

The University of Chicago

The Future of Meatless Diets: Perceptions and Decisions About Meat Consumption in the US

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A thesis submitted for partial fulfillment of the requirements for a Bachelor of Arts degree in

Public Policy Studies

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April 2022

Acknowledgements

I would like to thank the numerous individuals who have provided me support and advice throughout my time at the University of Chicago and throughout my thesis writing process. Thank you to Juan Aritz Ardiszone for always providing constructive critique and for pushing me to write the best thesis that I could write. I greatly appreciate the advice and feedback given by Jim Leitzel, who was the person to introduce me to the topic of farm animal welfare in public policy. Thank you to Levi Hencke who has been a beacon of support and for being someone I could always talk to about my thesis. Thank you to my amazing friends that I have made throughout my time here; Kayla, Marissa, Amanda, and so many more. Thank you to Noodle and Oates who have done more for me than they will ever know.

Abstract

Dietary consumption is a universal aspect of daily life and impacts human existence through nutrition, health, and the environment. While plant-based diets have long existed in the Western world, meat consumption and attachment to meat have increased and increasingly defined consumers. In this research, I survey Americans to examine this construct of meat attachment, attitudes about meat, current behaviors, and dietary intentions. I also explore consumer decision-making regarding dietary options by modifying two aspects of choice architecture: the default and information provision. My research found that while US consumers maintain a strong attachment to meat, changing the default option on a menu and providing information did influence consumers to opt for the meatless choice. I, therefore, recommend that the US Department of Agriculture and Health and Human Services reform the National Dietary Guidelines and improve the National School Lunch Program to incorporate plant-based options and invest in a plant-based future.

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The Future of Meatless Diets: Perceptions and Decisions About Meat Consumption in the US

Introduction

Dietary choices define human life. The food that peoples choose to consume has shifted globally in ways that impact both public health and the environment. The food a nation eats will play an outsized role in national public health. In fact, unhealthy diets are the biggest risk factor for noncommunicable diseases and are the most common cause of death globally.¹ Increased production of processed foods along with changing lifestyles have caused a shift in dietary patterns that negatively impact individual health outcomes. Food choices also affect local and global environments and are an important determinant for environmental sustainability. Agricultural food production accounts for about 30 percent of greenhouse gases (GHGs),² causes pollution that alters ecosystems,³ biodiversity loss, and species extinctions⁴ among other negative environmental impacts.

Thus, animal farming plays a significant role in producing many of the negative impacts associated with larger agricultural productions. Regarding human health, the consumption of unprocessed and processed red meat is associated with significant increases in disease risk and mortality from coronary heart disease, type II diabetes, stroke, and colorectal cancer in high-

¹ Francesco Branca et al., “Transforming the Food System to Fight Non-Communicable Diseases,” *BMJ*, January 28, 2019, 1296, <https://doi.org/10.1136/bmj.1296>.

² Jonathan A. Foley et al., “Solutions for a Cultivated Planet,” *Nature* 478, no. 7369 (October 12, 2011): 337–42, <https://doi.org/10.1038/nature10452>.

³ Peter M. Vitousek et al., “Human Alteration of the Global Nitrogen Cycle: Sources and Consequences,” *Ecological Applications* 7, no. 3 (1997): 737–50, [https://doi.org/10.1890/1051-0761\(1997\)007\[0737:HAOTGN\]2.0.CO;2](https://doi.org/10.1890/1051-0761(1997)007[0737:HAOTGN]2.0.CO;2).

⁴ Gerardo Ceballos et al., “Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction,” *Science Advances* 1, no. 5: e1400253, accessed November 2, 2021, <https://doi.org/10.1126/sciadv.1400253>.

income regions.⁵ Producing just one serving of red meat has outsize impacts on acidification, GHG emissions, land and water use, and eutrophication.⁶ Importantly, dietary choices that involve animals also impact morality. Farm animals live in concerning conditions; they are held captive in close confinement, with a lack of installations and materials for necessary species-specific activity and are slaughtered at too early a time in their lives. Animal productions that do not produce meat, such as dairy or egg farms, also shorten the life spans of their respective species due to health problems inherent to these systems.⁷

Despite growing attention to the consequences of meat production, meat consumption in America is growing. In 2020, Americans consumed around 264 pounds of meat per person, which is a 35 percent increase since 1961.⁸ To compare, the USDA Dietary Guidelines for Americans for 2020-2025 recommends that only about 85 pounds of meat are consumed per year. Meat consumption is only projected to grow through the year 2023.

With growing issues of sustainability, health, and morality, it is imperative that consumers consider and adopt diets with reduced meat, and, if possible, meatless and plant-based diets. Not only are reduced meat, vegetarian, and vegan diets nutritionally sustaining and fulfilling, but the differences in nutrient intake between plant-based and meat-based diets also result in a healthier individual.⁹ Vegetarian diets have consistently been shown to decrease the

⁵ Michael A. Clark et al., “Multiple Health and Environmental Impacts of Foods,” *Proceedings of the National Academy of Sciences* 116, no. 46 (November 12, 2019): 23357–62, <https://doi.org/10.1073/pnas.1906908116>.

⁶ Clark et al. 2019.

⁷ Harald Grethe, “The Economics of Farm Animal Welfare,” October 2017, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3060466.

⁸ Gretchen Kuck and Gary Schnit, “An Overview of Meat Consumption in the United States • Farmdoc Daily,” *farmdoc daily*, May 12, 2021, <https://farmdocdaily.illinois.edu/2021/05/an-overview-of-meat-consumption-in-the-united-states.html>.

⁹ Timothy J. Key, Paul N. Appleby, and Magdalena S. Rosell, “Health Effects of Vegetarian and Vegan Diets,” *Proceedings of the Nutrition Society* 65, no. 1 (February 2006): 35–41, <https://doi.org/10.1079/PNS2005481>.

risk of a variety of chronic diseases including obesity¹⁰ and ischemic heart disease.¹¹

Furthermore, completely removing meat from the diet is correlated with tremendous reductions in GHG emissions and land use, all improving the global environment.

Understanding consumer behavior along with intentions and strategies to reduce meat consumption are particularly important areas of research. Previous studies on the topic have demonstrated that some consumers are willing to pay more for farm animal welfare and that most consumers are concerned about the animals that are raised for food. However, little research has been conducted on why Americans are attached to and continue to consume meat and what would encourage US consumers to accept a more plant-based diet.

Using principles of behavioral economics, I plan to not only examine US consumers' perspectives on meat consumption but also to explore how changing choice architecture can encourage consumers to make a switch in dietary choices. Better understanding the US consumer base in relation to their dietary consumption behaviors and decision to eat meat will help to contextualize and frame future policy decisions involving dietary recommendations and US nutrition programs.

Literature Review

Background on the Arguments Against Farm Animal Agriculture, Consumer Choice, Attachment to Meat, and the Power of the Meatless Diet.

¹⁰ Timothy J. Key and G. Davey, "Prevalence of Obesity Is Low in People Who Do Not Eat Meat.," *BMJ: British Medical Journal* 313, no. 7060 (September 28, 1996): 816–17, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2352221/>.

¹¹ Timothy J. Key et al., "Mortality in Vegetarians and Nonvegetarians: Detailed Findings from a Collaborative Analysis of 5 Prospective Studies," *The American Journal of Clinical Nutrition* 70, no. 3 Suppl (September 1999): 516S-524S, <https://doi.org/10.1093/ajcn/70.3.516s>.

Arguments Against Farm Animal Agriculture

Animal agriculture or animal husbandry is a branch of agriculture that involves raising animals for meat, fiber, milk, or other products. The meat industry refers to modern industrialized livestock agriculture for the production, packing, preservation, and marketing of meat. Meat, also referred to as red meat, includes all forms of beef, pork, lamb, and veal.

Much of the recent literature regarding global agriculture has focused on farm animal husbandry, with increasing criticality towards meat production systems. The modern agriculture system has industrialized and become more efficient using Concentrated Animal Feeding Operations (CAFOs), increasing milk, egg, and meat production. Although intensification produces animal meat at a low monetary cost to consumers, there are many externalized costs. Consequences of modern meat production and consumption generally fall into three categories: public health, the environment, and farm animal welfare.

Public Health

Over the past century, public health has come a long way in dramatically decreasing deficiencies in nutrition, fighting infectious diseases, and greatly increasing the expected lifetimes of individuals. Although innovative medicines have generally improved health in the US, the rates of chronic diseases – many of which are related to diet and nutrition – have increased. 41 million deaths per year, corresponding to 71% of all global deaths, can be attributed to chronic diseases.¹² On a larger scale, the production of meat through intensified methods contributes to global health issues such as antibiotics resistance and zoonosis.¹³ The dietary guidelines from the USDA point out that lower intakes of meats, including processed

¹² World Health Organization, “Non Communicable Diseases,” accessed March 10, 2022, <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>.

¹³ Bertrand Dumont et al., “Rôles, Impacts et Services Issus Des Élevages En Europe. Synthèse de l’expertise Scientifique Collective,” Other (auto-saisine, 2016), <https://doi.org/10.15454/c0hw-k742>.

meats and poultry, have been identified as characteristics of healthy eating patterns, and that leaner meats are preferred for intake.¹⁴ Despite that, high-protein diets based on meat have gained popularity, resulting in more individuals consuming excessive amounts of meat, meaning more than the USDA recommended amount of meat.¹⁵ However, recent literature points to a link between increased meat consumption and the risk of chronic diseases. Higher intake of meats, including processed and unprocessed meats, have been found to be associated with a higher risk for cardiovascular disease (CVD), obesity, type 2 diabetes (T2D), and certain types of cancer.¹⁶

Cardiovascular Disease (CVD)

Cardiovascular disease refers to several disorders of the heart and blood vessels including coronary heart disease, congenital heart disease, and pulmonary embolism.¹⁷ Heart disease is the leading cause of death for men, women, and people of most racial and ethnic groups in the US.¹⁸ Risk factors for cardiovascular disease include high blood pressure, high blood cholesterol, and importantly dietary choices. The evidence regarding the relationship between meat consumption and CVD has been mixed. Previous studies attempting to show a link between CVD and meat consumption have drawn limited results or have indicated that no such relationship exists. One study, for example, found that increased carbohydrate intake, rather than animal protein, was the primary associative variable in CVD mortality.¹⁹ However, this study suffered from issues with

¹⁴ US Department of Agriculture and US Department of Health and Human Services, “Dietary Guidelines for Americans, 2020-2025.”

¹⁵ Jamie Greenheck et al., “Giving Meat Meaning: Creating Value-Based Connections with Consumers,” *Animal Frontiers: The Review Magazine of Animal Agriculture* 8, no. 3 (June 19, 2018): 11–15, <https://doi.org/10.1093/af/vfy008>.

¹⁶ US Department of Agriculture and US Department of Health and Human Services 2020.

¹⁷ World Health Organization, “Cardiovascular Diseases (CVDs),” accessed March 10, 2022, [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)).

¹⁸ CDC, “Heart Disease Facts | Cdc.Gov,” Centers for Disease Control and Prevention, February 7, 2022, <https://www.cdc.gov/heartdisease/facts.htm>.

¹⁹ Mahshid Dehghan et al., “Associations of Fats and Carbohydrate Intake with Cardiovascular Disease and Mortality in 18 Countries from Five Continents (PURE): A Prospective Cohort Study,” *The Lancet* 390, no. 10107 (November 4, 2017): 2050–62, [https://doi.org/10.1016/S0140-6736\(17\)32252-3](https://doi.org/10.1016/S0140-6736(17)32252-3).

confounding variables like income and did not distinguish between the impacts of types of animal protein and products on CVD risk. On the other hand, in a meta-analysis of 36 randomized controlled trials, compared to plant protein intake, red meat consumption yielded significantly less decreases in total cholesterol.²⁰ Further, compared to poultry and fish-based diets, red meat showed no significant differential effects, indicating that meat-based diets as a whole are similar in regards to effects on cholesterol. In line with this meta-analysis was a longitudinal cohort study that concluded that adherence to a diet that was higher in plant foods and lower in animal foods was associated with lower risk of incident CVD, CVD mortality, and all-cause mortality.²¹ Specifically, the lower the intake of animal foods, the lower the risk.

Type 2 Diabetes (T2D)

T2D is characterized by insulin resistance, in which cells do not respond normally to insulin, causing high blood sugar, which is damaging to the body and can cause other serious health problems. About 1 in 10 Americans have diabetes and, of them, about 90-95% have type 2 diabetes.²² While T2D usually arises in adults over the age of 45, younger populations are developing it. Risk factors for T2D include physical activity, body weight, hypertension and hypercholesterolemia, and diet. Several systematic reviews and meta-analyses of cohort and longitudinal studies have shown an association between meat consumption and increased T2D risk. In particular, a meta-analysis of 56 cohort studies on protein intake demonstrated that higher intake of total protein and animal protein, specifically red meat and processed meat, were

²⁰ Marta Guasch-Ferré et al., “Meta-Analysis of Randomized Controlled Trials of Red Meat Consumption in Comparison With Various Comparison Diets on Cardiovascular Risk Factors,” *Circulation* 139, no. 15 (April 9, 2019): 1828–45, <https://doi.org/10.1161/CIRCULATIONAHA.118.035225>.

²¹ Hyunju Kim et al., “Plant-Based Diets Are Associated With a Lower Risk of Incident Cardiovascular Disease, Cardiovascular Disease Mortality, and All-Cause Mortality in a General Population of Middle-Aged Adults,” *Journal of the American Heart Association* 8, no. 16 (August 20, 2019): e012865, <https://doi.org/10.1161/JAHA.119.012865>.

²² CDC, “Type 2 Diabetes,” Centers for Disease Control and Prevention, March 2, 2022, <https://www.cdc.gov/diabetes/basics/type2.html>.

associated with high risk of T2D in males and females.²³ Interestingly, the meta-analysis also found that intake of protein derived from plants had a protective factor for T2D in women.²⁴ More recently, a meta-analysis reviewing randomized controlled trials that investigated plant based versus meat based diets found that plant based diets significantly lowered body weight, BMI, and waist circumference compared to meat based diets, providing evidence for the use of plant based diets to manage T2D.²⁵ On a more biological level, a prospective study of middle-aged men and women found increased biomarkers for T2D present in those that consumed red meat, indicating that red meat consumption was related to an elevated risk of T2D.²⁶ Although some studies have indicated that the effect of meat consumption on T2D risk is small or nonexistent, more recent data have concluded otherwise. The above literature shows a strong relationship between meat consumption and increased risk of T2D.

Cancer

Cancer is a disease in which some cells grow uncontrollably, forming tumors that spread to other parts of the body.²⁷ Cancer is one of the leading causes of morbidity and death in the US and is a major public health problem worldwide. The most common malignancies in men are prostate, lung, and colorectal cancers; for women, the most common are breast, lung, and colorectal cancers.²⁸ There is strong evidence that the increased consumption of meat, especially

²³ Shuang Tian et al., “Dietary Protein Consumption and the Risk of Type 2 Diabetes: A Systematic Review and Meta-Analysis of Cohort Studies,” *Nutrients* 9, no. 9 (September 2017): 982, <https://doi.org/10.3390/nu9090982>.

²⁴ Tian et al., “Dietary Protein Consumption and the Risk of Type 2 Diabetes.”

²⁵ Grace Austin, Jessica J. A. Ferguson, and Manohar L. Garg, “Effects of Plant-Based Diets on Weight Status in Type 2 Diabetes: A Systematic Review and Meta-Analysis of Randomised Controlled Trials,” *Nutrients* 13, no. 11 (November 2021): 4099, <https://doi.org/10.3390/nu13114099>.

²⁶ Clemens Wittenbecher et al., “Amino Acids, Lipid Metabolites, and Ferritin as Potential Mediators Linking Red Meat Consumption to Type 2 Diabetes,” *The American Journal of Clinical Nutrition* 101, no. 6 (June 1, 2015): 1241–50, <https://doi.org/10.3945/ajcn.114.099150>.

²⁷ National Cancer Institute, “What Is Cancer? - National Cancer Institute,” September 17, 2007, <https://www.cancer.gov/about-cancer/understanding/what-is-cancer>.

²⁸ National Cancer Institute, “Cancer Statistics - National Cancer Institute,” April 2, 2015, <https://www.cancer.gov/about-cancer/understanding/statistics>.

processed meat, is a cause of cancer.²⁹ Two large prospective cohort studies conducted in the US found that a higher consumption of red meat was associated with significantly elevated risk of cancer mortality.³⁰ There was a greater risk observed for processed red meat.³¹ In regards to colorectal cancer, recent meta-analyses of cohort, case-control, and prospective studies found that higher intakes of red meat and processed meat were significantly associated with colorectal cancer risk.^{32,33} Interesting to note is that a meta-analysis of 13 prospective studies found that a 100 g/day increase in intake of total red and processed meat is associated with a 14% increased risk of colorectal cancer.³⁴ In the case of lung cancer, a recent literature search concluded from 6 cohort studies and 28 case-control investigations that higher total red meat consumption was associated with lung cancer; in particular, increasing intake of meat by 120 g increments was found to increase the risk of lung cancer by 35%.³⁵ For breast and prostate cancers, the results regarding associations between meat consumption and cancer incidence were less conclusive. For breast cancer, total meat intake was non-significantly associated with risk, but processed meat intake was significantly associated.³⁶ A more recent, but geographically localized, analysis found that total meat consumption of more than three times a week was significantly associated

²⁹ World Cancer Research Fund and American Institute for Cancer Research, “Diet, Nutrition, Physical Activity and Cancer: A Global Perspective,” Continuous Update Project Expert Report 2018.

³⁰ An Pan et al., “Red Meat Consumption and Mortality: Results from Two Prospective Cohort Studies,” *Archives of Internal Medicine* 172, no. 7 (April 9, 2012): 555–63, <https://doi.org/10.1001/archinternmed.2011.2287>.

³¹ Pan et al., “Red Meat Consumption and Mortality.”

³² C.M. Hutter et al., “Characterization of Gene-Environment Interactions for Colorectal Cancer Susceptibility Loci,” *Cancer Research* 72, no. 8 (2012): 2036–44, <https://doi.org/10.1158/0008-5472.CAN-11-4067>.

³³ B. Magalhães, B. Peleteiro, and N. Lunet, “Dietary Patterns and Colorectal Cancer: Systematic Review and Meta-Analysis,” *European Journal of Cancer Prevention* 21, no. 1 (2012): 15–23, <https://doi.org/10.1097/CEJ.0b013e3283472241>.

³⁴ Doris S. M. Chan et al., “Red and Processed Meat and Colorectal Cancer Incidence: Meta-Analysis of Prospective Studies,” ed. Daniel Tomé, *PLoS ONE* 6, no. 6 (June 6, 2011): e20456, <https://doi.org/10.1371/journal.pone.0020456>.

³⁵ X.-J. Xue et al., “Red and Processed Meat Consumption and the Risk of Lung Cancer: A Dose-Response Meta-Analysis of 33 Published Studies,” *International Journal of Clinical and Experimental Medicine* 7, no. 6 (2014): 1542–53.

³⁶ D.D. Alexander et al., “A Review and Meta-Analysis of Red and Processed Meat Consumption and Breast Cancer,” *Nutrition Research Reviews* 23, no. 2 (2010): 349–65, <https://doi.org/10.1017/S0954422410000235>.

with the risk of developing breast cancer.³⁷ Similarly, the conclusions regarding the relationship between meat consumption and prostate cancer have also been somewhat inconclusive. While a meta-analysis of 15 studies of red meat and 11 studies of processed meat found that there was no significant association between prostate cancer risk and meat consumption,³⁸ a more recent review that differentiated between stage and grade of risk factor found that higher intake of processed and unprocessed meat was positively associated with risk of advanced and fatal cancers in North America only.³⁹ Although meat is a source of protein and certain vitamins and minerals, there is robust evidence that excess meat consumption plays an important role in major health problems.

The production of meat also impacts human health. CAFOs are notoriously bad at managing the tons of manure that are produced by the thousands of animals that are kept. The results are localized harms towards human health such as air pollution, waste spills, and impaired drinking water.⁴⁰

Environment

Outside of human health, farm animal production negatively impacts the environment. Meat production is a major driver of climate change. Animal husbandry is an intrinsically inefficient process. Animal agriculture is associated with large annual greenhouse gas (GHG) emissions and is the second largest contributor to human made GHG emissions, only after fossil

³⁷ N. Namiranian et al., “Risk Factors of Breast Cancer in the Eastern Mediterranean Region: A Systematic Review and Meta-Analysis,” *Asian Pacific Journal of Cancer Prevention* 15, no. 21 (2014): 9535–41, <https://doi.org/10.7314/APJCP.2014.15.21.9535>.

³⁸ D.D. Alexander et al., “A Review and Meta-Analysis of Prospective Studies of Red and Processed Meat Intake and Prostate Cancer,” *Nutrition Journal* 9, no. 1 (2010), <https://doi.org/10.1186/1475-2891-9-50>.

³⁹ Kana Wu et al., “Associations between Unprocessed Red and Processed Meat, Poultry, Seafood and Egg Intake and the Risk of Prostate Cancer: A Pooled Analysis of 15 Prospective Cohort Studies,” *International Journal of Cancer* 138, no. 10 (May 15, 2016): 2368–82, <https://doi.org/10.1002/ijc.29973>.

⁴⁰ Wendee Nicole, “CAFOs and Environmental Justice: The Case of North Carolina,” *Environmental Health Perspectives* 121, no. 6 (June 2013): a182–89, <https://doi.org/10.1289/ehp.121-a182>.

fuels.⁴¹ Livestock production produces about 14.5% of global GHG emissions, which is equivalent to 7.1 gigatons of CO₂ per year⁴². In the US, animal farming has become the greatest contributor to air pollution damages.⁴³

Further, industrial production of meat is a leading cause of deforestation, water and air pollution, and biodiversity loss (IPCC 2022). For example, meat production is linked to 75% of the historic deforestation in the Brazilian Amazon rainforest.⁴⁴ Animal farming requires the devotion of many resources including nearly 40% of the earth's ice-free land.⁴⁵

Within the US, CAFOs have contributed to massive amounts of water and air pollution, including contaminating drinking and groundwater with dangerous amounts of nitrates and coliform bacteria that are found in fertilizer and manure.⁴⁶ CAFOs also release chemicals into the local air such as ammonia, hydrogen sulfide, and other toxic particulates⁴⁷ that not only hurt human health but also devastate the local environment.

Farm Animal Welfare

Farm animal welfare has a variety of definitions, which are all generally based on the five freedoms: freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury,

⁴¹ Pierre J. Gerber and Food and Agriculture Organization of the United Nations, eds., *Tackling Climate Change through Livestock: A Global Assessment of Emissions and Mitigation Opportunities* (Rome: Food and Agriculture Organization of the United Nations, 2013).

⁴² Ibid.

⁴³ Peter Tschofen, Inês L. Azevedo, and Nicholas Z. Muller, "Fine Particulate Matter Damages and Value Added in the US Economy," *Proceedings of the National Academy of Sciences* 116, no. 40 (October 2019): 19857–62, <https://doi.org/10.1073/pnas.1905030116>.

⁴⁴ Brian Machovina, Kenneth J. Feeley, and William J. Ripple, "Biodiversity Conservation: The Key Is Reducing Meat Consumption," *Science of The Total Environment* 536 (December 1, 2015): 419–31, <https://doi.org/10.1016/j.scitotenv.2015.07.022>.

⁴⁵ Navin Ramankutty et al., "Farming the Planet: 1. Geographic Distribution of Global Agricultural Lands in the Year 2000," *Global Biogeochemical Cycles* 22, no. 1 (2008), <https://doi.org/10.1029/2007GB002952>.

⁴⁶ JoAnn Burkholder et al., "Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality," *Environmental Health Perspectives* 115, no. 2 (February 2007): 308–12, <https://doi.org/10.1289/ehp.8839>.

⁴⁷ Carrie Hribar and Mark Schultz, "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities," 2010, 30.

and disease; freedom to express most normal behaviors; and freedom from fear and distress.⁴⁸

About 99% of US farmed animals that Americans consume originate from Concentrated Animal Feeding Operations (CAFOs), which are a type of large-scale industrial agricultural facility that raises livestock at a high density.⁴⁹ CAFOs and other intensified practices fail to meet even minimal guidelines of the five freedoms. The intensification of animal production in the US has greatly and negatively impacted the welfare of farm animals through the extreme confinement of animals, overcrowding, overuse of antibiotics, lack of outdoor access, and more.⁵⁰ Furthermore, the industry utilizes painful practices such as castration without anesthesia, tail docking, beak trimming, dehorning, and teeth clipping.⁵¹

Meat Consumption

For thousands of years, humans have been consuming the meat and the by-products of animals. Population growth, urbanization, and income growth in the 21st century have sparked a global increase in the demand for food of animal origin. Total meat consumption in the United States, the European Union, and the developed world as a whole has steadily increased from 1961 to 2003.⁵² In fact, both the average per capita consumption of meat and the total amount of meat consumed are rising.⁵³ Furthermore, the United Nations Food and Agriculture Organization (FAO) projects that the world is expected to eat more meat in 2021 than ever before, with the

⁴⁸ Department for Environment, Food & Rural Affairs, “FAWC Report on Farm Animal Welfare in Great Britain: Past, Present and Future,” GOV.UK, accessed March 11, 2022, <https://www.gov.uk/government/publications/fawc-report-on-farm-animal-welfare-in-great-britain-past-present-and-future>.

⁴⁹ Burkholder, “Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality.”

⁵⁰ Goldberg, “Farm Animal Welfare and Human Health.”

⁵¹ Céline Bonnet et al., “Viewpoint: Regulating Meat Consumption to Improve Health, the Environment and Animal Welfare,” *Food Policy* 97 (December 1, 2020): 101847, <https://doi.org/10.1016/j.foodpol.2020.101847>.

⁵² Carrie R. Daniel et al., “Trends in Meat Consumption in the United States,” *Public Health Nutrition* 14, no. 4 (April 2011): 575–83, <https://doi.org/10.1017/S1368980010002077>.

⁵³ H. Charles J. Godfray et al., “Meat Consumption, Health, and the Environment,” *Science* 361, no. 6399 (July 20, 2018): eaam5324, <https://doi.org/10.1126/science.aam5324>.

fastest growth occurring in low- and middle-income countries.⁵⁴ More specifically, the FAO projects a global increase in total meat consumption of 14% by 2030, which includes a 17.8% increase of consumption of poultry, a 5.9% increase in beef, and a 13.1% increase in pork.

The United States is a particularly high consumer of meat. Research has shown that the total meat consumption in the US has nearly doubled between 1909 and 2007.⁵⁵ While total meat consumption is increasing, US consumption varies significantly depending on the type of meat. Despite a slight decrease in the consumption of beef and steady consumption of pork, massive increases in the per capita consumption of poultry have largely accounted for the increasing trend of consumption in the US.⁵⁶ Not only are general consumption trends in the US increasing, but most of the US population over-consumes meat. The USDA recommends a dietary intake of 26-ounce equivalents per week of protein from meat, poultry, and eggs.⁵⁷ Based on those recommendations and current consumption habits, the average American in 2018 consumes about 50% more protein than recommended.⁵⁸

In 2019, plant-based meats and other meat-alternatives gained much traction in the meat market. Although vegetable replacements for meat have long existed as a consumer option, meatless meat products offer an almost perfect substitute for real meat; the product, which is made from plants or grown in a lab, is meant to taste, look, and is marketed as meat. Despite four in ten Americans having tried meatless meat substitutes and around 60% reporting that they

⁵⁴ Organisation for Economic Co-operation and Development and Food and Agriculture Organization, “OECD-FAO Agricultural Outlook 2021-2030,” 2021, 15, <https://doi.org/10.1787/19428846-en>.

⁵⁵ Daniel et al., “Trends in Meat Consumption in the United States.”

⁵⁶ US Department of Agriculture, “USDA ERS - Livestock and Meat Domestic Data,” 2022, <https://www.ers.usda.gov/data-products/livestock-and-meat-domestic-data/>.

⁵⁷ US Department of Agriculture and US Department of Health and Human Services, “Dietary Guidelines for Americans, 2020-2025.”

⁵⁸ US Department of Agriculture, “USDA ERS - Food Availability and Consumption,” 2022, <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-availability-and-consumption/>.

would eat plant-based meat substitutes again, 97% of Americans today continue to eat meat.⁵⁹ In general, during the last century, there has been a massive and global shift towards increased consumption of meat and animal products, and a decreased consumption of grain and plant-based foods.⁶⁰

The trend of increased meat consumption in the US reinforces the theory of meat attachment, which argues that individuals have a high positive affect and dependence towards meat and feel sadness and deprivation when considering abstaining from or reducing meat consumption.⁶¹ It is relatively well known that an affective connection towards meat exists, but the degree to which that connection exists in US consumers and the role it plays in discouraging consumers from accepting plant-based meat substitutes have yet to be determined. Additionally, while previous research on meat consumption and changing dietary habits have been conducted, they have mostly been reflections of cultures and peoples outside of the US. Differences in meat consumption may reflect cultural differences, so it is important to conduct research on a country-by-country basis.⁶²

Power of the Plant-Based Diet

Plant-based diets have existed throughout human history. Plant-based diets include dietary patterns that are characterized by high consumption of plant foods and low consumption of animal flesh and/or animal-derived products. Importantly, plant-based eating patterns simply

⁵⁹ Gallup Inc, “Four in 10 Americans Have Eaten Plant-Based Meats,” Gallup.com, January 28, 2020, <https://news.gallup.com/poll/282989/four-americans-eaten-plant-based-meats.aspx>.

⁶⁰ Mickey Chopra, Sarah Galbraith, and Ian Darnton-Hill, “A Global Response to a Global Problem: The Epidemic of Overnutrition,” *Bulletin of the World Health Organization* 80 (2002): 952–58, <https://doi.org/10.1590/S0042-96862002001200009>.

⁶¹ João Graça, Maria Manuela Calheiros, and Abílio Oliveira, “Attached to Meat? (Un)Willingness and Intentions to Adopt a More Plant-Based Diet,” *Appetite* 95 (December 1, 2015): 113–25, <https://doi.org/10.1016/j.appet.2015.06.024>.

⁶² Marcia Hill Gossard and Richard York, “Social Structural Influences on Meat Consumption,” *Human Ecology Review* 10, no. 1 (2003): 1–9, <https://www.jstor.org/stable/24707082>.

implies a focus primarily from plants; a plant-based diet does not necessarily mean the person never eats meat or dairy but rather proportionately chooses more foods from plant sources. Plant-based diets are most associated with vegetarian or vegan diets. A vegetarian diet is one that does not include the consumption of meat, poultry, or fish. Vegans are defined as individuals who do not eat any animal products or byproducts. Throughout the world, several individuals abide by plant-based diets, but in many countries, like the US, vegetarians are a minority population. In 2018, a Gallup poll estimated that 5% of Americans consider themselves to be vegetarians,⁶³ which only represents a 4 percent increase since 1971.⁶⁴ Despite the low number of individuals being vegetarian, plant-based diets are healthier and more sustainable than diets with meat.

Although some think that a plant-based diet is not nutritionally sustaining, appropriately planned vegetarian diets are considered healthful and nutritionally adequate for all stages of life.⁶⁵ Vegetarian diets also afford differences in nutrient intake, such as increased intake of dietary fiber, vitamin C, and E, and low intake of saturated fat, which are all associated with favorable effects on human health.⁶⁶ Meatless or reduced meat diets have also had important impacts in reducing chronic diseases. Studies of vegetarians have consistently reported lower

⁶³ Gallup, “What Percentage of Americans Are Vegetarian?,” Gallup.com, September 27, 2019, <https://news.gallup.com/poll/267074/percentage-americans-vegetarian.aspx>.

⁶⁴ Euromonitor Internatioal, “The War on Meat - How Low-Meat and No-Meat Diets Are...,” August 16, 2011, <https://www.euromonitor.com/article/the-war-on-meat-how-low-meat-and-no-meat-diets-are-impacting-consumer-markets>.

⁶⁵ Vesanto Melina, Winston Craig, and Susan Levin, “Position of the Academy of Nutrition and Dietetics: Vegetarian Diets,” *Journal of the Academy of Nutrition and Dietetics* 116, no. 12 (December 1, 2016): 1970–80, <https://doi.org/10.1016/j.jand.2016.09.025>.

⁶⁶ Timothy J. Key, Paul N. Appleby, and Magdalena S. Rosell, “Health Effects of Vegetarian and Vegan Diets,” *Proceedings of the Nutrition Society* 65, no. 1 (February 2006): 35–41, <https://doi.org/10.1079/PNS2005481>.

proportions of obesity compared to on-vegetarians,⁶⁷ lower plasma cholesterol,⁶⁸ and lower mortality from ischemic heart disease.⁶⁹

In terms of sustainability, meatless diets are an important step to reducing the overall environmental burden of the food system. Meatless diets have the potential to reduce GHG emissions. GHG emissions vary widely amongst individual foods. But, relative to animal-based foods, such as meat and dairy products, plant-based foods have lower associated GHG emissions. Much of the reduction in GHG emissions is a result of the replacement of red meat in the diet. For example, vegan and vegetarian diets cause around a 35% reduction in GHG emissions, compared to no change for diets where meat was partially replaced by a variety of food.⁷⁰ A life cycle analysis comparing ruminant meat products and plant-based products concluded that the GHG footprint for the meat products was 19-48 times higher than that of the plant-based protein product.⁷¹ More specifically, a global-level data meta-analysis determined that the largest difference in GHG emissions found was that the emissions per gram of protein for ruminant meats such as beef and lamb was 250 times higher than those of legumes.⁷² Furthermore, the potential to reduce land demand for agriculture is largely dependent on the amount of meat consumed. If all animal products were substituted with plant-based food, the land demand

⁶⁷ T. Key and G. Davey, "Prevalence of Obesity Is Low in People Who Do Not Eat Meat.," *BMJ: British Medical Journal* 313, no. 7060 (September 28, 1996): 816–17, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2352221/>.

⁶⁸ T. J. Key et al., "Mortality in Vegetarians and Nonvegetarians: Detailed Findings from a Collaborative Analysis of 5 Prospective Studies," *The American Journal of Clinical Nutrition* 70, no. 3 Suppl (September 1999): 516S–524S, <https://doi.org/10.1093/ajcn/70.3.516s>.

⁶⁹ Key, Appleby, and Rosell, "Health Effects of Vegetarian and Vegan Diets."

⁷⁰ Ujué Fresán and Joan Sabaté, "Vegetarian Diets: Planetary Health and Its Alignment with Human Health," *Advances in Nutrition* 10, no. Suppl 4 (November 2019): S380–88, <https://doi.org/10.1093/advances/nmz019>.

⁷¹ William J. Ripple et al., "Ruminants, Climate Change and Climate Policy," *Nature Climate Change* 4, no. 1 (January 2014): 2–5, <https://doi.org/10.1038/nclimate2081>.

⁷² David Tilman and Michael Clark, "Global Diets Link Environmental Sustainability and Human Health," *Nature* 515, no. 7528 (November 2014): 518–22, <https://doi.org/10.1038/nature13959>.

required would be reduced by up to 60%.⁷³ This is striking compared to if meat was reduced by half, which results in a reduction of land demand by only 5%.⁷⁴

Data and Methods Overview

Experimental Design

To gain knowledge about US dietary preferences and meat consumption, a survey was conducted and distributed over SurveyMonkey, an online platform that is user friendly and easy to distribute to respondents. The method of the survey was chosen as it is an efficient way to collect data on many individuals and provide a wide variety of information that can be generalized to the US population at large. Furthermore, the data collected allows precise comparisons to be made among the responses.

The survey, outside of asking about the background and demographic information, asks about the individual's current consumption habits regarding meat.⁷⁵ Specifically, the survey uses the Meat Attachment Questionnaire (MAQ), which is a questionnaire that measures a positive bond towards meat consumption. Participants were asked to indicate the extent to which they agreed or disagreed with each statement in an initial item pool (Table 1) on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 1. *Item pool for the Meat Attachment Questionnaire (MAQ).*

Survey Questions

⁷³ E. Hallström, A. Carlsson-Kanyama, and P. Börjesson, “Environmental Impact of Dietary Change: A Systematic Review,” *Journal of Cleaner Production* 91 (March 2015): 1–11, <https://doi.org/10.1016/j.jclepro.2014.12.008>.

⁷⁴ Eric Audsley et al., “Food, Land and Greenhouse Gases The Effect of Changes in UK Food Consumption on Land Requirements and Greenhouse Gas Emissions. Report for the Committee on Climate Change.,” Report, December 21, 2010, <http://dspace.lib.cranfield.ac.uk/handle/1826/6496>.

⁷⁵ See Appendix for the full list of survey questions.

To eat meat is one of the good pleasures in life.
 I love meals with meat.
 I'm a big fan of meat.
 A good steak is without comparison.
 By eating meat I'm reminded of the death and suffering of animals.
 To eat meat is disrespectful towards life and the environment.
 I feel bad when I think of eating meat.
 Meat reminds me of diseases.
 To eat meat is an unquestionable right of every person.
 According to our position in the food chain, we have the right to eat meat.
 Eating meat is a natural and undisputable practice.
 I don't picture myself without eating meat regularly.
 If I couldn't eat meat I would feel weak.
 I would feel fine with a meatless diet.
 If I was forced to stop eating meat I would feel sad.
 Meat is irreplaceable in my diet.

The questionnaire produces a four-factor solution of hedonism, affinity, entitlement, and dependence, which are associated with attitudes towards meat, human supremacy beliefs, eating habits, and dietary identity.⁷⁶ Previous research developing and testing the MAQ indicated that the four-dimensional model of meat attachment is a valid and reliable measure of a positive bond towards meat consumption.⁷⁷

The model has yet to be employed on data gathered from a large US sample. The US sample gathered will be analyzed to determine how well the sample fits the model of meat attachment, concluding the strength of a positive bond towards meat consumption exists in US consumers. To do this, confirmatory factor analysis will be conducted, which tests whether measures of a certain construct are consistent with a given model. The data will also allow for replicating and strengthening evidence concerning the MAQ's reliability and predictive ability.

⁷⁶ Graça, Calheiros, and Oliveira, "Attached to Meat?"

⁷⁷ Graça, Calheiros, and Oliveira, "Attached to Meat?"

The survey also asked participants to indicate their personal dietary identities and eating habits. Additionally, respondents were asked to report their willingness to reduce or eliminate meat consumption and to follow a plant-based diet and whether they have previously adjusted their dietary habits and their primary concerns if they did make changes. For participants that do consume meat or animal-based products, they were asked about real or perceived barriers to trying alternatives or reducing meat intake. Finally, individuals were asked about whether they considered plant-based diets to be a lasting societal change.

The second half of the study will examine biases behind decision-making on food by employing methods of choice architecture. Choice architecture refers to the myriad of ways that a choice can be presented to the decision-maker, and how that presentation affects what choice is made.⁷⁸ There is no neutral architecture; any way that a decision is presented will influence the choice made. Previous research has documented the success that changing choice architecture has on making decisions.

The experiment was chosen as the best method as it allows for the influences of specific variables to be modulated and determined.

Experiment 1 will test the impact of changing defaults in decision-making. Defaults are settings or choices that are given to consumers if they do not specify an alternative.⁷⁹ All choice presentations have a default, even if the default option is the status quo, or no choice is made.

⁷⁸ Richard H. Thaler and Cass R. Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Nudge: Improving Decisions about Health, Wealth, and Happiness (New Haven, CT, US: Yale University Press, 2008).

⁷⁹ Christina L. Brown and Aradhna Krishna, “The Skeptical Shopper: A Metacognitive Account for the Effects of Default Options on Choice,” *Journal of Consumer Research* 31, no. 3 (December 1, 2004): 529–39, <https://doi.org/10.1086/425087>.

Previous literature in domains including investment,^{80,81} insurance,⁸² organ donation,⁸³ and marketing⁸⁴ have indicated that the default option will be chosen more than another choice.

Other studies on the topic of food decisions have shown that changes to the placing or prevalence of vegetarian options on a menu could increase consumption of the vegetarian option and reduce meat consumption.^{85, 86, 87}

The structure of Experiment 1 is depicted in Figure 1. Participants were randomly assorted to one of the three conditions and asked to make a choice. In condition 1, the default option was a hamburger and participants were given the option to switch to an impossible burger. In condition 2, the default option was an impossible burger and respondents were given the option to switch to a hamburger. Finally, condition 3 was the control, where both options were provided. I hypothesize that participants will opt for the default option, compared to the control, even if the default is the meatless option.

⁸⁰ Henrik Cronqvist and Richard H. Thaler, “Design Choices in Privatized Social-Security Systems: Learning from the Swedish Experience,” *American Economic Review* 94, no. 2 (May 2004): 424–28, <https://doi.org/10.1257/0002828041301632>.

⁸¹ Brigitte C. Madrian and Dennis F. Shea, “The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior*,” *The Quarterly Journal of Economics* 116, no. 4 (November 1, 2001): 1149–87, <https://doi.org/10.1162/003355301753265543>.

⁸² Eric J. Johnson et al., “Framing, Probability Distortions, and Insurance Decisions,” *Journal of Risk and Uncertainty* 7, no. 1 (August 1, 1993): 35–51, <https://doi.org/10.1007/BF01065313>.

⁸³ Eric J. Johnson and Daniel G. Goldstein, “Do Defaults Save Lives?,” SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, November 21, 2003), <https://papers.ssrn.com/abstract=1324774>.

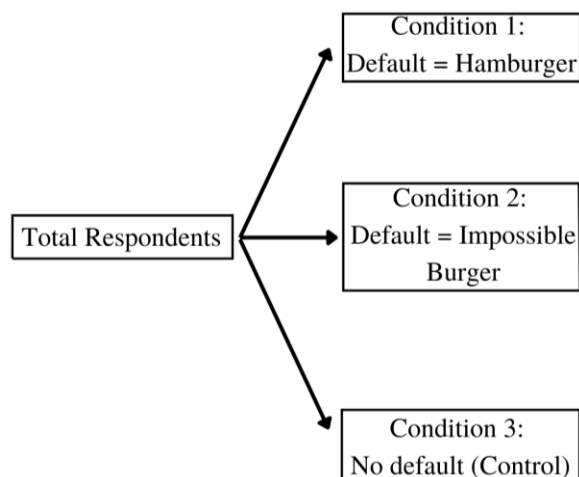
⁸⁴ Noah J. Goldstein, Robert B. Cialdini, and Vidas Griskevicius, “A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels,” *Journal of Consumer Research* 35, no. 3 (October 1, 2008): 472–82, <https://doi.org/10.1086/586910>.

⁸⁵ Christina Gravert and Verena Kurz, “Nudging à La Carte: A Field Experiment on Climate-Friendly Food Choice,” *Behavioural Public Policy* 5, no. 3 (July 2021): 378–95, <https://doi.org/10.1017/bpp.2019.11>.

⁸⁶ Emma E. Garnett et al., “Impact of Increasing Vegetarian Availability on Meal Selection and Sales in Cafeterias,” *Proceedings of the National Academy of Sciences* 116, no. 42 (October 15, 2019): 20923–29, <https://doi.org/10.1073/pnas.1907207116>.

⁸⁷ Verena Kurz, “Nudging to Reduce Meat Consumption: Immediate and Persistent Effects of an Intervention at a University Restaurant,” *Journal of Environmental Economics and Management* 90 (July 1, 2018): 317–41, <https://doi.org/10.1016/j.jeem.2018.06.005>.

Figure 1. *Design for Experiment 1 testing changing defaults on decision-making.*



Experiment 2 uses information provision as a nudge. Information provision is an aspect of attribute translation and expansion. Decision-makers choose between alternatives by conducting cost-benefit analyses on different attributes. Making certain attributes more salient, such as the impact of meat consumption on the environment, can influence decision-making.⁸⁸ Research on information provision has concluded that highlighting the most important attributes and mapping the attribute to its consequences encourages decision-makers to explicitly distinguish between alternatives, leading these expanded attributes to receive more consideration.^{89,90} Furthermore, a previous study on dietary choices and information provision indicated that people prefer to stay uninformed about the consequences of their actions and

⁸⁸ Eric J. Johnson et al., “Beyond Nudges: Tools of a Choice Architecture,” *Marketing Letters* 23, no. 2 (June 2012): 487–504, <https://doi.org/10.1007/s11002-012-9186-1>.

⁸⁹ Samuel Bond, Kurt Carlson, and Ralph Keeney, “Generating Objectives: Can Decision Makers Articulate What They Want?,” *Management Science* 54 (January 1, 2008): 56–70, <https://doi.org/10.1287/mnsc.1070.0754>.

⁹⁰ Katherine A. Burson, Richard P. Larrick, and John G. Lynch, “Six of One, Half Dozen of the Other: Expanding and Contracting Numerical Dimensions Produces Preference Reversals,” *Psychological Science* 20, no. 9 (September 1, 2009): 1074–78, <https://doi.org/10.1111/j.1467-9280.2009.02394.x>.

engage in information avoidance in decision making on moral choices such as eating meat.⁹¹

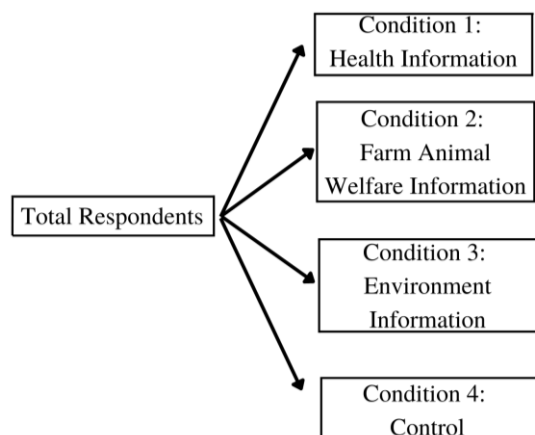
They found that information provision did decrease consumption of meat at varying rates, but such an experiment has yet to be conducted in the US.⁹²

The structure of Experiment 2 is shown in Figure 2. Participants were randomly assorted to one of the four conditions and asked to read a brief paragraph providing information. Then participants were asked to order either a hamburger or an impossible burger. In condition 1, the paragraph provided information about the health consequences of eating meat. In condition 2, the information provided was about the negative impacts of meat production on farm animal welfare. The information given in condition 3 described how meat-based diets impart negative consequences on the environment. Finally, condition 4 was the control condition. I hypothesize that the provision of information against meat consumption will cause people to order the meatless option, compared to the control. Based off the concern areas identified in the survey, I predict that the greatest number of participants will opt for the meatless option when presented with information about health, a moderate amount will choose the Impossible burger when offered information about the environment, and the smallest number of respondents will opt for the Impossible burger after reading the information about farm animal welfare.

⁹¹ Raphael Epperson and Andreas Gerster, "Information Avoidance and Moral Behavior: Experimental Evidence from Food Choices," SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, October 8, 2021), <https://doi.org/10.2139/ssrn.3938994>.

⁹² Epperson and Gerster, "Information Avoidance and Moral Behavior."

Figure 2. Design for Experiment 2 testing information provision on decision-making.



Part 1: Survey

Participants and Procedure

The survey was distributed over SurveyMonkey and advertised through social media platforms like Facebook and Twitter. The survey was accessible in English for about one and a half months between December 16th, 2021, and February 1st, 2022. During this period, 183 individuals completed the survey questionnaire, but 47 responses were excluded from analysis due to incomplete responses. Thus, the sample consisted of 137 participants (Table 2). There is an observed bias in the data; the sample is skewed towards white, younger, female participants. The bias is likely the consequence of sampling primarily from a university population.

Table 2. *Sample characteristics for the survey.*

Variable	Category	N	%
Age	<25	103	75.2
	25-44	28	20.4
	>44	6	4.4

Gender	Female	87	63.5
	Male	38	27.7
	Nonbinary/Third Gender	10	7.3
	Prefer not to say	2	1.5
Race	Asian or Asian American	17	12.4
	Black or African American	14	10.2
	Hispanic or Latino	18	13.1
	Native American or Alaskan Native	1	0.7
	White or Caucasian	79	57.7
	Another race/ethnicity not listed here	8	5.8
Political Orientation	Conservative	4	2.9
	Liberal	57	41.6
	Moderate	22	16.1
	Progressive	52	38.0
Dietary Identity	Omnivore	115	83.9
	Vegetarian	6	4.4
	Vegan	16	11.7

Data Analysis

Although the MAQ has been shown to be a reliable and valid test for evaluating feelings about meat, it is important to verify these correlations within this new dataset. Thus, confirmatory factor analysis (CFA) was conducted for the item pool to determine the adequacy of my data in relation to the MAQ and to test the four-factor solution. The ratio χ^2/df was used to evaluate the appropriateness of the model (with good to acceptable values being ≤ 5) since the model chi-square test is sensitive to sample size.⁹³ Comparative fit index (CFI), Tucker Lewis index (TLI), root-mean-square error of approximation (RMSEA), and standardized root mean square residual (SRMR) were used as model fit indices. The criteria for good to acceptable fit

⁹³ Karin Schermelleh-Engel, Helfried Moosbrugger, and Hans Müller, "Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures," *Methods of Psychological Research* 8, no. 2 (2003): 23–74.

were $CFI \geq 0.90$, $TLI \geq 0.90$, $RMSEA \leq 0.08$, and $SRMR \leq 0.10$.^{94,95,96} To determine the reliability of the MAQ, I used Cronbach's alpha, in which values between 0.70 and 0.95 are seen as acceptable.⁹⁷

Results from the survey also assessed associations with attitudes towards meat, eating habits, and dietary identity. Furthermore, the survey examined the effects of attitudes towards meat and current consumption habits in willingness to reduce meat consumption and to follow a plant-based diet. These statistics were compared to the results of a survey conducted in June 2020 of a nationally representative sample of US adults by Mattson, a North American food and beverage consulting company.⁹⁸

Survey Results

Confirmatory Factor Analysis and Correlations

Confirmatory factor analysis was conducted on the data testing the four-factor solution (Figure 3).

⁹⁴ Litze Hu and Peter M. Bentler, "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives," *Structural Equation Modeling: A Multidisciplinary Journal* 6, no. 1 (January 1, 1999): 1–55, <https://doi.org/10.1080/10705519909540118>.

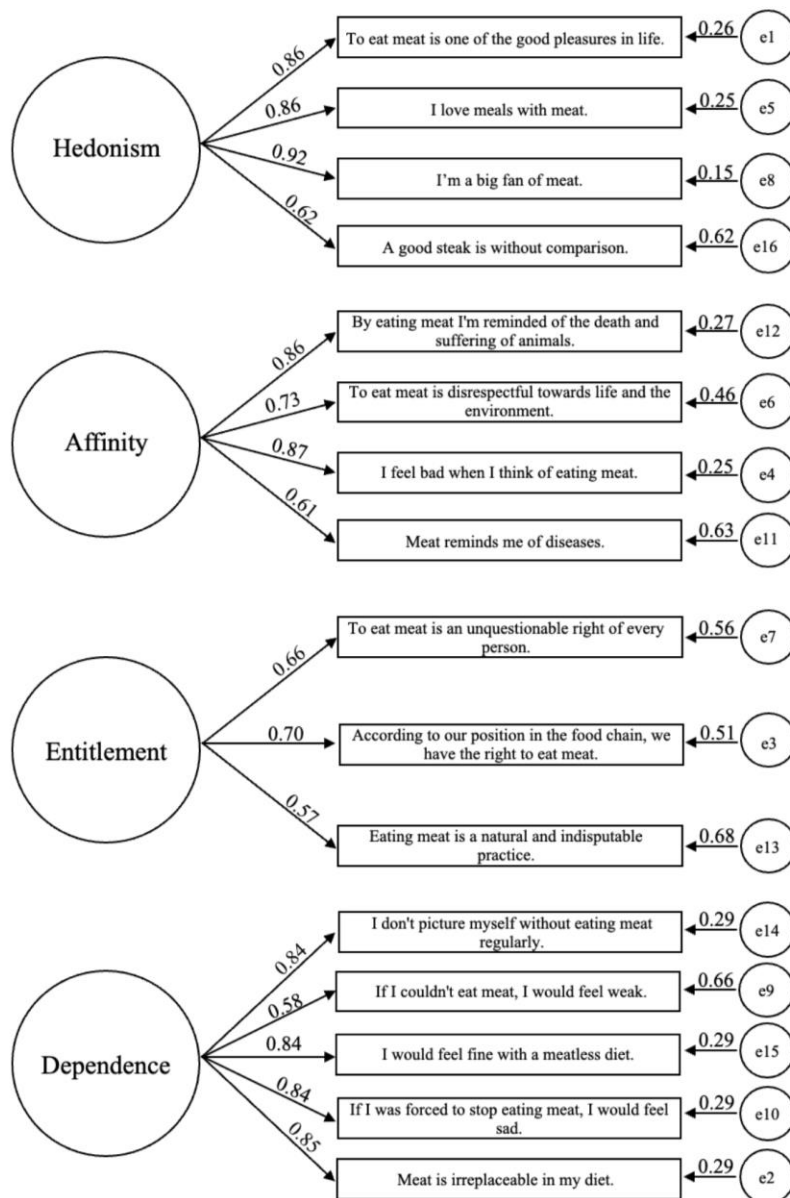
⁹⁵ Herbert W. Marsh, Zhonglin Wen, and Kit-Tai Hau, "Structural Equation Models of Latent Interactions: Evaluation of Alternative Estimation Strategies and Indicator Construction," *Psychological Methods* 9, no. 3 (September 2004): 275–300, <https://doi.org/10.1037/1082-989X.9.3.275>.

⁹⁶ Robert J. Vandenberg and Charles E. Lance, "A Review and Synthesis of the Measurement Invariance Literature: Suggestions, Practices, and Recommendations for Organizational Research," *Organizational Research Methods* 3, no. 1 (January 1, 2000): 4–70, <https://doi.org/10.1177/109442810031002>.

⁹⁷ Mohsen Tavakol and Reg Dennick, "Making Sense of Cronbach's Alpha," *International Journal of Medical Education* 2 (June 27, 2011): 53–55, <https://doi.org/10.5116/ijme.4dfb.8dfd>.

⁹⁸ Elaine Watson, "SHIFT20: How Are Consumers Thinking about Plant-Based Eating? Mattson Unveils New Survey Data," accessed March 24, 2022, <https://www.foodnavigator-usa.com/Article/2020/07/14/SHIFT20-How-are-consumers-thinking-about-plant-based-eating-Mattson-unveils-new-survey-data>.

Figure 3. *Confirmatory factor analysis of the Meat Attachment Questionnaire in the food survey showing a four-factor structure. Standardized coefficients are present.*



The model met criteria for good fit ($\chi^2/df = 1.29$; CFI = 0.98; RMSEA = 0.05; SRMR = 0.05; TLI = 0.98). All subscales showed moderate to strong correlations with each other (Table 3). Reliability analyses for the MAQ subscales showed mostly strong values of internal

consistency, with Cronbach's alpha for the subscales ranging from 0.67 to 0.89. The factor, entitlement, had a lower Cronbach's alpha, indicating that potentially more questions could be used to measure and validate the factor.

Table 3. *Subscale reliabilities, means, standard deviations, and correlations.*

MAQ Scale and Subscales	Cronbach's alpha	M	SD	1	2	3	4
Hedonism	0.88	3.24	0.80	-			
Affinity	0.85	3.62	0.75	0.77*	-		
Entitlement	0.67	2.97	0.82	0.53*	0.59*	-	
Dependence	0.89	2.51	0.78	0.89*	0.79*	0.60*	-

* $p < 0.01$.

Model Validity

Based on conclusions reached by the previous study on the MAQ, I expect scores on all measures to: (1) show a positive correlation with attitudes towards meat and meat-eating habits; (2) show association with current dietary habits; and (3) yield higher scores for those that identify as men than those that identify as women.

Table 4. *Correlations between MAQ subscales, dietary habits, and dietary identities.*

MAQ Subscales	Habits	Dietary Identity		
		Omnivore	Vegetarian	Vegan
Hedonism	0.66*	0.44*	-0.16*	-0.28*
Affinity	0.62*	0.39*	-0.14*	-0.36*
Entitlement	0.34*	0.23	-0.15*	-0.35
Dependence	0.67*	0.46*	-0.07	-0.03

* $p < 0.01$.

As predicted, all factors from the MAQ showed positive correlations with eating habits and yielded the anticipated pattern of associations with dietary identity, showing moderate to strong relationships with participants identifying as meat consumers, weaker negative correlations with those identifying as vegetarian, and stronger negative associations with those identifying as vegan.

Concerning differences between those that identify as men and those that identify as women, one-way ANOVAs revealed that men scored systematically higher than women on the hedonism and affinity subscales (Table 5). While the average score on the entitlement and dependence subscales is higher for those that identify as men than those that identify as women, the variation may not be systematically determined by differences between sex. The lack of significance could be explained by a low number of responses to the survey as well as more progressive conceptions and understandings of gender as fluid.

Table 5. Means, standard deviations, and mean differences between men ($N = 39$) and women ($N = 92$) by MAQ subscale.

MAQ Subscales	Men		Women		F	Cohen's d
	M	SD	M	SD		
Hedonism	3.54	0.79	3.12	0.82	4.20*	0.50
Affinity	3.90	0.70	3.51	0.77	5.30*	0.53
Entitlement	3.12	0.93	2.91	0.81	1.60	0.24
Dependence	2.71	0.83	2.43	0.74	1.70	0.33

* $p < 0.05$.

Current Behaviors

Despite most respondents identifying as a meat consumer, 12% (N=17) of respondents indicated that they are vegetarian, corresponding to a national growth of four percentage points in those who follow a plant-based diet.⁹⁹ Indeed, most participants (92%) indicated that they had made conscious adjustments to their diets for a variety of reasons. Furthermore, most the respondents (89.5%) pointed out that they had tried meat substitutes or meat alternatives before, aligning with the expansion of the market for meat alternatives. The increase in the number of self-identified vegetarians correlates with the fact that more Americans are concerned with the impact of dietary habits on the environment, animal welfare, and public and individual health (Table 6).

Table 6. *Comparisons between concern topics.*

Concern Area	2022 Food Survey (%)	2020 Mattson Survey (%)
Environment	55	48
Animal Welfare	30	26
Public and Individual Health	66	65

Some of those that were concerned about the impact of dietary choices on public and individual health described specific conditions as to why they were concerned about health; for example, a few respondents expressed a desire to lose weight, while others described disordered eating or chronic illnesses. Other respondents stated that they changed their diet due to religious or political reasons.

To better understand the relation between concern area and dietary identity, I examined the proportional representation of dietary identities in the three concern categories (Table 7).

⁹⁹Gallup, “What Percentage of Americans Are Vegetarian?”

Unsurprisingly, vegans and vegetarians held an increased proportion of representation regarding concerns about the environment and animal welfare. In contrast, omnivores held a decreased proportion of representation for all concerns but public and/or individual health.

Table 7. *Representation of dietary identities by concern category.*

Dietary Identity	Total (%)	Concern about Environment (N=76)	Concern about Animal Welfare (N=41)	Concern for Public and/or Individual Health (N=91)
Omnivores	84.94	76.32	63.41	89.01
Vegans	4.38	7.9	12.20	4.04
Vegetarians	11.68	15.79	24.39	6.59

Consumer Intentions

In looking primarily at those who identified as omnivores, respondents' intentions to reduce meat were mixed. 20.2% of respondents indicated that they do not intend to maintain their current levels of meat consumption. These study participants isolated a few main reasons for wanting to reduce meat consumption including the unsustainable nature and environmental impact of meat production as well as the health benefits of reducing meat consumption. Explanations for currently eating meat or not wanting to reduce meat intake outside of meat affinity captured by the MAQ included easier access to meals with meat, financial restrictions that limit dietary options, comfortability with meat as a source of protein and associated amino acids, health conditions that either prevent the consumption of meat substitutes or require certain nutrients naturally found in meat, cultural or familial reasons, and prior reduction in meat intake. Many respondents wrote that they found no reason to reduce their meat intake and found that a change in diet is unnecessary. When asked how willing they would be to reduce their current

levels of meat consumption by half, 64.9% of respondents said yes. This proportion decreased to 60.5% when participants were asked about their willingness to abide by a plant-based diet.

Despite the increase in access to and variety of meat alternative products, the low proportion of respondents willing to transition away from meat indicates that there are barriers to acceptance of meat substitutes (Table 8).

Table 8. *Comparisons between barriers to acceptance of meat alternatives and substitutes.*

Barrier	2022 Food Survey (%)	2020 Mattson Survey ¹⁰⁰ (%)
Prefer to eat meat	50	55
Too expensive	37.7	50
Don't like the taste	31.6	18
Never thought about buying alternatives	4.4	34
Others in my household won't eat them	15.8	34
Too processed	14.9	31
Too many ingredients that I can't pronounce	4.4	19

Despite obstacles to the use of meat substitutes for US consumers, most agreed that plant-based diets are a change in consumption that will last. More Americans today are accepting of the shift towards plant-based consumption (Table 9).

Table 9. *Comparisons between understandings of the future of plant-based diets.*

Plant-based diets are...	2022 Food Survey (%)	2020 Mattson Survey (%)
A fundamental change in how we eat that will continue forever	33.6	58

¹⁰⁰ Elaine Watson, "SHIFT20: How Are Consumers Thinking about Plant-Based Eating? Mattson Unveils New Survey Data," accessed March 24, 2022, <https://www.foodnavigator-usa.com/Article/2020/07/14/SHIFT20-How-are-consumers-thinking-about-plant-based-eating-Mattson-unveils-new-survey-data>.

A fundamental change in how we eat that will continue for a long time	45.3	25
Trendy now, but will not stand the test of time	21.1	16
A fad and will be gone quickly	0	2

Part 2: Experiments

Participants and Procedure

The two experiments were developed and distributed over Qualtrics and disseminated over social media platforms like Facebook and Twitter. Both experiments were accessible in English and were available for responses from February 21, 2022, to March 24, 2022. During this period, 107 individuals completed the experiment on defaults and 83 individuals completed the experiment on information provision. Due to incomplete responses, the number of participants for the default experiment for analysis was 97 (Table 10) and the number of usable responses for analysis of the information provision experiment was 67 (Table 11). Like the sample demographics from the survey, there is an observed bias in the data; the sample is skewed towards white, younger, female participants. The bias is likely the consequence of sampling primarily from a university population.

Table 10. *Sample characteristics for Experiment 1 on changing defaults.*

Variable	Category	N	%
Age	<25	77	79.4
	25-44	13	13.4
	>44	7	7.2
Gender	Female	69	71.1
	Male	22	22.7
	Nonbinary/Third Gender	4	4.1
	Prefer not to say	1	1.0

Race	Asian or Asian American	16	16.5
	Black or African American	5	5.2
	Hispanic or Latino	9	9.3
	Native American or Alaskan Native	1	1.0
	White or Caucasian	63	64.9
	Another race/ethnicity not listed here	3	3.1
Political Orientation	Conservative	2	2.1
	Liberal	44	45.4
	Moderate	13	13.4
	Progressive	38	39.2
Dietary Identity	Omnivore	83	85.6
	Vegetarian	10	10.3
	Vegan	4	4.1

Table 11. *Sample characteristics for Experiment 2 on information provision.*

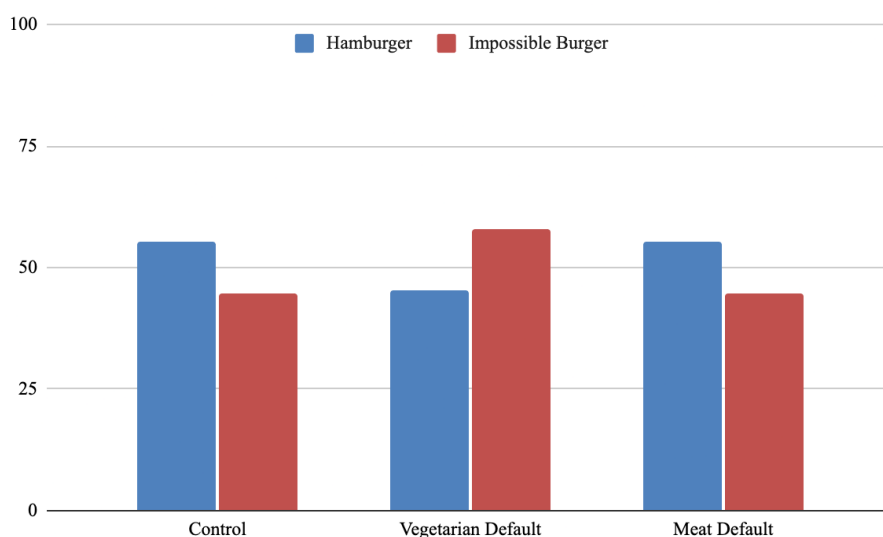
Variable	Category	N (67)	%
Age	<25	52	77.6
	25-44	10	14.9
	>44	5	7.5
Gender	Female	41	61.2
	Male	20	29.9
	Nonbinary/Third Gender	4	6.0
	Prefer not to say	1	1.5
Race	Asian or Asian American	7	10.4
	Black or African American	4	6.0
	Hispanic or Latino	8	11.9
	White or Caucasian	44	65.7
	Another race/ethnicity not listed here	4	6.0
Political Orientation	Conservative	2	3.0
	Liberal	29	43.3
	Moderate	7	10.4
	Progressive	29	43.3

Dietary Identity	Omnivore	56	83.6
	Vegetarian	8	11.9
	Vegan	3	4.5

Experiment Results

For the experiment on defaults, among those who received the control condition, 55.2% of study participants opted to order the hamburger, whereas 44.8% chose the Impossible burger option. In the Vegetarian Default condition, in which participants were provided an Impossible burger as the default option, the proportion of participants choosing the meat-free option increased to 58.1%. When the Meat condition was presented, the proportion of study participants who opted for the hamburger or the Impossible burger matched that of the control group (Figure 4).

Figure 4. *Proportion of participants choosing the hamburger or Impossible burger option given defaults.*

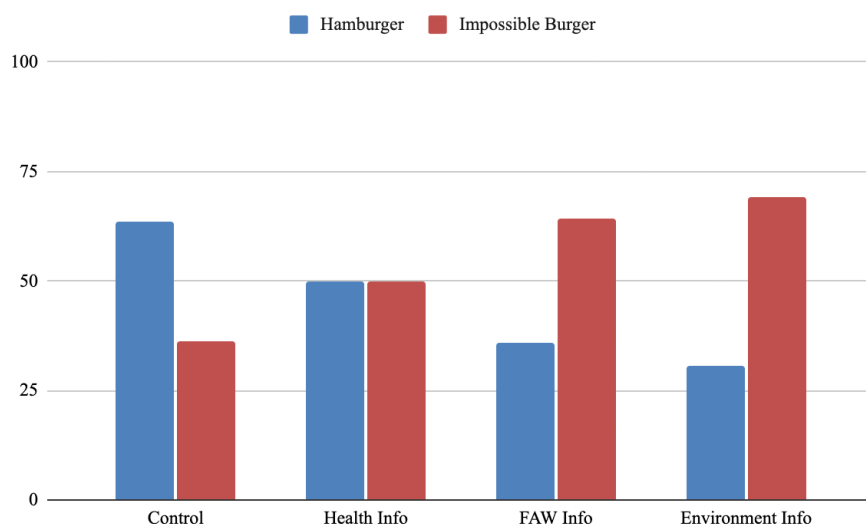


I conducted a general logistic regression using the default data. The model revealed that providing a meat-alternative option as the default increased the probability that participants

would choose the Impossible burger compared to those who received the control option (Estimate = 0.46, p-value = 0.374). In contrast, both the control menu and the menu that presented meat as a default decreased the probability of study participants either choosing the Impossible burger (Estimate = -0.21, p-value = 0.58) or switch to the meat-free option from the hamburger default (Estimate = 0, p-value = 1).

For the experiment on information provision, 63.6% of those who received the control information opted for the hamburger, whereas 36.4% opted for the Impossible burger. Providing information to the participant prior to making the decision did impact what meal option individuals chose. Providing information about the environment had the greatest impact on decision-making, with 69.2% opting for the Impossible burger. The second largest impact on decision-making was providing the information on farm animal welfare, which increased the proportion of individuals who chose the Impossible burger to 64.3%. Providing the information on health increased the proportion as well but not to nearly as large of an extent; 50% of study participants opted for the Impossible burger (Figure 5).

Figure 5. *Proportion of participants choosing the hamburger or Impossible burger option given information provision.*



Like the data from the default experiment, I conducted a general logistic regression model on the data from the information provision experiment. The model indicated that the information on the environmental consequences of meat production had the greatest influence on decision-making (Estimate = 0.33, p-value = 0.1), followed by the information on farm animal welfare (Estimate = 0.28, p-value = 0.2). The information on the health impacts of meat consumption had the smallest impact (Estimate = 0.14, p-value = 0.48).

Discussion

The data gathered from the survey and the experiments produced interesting results for the future of meat consumption and consumer behavior. This work advances understandings of meat attachment via validation of the Meat Attachment Questionnaire (MAQ) as well as potential constructions that impact consumer decision-making.

Based on the results from the survey, the four-factor model of meat attachment of the Meat Attachment Questionnaire, which includes hedonism, affinity, entitlement, and

dependence, is a valid measure of US consumers' bonds towards meat consumption. Hedonism, affinity, and dependence are most reliable and consistent as factors in describing meat attachment. The results of the MAQ may assist in better understanding the psychology and cognitive processes behind US consumer attachment to meat, thus helping to contextualize policy to overcome this attachment.

The comparison of my survey results and that of the 2020 Mattson survey point to more consumers trying and interacting with meat substitutes; a large proportion of participants wrote about the taste, price, and ingredients of meat substitutes. Although most of the respondents of the survey had tried meat substitutes or alternatives before, these consumers still indicated they did not want to decrease their consumption of meat via the use of alternatives. This indicates that the meat alternatives on the market are not perfect substitutes. In fact, some participants indicated that the alternatives available to them did not taste as good as meat, were more expensive, were too processed, or did not provide as many nutrients as meat. Participant responses about barriers to acceptance of meat alternatives may encourage progress in innovation and development of meat substitutes to address these concerns.

The results from the Intentions section of the survey indicate that while some consumers currently do not have a goal to reduce meat, many of them are not unwilling to follow a plant-based diet or to reduce their meat consumption if asked. Interesting to note is that, compared to 2020, more consumers believe that the shift to and acceptance of plant-based diets is a fundamental change in consumption that will continue well into the future. Although the proportion that consider plant-based diets to be trendy increased since 2020, it seems that for the near future encouragement towards reduce meat consumption habits could be successful. This

understanding of consumer thinking may help in informing practice and policy regarding government recommended meat intakes.

Due to the small sample size, the results from the experimental data are somewhat inconclusive. The statistical power for the default experiment was 0.21 and the power for the information provision experiment was 0.16. The low power indicates that the samples sizes are too small. Despite the small sample sizes, the data from the experiments point towards the important role that defaults can play in decision-making.

The experiment on defaults characterized the influence that defaults have on decision-making for dietary choices. Compared to the control, presenting a meatless option as the default on a menu increased the number of study participants who chose the Impossible burger. Thus, the presence of the default influenced participants towards increased consumption of the meat-free option. Interestingly, when the hamburger was presented as the default, the distribution of participant choice matched that of the control. This finding points to the fact that American consumers consider hamburgers, or meat options, to be the default regardless of potential efforts of neutrality.

The information provision experiments also revealed interesting conclusions regarding consumer behavior. Survey participants indicated that they were concerned primarily about dietary influences on health, then the environment, and finally on farm animal welfare, in decreasing order of concern. Thus, I would expect that the presentation of health information would correlate with the greatest increase in meatless. While health information did increase the number of individuals who opted for the Impossible burger, information about farm animal welfare and the environment had larger influences on decision-making. A key aspect of information provision in choice architecture is the salience of the information. Based on the data

gathered, information about the consequences of meat consumption on the environment was the most salient, closely followed by information about farm animal welfare. These conclusions may help shape policies and programs that inform consumers about consumption habits.

Policy Recommendations

Based on data analysis and conclusions, I recommend the following policy changes: reform the National Dietary Guidelines to reflect attitudes about plant-based diets, improve the National School Lunch Program to incorporate more plant-based options, and invest in a plant-based future.

Reform the National Dietary Guidelines

National dietary guidelines, like the US Department of Agriculture’s (USDA) MyPlate, should be reformed to accommodate the increasing shift towards and acceptance of plant-based diets. In particular, the Department of Agriculture and Health and Human Services updates and publishes the *Dietary Guidelines for Americans* for release every five years under the National Nutrition Monitoring and Related Research Act of 1990.¹⁰¹ While the current guidelines do include vegetarian options such as nuts, seeds, and soy products as examples of foods that provide a good source of protein, meat and poultry are presented as default protein sources. Any instance that protein is mentioned, in the listed examples of protein sources, meat is listed first, and the plant-based options are listed last. The presence of meat as the default diet is persistent throughout the *Dietary Guidelines*; a healthy vegetarian dietary pattern is described as a variation of the original healthy US-style dietary pattern.¹⁰² Furthermore, mentions of vegetarian or vegan diets are constantly described in contrast to meat-based diets throughout the guidelines. While

¹⁰¹ US Department of Agriculture and US Department of Health and Human Services, “Dietary Guidelines for Americans, 2020-2025.”

¹⁰² US Department of Agriculture and US Department of Health and Human Services, “Dietary Guidelines for Americans, 2020-2025.”

much of these descriptions are devoted to what plant-based diets may be missing, such as heme iron or vitamin B12, the benefits of these alternative diets are not elucidated. Because the *Dietary Guidelines* are used to develop national nutrition programs and are used by policymakers and nutrition professionals in their work, the assumption of meat as a default and the failure to explain the benefits of reduced meat or plant-based diets are directly translated to consumers.

Based off the results of my experiments, the presentation of information about meals is important in what decisions consumers end up making. In particular, the data indicated that most consumers internally associate meat as the default; but, when a meatless option is presented as the default, most consumers opt for the vegetarian option. I would recommend that the next iteration of the *Dietary Guidelines* include an explanation of the benefits of plant-based diets and incorporate vegetarianism, not as a diet variation, but as the default diet. In this explanation, I would recommend that the guidelines emphasize the environmental and farm animal welfare consequences of meat consumption as that information was the most salient and had the largest impact in my study.

Furthermore, while plant-based diets have become more acceptable and understood as interpreted from my data, the *Dietary Guidelines* should include advice about recommended foods to eat when reducing meat as well as address questions and beliefs among meat eaters. My results indicate that more Americans are willing to try and incorporate plant-based meals and foods into their diets. For national policies to be inclusive of the growing number of plant-based eaters, federal dietary guidelines should include both paths of transition to reduced meat meals as well as recommendations for preferred plant-based foods to consume.

These guidelines are developed for professionals including policymakers and nutrition educators and, thus, has a large impact on national nutrition programs and dietary policies.

MyPlate, which is used by Americans to stay informed about health eating practices, is created using the information summarized in the *Dietary Guidelines*. In reforming the *Dietary Guidelines*, it will also be important to reform MyPlate and other nutrition programs to reflect the incorporation of plant-based foods, so that updated nutrition and dietary information are translated efficiently and effectively to consumers.

Improving the National School Lunch Program (NSLP)

The NSLP is a “federally assisted meal program operating in public and nonprofit private schools and residential childcare institutions” and served an average of 29.6 million children each school day in fiscal year (FY) 2019.¹⁰³ The NSLP has strict nutrition standards that includes limits on calories, sodium, and unhealthy fats. Additionally, the program sets the amount of food types that are allowed per meal; for example, each meal must have $\frac{3}{4}$ cup of vegetables, 1 cup of 1% or fat-free milk, $\frac{1}{2}$ cup serving of fruit, and an entree that includes whole grains and lean protein.¹⁰⁴ The meals must meet federal nutrition standards and provide a third or more of the recommended levels for key nutrients. The program is mostly advisory; it provides nutrition standards that the states and school districts must implement but what specific foods to serve and how they are prepared and made are decisions made local food authorities.

On a higher level, the US government should expand the ability for meat-substitute products to secure Child Nutrition Labels, which would allow those products to be served in K-12 cafeterias under the NSLP. Meat substitutes are known by the USDA as “alternate protein products” (APP). For an APP to be served as a replacement for a protein entree, it must receive a Child Nutrition Label by meeting a variety of requirements that often limits the ability of

¹⁰³ US Department of Agriculture, “National School Lunch Program | Food and Nutrition Service,” <https://www.fns.usda.gov/nslp>.

¹⁰⁴ School Nutrition Association, “School Nutrition Standards,” <https://schoolnutrition.org/aboutschoolmeals/schoolnutritionstandards/>.

alternatives to be served in place of meat. Common protein substitutes like tofu, dried beans, and soy yogurt and milk must meet specific, and often difficult to reach, criteria to be considered APPs otherwise they cannot be substituted as a meat alternate. For example, for tofu to qualify as a meat alternate, it must be “easily recognized by children as part of a food group that contributes to a healthy meal” and cannot be incorporated into another recipe that is either not recognizable or does not represent a meat substitute.¹⁰⁵ Such a criterion is extremely limiting and prevents the widespread use of tofu as a protein substitute. Because my results indicate that alternatives like tofu are not perfect substitutes of meat, the USDA should expand the ability of plant-based alternatives to be incorporated as protein supplements outside of what may be recognizable by children. This could include the use of tofu blended into a soup or a smoothie.

Chicago Public Schools (CPS) has more specific nutrition guidelines; for example, CPS states that “all grain items served at breakfast and lunch are whole-grain rich” and that “protein must be included as a component in breakfast three times a week for both hot and cold menus”. CPS, as part of their breakfast and lunch policies, includes that there must be a minimum of one meatless breakfast and lunch option provided every day, allowing for children and young adults to explore plant-based diets. CPS is not unique in this aspect; there have been other schools around the country that have begun incorporating plant-based or vegetarian and vegan options. One issue is that students choose to not opt for the vegetarian item on the menu. The result is that school cafeteria managers choose to not prepare the vegetarian option, thus eliminating the purpose of meatless days.

¹⁰⁵ Food and Nutrition Service, “Crediting Tofu and Soy Yogurt Products in the School Meal Programs and the CACFP,” <https://www.fns.usda.gov/cn/crediting-tofu-and-soy-yogurt-products-school-meal-programs-and-cacfp>.

Investing in a Plant-Based Future

The USDA is the primary governmental institution responsible for overseeing national nutrition guidelines and implementing programs to encourage the acceptance of those guidelines for a healthier America. One of the prominent programs administered by the USDA via the Food and Nutrition Service (FNS) are the Child Nutrition Programs. The Child Nutrition Programs includes a variety of services including the School Breakfast Program, the Summer Food Service Program, and the National School Lunch Program (NSLP), which provides per meal reimbursements. For example, during the 2021-2022 academic year, the federal government reimbursed schools in the contiguous states a maximum rate of \$3.83 per free lunch served, \$3.43 per reduced-price lunch served, and 44 cents per paid lunch served.¹⁰⁶

For FY 2021, the Child Nutrition Programs were budgeted \$25 billion dollars.¹⁰⁷ Based on data from FY 2019, around 61% (\$15.25 billion) of that funding will go towards the NSLP.¹⁰⁸ While costs differ between schools and school districts, the average school meal program costs more than the federal reimbursements offered due to the cost of food, labor, supplies, services, and more.¹⁰⁹ The result is that food service directors at schools cut expenses by serving the cheapest and easiest-to-prepare meals, which also tend to be the least healthy, that still meet nutrition standards. Furthermore, schools often rely on the sale of school meals and unhealthy à la carte items to close budget gaps.

¹⁰⁶ Food and Nutrition Service, “National School Lunch, Special Milk, and School Breakfast Programs, National Average Payments/Maximum Reimbursement Rates (July 1, 2021 - June 30, 2022),” <https://www.fns.usda.gov/cn/fr/071621>.

¹⁰⁷ US Department of Agriculture, “United States Department of Agriculture FY 2021 Budget Summary,” <https://www.usda.gov/sites/default/files/documents/usda-fy2021-budget-summary.pdf>.

¹⁰⁸ In FY 2019, the NSLP spent \$14.1 billion of the \$23 billion Child Nutrition Programs budget.

¹⁰⁹ Food and Nutrition Service, “School Nutrition and Meal Cost Study | Food and Nutrition Service,” <https://www.fns.usda.gov/school-nutrition-and-meal-cost-study>.

Increasing funding for the NSLP could help expand the ability for schools to purchase higher-quality fruits and vegetables and alternative protein products. The government should also invest in expanding the availability of plant-based substitutes to schools. Of the numerous food items that are available to purchase for breakfasts and lunches, there are 26 vegetable options that may meet protein requirements and 98 meat categories, with plentiful subcategories.¹¹⁰ Of the vegetarian options, most are various kinds of beans or legumes rather than actual meat-alternatives like Impossible meat or Beyond Burger. Many respondents to my survey indicated that they would explore and incorporate meat substitutes into their diet if the products were more financially affordable and accessible. Increasing funding for plant-based meals and snacks in schools would provide students access to these plant-based options via the reduced-price or free meal program, directly addressing issues of cost.

Investing in a plant-based future also means reducing the influence of meat corporations on nutritional guidelines and food policies. Part of the process of developing nutrition guidelines involves an advisory committee of experts that prepares a detailed report intended to frame and inform the final guidelines. Yet, the final guidelines for 2020-2025 excluded the health impacts of red and processed meat consumption. In fact, the 2015 dietary guidelines also excluded the negative consequences of red meat due to pushback and lobbying from the meat industry; the USDA argued that that linking meat consumption to issues of sustainability and the environment was outside the scope of the guidelines.¹¹¹ Yet, respondent comments throughout my survey and experiment pointed to consumer awareness of the link between diet and nutrition, human health,

¹¹⁰ US Department of Agriculture, “Meat/Meat Alternates - Food Buying Guide for Child Nutrition Programs,” January 1, 2018.

¹¹¹ US Department of Agriculture, “2015 Dietary Guidelines: Giving You the Tools You Need to Make Healthy Choices,” <https://www.usda.gov/media/blog/2015/10/06/2015-dietary-guidelines-giving-you-tools-you-need-make-healthy-choices>.

climate change, and environmental destruction. If the dietary guidelines are supposed to represent accurate and up-to-date scientific research and consumer knowledge, then they must include this more integrated approach to nutrition and ignore the influences of meat corporations.

Limitations of Policy Recommendations

While my policy recommendations can make differences in nutrition for Americans, there are limitations. Although it is important for the nutrition guidelines to include accurate information about plant-based diets and relevant information about the consequences of meat consumption, as seen in the literature review, the science and research on the topic show mixed results. Delving through a history of various and contrasting studies would be a long and arduous process. Additionally, the next national dietary guidelines are set to be released in 2025, meaning there is much time between the passage of my recommendations and any subsequent implementation. Even if all the recommendations were implemented, the benefits of a plant-based diet are reliant on consumers to adopt plant-based habits. For example, even if schools begin to serve more meatless meals, it is up to the individual students to request the food and eat it. If people opt to continue to choose meat despite my policy recommendations, the consequences of meat consumption would persist.

Conclusion

Meat consumption globally continues to rise despite increasing associations between intake of meat with negative health outcomes, environmental destruction, and violations of farm animal welfare. US consumers demonstrate a strong attachment to meat as determined by scores on the Meat Attachment Questionnaire. Respondents presented a variety of obstacles to adoption of plant-based diets but demonstrated a willingness to reduce meat consumption and incorporate meat substitutes. When presented with varying decisions between a meat and a plant-based

option, participants were responsive to changing the default option and providing information on the environmental and farm animal welfare impacts of meat consumption.

Future studies on this topic could focus on the strength of the MAQ factors and explore trends across varying demographics. Culture and family upbringing are important aspects in characterizing personal diet choices. It would be interesting to determine how and to what degree personal background plays in meat attachment. Future research could also examine whether the type of protein source influences experimental results. Do plant-based sources like tofu or tempeh impact decision-making for consumers? Another study could analyze whether different types of meat-like alternatives influence consumer choice and how certain meat substitutes succeed where others fail. Do companies like Impossible Foods or Beyond Burger present information that is salient to some consumers but not to others?

Food is the future; what we eat has tremendous impacts on the future of world. Diet is deeply related to human health, environmental wellbeing, and farm animal welfare. Meat consumption is a major part of the global diet but is only aspect of the larger food system. While reducing meat consumption is a step in the right direction towards achieving a healthier future, idk how to finish this.

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Appendix: Survey Questions

Answer choices are indicated in brackets for multiple-choice questions.

Background

- What is your age?
- What is your gender? [Female/Male/Non-binary/third gender/Prefer not to say]
- Which of the following best describes your race/ethnicity? [Asian or Asian American/Black or African American/Hispanic or Latino/Native Hawaiian or other Pacific Islander/Native American or Alaskan Native/White or Caucasian/Another race/ethnicity not listed here]
- What state do you currently reside in?
- What is your estimated pre-tax income in 2020? [No more than \$9,950/\$9,951-\$40,525/\$40,526-\$86,375/\$86,376-\$164,925/\$164,926-\$209,425/\$209,426-\$523,600/\$523,601 or more]
- What is your education level? [Less than high school/High school diploma or GED/Some college/Bachelor's/Graduate or Professional Degree]
- Which of the following best describes your current status in the labor force? (Check all that apply) [Student/Retired/Employed/Unemployed/Other]
- How would you describe your political orientation?
[Conservative/Liberal/Moderate/Progressive]

Dietary Information

- How would you best describe your diet? [Omnivore - someone who eats food of both plant and animal origin/Vegetarian - someone who does not eat meat, but eats animal products (eg honey, eggs)/Vegan - someone who does not eat meat or any animal products]
- How often do you eat meat in a week? [None/1-2 times/3-5 times/6+ times]
- How often do you eat fish in a week? [None/1-2 times/3-5 times/6+ times]
- How often do you eat fruits and vegetables in a week? [None/1-2 times/3-5 times/6+ times]
- How often do you eat grains and legumes? [None/1-2 times/3-5 times/6+ times]

Meat Attachment Questionnaire

Answer choices for this section were on 5-point Likert-type scale ranging from strongly disagree to strongly agree.

- To eat meat is one of the good pleasures in life.
- I love meals with meat.
- I'm a big fan of meat.
- A good steak is without comparison.
- By eating meat I'm reminded of the death and suffering of animals.
- To eat meat is disrespectful towards life and the environment.
- I feel bad when I think of eating meat.
- Meat reminds me of diseases.
- To eat meat is an unquestionable right of every person.

- According to our position in the food chain, we have the right to eat meat.
- Eating meat is a natural and undisputable practice.
- I don't picture myself without eating meat regularly.
- If I couldn't eat meat I would feel weak.
- I would feel fine with a meatless diet.
- If I was forced to stop eating meat I would feel sad.
- Meat is irreplaceable in my diet.

Current Behaviors & Intentions

- Have you ever made conscious adjustments to your diet? This includes changing the types of food you eat, adjusting the amount, etc. [Yes/No]
- If you have thought about or made changes to your food preferences, please select what motivated you to make those changes. [Concern about the environment/Concern about animal welfare/Concern for public and/or individual health/Other]
- If you selected other, please indicate the reasons that explain your choice.
- If you currently eat meat, do you intend to maintain your current levels of meat consumption? [Yes/No]
- Please indicate the reasons that explain your choice
- If you currently eat meat, are you willing to reduce your current levels of meat consumption, for example, by half? [Yes/No]
- If not already, are you willing to follow a plant-based diet (i.e., in which meat is excluded/avoided or its consumption is infrequent and in small portions)? [Yes/No]

- Have you tried meat substitutes or meat alternatives before? Meat substitutes and alternatives are meat-like substances made from vegetarian ingredients. [Yes/No]
- If you currently eat meat, please select what is preventing you from substituting meat with alternatives. [Prefer to eat meat/Too expensive/Don't like the taste/Never thought about buying alternatives/Others in my household won't eat them/Too processed/Too many ingredients that I can't pronounce/Can't get enough protein/Too time-consuming/Other]
- If you selected other, please indicate the reasons that explain your choice.
- Do you think plant-based diets are: [A fundamental change in how we eat that will continue forever/A fundamental change in how we eat that will continue for a long time/Trendy now, but will not stand the test of time/A fad and will be gone quickly]