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This or That?: A Study of Online Supermarket Interventions and Their Ability to Influence Healthy Food Choices

Abby Tobin

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THIS OR THAT?: A STUDY OF ONLINE SUPERMARKET INTERVENTIONS AND THEIR ABILITY TO INFLUENCE HEALTHY FOOD CHOICES

By Abby Tobin

Advisor: Dr. Jonathan Noel

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Abstract

As obesity rates continue to rise in the United States, there is an increasing need for new ideas and solutions to combat this worrisome epidemic. This study targets the food purchase behavior of consumers by attempting to sway their food choices using various “nudges,” or alterations in choice architecture. Participants were exposed to various interventions that were applied to product images on a fake grocery store website. Participants that fit inclusion criteria of being 18 years or older were recruited through survey-taking groups found on Reddit and Facebook. After randomization into either the control or intervention group, participants took a Google Forms survey that included five different categories of food. The intervention group was exposed to five different interventions, each category of food receiving a single intervention. The control group was exposed to unaltered images. Responses to this survey were dichotomized and used in a logistic regression analysis after adjusting for age, sex, ethnicity, and race. Data analysis revealed that there were no significant differences in Researcher-Labelled Healthy/Researcher-Labelled Unhealthy food choice between the control and intervention group ($p > .05$). Significant differences were found by sex, race, and ethnicity for some, but not all, interventions. The goal of this research was to reveal if these nudges could persuade consumers into purchasing specific foods, and to consider this method as a way to encourage healthier eating. The results of this study should be used to continue conversations and research regarding obesity alleviation efforts by targeting the online grocery shopping experience.

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Introduction

Severity of Obesity in the US & Demographic Disparities

Obesity is defined by the CDC as weight that is higher than what is considered as a healthy weight for a given height. This relationship between height and weight is used in the calculation of Body Mass Index, or BMI, a unit that reveals whether a patient is considered obese. Obesity has become an epidemic in the USA, increasing from a 30.5% prevalence in 2000 to a staggering 42.4% in 2018. While a BMI of 30 is considered obese, a BMI of 40 or more is considered “class 3 obesity,” otherwise known as extreme obesity. This extreme obesity in American adults increased from 4.7% in 2000 to 9.2% in 2018 (*Overweight & Obesity*, 2021). According to the CDC, the prevalence of obesity among children and adolescents of ages 2-19 is 18.5%, equaling around 13.7 million people. Around 20.6% of 12-19 year olds are obese, meaning 1 in 5 have a BMI in or above the 95th percentile (*Overweight & Obesity Statistics*, 2017). Obesity does not affect everyone equally, and as a result, there are disparities based on sex, socioeconomic status, age, race, ethnicity, and even geographical location.

While more men than women are considered overweight (38.7% of men and 26.5% of women), women show higher rates of both obesity and extreme obesity. About 40.4% of women are obese and 9.9% are extremely obese, while 35% of men are obese and 5.5% are extremely obese (*Overweight & Obesity Statistics*, 2017). One of the most significant determinants of overall health is socioeconomic status, or SES. Current research suggests an inverse relationship between income and obesity risk in adult women in developed countries (Pavela et al., 2016). For women, as the poverty income ratio (ratio of a person’s income to their poverty threshold)

decreases, obesity rates consistently increase. For men, however, this relationship is inconsistent (Pavola et al., 2016). Along with income, education level is another determining factor of overall socioeconomic status. Women have a similar consistent inverse relationship between education level and obesity. As education level advances, obesity rates fall. The obesity rate in women with less than a high school education is 42.1% while it is 23.4% in women with a college degree. Men, however, again show an inconsistent relationship between education and obesity. While obesity rates drop in males between education levels of less than high school and college graduate, men with some college experience have higher obesity rates than every other educational category (Pavola et al., 2016). When considering age, young adults aged 18-24 years have almost half the prevalence of obesity as older adults aged 45-54 years. 18.9% of young adults are obese, while 37.6% of older adults are obese (*Overweight & Obesity*, 2021).

Obesity impacts racial and ethnic groups disproportionately. Non-Hispanic Black adults had the highest prevalence of obesity in the years 2017-2019 (39.8%), followed by Hispanic adults (33.8%), and non-Hispanic White adults (29.9%) (*Obesity, Race/Ethnicity*, 2021). Within the group of non-Hispanic Black adults, African American women have the highest rate of obesity, with 4 out of 5 African American women being overweight or obese (*The Health Effects*, 2020). Although obesity levels are still rising for every racial group, Asian Americans have the lowest prevalence of obesity out of all groups at a rate of 17.4% (*Obesity, Race/Ethnicity*, 2021).

These disparities in obesity rates between different races can be studied at a wider community level. The racial composition of a community has a significant impact on the likelihood of an individual to be obese (Kirby et al., 2012). Individuals living in a community with a high proportion of Hispanics are more likely to be obese, but only if they are Hispanic,

non-Hispanic White, or non-Hispanic Asian. An individual living in a community with a higher concentration of Asians may be less likely to be obese, but only if they are a non-Hispanic White man. While non-Hispanic Blacks have the highest rates of obesity, when studied at a community level, an individual living in a community with a high proportion of non-Hispanic Blacks is no more likely to be obese than individuals living in other communities, regardless of race or ethnicity (Kirby et al., 2012).

Obesity rates also differ based on geographical location in the United States, meaning that the risk of an individual becoming obese varies based on their state of residence. The highest rates of obesity are found in the Midwest and South regions of the country. The states with the highest rates of obesity are Arkansas, West Virginia, Michigan, Louisiana, Alabama, South Carolina, Indiana, Kansas, Kentucky, Oklahoma, Mississippi, and Tennessee, all reporting an obesity rate of 35% or more. Mississippi has the highest reported rate of obesity at 40.8% as of 2019. Colorado has the lowest rate of obesity at 23.8%, around half the percentage seen in Mississippi (Elflein, 2021). The states with the highest rates of obesity are also experiencing the highest rates of poverty in the country (*2019 Poverty*, 2019). Citizens with lower incomes are more likely to purchase cheaper, less nutritious foods that increase their risk of becoming obese. Areas with high poverty rates are also more likely to be “food deserts,” or areas that don’t have sufficient access to fresh and nutritious food (Levine, 2011).

Consequences of Obesity

Obesity is not just a cosmetic issue, but also a life threatening condition that is a precursor for numerous serious diseases. There are many possible health conditions that one may experience as a result of obesity, and they include high blood pressure, stroke, coronary heart

disease, many types of cancers, and a general low quality of life (*Leading*, 2020). While some consequences of obesity are at the forefront of the public's concern (such as physical health effects like diabetes), others are often overlooked, such as mental health. Some repercussions of obesity aren't even directly related to the health of an individual, such as the financial costs experienced at individual and country wide levels.

Some of the more direct consequences of obesity involve the physical health and well-being of those with the condition. Hypertension, or high blood pressure, is a common health risk associated with obesity. At least 75% of hypertension cases in adults are directly related to obesity (Landsberg et al., 2013). Experiencing obesity and hypertension concurrently greatly increases the risk of developing cardiovascular disease, as they are considered comorbid risk factors for this health condition. The risk of coronary heart disease is three fold in people with BMIs of 29 or greater compared to those with BMIs of 22 or less. The risk of congestive heart failure, the top cause of death in the United States, increases as the duration of obesity in an individual increases. As the body gains excess weight, the heart has to work harder to transport blood throughout the body. This causes the heart to become enlarged, and its structure and function become compromised (Pi-Sunyer, 1998). Another devastating and potentially fatal condition linked to obesity is type 2 diabetes. This disease is caused by a combination of low insulin production by the pancreas and an increased resistance to the effects of insulin (Al-Goblan et al., 2014). As of 2017, 462 million individuals were afflicted with type 2 diabetes, about 6.28% of the world's population (Khan et al., 2020). Obesity affects every part of the body, and the result is an overall increased mortality in obese individuals. Persons with a BMI of 30 and above have mortality rates of 50-100% more than persons of a healthy BMI in the range of 20-25 (Pi-Sunyer, 1998).

Obesity, while most commonly considered a physical health-related issue, can also negatively impact the psychosocial wellbeing of those suffering with it. Comprehensive research suggests that 20%-60% of people with obesity in North America are also suffering from a psychiatric illness (Sarwer, 2016). It is estimated that obesity increases the odds of experiencing mood and anxiety disorders by 25% (Simon et al., 2006). The most common mental disorder experienced alongside obesity is depression. The risk of having a major depressive episode is five times higher in those experiencing extreme obesity compared to those of a normal weight. This relationship between obesity and depression was found to be much stronger in women than in men. There have also been observations of depression in one-third of patients who are receiving bariatric surgery (weight loss surgery), and around half have experienced a lifetime of depression (Sarwer, 2016). Other noteworthy mental disorders found to be associated with obesity in the US are bipolar disorder, panic disorder and agoraphobia. The strongest associations between obesity and mood disorders (including depression and bipolar disorder) were found in non-Hispanic Whites and college graduates (Simon et al., 2006).

Another common mental disorder observed in people with obesity is disordered eating. Disordered eating can present in a number of ways, such as binge eating, purging, and emotional eating. Many patients seeking weight loss surgery report that they commonly eat for emotional reasons, or struggle controlling their portion sizes and eating behavior based on environmental cues related to food. Binge eating is the disorder that is most common among people with obesity. Binge eating is the consumption of a substantial amount of food within a short period of time until extremely full, and it is associated with a feeling of complete lack of control. Many people experiencing binge eating report a feeling of disgust after an episode. Sometimes, this binge eating is followed by self-induced vomiting or excessive exercise, meant to “compensate”

for the previous behavior. Binge eating can greatly reduce the effectiveness of weight loss efforts such as bariatric surgery, and often result in premature weight gain after the surgery (Sarwer, 2016).

Obesity not only costs people their lives, but it is costly from a monetary perspective. There are two types of expenses related to the treatment of obesity and its accompanied conditions: direct and indirect costs. Direct costs are the more obvious expenses that ensue from health services and treatments, such as medication, surgery, and x-rays. These direct costs added up to be around \$480.7 billion in 2016 (Waters, 2018). Then there are indirect costs, or those that are related to lost resources as a result of the health condition. There are three categories of indirect costs, one of which is the value of lost productivity resulting from missed work and time off of work. Employees are then losing their wage and employers are losing the work that is usually completed by the employee. Along with increased time off needed for medical treatment, obese individuals miss more days of work due to short or long term disability and they may even experience premature death. Even while present at work, individuals with obesity may have reduced rates of productivity (*Economic*, 2016). This lost productivity is estimated to have cost the United States \$1.24 trillion in 2016 (Waters, 2018).

The American Diet

In the past, undernutrition was a major concern in the United States associated with a poor diet (*Children*, 2019). Recently, the term “poor diet” is more likely to be used to describe a diet containing an excess of nutrients such as sodium, calories, fats, and added sugar. Many Americans consume what is known as the “Western pattern diet.” The Western pattern diet is the

overconsumption of saturated fats, junk foods, “empty” carbohydrates, and red meats, while lacking nutrient rich foods like fruits, vegetables, seafood, poultry, and whole grains (*Western*, n.d). This diet leaves many with excess weight along with multiple nutrient deficiencies involving various vitamins and minerals. In general, Americans' energy intake does not align with the recommendations set by the USDA. Most of the energy consumed by Americans comes from fruit juice, refined grains, and potatoes (21.2%), with another 14.4% coming from food and drinks with added sugars. More than 10% of total consumed energy is derived from saturated fats, surpassing the dietary guidelines. Most of the total protein consumed by Americans comes from red meat rather than whole grains, fish, or nuts (Shan et al., 2019). The relative risk of weight gain increases in those that consume food groups that are characteristic of the Western pattern diet, such as refined grains (RR 1.11), red meat (RR 1.23), and sugar sweetened beverages (RR 1.20). Obesity risk can be reduced when eating high quantities of fruit (RR 0.88), vegetables (RR 0.93), whole grains (RR 0.85), and fish (RR 0.75) (Schlesinger et al., 2019). Following the Western pattern diet is associated with a 22% higher risk of mortality due to cardiovascular disease, 16% higher risk of cancer, and 21% higher risk of all-cause mortality (Heidemann et al., 2008).

Health Nudges

The term “nudging” was first coined by Richard Thaler, an economist, and Cass Sunstein, a Harvard Law School professor, in their book *Nudge*. A nudge is defined as any aspect of the choice architecture that alters people’s behavior in a predictable way without excluding any options or significantly changing their economic incentives (Thaler, 2008). By framing these options in different ways, consumers can be gently drawn towards certain products. Customers

do not want to be told which products they should or shouldn't buy; therefore gentle nudges and alterations of the environment surrounding the choice can be implemented so as to maintain freedom of choice (Thaler, 2008).

The dual process model is a concept that can be used to analyze the behavior of consumers in response to nudging. This model explains the nature of social behavior and states that humans make decisions based on two interrelated systems. The first is known as the reflective system, where decisions are made based on facts and values (Bucher et al., 2016). An example of this type of decision making would be a consumer examining the nutrition facts of different food products in order to decide the best option. The next system of the dual process model is known as the impulsive system, which prompts behavior through emotions and moods. This type of response is known as an affective response, and it requires little to no cognitive output (Bucher et al., 2016). An example of someone using the impulsive system to make food choices would be a shopper making an unplanned purchase of chocolate that was displayed near the checkout. Nudging is often meant to target this "automatic" system of the dual-process model, but it is not yet known whether other factors such as habits, health consciousness, or strong brand preference can interfere with these effects (Bucher et al., 2016).

A term often used in association with choice architecture is libertarian paternalism. This concept is meant to indicate the possibility of preserving freedom of choice while also positively influencing the choices of individuals (Hansen, 2016). Thaler and Sunstein see paternalism as helping individuals to be better off by influencing their choices in a certain way. The libertarian characteristic is related to the assertion that people should always be capable of doing what they like while also being able to withdraw themselves from unwanted circumstances. This type of practice is meant to be non-invasive by refraining from blocking off options, and rather moving

consumers towards better choices. While libertarian paternalism is seen as the concept or policy, nudging is the action used to implement the policy unto different circumstances (Hansen, 2016).

Influencing Food Choice

Grocery stores are currently employing psychology-based methods to influence food choice, but not necessarily healthy food choice. Most grocery stores place sugary cereals strategically at a child's eye level and will also set up fun displays of low-nutrient foods to appeal to children (Harris et al., 2020). Every aspect of grocery stores, from their shelf design, to the layout of the store, and even the location of the exits is deliberate and planned. A one-way entrance forces customers to walk throughout the entire store, passing all of the enticing displays, in order to make it to the exit. The dairy section is often placed on the far end of the store, ensuring that shoppers have to walk through the full expanse of the building. The produce department is usually placed near the entrance, where the colors, scents, and textures of fruits and vegetables are meant to stimulate the senses of customers in order to make them hungry and more likely to purchase more food. Special lighting and occasional misting of the produce makes it look fresh-picked and more desirable (Rupp, 2021).

There have been many studies examining the effectiveness of nudges within grocery stores and other environments. Something as simple as manipulating food placement within a store can impact consumer food choice (Kroese et al., 2016). Enforcing policies on food placed at supermarket checkouts can greatly decrease purchases of sugary snacks, candy, chocolate, and chips (Ejlertskov et al., 2018). Some larger companies, like Google, utilize simple psychology to promote healthier lifestyle choices. An example of this is the use of a traffic light coloring system in the workplace dining area. Healthy ingredients at the salad bar are displayed in green

containers, while unhealthy toppings like cheese or croutons are put into red containers. Unhealthy options like cookies are stored in opaque jars, and healthy foods are stored in clear containers (Thieroff, 2015). Traffic light labelling can be used on nutrition fact labels in order to highlight important nutrients such as calories, fat, sodium, and sugar. This system of nudging can result in significantly reduced amounts of unhealthy levels of nutrients (Emrich et al., 2017).

The simple act of making nutrition information more readily available to consumers can greatly influence their decision making when grocery shopping. This can be done by providing nutrition information on the front of the product, also known as front-of-pack or FOP labelling. Not only does truthful and transparent nutrition labelling aid consumers in their food choice, but it also encourages the food industry to produce food of higher quality in order to avoid these nudges that may display their products in a negative light (Scrinis, 2016). Nutrition fact transparency is also seen on some restaurant menus, where calorie counts are provided for each menu product. Providing calorie counts results in a lower overall quantity of calories consumed by restaurant patrons (Long et al., 2015; Yamamoto et al., 2005).

Because in-store interventions have succeeded at manipulating consumer behavior, health related interventions imposed on online platforms have begun to be studied. Including a simple logo on the 20% of products with the lowest amount of calories could persuade shoppers into purchasing lower calorie foods (Eric et al., 2020). “Prominent positioning,” or intentionally reorganizing products on an online webpage, may persuade consumers to purchase foods with less unhealthy nutrients such as saturated fat. Another nudge found to be successful is implementing a pop-up screen that provides healthier alternatives to a chosen product. Using these interventions together reduces the total amount of saturated fat in customers’ online shopping carts (Koutoukidis et al., 2019). Combining a 25% price reduction on healthy food

choices with “salience nudges,” or nudges that draw consumer attention to a specific product through arrows or frames, can increase healthy food choice behavior through online grocery shopping (Hoenink et al., 2020).

Objectives of Study

The unhealthy Western style eating that many Americans have adopted is a leading cause of the obesity epidemic. The act of nudging is effective in drawing consumers towards healthier food options while grocery shopping. Nudging is a way to enact the concept of libertarian paternalism, or the preserving of freedom of choice while also positively influencing the choices of individuals. Grocery stores maintain their own version of this idea by implementing choice architecture and altering the shopping environment to influence consumer choices. This is obtained through food placement, store layout, lighting, and staging of products. Making alterations such as placement changes, traffic light coloring, and front-of-pack labelling can effectively sway consumer behavior. Some studies have researched similar nudges but in an online format. These studies focused on application of logos, prominent positioning, pop-up screens, and price reductions, all finding positive results.

All of the previously mentioned studies tested their nudges across food categories rather than within categories. This present study is solely focusing on within-category nudges on a less commonly studied online format. Each category of food received a unique intervention on certain product images. Each of the five categories (soup, yogurt, pizza, chips, and cereal) were randomly split into healthy/unhealthy categories. Because this process was random, the acronyms “RLH” (researcher-labelled healthy) and “RLU” (researcher-labelled unhealthy) will

be used when referencing one of the categories. This means that three out of six products received the intervention while the other three were left untouched. The previously mentioned decision theory, the dual process model, can be applied to the interventions used in this study. While some interventions focused on providing information to the consumer (calorie, sodium, and fat content), others were centered around subliminal messaging (traffic light coloring and brightness alterations). The information-providing nudges may play towards the “reflective system” of the dual process model, where decisions are made based on facts. The nudges that involve visual alterations are more related to the “impulsive system,” where decisions are made using emotion or mood rather than thought. The survey aligns with the concept of libertarian paternalism because participants are still given freedom of choice, but the environment around their choices is altered to encourage favorable choices.

The goal of this research was to ascertain if any of the interventions were effective enough at influencing consumer behavior to be implemented on actual store websites. It was hypothesized that the interventions used will nudge consumers towards the options considered “healthier,” or the RLH options, within the study. It was also speculated that within-category nudging may be more effective at encouraging healthier substitutes rather than across-category nudging because the consumer is choosing from very similar products (Young et al., 2013).

Methodology

This study is a randomized control trial using a survey to collect data. A control group will be used as a mode of comparison to study the effectiveness of the interventions.

Randomization will limit selection bias and allow a fair comparison of the data between the two trial groups.

Recruitment methods

In total, 121 participants were recruited for this study, all of them fitting the inclusion criteria of being at least 18 years of age. These participants were recruited using two different online platforms: Facebook and Reddit. Each of these platforms offers specific groups or forums for collecting research and distributing surveys. Each “ad” posted in the various groups contained a short description of the study and its purpose, along with a direct link to the Google Forms survey. The direct link included in each ad brought all participants directly to the survey. Participants were given a set of three screening questions to ensure that they met inclusion criteria of being 18 years or older. The questions included were “What is your age?”, “Do you shop online?”, and “Do you have a regular grocery store that you shop at?” It was necessary to include two questions in addition to the age question so participants would not guess at what the eligibility criteria may be. Participants that answered that their age is under 18 were directed to a separate page thanking them for their time.

Procedure

Eligible individuals were presented with a consent form that determined their willingness to participate in the study by choosing from “Yes, I agree” or “No, I do not agree.” Participants that consented to the survey continued on to demographic questions (sex, age, race, ethnicity). The randomization of this survey was accomplished by having participants choose between two

mirror images of a tree, labelled “Here” or “That.” Participants' choice of image determined which survey they took. The “Here” image brought participants to the control survey (not featuring interventions) and the “That” image brought participants to the intervention survey (featuring the interventions). Randomization was further improved by shuffling the order of the two options for each survey-taker. Both surveys included a series of questions made up of images with various product choices. Participants answered multiple choice questions in order to choose one product from each image (labelled 1-6).

Covariates

Demographic information about the participants was determined by a series of four questions at the beginning of the survey. The first of which was “What sex were you at birth?” followed by “What is your age (yrs)?” Participants chose from a series of age groups including under 18 and 65+. The ethnicity of respondents was determined by the question “Are you of Hispanic, Latino, or Spanish origin?” Lastly, survey takers responded to the question “How would you describe yourself?” by choosing their race from the provided options or typing it in the “other” answer box.

Interventions

The interventions chosen for this study were meant to be simple, seemingly small additions to the simulated webpage images used in the survey. The interventions included were calorie count display, nutrient information logos, traffic light coloring, and altered image brightness. The interventions were used to make a distinction between “healthy” and “unhealthy”

food options in each category. The foods belonging to each category were randomly chosen by the researcher, and will further be referred to as either “RLH” (Researcher-Labelled Healthy) or “RLU” (Researcher-Labelled Unhealthy) options.

The typical online grocery store website does not make nutrition information readily visible for customers until they specifically look for it by clicking on the product and searching for the nutrition facts (*Browse*, 2021; Appendix B). Nutrition information can become more readily available to consumers by placing it on or near the cover image of the product. The intervention survey included the calorie count of six different yogurt choices, displayed directly above each image. Three of the six displayed yogurts had a calorie count above 100, and three had a calorie count below 100. Food labeling on restaurant menus has been shown to result in an overall reduced consumption of calories and fat (Shangguan et al., 2019). Nutrient information logos were utilized in two different ways within the survey. The first way that logos were used was to highlight positive nutrient information. This was accomplished by placing a “low sodium” logo directly on three out of six included soup cans. Logos can also be used to highlight negative nutrient information, or warn consumers of unhealthy levels of nutrients in foods. Participants were shown six bags of chips, where three of these bags had a “high fat” logo placed on the upper corner of each picture. Both of these nutrient information logos were kept to a black and white theme so as to not interfere with the next intervention that used color as its influential quality. Nutrient logos are successful at showing consumers which options are healthier, but there is a lack of answers considering their usefulness at encouraging healthful food choice (Borgmeier, 2009). The next intervention utilized traffic light colors (red and green) to outline the images of six frozen pizzas based on which pizzas were RLH or RLU. The red and green

coloring was used to frame each pizza product image. Consumers have been known to choose healthier products when faced with this color-code (*Traffic*, 2014). The last intervention featured in the experimental survey focused on visual salience (noticeability) by alteration of image brightness. Unlike lighting alterations within a grocery store, using this intervention online allows single products to be “darkened” if they are considered less healthy options, while the healthier options appear brighter. Out of a selection of six different cereals, three were altered to appear slightly darker than the rest to encourage consumers to choose the other three RLH options. Perceptual salience-or the extent to which certain features contrast with the surroundings-can play a key role in focusing attention when there are multiple items present (Dai et al., 2020).

Study Design Rationale

Data in this study was collected through an online survey for two reasons. A survey is a safe mode of data collecting considering the COVID-19 pandemic occurring during this research. It does not require the researcher nor the participants to be interacting face-to-face or to be in a public setting. Because this research is focused on online shopping, an online survey can best simulate this process compared to a survey given on paper. A survey simulating an online store allows both a single product category and intervention to be studied at a time. This provides a lower risk of extraneous factors compared to a simple observation-based study of typical online grocery shopping behavior on a real website.

Statistical Analysis

This survey collected quantitative, nominal data. Raw survey data was imported into SPSS for data cleaning and analysis. Responses for each product choice question were re-coded to dichotomize their identity of RLH or RLU within each product category in both the intervention and control groups. Potential differences in RLH/RLU food choice were revealed between the groups by using logistic regression analysis and adjusting for age, sex, ethnicity, and race. Because a total of 1.6% of the sample were within the age groups 45-54 and 55-64, the categories were collapsed into three groups of ages 18-24, 25-34, and 35+. A similar scenario was found within the racial demographics of the sample where there were many racial categories containing a single participant, leading to the collapse of racial categories to “White” and “BIPOC” (Black, Indigenous, and People Of Color). Additional tables feature differences between healthy/unhealthy food choice by group using odds ratio (OR), *p*-value, and confidence intervals (CI).

Results

Descriptive Statistics of Sample

121 people participated in the survey, but three responses were missing information and were not included in the analysis (Table 1). This resulted in a sample size of 118. 71.9% of the sample was female, and a majority of the participants belong to the age group of 18-24 (58.7%) (Table 1). 87.6% of the sample reported that they were not of Hispanic, Latino, or Spanish origin

(Table 1). Most of the sample was White (66.1%) (Table 1). Descriptive statistics of the control and intervention groups revealed that the only significant difference between the groups was between males and females ($p = .022$) with the control group containing almost 20% more males than the intervention group (Table 2).

Table 1. Descriptive Statistics of the Total Sample

Variable	<i>n</i>	%
Sex		
Female	87	71.9%
Male	31	25.6%
Missing	3	2.5%
Age		
18-24	71	58.7%
25-34	34	28.1%
35+	13	10.7%
Missing	3	2.5%
Hispanic/Latino/Spanish Origin		
No	106	87.6%
Yes	12	9.9%
Missing	3	2.5%
Race		
White	80	66.1%
BIPOC	37	30.6%
Missing	4	3.3%

Table 2. Descriptive Statistics of Experimental Groups

Variable	Control (n)	%	Intervention (n)	%	<i>p</i>
Sex					
Female	41	65.1%	46	83.6%	.022
Male	22	34.9%	9	16.4%	
Age					
18-24	38	60.3%	33	60.0%	.170
25-34	16	25.4%	18	32.7%	
35+	9	14.3%	4	7.2%	
Hispanic/Latino/Spanish Origin					
No	58	92.1%	48	87.3%	.390
Yes	5	7.9%	7	12.7%	
Race					
White	41	65.1%	39	72.2%	.408
BIPOC	22	34.9%	15	27.8%	

Intervention Results

Unadjusted logistic regression models revealed that the interventions did not significantly alter the food choice of participants in all food categories (p 's > 0.05) (Tables 3-7). There were also no significant differences after adjusting for age, sex, ethnicity, and race ($p > .05$) (Tables 3-7). Bar graphs were created using the results from each food category to showcase the percent of participants within either group that chose the RLH or RLU options (Figures 1-5). While not statistically significant, the bar graphs for yogurt, pizza, and chips show a slight increase in the choice of RLH products in the intervention group (Figures 1, 3, 4).

Table 3. Yogurt Choice Regression Analysis Adjusted & Unadjusted

Predictor	<i>p</i>	OR	CI (95% lower)	CI (95% upper)
Adjusted				
Group	.536	.781	.358	1.706
Sex	.482	1.384	.559	3.429
Age	.706	1.107	.653	1.877
Ethnicity	.986	.989	.267	3.661
Race	.515	.753	.322	1.765
Unadjusted				
Group	.689	.858	.404	1.822

Table 4. Soup Choice Regression Analysis Adjusted & Unadjusted

Predictor	<i>p</i>	OR	CI (95% lower)	CI (95% upper)
Adjusted				
Group	.595	1.262	.535	2.978
Sex	.686	.814	.301	2.203
Age	.374	1.273	.748	2.165
Ethnicity	.015	5.098	1.368	19.001
Race	.866	.921	.356	2.385
Unadjusted				
Group	.899	1.053	.476	2.325

Table 5. Pizza Choice Regression Analysis Adjusted & Unadjusted

Predictor	<i>p</i>	OR	CI (95% lower)	CI (95% upper)
Adjusted				
Group	.996	.998	.411	2.423
Sex	.044	.260	.070	.963
Age	.719	1.108	.633	1.941
Ethnicity	.901	1.095	.260	4.614
Race	.958	1.027	.377	2.800
Unadjusted				
Group	.681	.837	.358	1.956

Table 6. Chip Choice Regression Analysis Adjusted & Unadjusted

Predictor	<i>p</i>	OR	CI (95% lower)	CI (95% upper)
Adjusted				
Group	.435	.700	.286	1.714
Sex	.910	1.063	.370	3.057
Age	.296	1.327	.781	2.253
Ethnicity	.895	1.103	.257	4.738
Race	.038	.286	.088	.934
Unadjusted				
Group	.286	.639	.280	1.457

Table 7. Cereal Choice Regression Analysis Adjusted & Unadjusted

Predictor	<i>p</i>	OR	CI (95% lower)	CI (95% upper)
Adjusted				
Group	.957	.979	.458	2.093
Sex	.474	1.381	.570	3.345
Age	.405	1.242	.746	2.069
Ethnicity	.713	1.277	.348	4.688
Race	.518	1.321	.568	3.072
Unadjusted				
Group	.952	1.023	.491	2.131

Figure 1. Healthy/Unhealthy Yogurt Choice by Group

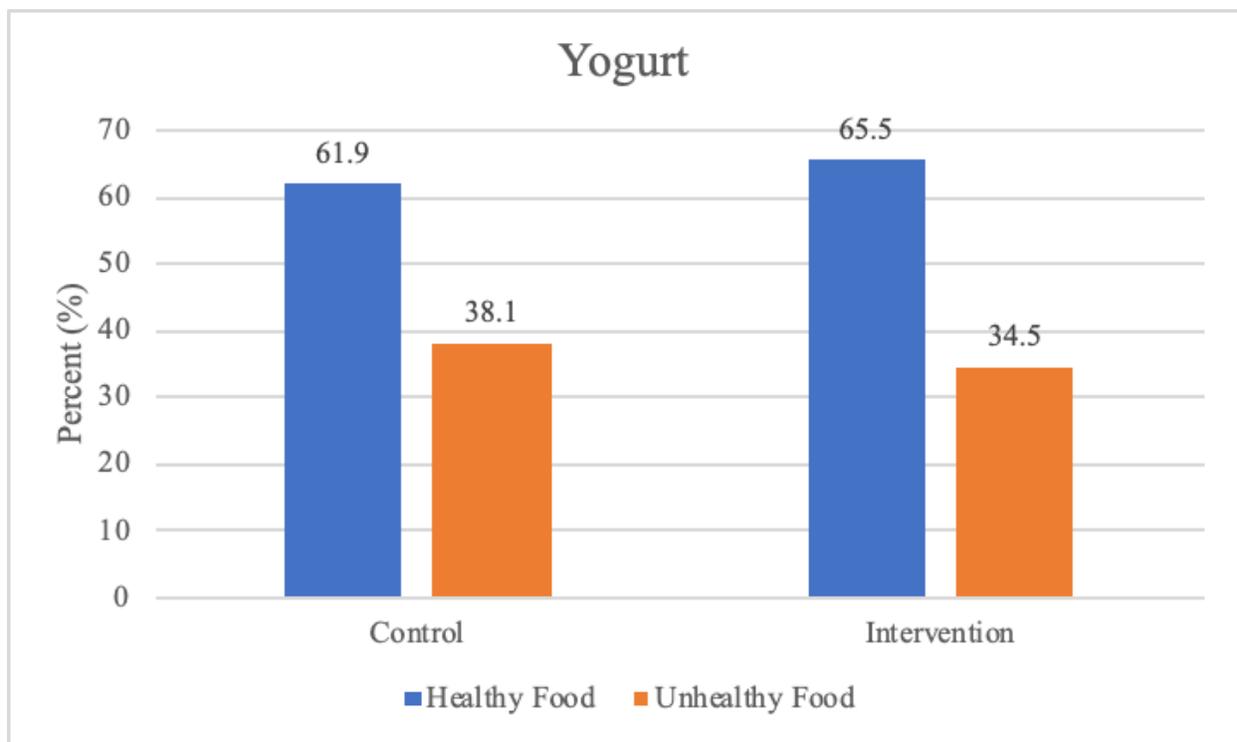


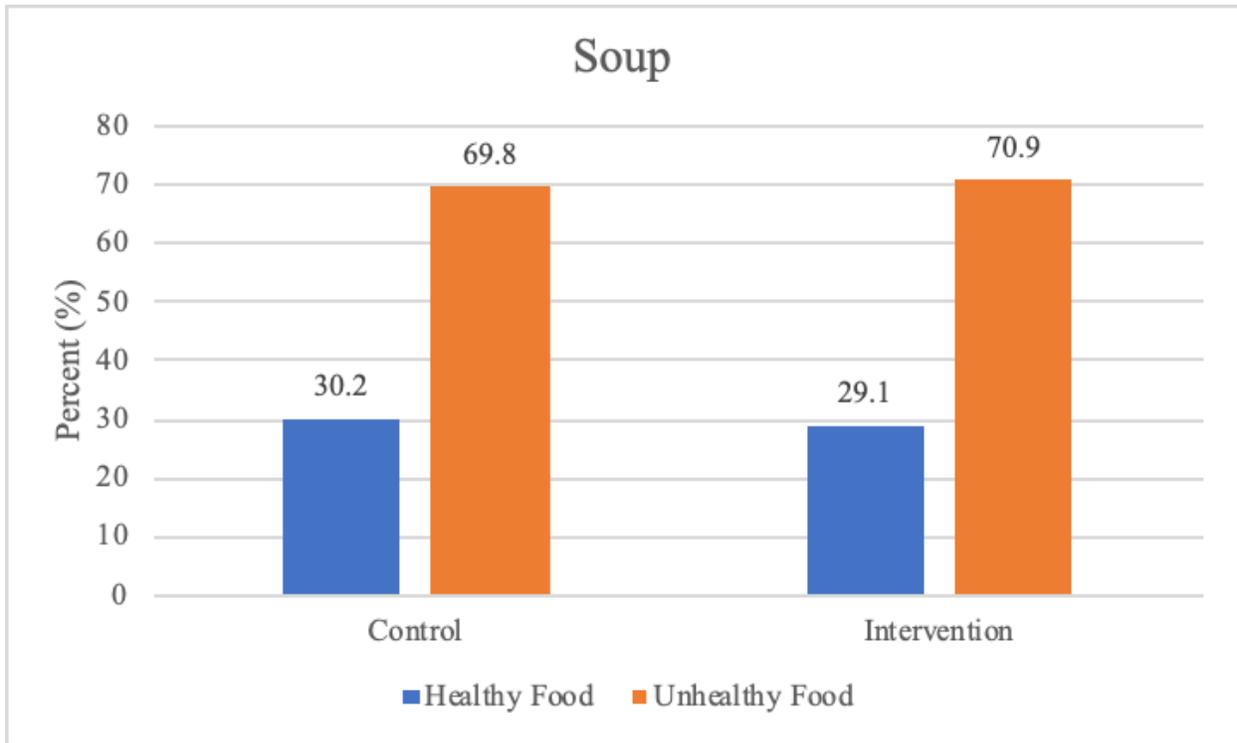
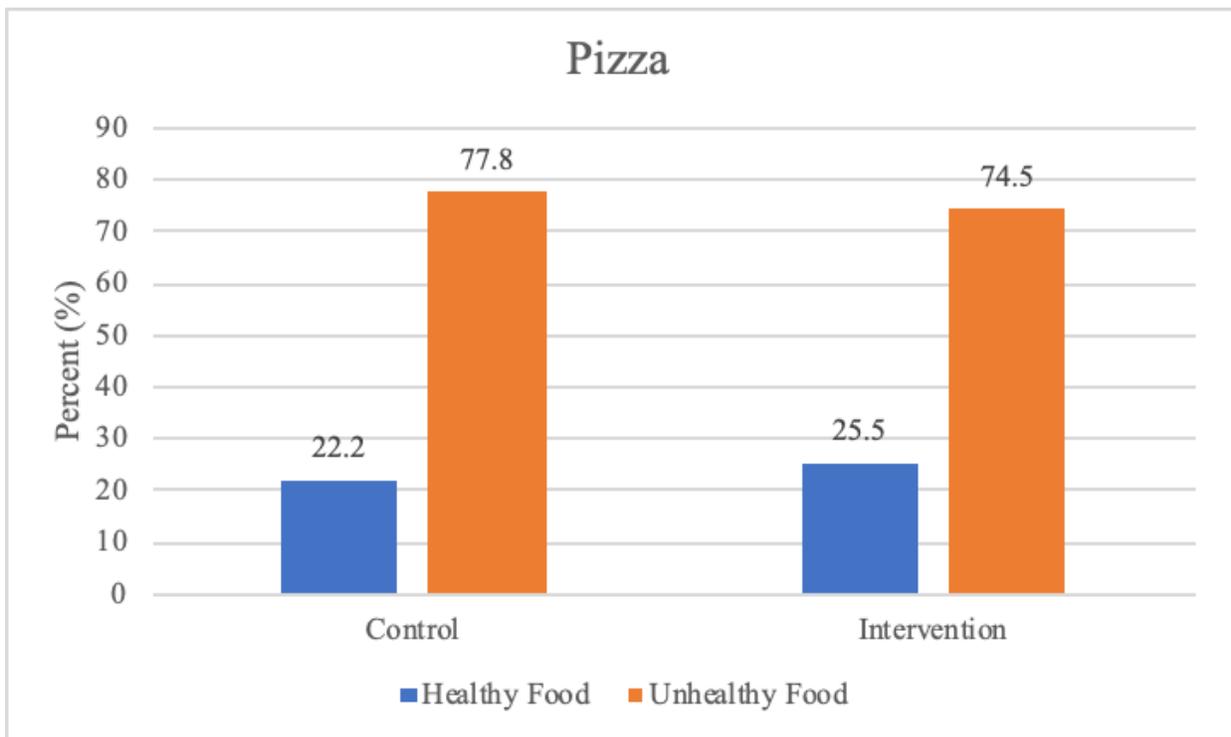
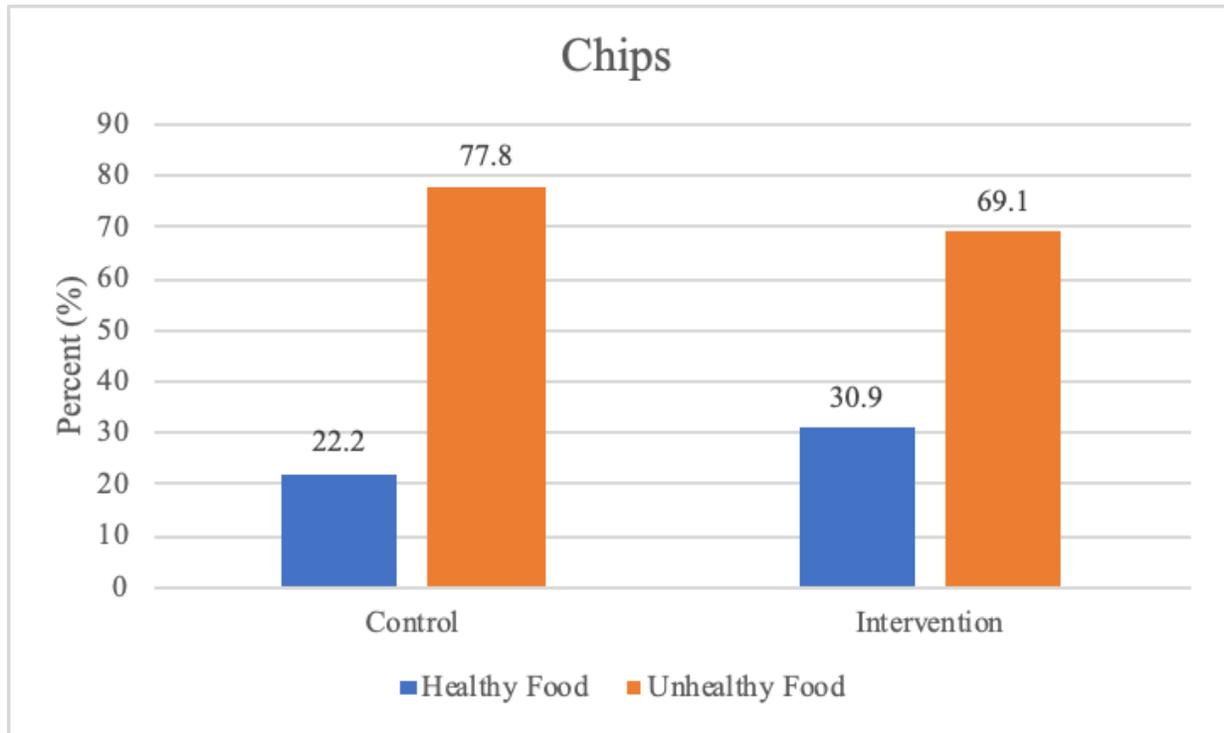
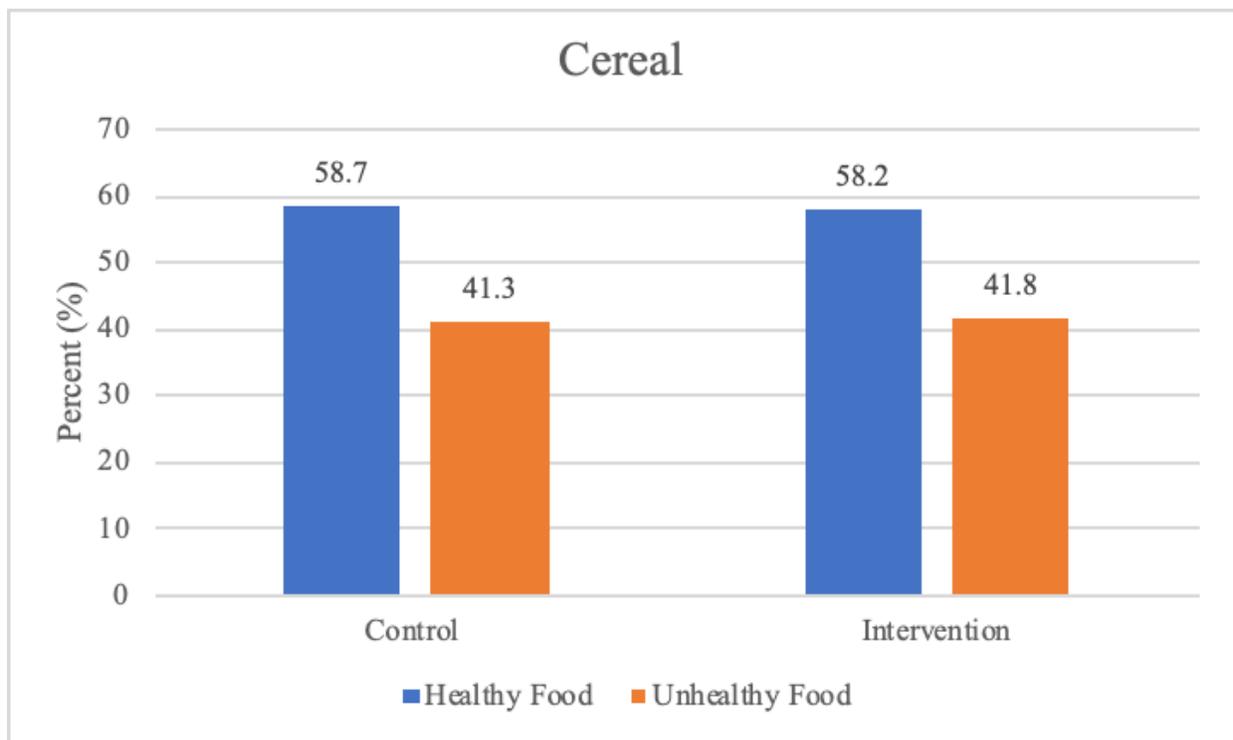
Figure 2. Healthy/Unhealthy Soup Choice by Group*Figure 3. Healthy/Unhealthy Pizza Choice by Group*

Figure 4. Healthy/Unhealthy Chip Choice by Group*Figure 5. Healthy/Unhealthy Cereal Choice by Group*

Significant Findings

There were a few significant differences in food choice by demographic groups. The first is found in the choice of soup by ethnicity (OR = 5.098, 95% CI 1.368, 19.001) (Table 4). Non-Hispanic Whites were more likely to choose Campbell soup (37.7%) while Hispanic participants were more likely to choose Progresso soup (33.3%). The next significant finding is pizza choice adjusted by sex (OR = .260, 95% CI .070, .963) (Table 5). While both sexes were most likely to choose Digiorno pizza (36.8% and 38.7%), females were more likely to choose Tony's (10.3% vs. 0%) and Celeste pizza (8.05% vs. 3.23%) while males were more likely to choose Red Baron (22.6% vs. 17.2%) and Tombstone pizza (29% vs. 17.2%). Lastly, adjusting chip choice by race revealed significant values (OR = .286, 95% CI .088, .934) (Table 6). BIPOC were far more likely to choose Lay's chips compared to Whites (81.1% vs. 62.5%), while Whites were more likely to choose Wise (16.3% vs. 2.7%) and Herr's (13.75% vs. 5.41%) chips.

Discussion

Discussion of Data

There were no significant differences in RLH food choice between the control and intervention groups based on the implemented interventions, demonstrating a need for additional investigation into the root causes for these outcomes. One of these causes may be related to brand preference or loyalty. The sample population of this survey was predominantly people of ages 18-24, also known as Generation Z. This generation exhibits strong commitments to certain

brands, meaning that many are loyal to brands that they have become familiar with and have enjoyed in the past (Carriero, 2020). This means that the interventions used in the study were not strong enough to overcome the brand loyalty of the participants, and this is especially highlighted in the responses seen in the chip category. The overwhelming majority of the sample choosing Lay's chips can likely be attributed to loyalty to this brand along with recognition of this brand. As of 2016, Lay's was ranked as the top potato chip brand in the United States (Wunsch, 2017).

Soup choice significantly differed based on the ethnicity of the participant. The majority of individuals of Hispanic, Spanish, or Latino origin chose Campbell's, Annie's, or Progresso soup. The majority of non-Hispanic individuals chose Campbell's, Gardein, or Wolfgang Puck soup. The most popular soup of the non-Hispanic population in the sample was Campbell's Chicken Noodle Soup (37.7%), while the most popular soup among the Hispanic population was Progresso Chicken Noodle Soup (33.3%). Consumer data shows that Caucasians are more likely to purchase Progresso soup than Campbells, which contradicts the findings of this study (Progresso, n.d.). Along with the small sample size, this discrepancy can also be attributed to sampling error, as the study sample is predominantly ages 18-24. The behavior of this age group may differ from the general population, resulting in atypical outcomes.

There was a major difference in pizza choice based on the sex of the participant. While DiGiorno pizza was the most popular among both sexes (36.8% of females and 38.7% of males), the less popular choices showed most of the variance. Celeste Pizza was chosen more than twice as much by females than males (8.05% vs. 3.23%). This pizza, along with having a female name, pictures a female mascot (Appendix B). Research has shown that men are less likely to buy products with either a female mascot or brand name (*Men*, 2021). Tony's pizza was chosen by 10.3% of females and 0% of males. Tony's and Celeste pizza both featured a front-of-pack

advertisement that says “100% Real Cheese.” Women are known to place a greater importance on healthy eating compared to men, and it may be possible that the female population in this study perceived these two pizzas as healthier due to the “100% Real Cheese” advertisements (Bärebring et al., 2020).

The last pronounced data finding was a variance in chip choice based on race. Lay’s chips were the most popular choice, with 62.5% of the White population and 81.1% of the BIPOC population choosing this brand. Based on consumer demographic data, 31.4% of Lay’s customer base is African American, while 24.8% is White. It also appears that young people (under 24) are more likely to choose Lay’s compared to older ages of 25-44 (Lay’s). The sample in this study is predominantly of ages 18-24, explaining the overwhelming majority that chose this brand of chips. The choices between the two populations also differed within chip options two and six, Wise and Herr’s brands. 16.3% of Whites chose Wise brand, while only 2.7% of BIPOC also chose this. 13.75% of Whites chose Herr’s brand, while only 5.41% of BIPOC chose this option.

Implications

It is crucial that public health officials continue to grow, change, and evolve solutions to the obesity epidemic to fit the modern world and its ever changing behavior. The findings of this study suggest that online interventions meant to nudge consumers towards healthier choices within the same product category may not be the best route of action. These interventions may work on a real website that reaches a larger population, but this study cannot prove it.

Healthfulness should be approached in a holistic fashion, and a single determinant of overall health (such as grocery shopping behavior) will never be the universal deciding factor of one’s

well-being. Because obesity is the result of a multitude of behaviors, an all-encompassing approach should be taken to address it (Hruby, 2015). This may include federal policies such as requiring all eating establishments to be completely transparent with the nutrition of their food, or beginning the use of warning labels for unhealthy foods. Transparency through calorie labelling on restaurant menus results in less calories consumed by customers (Long et al., 2015). If this type of honesty was acquired by all eating establishments, the overall health of the general population could greatly improve. Some regulations may be related to aiding the mental and emotional struggles that are either the predictors or results of obesity, such as including the services of a trained nutritionist or therapist as part of employee's benefits in the workplace. Behavioral interventions that target the individual in the workplace have resulted in moderate weight loss of employees (Thorndike, 2011). The importance of nutrition should be ingrained in the minds of young people to encourage healthfulness in the future. This could be achieved by requiring all public elementary schools and high schools to have a mandatory nutrition class for students, or implementing incentives for students to choose healthier options at lunch. Teaching young students about health and nutrition may result in an improvement in their future lifestyles and a reduced risk of obesity (Haghani et al., 2017). Healthier school lunches can play a role in reducing childhood obesity, and moreover, reduce risk of obesity and related diseases later in life (Miyawaki et al., 2019; Pandita et al., 2016).

There are multiple explanations for the ineffectiveness of the interventions used in this study which can help inform and recommend future research. The first of which could be related to the visual salience of the nudges themselves. If made bigger and more obvious, they may be more successful at altering customer product choice. Future studies could also test identical interventions used in both online and in-person environments to determine if the online format

itself has a significant effect on product choice. In order to eliminate brand loyalty bias, researchers should create their own products in future studies to increase the chances that the applied interventions are truly influencing product choice. Further research should also include a real website to simulate online grocery shopping and more closely match the real experience. The results of this study revealed that the demographics of an individual may play a role in their food choices. If more research on this topic is done, it may create opportunities for grocery stores to cater the online shopping experience to their customers based on their age, sex, ethnicity, or race. Researchers could also receive permission to track customer purchases from grocery stores in order to examine how these purchases relate to the attributes of each person. If more information can be revealed about shopping behavior and if, or how, it relates to the characteristics of a person, interventions can be customized in order to target specific demographics.

Limitations

The purpose of this study was to research the effects of interventions on online grocery shopping websites, but the format of the survey itself did not closely resemble a real online website. Usually, customers can choose from a wide variety of products within each category, but the survey only allowed participants to choose from six items. The survey featured static images rather than a fully dynamic website with features such as multiple product images, customer reviews, sale items, and more. The results of this study may have been different if a real website was created to simulate the online shopping experience. Because the survey was formatted in an online fashion, participants could have been focused on a number of other activities while taking

the survey, and they may have been distracted and not completely focused on the survey itself. It is impossible to know the true intentions of the survey takers. Some of the participants may have skimmed through all of the questions and failed to answer truthfully, altering the validity of the final results.

Another limitation was related to the recruitment techniques used to gather participants for the study. The majority of the participants were recruited through two Facebook groups that were designated survey-taking groups. The sample used in this study most closely resembles a convenience sample, or a non-probability sample taken from a population that is easy to contact or reach. The sample recruited for this study was also very small. As a result, the sample is not representative of the demographic makeup of the country and the results have poor generalizability. Young White females make up the majority of the sample and the results of this study may only apply to this specific demographic.

The specific food products that were chosen to be in the survey may have impacted the choices of participants. Brand preference and brand loyalty could have significantly altered the results of this study, with participants choosing their favorite brands or brands that they recognize. In both the intervention and control groups, Lay's chips were chosen more than any other chip, leading to the speculation that the participants have a strong preference towards this brand. If fake brands were created for this study, this could have eliminated the interference of brand preference and may have resulted in more favorable data.

Conclusion

The obesity rates in the United States are, and have been, a public health emergency as the morbidity and mortality of citizens continues to increase. Mental health is declining in those experiencing obesity, as financial expenditures related to this condition continue to rise. The Western pattern diet followed by the majority of US citizens is proving to be one of the main determinants of weight gain and risk of obesity-related death. This study focuses on diet by targeting the behavior of consumers while grocery shopping online. In an attempt to increase healthier food choice, alterations were made to product images in order to nudge shoppers towards healthier choices. The results of this experiment indicated that the utilized strategies did not make a significant impact on frequency of healthy food choices by the intervention group relative to the control group. Further research and innovation is necessary to continue the efforts of this study and find a way to make a significant change in eating behavior by focusing on the online grocery shopping practices of consumers.

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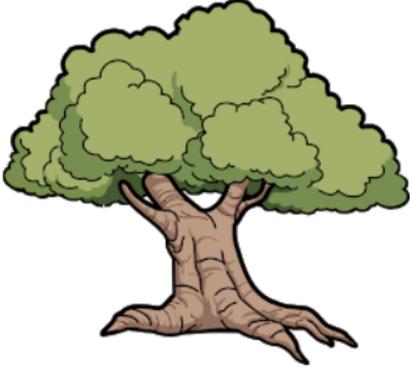
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Appendix A

Choose an image *



That



Here

This is the randomization question that sorted participants into the control or intervention group.

Appendix B

 <p>\$0.75 Yoplait Original Yogurt Mountain Blueberry Low Fat 6 oz cup \$0.13 / oz</p> <p>✂ SAVE 50¢ ON FIVE</p> <p>Add to Cart</p>	 <p>\$0.75 Yoplait Whips! Yogurt Mousse Orange Creme Low Fat 4 oz cup \$0.19 / oz</p> <p>✂ SAVE 50¢ ON FIVE</p> <p>Add to Cart</p>	 <p>\$0.75 Yoplait Whips! Yogurt Mousse Vanilla Creme 4 oz cup \$0.19 / oz</p> <p>✂ SAVE 50¢ ON FIVE</p> <p>Add to Cart</p>
 <p>\$0.75 Yoplait Original Yogurt Mixed Berry Low Fat 6 oz cup \$0.13 / oz</p> <p>✂ SAVE 50¢ ON FIVE</p> <p>Add to Cart</p>	 <p>\$0.75 Yoplait Whips! Yogurt Mousse Chocolate 4 oz cup \$0.19 / oz</p> <p>✂ SAVE 50¢ ON FIVE</p> <p>Add to Cart</p>	 <p>\$1.59 Oui by Yoplait French Style Yogurt Vanilla 5 oz jar \$0.32 / oz</p> <p>✂ SAVE \$1.00 ON FOUR</p> <p>Add to Cart</p>

This is an example of a typical grocery store website that does not show nutrition fact information directly on or near product images.

Item Detail

Nutrition

170 **6 g** **75 mg** **15 g**
CALORIES SAT FAT SODIUM SUGARS

Nutrition Facts

servings per container
Serving Size **1.0 jar**

Amount per serving
Calories **170**

	% Daily Value*
Total Fat 8g	11%
Saturated Fat 6g	28%
<i>Trans</i> Fat 0g	
Cholesterol 30mg	10%
Sodium 75mg	3%
Total Carbohydrate 17g	6%
Dietary Fiber 0g	0%
Total Sugars 15g	
Includes 9g Added Sugars	17%
Protein 5g	
Vitamin D	0%
Calcium	15%
Iron	0%
Potassium	6%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Details

Gluten free. Non GMO Project verified. nongmoproject.org. Made with whole milk. Comments? 1-800-967-5248 (M-F 7:30 - 5:30 CT) or ouibyyoplait.com.

Keep refrigerated.

Manufacturer
 YOPLAIT

Phone
 800-967-5248

These are the nutrition facts shown after clicking on a product.

Appendix C

Home / Products / Dairy & Eggs

Browse Products

Selected Category:
❖ Yogurt

Yogurt

SUZIE'S MARKET

 VIEW BAG →

Item	Image	Calorie Count	Price	Action
1		80 Cal	\$0.50	Add to Cart
2		120 Cal	\$0.50	Add to Cart
3		130 Cal	\$0.50	Add to Cart
4		120 Cal	\$0.50	Add to Cart
5		70 Cal	\$0.50	Add to Cart
6		80 Cal	\$0.50	Add to Cart

This survey question featured calorie count display on yogurt products.

Home / Products / Soups & Canned Goods

Browse Products

Selected Category:

❖ Soups

SUZIE'S MARKET

 VIEW BAG →

Soups

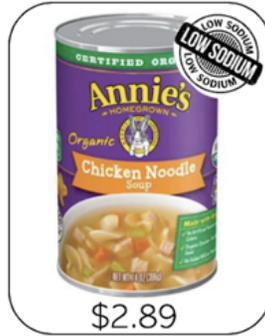
1



\$2.89

Add to Cart

2



\$2.89

Add to Cart

3



\$2.89

Add to Cart

4



\$2.89

Add to Cart

5



\$2.89

Add to Cart

6



\$2.89

Add to Cart

This survey question featured “low sodium” logos on soup products.

Home / Products / Frozen Foods

Browse Products

Selected Category:

❖ Frozen Pizza



Frozen Pizza

1



\$4.99

Add to Cart

2



\$4.99

Add to Cart

3



\$4.99

Add to Cart

4



\$4.99

Add to Cart

5



\$4.99

Add to Cart

6



\$4.99

Add to Cart

This survey question featured a traffic light coloring system on pizza products.

Home / Products / Chips & Snacks

Browse Products

Selected Category

◆ Potato Chips

SUZIE'S MARKET

 VIEW BAG →

Potato Chips

1



\$3.00

Add to Cart

2



\$3.00

Add to Cart

3



\$3.00

Add to Cart

4



\$3.00

Add to Cart

5



\$3.00

Add to Cart

6



\$3.00

Add to Cart

This survey question featured “high fat” logos on chip products.

Home / Products / Breakfast & Cereal

Browse Products

Selected Category:

Cereal

SUZIE'S MARKET

VIEW BAG →

Cereal

1



Add to Cart

2



Add to Cart

3



Add to Cart

4



Add to Cart

5



Add to Cart

6



Add to Cart

This survey question featured brightness adjustments on cereal products.