received a mailing showing the voter turnout record of their household as well as their neighbors' (Gerber 2008, 34). The mailings sent to the third and fourth

groups also stated that a follow-up mailing would be sent to them and their neighbors with a record of who voted in the upcoming election. The authors found strong evidence that social pressure increases voter turnout--in fact, as effectively as door-to-door canvassing (Gerber 2008, 34). Specifically, the control group had a voter turnout rate of 29.7%, the civic duty mailing group had a turnout rate of 31.5%, and the neighbor mailing group had the highest turnout rate at 37.8% (Gerber 2008, 38).

In "Social Norms and Energy Conservation," Hunt Allcott examines one of the "most notable non-price energy conservation programs" which is run by a company called OPOWER. The company mails Home Energy Report Letters to consumers in which they receive information regarding their household energy consumption, that of their neighbors, and a rating which tells them where they stand in comparison to their neighbors. Allcott notes that the neighbor comparison aspect of the study was directly inspired by Schultz et al's 2007 experiment on social norms and energy usage as well as Gerber et al's study on social pressure and voter turnout and similar studies by Beshears et al (2009) on retirement savings and Frey and Meier (2004) on charitable giving (Allcott 2011, 1082). The Home Energy Reports contain two key components, the "social comparison module" and the "action steps module." The social comparison module compares the household's energy usage to the average and 20th percentile of its comparison group, which is comprised of 100 geographically proximate and similar (in size, characteristics, etc.) homes. The action steps module provided tips for becoming more energy efficient.

OPOWER also collected surveys in which they asked households to self-report what they had done to change their behavior in response to the Home Energy Reports. Many of them reported doing simple things like turning off the lights when leaving a room, unplugging

electronics, etc., (Allcott 2011, 1088). After examining OPOWER's programs, Alcott found that they produced, on average, a 2% reduction in energy usage. In order to put this reduction in perspective, Alcott explains that this is equivalent to a short-term price increase of 11 to 20% or a long-term price increase of 5% (Alcott 2011, 1093). He concludes by stressing the cost-effectiveness of this intervention and its potential significance in reducing greenhouse gas emissions to combat climate change.

STUDY DESIGN

STUDY OVERVIEW

My study will draw on Thaler and Sunstein's book, *Nudge: Improving Decisions about Health, Wealth, and Happiness,* as well as the existing literature on food waste nudges and the power of social pressure in changing behavior. This study will explore the hypothesis that incorporating an element of social comparison or pressure into a traditional anti-food waste messaging campaign could have a significant effect on reducing food waste on a college campus like Penn's. Whitehair et al's (2013) research on the effects of simple feedback in a university dining hall setting proved that this type of feedback campaign can significantly reduce food waste; they found a reduction of 15% as a result of their intervention. However, they also found that incorporating data and statistics on food waste did not have a significantly greater impact than the simple messaging posters. Given the existing research on the power of social pressure in producing various prosocial behaviors, such as reducing energy use and voting, one would expect incorporating an element of social influence to have a significant impact on food waste, especially in a setting where individuals are very attuned to social pressure as students often are during their first year of college.

In my experiment, the simple anti-food waste poster condition can be compared to the civic duty intervention in Gerber et al's study on social pressure and voter turnout. Both of these treatments rely on intrinsic pressure or morality to change individuals' behavior. These conditions both focus on civic duty alone. This condition should have an effect on food waste, but a smaller one than those which include an element of social influence. This should both eliminate the boomerang effect that sometimes occurs with normative messaging and result in a greater reduction of food waste.

METHOD

Participants:

The participants in this study will be University of Pennsylvania students enrolled in a university meal plan. This group is mostly composed of first year students as they are required to enroll in a meal plan while other students are not. Specifically, the participants will be students who choose to eat at the various buffet-style dining halls in which students swipe their student ID cards upon entry and are then allowed to take as much food as they want to eat during that meal. Further, participants will be only those students who choose to eat at these dining halls during the five week period during which the experiment will be conducted.

Apparatus and Materials:

The experiment will require various materials including "food waste only" trash bins to be placed in each dining hall in which the experiment will be conducted. It will also require four scales, one for each dining hall, which will be used to measure the pounds of food wasted each day in each dining hall. Next, an apparatus to count the number of students who eat at the dining hall each day will also be necessary. This device is popularly called a "tally counter" and is often used to count the number of people entering an event. These are all of the materials necessary to

collect the food waste each day, measure the pounds of food wasted each day, and count the number of students eating at the dining halls each day.

For the experiment, students will be given two surveys, a preliminary survey as well as a post-experiment survey. The preliminary survey will ask students basic information about themselves, such as their age, gender, hometown, year, area of study, etc. It will also contain questions on various environmental issues in order to determine the students' general attitudes toward the environment and sustainability. Finally, the survey will ask students a few questions regarding food waste in particular. This information will be useful in analyzing the results of the study to see if students' behavior (ie how much food they waste on average) matches their stated beliefs regarding the environment and specifically food waste or if there is some dynamic inconsistency occurring.

Next, the four different posters, one for each of the four different treatments, will need to be designed and produced so that each can be prominently displayed throughout the four dining halls. For condition 1, the poster will provide simple feedback, like that of Whitehair et al's (2013) study. The poster for condition 2 will include the same message as that of condition one, but also a comparison to Drexel University, Penn's neighbor. For condition 3, the poster will be exactly like that of condition 2, but with a social comparison to Princeton, Penn's rival, rather than Drexel. Finally, for condition 4, the poster will be the same as conditions 2 and 3, but will include a reference to a more distant university (ie any geographically distant, public, less selective university). Finally, another survey will be distributed after the experiment is completed. This survey will ask students if they noticed the posters and whether or not the posters had any effect on their behavior.

Procedure:

The study will take place in the four "all-you-care-to-eat" dining halls at Penn. These are 1920 Commons, New College House, English House, and Falk Dining Cafe at Hillel. The first step of the experiment will involve taking inventory of the amount of food waste, in pounds of food waste produced at each dining hall throughout the entire day (breakfast, lunch, and dinner) for one week. This number will be divided by the number of students that ate at the dining hall that day. Once the lbs of food wasted by each student, on average, during each day is known then the average of those numbers will be taken to get the lbs of food wasted by the average student during a day for that week. This method will be replicated in each dining hall and for each subsequent week of the experiment.

During the same week in which the baseline condition is being measured, a preliminary survey will be distributed to participants. The survey will ask students a number of basic questions about themselves, various questions on the environment, and finally specific questions on food waste and their own habits when it comes to wasting food. Again, this information may be useful in determining whether the amount of food students waste is consistent with their stated beliefs on the environment and food waste or if they are exhibiting a level of dynamic inconsistency. It is possible that although students believe they should do what they can to protect the environment and reduce the effects of global warming, they may not realize the impact that food waste has on the environment or they may realize this but still act inconsistently with their beliefs whether it is due to bad habits or a lack of attention. If this is the case, this dynamic inconsistency could be corrected for by drawing attention to the issue of food waste, thus reminding students of their stated beliefs, which is what the posters in each of the conditions will do.

Next, simple feedback posters will be introduced to and displayed throughout each dining

hall for a one-week period. The poster will have a simple message such as, “Do your part to protect the environment and fight climate change. Don’t waste food!!” This will be known as condition 1. These posters, as well as those for the subsequent treatment conditions, will be displayed in each dining hall for a week and during the same week. Therefore, the experiment will be spread out over a total of five weeks (one week to collect baseline or control data, and then one week to collect data for each subsequent treatment condition). Although this is a large time commitment for those involved in running the experiment, it is the best way to ensure that no third variables are affecting the credibility of the experiment. For example, if instead of testing each condition in each dining hall, we matched one condition to one dining hall, there may be something about the students that eat at that dining hall that would affect the credibility of the experiment. For this reason, we must run all of the conditions at each dining hall to make the experiment as randomized as possible.

The next condition will involve introducing a poster with the same exact message as those in condition 1 in conjunction with a social comparison to a geographically proximate university. For the case of Penn, we will use a comparison to Drexel. The poster will read, “Did you know: Penn students on average waste X grams of food each day while Drexel students only waste X grams of food--that’s X grams of food less! If you waste less than this, keep up the good work. If not, do your part to protect the environment: don’t waste food!!”

The third condition will be identical to condition two except Drexel will be replaced with Princeton, Penn’s athletic rival. The fourth condition will also be like conditions two and three except the social comparison will be with a school that is geographically distant and different in other aspects of university life as well. Including a less proximate comparison should reveal whether or not the type of social comparison is important when attempting this type of nudge.

In each condition, like in the baseline condition, food waste will be measured in pounds of food wasted per person each day for a week and then the average will be calculated. There will be separate trash cans set up in the dining halls that will say "food waste only." A volunteer will monitor students as they are throwing away their waste in order to make sure that students are throwing all of their food waste and only food waste into the food waste only bin and not into the other trash bins. In addition, the number of students who swipe into the dining hall for each meal during the day, each day of the week for the five week period must be measured. This could be accomplished by having another volunteer at the entrance with a tally counter to take attendance. Alternatively, it may be possible to see if Penn Dining Staff has this data and if they would be willing to share it for the purposes of this experiment.

Immediately after all of the data is collected and the experiment is over, students will receive another survey asking them if they noticed the posters and whether or not the posters caused them to change their behavior in any way.

EXPECTED RESULTS & DATA ANALYSIS

Throughout the experiment food waste will be measured in pounds each day of the week for the five weeks of the experiment. It will be measured after breakfast, lunch, and dinner each day and the total will be used for that day. Next, this number will be divided by the total number of students who ate at the dining hall that day. Then, the average amount of food waste per student on any given day will be calculated for each week at each dining hall. This will give us the average pounds of food wasted per student over the course of a day for each week at each dining hall. One potential problem is making sure students actually dispose of all and only their food waste in the "food waste only" bin that will be used to collect the data each day. In order to ensure the integrity of the results, there must be a way of ensuring that students do not throw

their food waste into other garbage bins and vice versa, that they do not throw other garbage into the "food waste only" bin. Again, this may require physically monitoring the students as they throw away their trash at each dining hall throughout the entire course of the experiment.

The data will be analyzed using paired t-tests since the sets of data are not independent; they are related in that they all take place over the same period of time and use the same pool of subjects before and after certain experimental treatments. The hypothesis we are testing is that the posters using proximate social comparisons (conditions 2 and 3) should have a significant effect in reducing food waste compared to the baseline condition and when compared to condition 1 (simple feedback). Using paired t-tests on the data will allow us to see if the posters were actually effective in reducing food waste or if the results were simply caused by random noise. Therefore, a series of paired t-tests will be conducted in order to determine whether or not the differences in average amount of food waste per student between the baseline or control condition and the other treatment conditions (conditions 1, 2, 3, and 4) are statistically significant. After that, another series of paired t-tests will be conducted to determine whether or not the differences in the mean amount of food waste per student in a day under the conditions that included a social comparison (conditions 2, 3, and 4) versus the simple feedback condition (condition 1) were statistically significant. That is, paired t-tests will be conducted comparing week two data to weeks three, four, and five data. This will reveal whether or not the posters using social comparison provide a significant advantage over a simple message encouraging students not to waste food.

Based on the findings in Whitehair et al (2013) and Gerber et al (2008), one would expect each condition of the experiment to have a significant reduction in the amount of food wasted, on average, per student throughout the course of a day. Further, one would expect the social

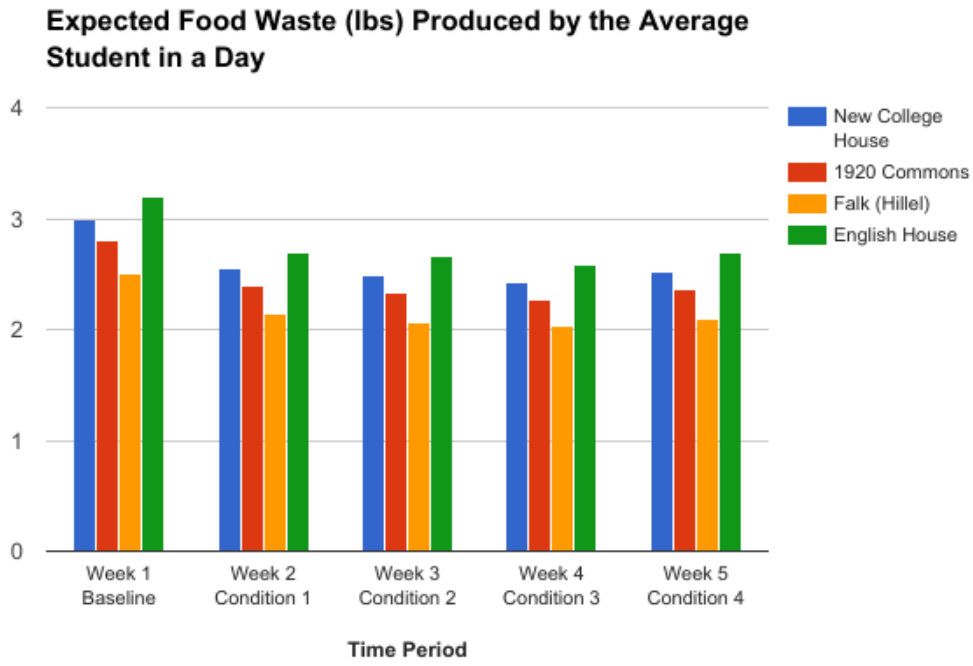
comparisons that use a university of close proximity to Penn, whether geographically like Drexel or by nature of it being a rival school, like Princeton, to have an even greater effect on the average amount of food wasted be students throughout the day. However, the less proximate social comparison may have less of an impact on students; even though it may have slightly more of an effect than the simple feedback poster (condition 1). Finally, the phrase "if you waste less than this, keep up the good work!" should eliminate the potentially negative boomerang effect in which students who believe they are wasting less food than the average student feel it is acceptable for them to waste more food (Schultz et al 2007).

Whitehair et al (2013) found that the students eating at the dining hall they studied wasted approximately 62.76 grams of edible food per tray on average during the baseline condition. In order to realistically anchor my expected results for this study, I will use this number as a baseline. If students on average wasted 62.76 grams of edible food per tray, and they eat at the dining hall three times in a day, that means the average student wastes 188.28 grams, or 0.42 pounds of food per day and 1,317.96 grams, or 2.91 pounds, in a week. Whitehair et al found that simple written messages decreased food waste by 15%. Thus, we would expect condition 1 to reduce food waste by approximately 15% as well. If my hypothesis is correct, condition 2 will reduce food waste by a slightly smaller percentage than condition 1 and condition 3 will reduce food waste even more. Table 1 depicts expected results in which condition 1, as in Whitehair et al (2013), reduced food waste by 15%. Condition 2 produces a reduction in food waste of 17% and condition 3 reduces food waste by 19% in comparison to the baseline condition (week 1). Finally, condition 4 reduces food waste by slightly more than condition 1, or by 16% for the purposes of this analysis. Figure 1 also displays these expected results, but graphically.

Table 1. Expected Food Waste (lbs) Produced by the Average Student in a Day

	Week 1 (Baseline)	Week 2 (Condition 1)	Week 3 (Condition 2)	Week 4 (Condition 3)	Week 5 (Condition 4)
New College House	3	2.55	2.49	2.43	2.52
1920 Commons	2.8	2.39	2.33	2.27	2.36
Falk (Hillel)	2.5	2.14	2.07	2.03	2.1
English House	3.2	2.7	2.66	2.59	2.69

Figure 1. Graph of Expected Results



Paired t-tests comparing week 1, the baseline condition, to each of the other conditions prove each to be statistically significant. Next, comparing week 2, the simple feedback condition to the other treatment conditions, each incorporating different social comparisons, shows that the difference between the mean of week 2 and that of each of the other weeks is statistically significant, and not just the result of random noise. Specifically the paired t-tests showed that the

difference between week 2 and week 3 is very statistically significant, with the difference between the means of week 2 and week 3 being 0.0575. The difference between week 2 and week 4 is extremely statistically significant, with a difference in means of 0.115, and the difference between week 2 and week 5 is statistically significant, with a difference in means of 0.0275.

Since one of the goals of this experiment was to determine what type of social comparison is most effective at reducing food waste, the data analysis should also compare the difference in means of conditions 2, 3, and 4. First, the data from conditions 2 and 3, the comparisons to Drexel and Princeton should be analyzed; these schools represent Penn's geographic neighbor and athletic rival respectively, making them most likely to evoke a competitive response from Penn students. To assess whether or not the different social comparisons had significantly different effects, a paired t-test can also be conducted between the weeks with social comparison posters (weeks 3, 4, and 5).

First, a statistical analysis of weeks 3 and 4 shows that the differences between the mean amount of food wasted per student in a day during weeks 3 and 4 is very statistically significant. That is, the mean of week 3 minus week 4 is 0.0575 which falls under the 95% confidence interval ranging from 0.0375 to 0.0775 (GraphPad Software). In addition, a paired t test of data from weeks three and five also shows an extremely statistically significant relationship, with a p value of 0.0001, a difference between the means of -.03, and a 95% confidence interval from -.03 to -.03 (GraphPad Software). Finally, an analysis of weeks four and five is also extremely statistically significant with a p value of 0.0008, a difference in the means equaling -0.0875, and a 95% confidence interval ranging from -0.1075 to -0.0675.

DISCUSSION

Discussion of Results:

These results prove that each treatment condition has a statistically significant effect on the amount of food wasted in comparison to the baseline or control condition (week 1) and that incorporating social comparison into the feedback messages reduces food waste even further than a simple anti-food waste message (condition 1). These results also show that conditions 2 and 3, referencing more proximate social comparisons, are more statistically significant than condition 4, the more distant comparison.

Limitations of this Study:

As with many psychology experiments conducted at universities, the participants in this study are "WEIRD," as in they are mostly western, educated, and from industrialized, rich, and democratic societies. Moreover, since the participants in this study are a very particular group, students at the University of Pennsylvania who are enrolled in a university meal plan, the applicability of this study to other settings may be limited. For example, one could imagine this type of school rivalry evoking a response in college students, but it is unclear whether or not this would have the same effect on a larger scale or even at a different school. There could be something about Penn's competitive culture that could make this study more successful here than in other settings. However, the existing research on social influence suggests that this type of social comparison does have an effect on everyone. Nonetheless, this type of experiment could be tested in other universities to determine its applicability in other settings or schools.

Conclusions & Future Study:

If this study is successful, it would provide further support for the idea that feedback campaigns can be an effective form of nudging and that social pressure is even more powerful

than simple feedback or moral appeals. Further studies on this topic could look at how framing the messages differently may impact results. For example, would framing the message as a monetary loss be more effective than a simple social comparison? In addition, this study could be replicated at other universities as well as high schools and elementary schools, prisons, hospitals, etc, since these institutions often have similar buffet style cafeteria systems which also produce large quantities of food waste (Whitehair et al 2013). If an experiment like this proved to be effective, it could be implemented in these institutions and have a real impact.

CONCLUSION

Given the amount of polarization in American politics today when it comes to environmental policy, behavioral economics, specifically "nudges," provide a cost-effective solution that both parties should be able to see benefits in. It has been repeatedly proven by social scientists that both feedback and social influence nudges have a great effect on individuals' behavior without limiting their choices or even costing very much. Thus, this type of intervention could be a potential solution to this life or death issue in an extremely polarized time.

REFERENCES

Allcott, Hunt (2011). Social Norms and Energy Conservation. *Journal of Public Economics 95* (9): 1082.

"America's Food Waste Problem" (2016). *United States Environmental Protection Agency*. https://www.epa.gov/sciencematters/americas-food-waste-problem

Croson, Rachel and Treich, Nicolas (2014). Behavioral Environmental Economics: Promises and Challenges. *Environmental and Resource Economics 58* (3): 335.

Freedman, M.R. and Brochado, C., (2010). Reducing portion size reduces food intake and plate waste. *Obesity 18*: 1864–1866.

Getty, V.M. and Thiagarajah, K. (2013). Impact on plate waste of switching from a tray to a trayless delivery system in a university dining hall and employee response to the switch. *Journal of the Academy of Nutrition and Dietetics 113*: 141–145.

Gerber, A. S., Green, D. P., & Larimer, C. W. (2008). Social pressure and voter turnout: Evidence from a large-scale field experiment. *The American Political Science Review, 102* (1): 33-48.

Hertwich, E.G., Peters, G.P., (2009). Carbon footprint of nations: a global, trade-linked analysis. *Environmental Science & Technology 43*: 6414–6420.

Kallbekken, S. and Saelen, H. (2013). Nudging hotel guests to reduce food waste as a win-win environmental measure. *Economics Letters 119* (3): 325.

Petersen, J.E. et al (2007). Dormitory residents reduce electricity consumption when exposed to real time visual feedback and incentives. *International Journal of Sustainability 8* (1): 16–33.

Quick Calcs (2017). *GraphPad Software*. GraphPad Software Inc. Web.

https://www.graphpad.com/quickcalcs/ttest1/

Schultz, P.W., Nolan, J.M., Cialdini, R.B., Goldstein, N.J., and Griskevicius, V. (2007). The constructive, deconstructive, and reconstructive power of social norms. *Psychological Science 18* (5): 429-434.

Sobal, J.,Wansink, B., (2007). Kitchenscapes, tablescapes, platescapes, and foodscapes. *Environment and Behavior 39*: 124–142.

Thaler, Richard and Cass Sunstein (2009). *Nudge: Improving Decisions About Health, Wealth, and Happiness.* Penguin Books.

UNEP (2015). Food Waste: The Facts. *WorldFoodDayUSA.Org*. http://www.worldfooddayusa.org/food_waste_the_facts

Van Ittersum, K and Wansink, B. (2012). Plate size and color suggestibility: the Delboeuf illusion's bias on serving and eating behavior. *Journal of Consumer Research 39*: 215–228.

Van Ittersum, K. and Wansink, B. (2013). "Portion size me: plate-size induced consumption norms and win-win solutions for reducing food intake and waste." *Journal of Experimental Psychology 19* (4): 320.

Whitehair, K.J.; Shanklin, C.W.; Brannon, L.A., (2013). Written messages improve edible food waste behaviors in a university dining facility. *Journal of the Academy of Nutrition and Dietetics 113*: 63–69.

Wilson, James Q. (1973). Organizations and public policy. *Political Organizations*. New York: Basic Books Inc: 327-345.