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Effects of Meat Attachment and Social Normative Messaging on Consumer Acceptance of a Blended Plant-Forward Sausage Patty

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EFFECTS OF MEAT ATTACHMENT AND SOCIAL NORMATIVE MESSAGING ON CONSUMER ACCEPTANCE OF A BLENDED PLANT-FORWARD SAUSAGE PATTY

by

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DEDICATION

I wish to dedicate this work to my family, with a special note to my parents, Benjamin Garza and Frances Sanchez. You both provide unconditional love and encouragement that motivates me to be the best person I can be.

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Objective. The consumption of red and processed meat in the US diet is rooted in psychological and social determinants. While meat alternatives (e.g., Beyond Beef) have recently entered the food and beverage market, they are not well received by consumers. The purpose of this study was to examine the effect of meat attachment and social normative messages on consumer acceptance of a blended, plant-forward meat product. **Methods.** Seventy-one university students (Age: M = 22.14; Gender: Female = 52) between the ages of 18-30 and without food allergies were recruited. This study utilized a 2 (between-subjects; social normative messages) x 2 (within-subjects, form of sausage patty) mixed design. Subjects were randomly assigned to view and critique a brief 30-second video with or without descriptive social normative messages. All participants evaluated the appearance, texture, flavor, aroma, and juiciness of a full-meat breakfast sausage patty (100% meat) and a plant-forward patty (50% meat, 50% texture vegetable protein), then completed the meat attachment questionnaire (MAQ). **Results.** Participants preferred the appearance (+0.72, $p < .001$), aroma (+0.38, $p < .001$), flavor (+0.54, $p < .001$), and juiciness (+0.35, $p = .039$) of the full meat patty compared to the plant-forward patty, with no identifiable difference between texture (+.02, $p = .204$) and overall acceptance (-.04, $p = .79$), regardless of the exposure to social normative messages. Although controlling for meat attachment affected the evaluation of patty appearance, this was not the case for sensory characteristics ($p = .004$, $\eta^2 = .119$). Lastly, sensory evaluations seemed to

depend on the form of sausage patty and exposure to normative messages for appearance ($p = .043$, $\eta^2 = .059$). and texture ($p = .014$, $\eta^2 = .086$). Yet, outcomes were contradictory and somewhat against predictions. **Conclusion.** Blended, plant-forward, meat alternatives could be an effective means to reduce meat consumption, especially when considering the texture and overall acceptance of the product. Future studies and development of plant-forward goods should seek to include varying proportions of textured vegetable protein. Further, the effect of descriptive social messages and meat attachment on consumer evaluations is not clear. More stringent and focused normative message exposures and a diverse subject pool are required to elucidate any possible effects on the sensory evaluation of food products.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

Introduction

Meat eating is ingrained in America psychology and culture. On average, Americans consume 10 billion animals a year [1]. The degree of animal consumption is defining of the Western diet - one that is exceedingly high in fat, red and processed meats and low in whole foods, fruits, and vegetables [2]. At the current rate of consumption, meat eating results in severe environmental, economic, and health-related consequences [3-5]. Although, recent changes in values and perspectives have sought to decrease meat consumption at the societal and individual level [6,7]. Even with pressing initiatives from government organizations, business strategies, and health societies, the pushback from meat-favoring psychological and social processes culminate in resistance toward reducing meat consumption [8]. The general rejection of healthful dietary patterns and meat alternatives reflects this pushback, as large-scale change is not possible without acceptance of adequate dietary substitutes [9-11]. The focal point of change must evaluate both the factors that affect consumer perceptions and consumer acceptance of food products [12]. When taken together, components of meat's psychological and social values may provide critical insight on the current perspective held toward meat alternative products.

For the purposes of this project, the definition of meat includes red meat (beef, lamb, pork), poultry, and fish - in alignment with perspective of the American Meat Science Association [13,14]. Further, processed meat denotes any meat preserved by smoking, curing, or salting such as deli meats, bacon, and sausages. The overconsumption of all forms of meat is an issue of concern. The severity of meat consumption overall is first put into perspective by reviewing the environmental, economic, and health strain of the meat industry.

Environmental and Economic Impact of Meat Consumption

The primary environmental impacts of the meat industry concern water, land, and fuel use, loss of biodiversity, and pollution [1,15,16]. Many of these impacts stem from the production of

animal feed, a significant component in the meat life cycle [17]. First, animal feed utilizes 35% of worldwide cropland [7]. Further, 60% of the total grain produced in high-income nations is reserved for animal feed alone [18]. Redirecting crop land's intended use and thousands of tons of grain directly to humans may help address the energy needs of the growing population, circumventing resource loss. Less energy is required when humans consume plants due to an animals' inefficient conversion of biomass - where bodily maintenance, waste, or inedible byproducts utilize 75-90% of the total energy consumed [19]. In addition to land use, estimates indicate one thousand tons of water are required to produce one ton of grain for feeding [20]. The energy requirements to support feed production alone are also substantial, with an estimated 1110MJ of energy required to produce enough feed for 1kg of edible beef [15]. At a feed conversion ratio of 6kg of grain to 1kg of edible beef, the resources required to grow, feed, and raise cattle for beef consumption is taxing [21]. Comparatively, approximately 50MJ cumulative energy, 22L water, and 2.43kg of feed are required to produce 1kg of edible poultry [22]. Variation in genetics, production systems, and feed consumption also note a considerably lower feed conversation ratio of 2.03 for certain systems of poultry farms [23]. Comparing these outcomes to other animal protein sources, such as poultry, highlights the resource requirements of high-demand beef production.

The meat industry also leads in the production of pollutants and toxicants. The major gases contributed by the industry's fuel use, feed production, and animal waste include carbon dioxide, nitrous oxide, methane, sulfur dioxide, and ammonia. These gases significantly increase the risk of global warming and terrestrial acidification [19,24]. Per every kilogram of beef, Asem-Hiablie's life cycle assessment (LCA) found a release of 146g methane, 48kg carbon dioxide, and 726g sulfur dioxide, and 370g of animal waste [15]. LCA and environmental impact comparisons suggest methane and carbon dioxide emissions from cattle contribute nearly ten times more to global warming potential than that of pork and chicken [25]. Comparisons between beef, pork, and chicken

appear significant. Per 100g of edible protein, pork releases 7.6kg while chicken releases 5.7kg of carbon dioxide [24]. Additionally, the increased methane release from both manure management and enteric fermentation of cattle (totaling over 40% of methane released from all fuel, industrial, agricultural, and waste sectors) explains the greater methane contributions from cattle over other sources of animal proteins [26]. Animal waste is a critical environmental detriment as the management of manure, urine, and inedible carcasses requires substantial energy and labor. Improper waste handling can increase the risk of nitrate pollutants in drinking water reservoirs or the release of high concentrations of ammonia and hydrogen sulfide in the air [15,27]. These contaminants may be responsible for the increased risk and prevalence of respiratory diseases in farm workers and those living in nearby farming communities [1,19]. The meat industry produces extensive quantities of greenhouse gas emissions and waste, with substantial contributions from beef alone.

The meat industry's production scale and supply chain costs affect the economy. Of the complete agricultural output in the U.S., 40% comes from livestock production, processing, and retailing [5]. This is not without benefit, as the trillion-dollar meat industry supports a $250 billion market for industry-related jobs and generates an annual $95.8 billion tax revenue for the federal government [28]. The industry's revenue stream and positive impact on employment and GDP continue to reinforce resource consumption. In 2019, the average consumption of beef by Americans was 6.4kg/capita/day [29]. To satisfy this public demand, farmers, slaughterers, processors, retailers, and restaurants utilize billions of dollars in resources and the laborious employment of about 500,000 people [28]. However, as with most industry-related labor, the meat industry incurs extensive labor and health costs. Nearly 50% of food system employees have experienced work-related injuries or illnesses [30]. Of all manufacturing and private sectors of the meat industry, the slaughtering and processing division held the highest injury rate in 2015, with 5.4

injured per every one-hundred employees [31]. Beyond the plants, employees and inhabitants of rural farming communities are at high risk for long-term consequences of pollutant and toxin exposure (as discussed with animal waste) such as immune system weakening and poisoning [32]. Even though the industry acts as a worthy catalyst for revenue in the domestic economy, the scale, practices, and waste produced brings adverse consequences for those employed by the industry directly.

Land and water use, gas emissions, excessive by-products and waste, inefficiency of biomass conversion, strenuous labor demands, and occupational injuries present significant environmental and economic pressures. At the current rate, these industry practices are not sustainable long term. This presents an opportunity for novel, innovative ideas to address the environmental and economic repercussions of meat consumption.

Meat's Impact on Human Health

Red meat is a critical and significant component of human diet and evolution. Sources of animal protein provide essential amino acids, bioavailable iron, and key animal-based nutrients (Vitamin B_{12}). The form of iron in red meat (heme) exemplifies meat's necessary role in the human diet as it provides a nutrient source that is more readily absorbed than plant forms (non-heme) of iron. Iron functions to transport oxygen, form red blood cells, and support cognitive development. For women and those in low-income areas, red meat is especially critical for overall development, bodily systems maintenance, and disease prevention [33]. However, in addition to the environmental and economic consequences, the overconsumption and reliance of red meat as a primary source of protein and energy has presented various health concerns. The protein recommended daily allowance for adult men and women is 45-60g per day [34]. Yet, consumption rates have shifted meat intake to the center of concern.

Red and processed meat intake increases risk of chronic disease [35]. In a meta-analysis by Micha, Wallace, and Mozaffarian, processed meat consumption (50g/day) was associated with an increased risk of coronary heart disease (42%) and diabetes mellitus (51%) [36]. Similarly, Larsson's meta-analysis found a 23% increased risk of all-cause mortality with excessive consumption of processed red meat (100g/day) [37]. In both analyses, the risk of chronic disease or mortality was not associated with an equivalent intake of processed and red meats. However, notably high quantities of total red meat intake exceeding 100g/day (both processed and unprocessed) have been previously associated with increased risk of diabetes mellitus, stroke, and cancer [36-38]. Cohort analyses concerning meat intake and health outcomes reflect similar associations. Prospective analyses of data collected from over 37,000 men in the Health Professionals Follow-up Study and Nurses' Health Study showed increased risk of total mortality per increases in one serving per day of red meat. Specifically, hazard ratios were 1.13 for unprocessed red meat and 1.20 for processed red [39]. Wang et al. found consistent evidence for increased risk of mortality with unprocessed red meat consumption, but only in US populations and not in European and Asian populations. The researchers speculate the association between red meat intake and mortality varies by population due to cooking habits, where barbecuing and grilling is more common in the US [40].

The effects of excessive sodium, iron, saturated and trans fats, and food additives on blood pressure, low density lipoproteins (LDL), and cholesterol moderate the risk of consuming high quantities of red and processed meats. Increased dietary sodium, iron, saturated fat, and cholesterol may increase blood pressure (hypertension) and LDL concentrations. The detrimental mechanisms of this process include plaque formation, arterial damage, blood clots, oxidative stress, and inflammation [41,42]. In excess these components are associated with an overall increased risk of cardiovascular diseases (CVD) such as stroke, heart attacks, or coronary heart disease [43]. The risk of developing these chronic diseases is often associated with low socioeconomic status, low fruit and

vegetable consumption, and lack of education about the long-term impacts of meat consumption [7,37].

The *Dietary Guidelines for Americans 2020-2025* (DGA) and the *EAT-Lancet Report* heeds the warnings presented by meat-intake research [34,44]. At the DGA's publication, about 75% of Americans met or exceeded meat intake recommendations. Thus, the U.S. Departments of Agriculture (USDA) and Health and Human Services (HHS) sought to reduce red meat intake without compromising protein quantity. First, the guidelines note the importance of limiting overall red meat intake while emphasizing any form of red meat over processed forms. Then, to help reduce and mitigate the effects of high meat consumption, the guidelines advocated for dietary variety, increases in alternative protein sources (such as fish, nuts, seeds, and lentils), and opting for low-fat food options (i.e., low fat milk). Americans typically consume meat in meals with high sodium and saturated fat content so suggestions for alternative proteins and dietary variety are conducive to reducing health risks [34]. In a broader and global sense, the EAT-*Lancet* Commission's Report addresses these health risks by pushing for change in the global food system that supports healthy diets and sustainable food production. Specifically, one global consumption target seeks to double intake of fruits, vegetables, legumes, and nuts and reduce less healthy foods such as added sugars and red meat by more than 50%. The five strategies supporting this global framework and goal acquisition are designed to support international commitment to increase consumption of plant-based foods, agricultural diversity, sustainable and innovative agricultural methods, habitat restoration and maintenance, and reductions in food waste [44]. The combined efforts from both the DGA and *EAT-Lancet Report* demonstrate the relevance, immediate need, and tools to transform current meat-related dietary trends on a large scale.

Plant Forward Solutions to Address Concerns of Meat Consumption

High rates of meat consumption present severe economic, environmental, and health-related consequences. Resource use and output will continue to increase as populations grow, yet growing resource requirements are not a sustainable option for the future. The industry will be forced to compensate by innovative farming, harvesting, and raising methods, new market opportunities, or a pull back on meat consumption [27]. Fortunately, forward thinkers in academia, business, and government have already pointed towards a more feasible, sustainable solution: plants. Vegetables, fruits, seeds, nuts, and lentils are under appreciated food sources in the Western diet. Nearly 85% of American adults (aged 19-59) under-consume vegetables, fruits, and fiber [34]. Yet, these plant products tend to be affordable, accessible, and capture a considerable portion of nutritional requirements. Not only would increasing consumption of plants aid Americans in meeting dietary recommendations, but it may also reduce economic, environmental, and health-related strains. Plant-forward diets are the most accessible and feasible means to address the environmental, economic, and health demands of producing and consuming high quantities of animal protein.

For the purposes of this paper, the term plant-forward describes an eating pattern with increased emphasis on plant foods over meat-based goods, not necessarily omitting meat entirely. Plant-forward styles of eating may encompass all forms of vegetarian or plant-based diets, including but not limited to vegans, lacto-vegetarians, flexitarians, and semi-vegetarians. The reduced consequences and increased benefits of consuming a plant-forward diet will be examined in the same environmental, economic, and health scopes.

Plant-forward dietary patterns produce less waste, consume less resources, and are therefore more sustainable [27,45]. Growing sources for alternative meat products, such as legumes, have been shown to enhance soil health, reduce fertilizer needs, and increase water holding capacity of farming land [16,46,47]. Life cycle analyses of meatless and meat-containing meals have shown an average

40% reduction in key environmental indicators - including carbon footprints, water and resource use, and health impacts [45]. Specifically, the carbon dioxide released from dinners containing standard portions of meat compared to meatless lunches drops significantly from 5k to 1kg. Plant foods may thus be less greenhouse-gas intensive per serving than meats [48]. Indeed, greenhouse gas emissions from tofu, nuts, peas, grains, and cassava contribute significantly less carbon dioxide than the tenth percentile of emissions from ruminant animals (e.g., cattle, goat, sheep) [24]. The culmination of resources required, and waste produced, may be avoided when the initial energy source is consumed - the feed. Relying on grains, seeds, and nuts as sources of energy for humans circumvents animals' inefficient conversion of biomass and reduces the overall amount of water, energy, and labor required to support meat consumption [49]. Altogether, increased plant substitution in meat-centric diets may reduce environmental harm.

Plant-forward perspectives may also provide novel opportunities and relieve economic stress. As noted in interviews with U.S. agriculture producers, consumer transitions towards plant-forward sectors can create new economic opportunities. Growing demands for protein-dense plants, alternative protein sources, and diversified feedstock needs for cultured meat may draw benefits to food security, quality of life, cropland opportunities, and diversification of income streams for farmers, ranchers, and those living in rural communities [16,50]. Additionally, continued growth of alternative-protein markets and a worldwide increase in non-meat protein consumption is expected to disrupt current meat industry trends [51]. Popular businesses and health societies have already capitalized on this transition by supporting plant-based foods, such as IKEA serving plant-based meatballs as early as 2015 [52].

Plant-forward government policies and business initiatives may also address health, labor, and economic concerns brought on by the meat industry [53]. First, a reduction in toxicants and pollutants lessens risk of respiratory damage from gas exposure, asphyxiation, and chronic illness

associated with working in meat processing plants and living in rural farming communities [16,31]. Then, increases in agricultural or alternative-meat job opportunities may reduce worker injury rates linked to animal processing and packing sites and increase productivity by avoiding injury losses [31]. Unfortunately, agricultural conditions are not without danger as legume and plant harvesters are subjected to heat stress, toxin exposure, and physically demanding labor [54]. Regarding the public, the $285 billion health care costs attributed to the meat industry (care services, medication, productivity loss) may also decrease [55]. Indeed, models estimating the effect of increased taxes on processed meats (up to 25%) predict a 16% decrease in meat consumption leading to 14% decrease in health costs and 9% decrease in associated deaths [55]. Thus, shifts towards plant-forward options, or reductions in meat consumption, may provide new revenue opportunities while simultaneously relieving considerable health and labor concerns.

Plant-forward diets circumvent the numerous health concerns associated with the Western diet and meat consumption. Generally, diets high in plant foods tend to be higher in fiber, magnesium, potassium, folate, and vitamins C and E [56]. When consumed consistently and in adequate quantities, many of these nutrients are associated with a lowered risk of heart disease, type 2 diabetes, prostate cancer, and hypertension [57]. Considering mortality, the Atherosclerosis Risk in Communities study examined the intake of over 12,000 middled-aged US adults. Outcomes indicate decreased risks from all-cause and cardiovascular disease mortality from 16% to 32% between participants with high and low adherence to plant-based or vegetarian diets [58]. An emphasis on plant foods also increases consumption and bioavailability of functional phytochemicals, including polyphenols such as flavanols, flavonoids, and isoflavones. Acting as antioxidants, these compounds engage in biomechanisms such as protecting endothelial cells from reactive oxygen species (oxidative stress), reducing platelet aggregation, and increasing vasodilation [59]. Consequently, plant

diets address the major health risks associated with elevated meat consumption by conferring protective effects and reducing one's risk of chronic disease and cancer [60,61].

The adoption of plant-forward diets is necessary for the longevity and prevention of chronic illness among peoples in the United States [34]. Increasing popularity, shifts in consumer values, government positions, and dissemination of healthful dietary information has begun altering the social climate, making the adoption of plant-forward diets much more attainable [7,62]. However, a lack of information and desire to change eating habits causes consumers to continue preferring high quantities of meat, disregard substitutions, and remain unwilling to adopt plant-based diets [8,63]. In combination, government positions, new consumer demands, and an unwavering subset of the population have inspired the development of innovative, meat alternatives.

Meat alternatives are constituted entirely of plants and seek to imitate then replace the immense animal-derived foods of the Western diet. Thereby, meat alternatives are inherently plant-forward. For example, milk and meat alternatives, such as almond, oat, and soy milk as well as *Beyond Beef* and *Impossible* burgers and chickpea *Chick'n* have flooded the food and beverage market [7]. While the sources of alternatives are vast, popular analogs include products with texturized vegetable proteins (TVP) derived from soy, wheat gluten, or nut proteins. Due to its similar physiochemical characteristics with meat, TVP analogs or blends with meat are viable options for meat substitution [64].

Sensory Evaluation of Meat and Meat Alternatives

As promising as meat alternatives seem, a negative perspective on substitution and consumer preference for traditional meat's sensory qualities are major barriers to the alternative protein movement. Worldwide and American consumers find the recent inception of protein alternatives unusual, unhealthy, unnatural, and artificial [65-67]. In-depth qualitative and quantitative surveys present a range of uncertainty, weariness, and poor sensory acceptance in consumer beliefs of meat

alternatives as sustainable, fully replaceable, enjoyable long-term, or as a large-scale solution to reduce meat consumption rates [16,27,68]. Yet, the issue underlying the current consumer perspective is that the sensory components of meat alternative products are deemed "negative" and unfavorable at first [69-72].

The sensory experience of taste, smell, texture, sight, and flavor is a critical factor in determining consumer enjoyment, acceptance, and consumption of foods. Researchers and businesses often conduct consumer acceptance tests, or sensory evaluations, to gather insights on consumer trends and perceptions of food products. The benefit of these panels includes an opportunity to evoke, manipulate, and assess how food is perceived by human senses. The primary assessment methods that allow researchers and businesses to gain a better understanding of food products include descriptive, discriminative, and preference and acceptance tests [73]. Assessments of meat alternative sensory attributes are critical to satisfying consumer demand.

Consumer surveys and acceptance tests of meat indicate the sensory qualities most valued by consumers include appearance (fat, marbling), texture (chewiness), and smell (freshness) [74-76]. Yet, current plant-protein products and meat alternatives do not adequately mimic the umami taste, flavor, and texture of traditional meat [77,78]. The umami flavor, caused by glutamate and inosinate nucleotides in meat, is critical to protein food choice and enjoyment as it acts as an evolutionary signal of amino acid availability [79,80]. The sought-after sensory experience of traditional meat and development of umami taste preferences negatively impacts opportunities for meat substitutes. Meat-favoring consumers may find the physical and sensory sensations of eating meat too familiar and enjoyable, preventing them from accepting meat alternative substitutes and thereby slowing immediate progress towards reducing meat consumption [81]. Even though meat alternatives face an uphill battle in achieving consumer acceptance, the replicability and flexibility of TVP-based substitution may address sensory concerns.

Objective evaluations have found soy and wheat TVPs to be most like chicken in chewiness, cutting strength, and water absorption [82]. TVPs blended with meat also magnify the functional properties and characteristics of meat analogs. For example, incorporating up to 40% TVP into burger patties has been shown to maintain certain physicochemical properties (i.e., cohesion, hardiness, gumminess) and slightly improve others, such as the color [64]. Reviews concerning the incorporation of soy TVP in various meat products indicate success in objective evaluations including fat emulsification, color replication, neutral flavoring, physical blending, and texture consistency [78]. In terms of sensory acceptance, greater success is seen when partially replacing meat with plant products rather than full replacements, even for stringent consumers with "anti" plant-based attitudes [83,84]. Even so, consumers have been able to identify sensory differences between TVP and beef, when partially and completely substituted in sausages [85]. Considering the incorporation of TVP into blended products and their improved sensory acceptance amongst reluctant consumers, a meat alternative consisting of a blend of TVP and chicken may find success. The midway focus, between the two extremes of consumer preference (high meat consumption to vegan diets), presents a more realistic opportunity to achieve satisfactory acceptance of meat alternative product.

The alternative protein movement has pressed sensory evaluation researchers to consider external influences on consumer acceptance. Protein-related analyses have begun to include effects of consumer preconceptions, meal context, and cultural influences on sensory outcomes [86]. A review of novel sensory evaluation techniques (e.g., biometric measurements, virtual environments, and artificial senses) also suggests holistic evaluations may provide a means to identify deeper influences on consumer preferences [87]. Indeed, distinguishing factors of consumer segments – such as geographic location, age, gender, income, and familiarity – have been associated with purchase intent and willingness to consume meat substitutes [71,75,88]. To continue the melding of

these forms of research, assessments of consumer acceptance should include psychological and social processes that govern the desire and intention to consume meat and disregard.

Theoretical models have examined numerous factors to group and explain the influences on one's food preferences, intentions, and frequency of consumption. For example, Chen and Antonelli describe food-internal, food-external, personal-state, cognitive, and sociocultural factors as the primary categorical influences on food choice [89]. Distinguishing factors from internal (sensory and perceptive) to external (environment) to personal (psychological habits and experiences) provides a multidisciplinary, conceptual framework to better understand consumer food choice and acceptance. Equally, food choice analyses have integrated the role of sensory evaluations, as done in a comparison of intrinsic and extrinsic influences on yogurt of varying sugar, fat, and flavor [90]. Overall, combined analyses of sensory evaluations including psychological and social mechanisms may allow for a more nuanced understanding of consumer acceptance and meat-eating behavior.

Psychosocial Components of Eating Meat

Red meat consumption is ingrained in various external and internal factors. The food environment encompasses numerous external influences and plays a significant and complex role in consumer purchasing and consumption behavior [5]. The consumption and preference for red meat showcases key elements of Herforth and Ahmed's definition of the food environment. Highly processed and preprepared forms of red meat are *convenient* and widely *available*, tend to appear more *affordable* and cost-effective, and are overtly *desirable* in their sensory appeal [91]. This is highlighted by the experience of U.S. immigrants who tend to increase consumption of high-fat food (including fatty red meat) and fast food when resettling [92]. These dietary changes are likely a result of food availability and affordability of cheap meat sources via fast food and highly processed food products [93]. Additionally, consumer familiarity, lack of awareness, refusal to break meat-eating habits, and the saturation of pleasure-seeking behavior are additional drivers perpetuated by the modern food

environment [94-97]. The modern food environment has pushed red meat to become the epitome of protein-driven eating and cravings.

Numerous internal factors affect meat eating behavior, such as pleasure, identity, dominance, celebration, culture, moral beliefs, meat appreciation, and normative behavior [8,98,99]. Consuming animals may fulfill a component of one's self-concept and dominance over other species, allowing meat to symbolize power and status over other species and peoples [98]. This dominance-driven psychological process is often associated with masculinity, highlighting adult men's greater likelihood to over consume red meat [8,35,99]. Because Western society is driven by principles of individualism and competition, this internalization and belief of meat as a "success" symbol may be reinforced and consistently driven by desires for power and dominance [53]. Ultimately, overindulgence and perpetuations of identity and dominance have supported the high consumption of meat as a traditional, Western practice while rejecting novel, plant-forward ideologies [100].

The approach taken by Graça et al., to understand the recent global shift towards increased meat consumption and decrease in plant-based foods, considers four primary factors that drive consumption: hedonism, affinity, entitlement, and dependence. Together, these factors determine one's *meat attachment* - defined as the positive bond one feels towards meat and their propensity to continue consuming it. The researchers have successfully validated this construct across diverse populations using the Meat Attachment Questionnaire (MAQ), finding associations with meat attitudes, eating habits, dietary identity, and subjective norms [8]. The meat attachment perspective is valuable as it seeks to explain consumptive behavior through an individual's bond with meat. The components of pleasure, affinity, dominance, and dependence sufficiently reflect the variety of psychological processes involved in meat eating behavior. However, poor associations with subjective norms limit the construct's reliability in explaining the social impact of normative

behavior on meat consumption [8]. Yet, the social mechanisms of eating behavior are just as influential as psychological ones.

The social representations of meat are often fundamental in creating connections and shared values within and between individuals [101]. Sharing food has significant evolutionary and cultural roots, as food once acted to promote cooperative behavior and the evolutionary fitness of groups [102]. As civilizations grew and countries developed, increases in GDP and annual income were generally associated with increased intake of meat proteins [103]. In the US, meat became intertwined with social and political transformations as land was widely available to raise animals, there was great opportunity for industrialization, and the professional meat associations were established early in the 21st century (e.g., American Meat Institute) [104-106]. Together, these factors shaped the importance of serving and sharing food also in various celebrations, family gatherings, and the modern cookout. The American cookout-style likely developed in the 1950s during suburban expansion and recovery from World War II when eating meat was considered "pious and patriotic" [107,108]. The continued appreciation and participation in these events - where large quantities of meat are served and shared - symbolizes and teaches values of trust, bonding, and community [109]. As an example, Mexican Americans offer numerous traditional food practices and dishes to celebrate closeness and share affection with family. Tamales, menudo, barbacoa, and carne asada often sit at the center or hang off the edges of plates at get-togethers. By garnering an appreciation and love for friends and family, these meat-based events implicitly become the symbols, preferences, and driving forces of celebration as people connect with others [7].

While social celebrations and sharing of foods have deep evolutionary, historical, and cultural roots, its interplay with modern Western beliefs promotes excessiveness. Eastern religions and cultures also consume meat, yet they do overconsume it. For example, in Chinese dinners, vegetables are typically the focal point while meat is subsidiary. Meals in Japan also tend to

emphasize vegetables, grains, fermented products, and fish over meat. The historical availability of food as well as religious and political influence (namely Buddhism and Hinduism) are driving forces for these plant-forward cultural practices. However, recent Western influence, industrialization, and economic development are increasingly responsible for expanding meat processing and consumption in Eastern cultures [110,111]. Indeed, the correlation between meat consumption and gross domestic product per person increases as countries begin developing before slowing down as development peaks [5,112]. The Western approach, values, and social presentations of meat play an overt role in advancing and perpetuating increases in meat-eating practices.

The customary values of identity, dominance, pleasure, kinship, and celebration define a critical aspect of Western ideology: meat is culturally significant. Meat's symbolism, values, and beliefs accumulate and disperse in various codes used by individuals to guide behaviors, referred to as social norms. Higgs suggests people have followed food social norms as an adaptive, evolutionary means - if we eat what others eat, we will select safe foods, fit in, share resources, and cooperate for survival [102]. When discussing the drivers and barriers of reducing meat consumption, Cheah argues social norms allow individuals to confirm behaviors and motivate distinctions with others, striking a balance between motivating and preventing behavior change [101]. For example, Western social agreements of meat as the center of the plate, prejudice towards plant-forward diets, and a lack of social support for non-meat eaters prevent individuals from reducing meat consumption with ease [62]. Conversely, the influence of social norms as a driver of dietary change may be advantageous. Social context and closeness with others of similar beliefs may cultivate an environment where reduced meat consumption and plant-forward eating patterns are favorable and more accessible [62,102,113]. Regardless, social norms play a critical role in reinforcing or changing eating behaviors through the ability to alter perceptions, affect behavioral choices, enhance acceptance within groups, and connections with others [102].

Social norms play an influential role in food eating intention and frequency. For example, when an eating "model" is present, participants will alter the intention and quantity of food they consume depending on how the model performs and how closely they identify with that model [114,115]. Researchers have also explored the indirect influence of normative messaging on eating behavior. By focusing on the primary forms of social norms, what others expect (injunctive norms) and what others do (descriptive norms), studies have collectively found that short, simple, descriptive normative messaging referring to relatable referent groups can most effectively change (or be associated with) eating behaviors and intentions [113,116-118]. Even without the direct presence of another individual, normative beliefs uphold the ability to alter eating behaviors.

Western beliefs regard meat as a symbol of pleasure, identity, dominance, status, celebration, and kinship. Whether conscious or direct, these symbols determine a variety of normative values translated into everyday behaviors. Albeit the power of these normative messages is discreet. In conjunction, examining psychological and social process may provide valuable insight on the conditions that influence meat-eating behavior. Specifically, the meat attachment construct and influence of social normative behaviors may sufficiently capture a key segment of the psychological and social mechanisms involved in meat consumption.

Aims

The environmental, economic, and health consequences of meat consumption have called for immediate intervention. Plant-forward dietary patterns with meat alternatives have garnered support and may sufficiently address these damaging concerns. However, the confluence of rigid psychological and sociological factors and the acceptance of meat alternatives have halted consumer favorability and preference for substitutions**.** The effects of individual meat attachment and social norms on the sensory evaluation of meat alternatives is warranted for examination.

In the current study, the effects of meat attachment and social normative messaging on an individual's perception of a blended, plant-forward meat product is examined. At the time of this project, the researcher was unaware of any findings that articulate the effect of social normative messaging on sensory evaluations, specifically. Previous marketing research has found that images of foods can increase taste perceptions relative to that food [119]. Specific components of organic food labels have also altered consumer acceptance via changes in sensory perceptions, depending on the product, sensory attributes, and type of information [120]. Researchers have hypothesized the sensory evaluations of food properties may be subject to normative influence due to consumer desire for social conformity and reward-related activities surrounding the subjective perception of foods [102]. Yet, a gap remains in our understanding of how manipulated social normative messaging may affect the sensory evaluation of foods directly. While also considering an individual's affinity for meat, insight may be gathered on how critical normative beliefs are to influence an individual's acceptance of meat alternative products. Further, the use of a meat-blended, midway product aligns with plant-forward approach that seeks to *reduce* meat consumption rather than omit meat entirely [121]. Rather than focusing on the extreme end of plant-based food acceptance, the blended approach may illuminate key sensory characteristics required to help transition individuals toward a plant-forward style of eating and away from one that is meat-centric.

The aims of this research were two-fold: (1) to measure consumer acceptance and sensory evaluation of a plant-forward (blended) sausage patty compared to a full meat patty; and (2) to determine the degree in which psychological and social (meat attachment; social, descriptive norms) operations interact and affect consumer evaluation of a plant-forward food. The exposure consisted of a video with social normative messages promoting the

acceptance and adoption of plant-forward eating patterns. The manipulation sought to determine if social, descriptive norms influence consumer acceptance of a blended plant-forward meat alternative. The primary hypotheses are below.

1. Subjects who receive the exposure will show an increase in acceptance of the blended, plant-forward product across all senses.
2. Accounting for an individual's attachment to meat will strengthen the effect of the exposure.

Regardless of one's affinity for meat, subjects exposed to normative influence may find the meat alternative product more enjoyable.

Methods

Subjects

Participants were recruited from a private university in South Texas by convenience sampling via emails, posts in learning management systems and announcements in undergraduate and graduate courses. Participants were briefed and provided with written consent upon arrival to the study location (Appendix B – Consent Form). A priori G*power analyses with a conservative effect of 0.20, alpha at 0.05, and power at 80% indicates a sample size of 98 is sufficient to detect all primary effects. A total of 76 participants participated in data collection during the Fall 2022 and Spring 2023 semesters. The subject pool reduced to 71 (Female = 52; Age = 22.19 ± 3.43) after processing as some subjects did not complete the entire questionnaire. Sample characteristics are displayed in **Table 1.**

Table 1. *Summary of Sample Characteristics*

		Age		Gender (F)		Hispanic (Yes)		Race (White)	
Condition	*N*	*M*	*SD*	*n*	%	*n*	%	*n*	%
Control	40	22.42	4.21	29	72.5	29	72.5	29	72.5
Experimental	31	21.87	1.98	23	74.2	17	54.8	29	96.7

Inclusion criteria dictated that subjects were attending the university and were within 18-30 years of age. Additional criteria included two conditions: subjects were not eliminating meat from their diet and subjects did not have any known or suspected food allergies to a set list of foods provided (Appendix A – Recruitment Survey). All study procedures and materials were approved by the University of Incarnate Word Institutional Review Board (#00005059).

Materials

Norm Video and Evaluation. Subjects were randomly assigned to watch one of two 30-second animated videos on an electronic device. Both videos, created with Canva software, contained a brief description of a plant-forward diet to provide adequate background and ensure participants were primed to understand the normative statements. The initial messages were as follows: "*A plant-forward diet is a flexible, inclusive eating pattern that emphasizes plant foods over meat, but does not omit meat entirely. Popular examples include vegan, vegetarian, semi-vegetarian, and Mediterranean diets."* Including contextual information – such as describing the relevant concepts – has proven an effective method for conveying normative messages, compared to messages alone [117]. The experimental condition (SM) received an additional descriptive normative statement suggesting plant-forward dietary patterns are more prevalent among today's younger population. The message is as follows: "*More American adults are transitioning towards a plant-forward style of eating. Previous research has found that 37% of young adults always or sometimes order vegetarian or vegan meals when eating out."* The statistic was taken from the Vegetarian Resource Group's 2016 Harris Poll where 37% of 2,015 adults indicated they always or sometimes purchase vegetarian or vegan meals at restaurants [122]. The wording and style of the normative message was influenced by previous social norm manipulations in eating behavior research [113,116-118]. Subjects in the control condition (C) did not receive the normative statements, instead their video ended after the background information. Subjects were asked to critique and evaluate the effectiveness of the video's marketing techniques

focusing on appearance, design, and presentation of the message (Appendix C – Normative Video and Evaluation).

Sausage Patty Recipe. Two sausage patties were prepared for the experiment. The control patty was entirely ground chicken (FMP) while the experimental patty was a 50/50 by weight blend of ground chicken and TVP (PFP; Appendix D – Recipe). The TVP took the form of dehydrated crumbles purchased from Bob's Red Mill [123]. Every patty weighed 100g and participants were served a quarter (25g) of both. Preventive measures to reduce exposure to harmful food allergens or pathogens were taken, such as storing food at temperatures below 41°F and cooking patties to an internal temperature of 165°F. Nutrient analysis for FMP and PFP included in Appendix E.

Acceptance/Sensory Evaluation. To perform a sensory evaluation, participants measured the sensory acceptance of appearance, texture, aroma, flavor, and juiciness of the samples on a 5-point hedonic scale (5 = like very much; 1 = dislike very much; Appendix F – Sensory Evaluation). The overall acceptability was also assessed on the same hedonic scale to capture acceptance in totality. Using a singular 5-point hedonic scaled item is supported by previous literature measuring consumer acceptance of food products and the validated use of parametric statistics with Likert-style data [120,124]. The order of sausage patty and sensory characteristic were randomized for every participant, to mitigate order bias.

Final Questionnaire Materials. Demographic information includes age and gender. The *MAQ* developed and validated by Graça, Calheiros, and Oliveira was used to measure participant attachment to meat (Appendix G – Meat Attachment Questionnaire) [8]. Through domains of hedonism, affinity, entitlement, and dependence, the MAQ provides an indication of one's attachment to meat products. All 16 items and scoring requirements (5-point Likert scale: 1 = strongly disagree; 5 = strongly agree) were used with permission from the primary author and

without edit. Participants also noted how many servings of meat were consumed within the last 24 hours.

Procedure

Upon arrival at their designated time slots, up to five participants were seated in the evaluation room. All subjects were seated facing opposite directions and were surrounded by screens to prevent viewing progress or reactions from other subjects. Randomization techniques assigning subjects to either SM or C conditions were set on the electronic devices prior to subject arrival.

Subjects received an explanation for the initial procedure, watched the Norm Video and completed the evaluation on the electronic device. During the procedure, participants were instructed to pay close attention to the design and content of the video. The subjects were instructed not to communicate with one another, left alone by the researchers, and given five minutes to complete the video evaluation.

To begin the second phase of the experiment, a second scripted explanation introduced the sensory testing and questionnaire. The coded sausage samples, cutlery, and water were served to each participant, giving them five to seven minutes for evaluation. Upon completion, subjects were then instructed to continue the electronic survey and complete the MAQ, demographic information, and were then debriefed.

All food samples were prepared the day before the experiment using safe food practices. Prior to testing, the sausage samples were heated on a stove-top skillet for 3-4 minutes at medium heat with one tablespoon of olive oil. Samples were plated and served hot with a cup of water to rinse the palate between tastings. To follow standard sensory evaluation practices, participants were not informed of the product and its information (expectation error), did not view reactions from other subjects (suggestion error), and were instructed to evaluate sensory qualities individually (halo effect) [73].

Statistical Analysis

A combination of descriptive and inferential statistics was used for this project. Demographic and outcome variables were analyzed using Pearson correlations to unveil baseline relationships. Consumer age, gender, and frequency of meat consumption were compared between groups to determine homogeneity assumptions. To test the specific aims of this research, 2x2 mixed model analysis of variance (ANOVA) and covariance (ANCOVA) were used. The norm manipulation (SM versus C) functioned as the between-subjects factor and the sausage patties (FMP versus PFP) as the within-subjects factor, while the MAQ scores were included in the model as a covariate. The main effects indicate if there were any differences in acceptance of the sausage patties or effects of the social norm condition, while the MAQ controlled for underlining psychological influences. All analyses were processed and conducted in IBM SPSS Statistics (Version 28) [125].

Results

Initial descriptive analyses indicated no significant differences between age, gender, ethnicity, and race between control and experimental video conditions (Table 1). Meat attachment scores were slightly above the midpoint for both control (M = 3.55) and experimental (M = 3.53) groups, yet the difference was not significant, $t(69) = .135$, $p = .893$. Meat consumption over the last 24 hours was also similar, with one to two servings consumed by 35% of the control and 39% of the experimental groups. No meaningful correlations were identified between demographics and outcome variables (Appendix H – Correlation Matrix).

Various mixed models, 2 (SM and C) x 2 (PFP and FMP) ANCOVA, were run to determine the effects of descriptive normative messaging on the sensory acceptance of a plant-forward sausage patty, while controlling for meat attachment. A unique model was run per sensory characteristic, including appearance, aroma, texture, flavor, and juiciness (five total). The only ANCOVA model to meet the appropriate statistical assumptions (e.g., Levene's Test, Homogeneity of Regression Slopes,

Normality) was the for the appearance characteristic. Five additional mixed model ANOVAs excluding the meat attachment covariate were run to comply with statistical assumptions.

The first aim of the project was addressed by the main effect of the sausage patty factor, per respective models. In terms of appearance, the ANCOVA model satisfied assumptions and revealed a significant difference in the sensory evaluation between the FMP and PFP, when controlling for meat attachment (**Table 2**). There was a preference for the FMP (M_{adj} = 4.23) over the PFP (M_{adj} = 3.51) regardless of video condition and when controlling for meat attachment $F(1, 67) = 9.02$, $p < .004$, $\eta^2 = .119$. Although the ANCOVA models were not statistically viable, the models produced a directional trend consistent across aroma, texture, flavor, and juiciness, where the FMP showed greater acceptance than the PFP.

Table 2. *Appearance ANCOVA Main Effects*
Main effect of the sausage patties concerning within-subjects differences in the 5-point acceptance scales of appearance, when controlling for meat attachment (ANCOVA).

	FMP		PFP (50/50)		Main Effects		
Characteristic	M_{adj}	*SE*	M_{adj}	*SE*	*F*	*p*	η^2
Appearance	4.23	0.11	3.51	0.08	9.02	.004*	.119

Models invalidated for other characteristics MAQ Score of 3.5402 factored into models as covariate. *Indicates statistical significance (<.05).

Removing the covariate, MAQ, from the analyses revealed significant effects by the sausage patty factor in four of five mixed ANOVA models (appearance, aroma, flavor, juiciness; **Table 3**). The greatest difference was still seen within sample appearance, where the FMP (M = 4.23) was far preferred over the PFP (M = 3.51), $F(1, 68) = 33.96$, $p < .001$, $\eta^2 = .333$. The most indistinct difference and smallest effect size was shown in sample juiciness where the FMP (M = 3.82) was slightly preferred over the PFP (M = 3.47), $F(1, 67) = 4.43$, $p = .039$, $\eta^2 = .062$. Texture was the only characteristic not significantly different between the FMP (M = 3.82) and PFP (M = 3.62) patties, $F(1, 68) = 1.64$, $p = .204$, $\eta^2 = .024$. In terms of overall acceptance scores, the FMP and PFP (M =

4.09 vs. $M = 4.13$, respectively) were nearly identical. A supplementary paired samples t-test confirmed the difference was non-significant, $t(69) = .264$, $p = .79$. Ultimately, the sensory acceptance assessment conducted in this experiment preferred the FMP over the PFP with variations depending on the sensory characteristic.

Table 3. *Sensory Characteristics Acceptance - ANOVA Summary*
Main effect of the sausage patties concerning the between-subjects differences in the 5-point acceptance scales of appearance, aroma, texture, and flavor (ANOVA).

	FMP		PFP (50/50)		Main Effects		
Characteristics	*M*	*SE*	*M*	*SE*	*F*	*p*	η^2
Appearance	4.23	0.11	3.51	0.08	33.96	<.001*	.333
Aroma	4.01	0.11	3.63	0.12	18.15	<.001*	.208
Texture	3.82	0.14	3.62	0.09	1.64	.204	.024
Flavor	4.12	0.12	3.58	0.09	15.39	<.001*	.185
Juiciness	3.82	0.14	3.47	0.11	4.43	.039*	.062

*Indicates statistical significance (<.05).

The second aim of this project is elucidated by the main effect and interaction of the video condition with the sausage patty predictor. The appearance focused ANCOVA model indicated no difference in acceptance of appearance between those not exposed to normative messages ($M_{adj} = 3.87$) and those exposed to normative messages ($M_{adj} = 3.87$), regardless of the sausage patty and when controlling for meat attachment, $F(1, 67) = 0.00$, $p = .983$, $\eta^2 = .000$. Regarding the ANOVA models and remaining characteristics, significant effects of the video condition were only seen in the aroma model (**Table 4**). Here, those exposed to normative messages ($M = 3.63$) revealed lower acceptance of aroma compared to those not receiving the exposure ($M = 4.01$), regardless of the sausage patty, $F(1, 69) = 5.68$, $p = .020$, $\eta^2 = .076$.

Table 4. *Social Normative Messaging – ANOVA Summary*
Main effects of the control and experimental video conditions concerning differences in the average 5-point acceptance of appearance, aroma, texture, flavor, and juiciness per both control and experimental patties (ANOVA).

	C		SM		Main Effects		
Characteristics	*M*	*SE*	*M*	*SE*	*F*	*p*	η^2
Appearance	3.87	0.10	3.87	0.12	0.00	.996	.000
Aroma	4.01	0.11	3.63	0.12	5.68	.020*	.076
Texture	3.73	0.12	3.71	0.12	0.02	.904	.000
Flavor	3.80	0.11	3.90	0.12	0.43	.514	.006
Juiciness	3.60	0.12	3.68	0.14	0.18	.067	.003

*Indicates statistical significance (<.05).

The form of sausage patty was also found to interact with the video conditions to determine differences in sensory acceptance scores. When controlling for meat attachment, the acceptance of the sausage patty appearance did depend on the form of sausage patty and video conditions $F(1, 67) = 4.32$, $p = .042$, $\eta^2 = .061$. Specifically, the participants who were exposed to social normative messages perceived a greater contrast between the acceptance of the FMP ($M_{adj} = 4.35$) and PFP ($M_{adj} = 3.39$), compared to participants not viewing normative messages (FMP: $M_{adj} = 4.10$, PFP: $M_{adj} = 3.64$). Excluding meat attachment from the model (ANOVA) produced nearly identical outcomes, $F(1, 68) = 4.26$, $p = .043$, $\eta^2 = .059$. The acceptance of texture also depended on the patty and video condition, although meat attachment was not included in this model, $F(1, 68) = 6.42$, $p = .014$, $\eta^2 = .086$. Participants exposed to the social normative messages preferred the texture of the PFP ($M_{adj} = 3.81$) over the FMP ($M_{adj} = 3.61$) compared to subjects who did not view the normative video and preferred the FMP ($M_{adj} = 4.0$) over the PFP ($M_{adj} = 3.44$). Lastly, a trending interaction was shown for aroma, $F(1, 69) = 3.76$, $p = .057$, $\eta^2 = .052$. Participants who did not view the normative messages revealed a greater preference and contrast in acceptance of the FMP ($M = 4.40$) and PFP

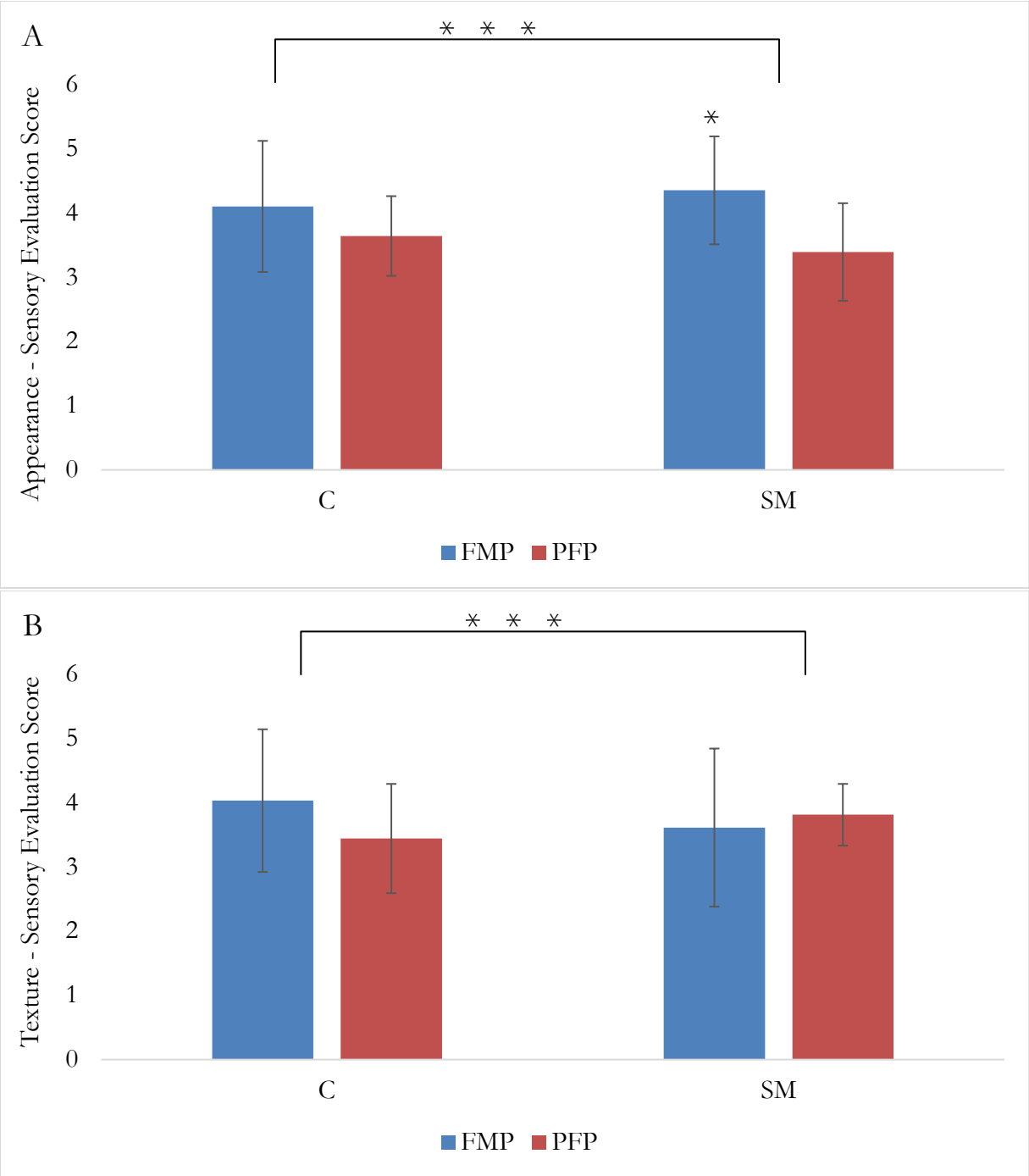
(*M* = 3.63) compared to those who received the normative message exposure [FMP: *M* = 3.77; PFP: *M* = 3.48]. Interaction outcomes are summarized in **Table 5** and presented in **Figure 1**.

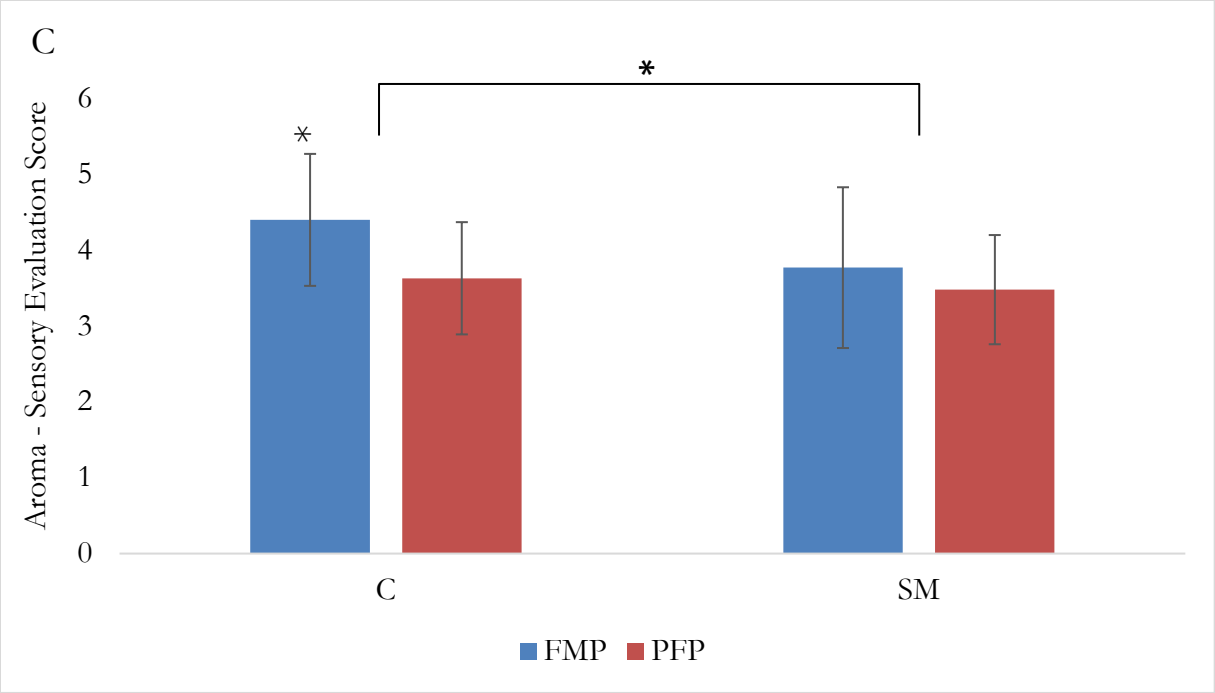
Table 5. *Sausage Patty and Video Condition Interaction – ANOVA Summary*
Summary of interaction effects between the form of sausage patty and the video condition, regarding appearance, texture, aroma, flavor, and juiciness outcomes (ANOVA).

		C		SM		Interaction Effects		
Characteristics		*M*	*SE*	*M*	*SE*	*F*	*p*	η^2
Appearance	FMP	4.10	1.02	4.35	0.84	4.26	.043*	.059
	PFP	3.64	0.62	3.39	0.76			
Aroma	FMP	4.40	0.87	3.77	1.06	3.76	.057	.052
	PFP	3.63	0.74	3.48	0.72			
Texture	FMP	4.03	1.11	3.61	1.23	6.42	.014*	.086
	PFP	3.44	0.85	3.81	0.48			
Flavor	FMP	4.10	0.97	4.13	1.02	0.36	.549	.005
	PFP	3.49	0.89	3.68	0.60			
Juiciness	FMP	3.77	1.20	3.87	1.07	0.01	.92	.000
	PFP	3.44	0.97	3.50	0.82			

*Indicates statistical significance (<.05).

Figure 1. *Sausage Patty and Video Condition Interactions*
Interaction effects of sausage patty (PFP and FMP) and video condition (SM and C) on the acceptance of various sensory characteristics. Panel A – Appearance; Panel B – Texture; Panel C – Aroma. Error bars represent standard error. *Indicate significant main effect ***indicate significant interaction at $\alpha < 0.05$.




C
Aroma - Sensory Evaluation Score
6
5
4
3
2
1
0
*
*
C
SM
FMP
PFP

Considering the reduced capacity of the original ANCOVA models, additional simple linear regression models were constructed to determine any predictive effect of meat attachment on consumer acceptance overall. Both regression models indicate there was a nonsignificant relationship between meat attachment and overall acceptance of the PFP (t = -1.336, p = .186) and FMP (t = 1.701, p = .093). Although, the direction of the models was consistent with the previous analyses and conceptual framework of the project – where meat attachment is associated with a preference for the FMP over PFP.

Discussion

The two primary aims of this paper were to compare consumer acceptance of a plant-forward, blended sausage patty to a full-meat patty and to determine the effect of meat attachment and social normative messaging on consumer preference. First, the PFP was expected to maintain acceptance throughout all sensory characteristics of appearance, aroma, texture, flavor, and juiciness and overall. Secondly, it was hypothesized that exposure to social normative messages would lead to an increase in the acceptance of the PFP compared to the FMP, while accounting for individual preferences for meat.

Aim #1

The sensory evaluation indicated consumers consistently preferred the appearance, flavor, aroma, and juiciness (in descending order) of the FMP over the PFP. The form and characteristic of TVP used in plant-forward products is critical to all sensations, but its effect on appearance has been previously emphasized [126]. Appearance is the first sensation experienced when consuming a food item. The visual sensation is an essential component of anticipatory perception, consisting of identifying visible notes in color, texture, size, and shape [127]. The plant-forward product presented here clearly contained an additional ingredient not typical of a sausage patty, as the TVP formed dark, visually apparent clumps with the ground chicken (Appendix I – Photos). Consumer

evaluations of appearance may have reflected this distinction. The dehydrated crumble form of TVP used here may not have been ideal for the final product's form [123]. Protein sources, dehydration, and extrusion methods determine the physiochemical properties - including moisture, fat, and protein content, color, shape, and hydration requirements - of texturized vegetable proteins [128]. In certain forms of plant-based products, a crumbling appearance may be more acceptable, but not in a minced, meat patty where ground meat minces tend to bind together due to their water and fat content [129]. Because the ending fibrous matrix is critical to TVP's similarity with meat, a form of TVP that is slightly elongated or has increased granule size might have resulted in a more acceptable appearance [130]. Further, a casing-enveloped product more typical of a sausage may avoid the crumbling issue and mask the appearance of certain forms of TVP in blended products. Sensory assessments by trained panelists, comparing various meat (pork, veal) versus meat-free sausages in cellulose casings, have indicated higher acceptance of appearance for meat-free products [131]. Ultimately, understanding the sensory effect of TVP on the appearance of plant-forward goods requires a regard for the physiochemical appeal of the TVP variation used as well as the final product outcome.

While the form of TVP may affect flavor, aroma, and juiciness, the flavor concoction and manipulation of TVP may better explain differences observed between the FMP and PFP. Previous studies using TVP-blended patties and meat-based meatballs found that consumer preference between blended and full-meat products began to differ as the "meaty" and "off" flavors become more apparent (attributed to a lack in umami flavoring) and as the sodium content decreases [132,133]. The TVP incorporated here was seasoned in similar quantities of salt, black pepper, thyme, marjoram, and sage as the meat mixture. However, participants may have disfavored the TVP's earthy, wheat-like flavor and scent. Presumably, the TVP used in this study could have benefitted from additional treatments and flavor enhancers, such as nutritional yeast, soy sauce, or

liquid smoke. Roasting and fermenting soybeans has previously reduced the "off" flavor and enhanced flavor properties of sausage products, so including these methods in soy based TVP could improve consumer acceptance [134]. Although chicken broth was used to rehydrate the TVP, utilizing a broth with increased sodium may allow plant-forward products to replicate the more intense flavor and juiciness profile expected of full meat products. Sodium plays an essential role in meat products as it increases hydration, water capacity, facilitates protein binding, and solubilizes fat create a uniform product [135]. Together, the manipulation of TVP and inclusion of flavor additives may affect consumer acceptance of flavor, aroma, and juiciness of blended, plant-forward products.

An alternative meat products must balance between saltiness and flavor to replicate the sensation of consuming meat. The perceived saltiness of meat products tends to decrease as the meat content increases, perpetuating consumer increases in both salt and meat consumption [136]. Indeed, up to 20% of dietary sodium intake for Americans has been attributed to processed meat products [137]. To reduce health outcomes associated with high sodium intake, health institutes have urged suppliers and meat processors to investigate alternative ingredients and enhancers that mimic the saltiness, flavor, and sensory experience of meat products [135]. Yet, flavor additives and enhancers are often used in vegan meals and meat alternatives to replicate the umami sensation and mask the earthy, non-meat flavor and scent of protein alternatives [138]. To effectively replicate the meat-eating experience, a counterintuitive event occurs where equal or greater additions of sodium-based flavor enhancers are added to meat substitutions [139]. The high degree of processing and preservation that some meat alternatives undergo may lead consumers to believe they must choose between the least harmful option, meat from livestock versus meat alternatives [140,141].

The quantity of TVP may generally explain the observed differences in preference for the appearance, aroma, flavor, and juiciness of the FMP versus the PFP. Consumer testing of meat hybrid products utilize far lower percentages of TVP than used in this study. Partial meat

replacements of 10-40% have limited deviations in product quality and maximized consumer preference [142]. Considering the effect of TVP on consumer acceptance of the PFP, reducing the total quantity of TVP from 50% may create a more enjoyable product. Reducing TVP may balance the sensory appeal of the final product. Indeed, a review of studies substituting TVP in various chicken and beef mince products found that the total product weight, moisture content, and sensory similarities between the TVP and meat are key determinants to maintain consumer acceptance [143]. These components were deemed critical to understanding the observed differences in acceptance of appearance, flavor, aroma, and juiciness. A complete reduction in TVP quantity thereby addresses the excessive granular appearance, melding capacity, "off" flavor and scent, and need for additional flavor additives and enhancers. Ultimately, a more thorough examination of the available TVP products on the market – considering the texturized plant proteins' original texture, shape, color, and flavors – may help produce a product with increased consumer acceptance [144].

No identifiable differences were observed between consumer acceptance of texture for the FMP and PFP. Study participants did not distinctly prefer these components of the meat or plant-forward product to the other. The lack of difference in acceptance of texture was unexpected, considering the effect of TVP on the other senses. Though, because the TVP was evenly incorporated, made up a greater volume of the product, and has mirroring physiochemical properties of animal protein, consumers may have not been able to distinguish differences in the chewiness, mouthfeel, and texture of the PFP [64,145,146]. The mimicry of texture is arguably the primary challenge of meat analogs, which has led to the inclusion of additional gelling, thickening, and emulsifying agents in plant-based products [142,147]. The plant-forward product produced here may provide utility for understanding the textural role of TVP in blended goods.

Upon the addition of plant products to the control patty, from 100% meat to 50% meat/50% plant, consumers displayed lower acceptance of the sensory characteristics - appearance,

flavor, aroma, and juiciness - individually but did not indicate changes to the overall acceptance of the products. High average acceptance scores were attributed to both products, indicating consumers "somewhat liked" the FMP and PFP equally. The overall acceptance of an item is critical to the success of its sensory evaluation, especially when the most influential components are emphasized [148]. In this project, the most influential components may include appearance, texture, and flavor. Indeed, in meat products, the texture characteristic has previously adjusted meat-eating perceptions yet showed limited differences between group evaluations [149]. Participants here showed preferences for the FMP in both appearance and flavor, as well as aroma. Although the sensory assessment did not elucidate which component consumers found most critical to the tested products. Perhaps a product comment section or questionnaire discussing preferences for the sensory characteristics could have addressed this concern. Regardless, the sensory evaluation provided valuable insight into consumer perceptions of a blended, plant forward product. The information provided by participants is essential to predicting meat substitutes' purchasing worth, consumer purchase intent, and utility to substitute or partially replace meat in meals [75,150,151]. The first aim of this paper was only partially met as no distinction was made between the overall acceptance of the two products, yet consumers preferred various sensations of the FMP over the PFP.

Aim #2

Social Normative Messaging

Inconsistent and limited differences were observed when participants were exposed to social normative messages and the individual attachment to meat was considered. When examining the PFP and FMP together, the video exposure only elicited differences for aroma, but not for appearance, texture, flavor, and juiciness. Because the PFP contained 50% ground chicken, perception of the product's aroma was not expected to change significantly between the group

receiving the normative message exposure and control. The decrease in acceptance of aroma conflicts with previous findings examining sensory acceptance of plant-forward meat substitutes. For example, adding additional meat flavoring to wheat-chickpea mixtures positively skewed consumer evaluations of the finished product's aroma [152]. This suggests the normative condition somehow influenced consumer acceptance negatively.

The opposing and lack of effects seen in aroma, appearance, flavor, and juiciness may be a result of numerous processes. Rather than instilling social pressure to conform, exposing subjects to normative messages may have led to bias, disengagement, or disagreement with the content resulting in decreased acceptance of the plant-forward product's aroma. The video medium in which the messages were delivered or lack of identification with the referent group may have caused this bias. Previous studies delivering normative messages have utilized posters or written paragraphs on paper [113,116,118]. The decision to use a brief, animated video was influenced by current social media trends. However, the content of the video was not clearly in alignment with said trends, considering there was no music, voiceover, individuals mirroring an activity, "rich" media, or opportunity for engagement [153]. Further, one's subjection to outside pressure and identification with a referent group influences whether one conforms to social norms. In this study, the referent groups were "American adults" and "young adults." More appropriate identifiers and referent groups could have been used, such as "college/university students." A disconnect with the normative message may clearly explain reduced effects by the exposure. Indeed, this limitation of social norm research has been identified and combatted using measurement tools to identify degrees of adherence with norms [154]. Perhaps only "high identifiers" are strongly influenced by the pressure induced by social normative messages [8].

When also considering the form of sausage patty, exposure to social normative messages did affect the sensory evaluation of texture and appearance. Changes in acceptance of product texture

were consistent with predictions: exposure to social norms positively influenced consumer evaluations of the PFP over the FMP than for those who did not receive the exposure. The influence also became more apparent as the exposure condition was considered, rather than the comparison between the forms of the sausage patty alone. Yet, in terms of appearance, outcomes went against predictions. Exposure to normative messages had a seemingly negative effect on consumer preferences. Subjects not only favored the FMP's appearance, but revealed a greater contrast in scores between the evaluation of the FMP and PFP when the normative exposure and meat attachment factors were included in the model.

The acceptance of the patty texture by the TVP was somehow enhanced for subjects exposed to the normative messages. This interaction may be explained by successful internalization of the social messages and texture's high value to consumer meat preferences [155,156]. The exposure's positive influence may be due to the sample's predominantly Hispanic ethnicity. The normative messages in the exposure described vegetarian, vegan, and Mediterranean diets prior to making connections to the referent group and supporting the intake of plant-foods. The food choices, habits, and culture anchored in the Hispanic population suggest both increased challenges and decreased awareness of plant-forward dietary patterns [121,157]. Hispanics have shown decreased acceptance of partial meat-replacement interventions (Flexitarian Flip) and greater perceived barriers (than benefits) to consuming a whole-food, plant-based diet [158,159]. Perhaps the normative messages in this study caused the Hispanic participants to acknowledge or reconsider their acceptance of novel and unique food items, such as the distinct PFP served to them. Unfortunately, this increase in texture acceptance cannot be clearly explained or supported by previous evidence and should be taken lightly.

The reduced impact of social normative messages overall may explain various findings. When examining the effects of front-of-pack normative messages, Zandstra, Carvalho, and van

Herpen found that exposing consumers to various forms of social norm messages (i.e., descriptive, or injunctive norms) altered consumer expectations of taste, but had no effect on their perception of saltiness or liking of that food. The researchers postulated that descriptive normative messages impact expectations more than sensory responses and perceived acceptance of food products [160]. While social norms are understood to impact individual and group behaviors, decisions, and judgements, the processes where this occurs is not fully understood [102,109]. It may be that when faced with new normative messages, individual's face bias depending on how those norms were originally learned and whether they are in alignment with one's perceived social standard [161]. Descriptive normative messages may not provide enough information to stimulate the bias that impacts one's behaviors, decisions, and judgements. Indeed, subjective norms have previously shown weak associations with behavior change when compared to attitudes and perceived behavioral control in the transtheoretical model paradigm [162]. Inconsistent effects were shown here even though the association subjective normative influence and behavior change may be stronger in college student samples [163]. Altogether, a confluence of these factors might explain how the social normative messages failed to instill significant changes to subject sensory acceptance.

Meat Attachment

The utility of the meat attachment measurement was generally limited by its poor or negligible associations with all sensory evaluation outcomes and the normative messaging exposure. Inclusion of the covariate in the appearance model did not affect the interaction term nor adjusted groups means. The variable weakened the predictive and explanatory ability of the sausage patty factor itself, as shown by the decrease in effect size (η^2 = .333 and η^2 = .119). Thus, meat attachment was not critical to the consumer evaluation conducted in this project.

Possible explanations include poor sample performance, reduced reliability in the sample under study, or protocol fatigue. First, discrepancies may be due to poor comprehension of

questionnaire items. The language used in certain items may be confusing or unclear to some participants, such as "Eating meat is a natural and indisputable practice" or "A good steak is without comparison." The "indisputable practice" and "without comparison" phrasing includes uncommon language that could spark uncertainty in the subject pool. This disconnect may be a result of the translation of the original questionnaire items from Portuguese to English [8]. Although, previous research has successfully assessed the MAQ's association with attitudes, beliefs, and expectations pertinent to meat perception in a variety of Indian, German, Chinese, and U.S. populations [164-166]. So, any issues related to comprehension of items may be specific to the population studied here. To the author's knowledge, no previous studies have sought to use the MAQ in a predominantly Hispanic group. The cultural impact of food and attachment to meat in Hispanic Americans may play a unique role that is not captured by the current version of the MAQ. Examinations of Hispanic beliefs indicate that meat is deemed fundamental to cultural traditions and practices and is directly related to meat intake and willingness to reduce consumption [167,168]. The combination of cultural influence and dietary awareness may alter the mechanism for Hispanic peoples' attachment to meat. Lastly, the meat attachment questionnaire was included at the end of the research protocol to avoid bias. The length of the initial study protocol prior to the MAQ was approximately 15-20 minutes. The total study time may have led participants to feel pressed for time, fatigued, or no longer inclined to thoroughly participate in the session without an incentive.

A more useful approach may have been to use one of the various, shorter subscales of the MAQ (i.e., hedonism, affinity, entitlement, and dependence) better associated with social normative influence. In their validation study, Graca et al. found that hedonism and dependence had a slighter stronger association with one's willingness to follow subjective norms compared to the affinity or entitlement subscales [8]. However, the MAQ and its subscales trended towards a weaker association with subjective norms compared to other predictor variables such as attitudes, habits, and human

supremacy. More interesting outcomes may be possible in a design focused on the interaction of MAQ subscales, individual preferences, or an intervention that draws out these components. For example, comparing affinity and individual acceptance of novel foods may provide finer insights into the predisposed, decreased acceptance or food neophobia that may occur with meat substitutes and novel foods in general [75,96]. Previous research examining the long-term acceptance of meat alternatives found that increasing exposure can increase participant liking over time, depending on the types of foods served in the meal (e.g., rice, potato, pasta, pizza, or salad-based meals). [169]. Future studies may seek to examine sensory appeal of meat substitutes over time while also considering influential psychological factors.

The results presented here defend and oppose the second aim of the project, as neither the psychological (meat attachment) nor sociological (social normative messaging) variables were consistently impactful to consumer evaluations. The primary study outcomes discussed were inconsistent, bidirectional, or non-measurable altogether. Regarding sensory acceptance testing, more detailed and planned exposures and thorough data collection is necessary to determine the impact of meat substitutes on consumer perception of aroma, texture, appearance, juiciness, and flavor.

Limitations

Aside from the specific weaknesses of the video condition and meat attachment questionnaire, additional limitations concern the general design of the experiment and study sample size. According to highly regarded food science procedures, a 9-point hedonic scale is typically used in sensory evaluations to provide adequate differentiation of consumer preferences [170,171]. The 5-point scale used here may have been confining. Subjects were constrained to only feel "very much" or "slightly" favoring or disfavoring of the products. A wider spread of options may have created more significant distinctions in the sensory outcomes, rather than most average responses looming

around the "neutral" to "liked slightly" subpoints. Additionally, untrained panelists were used in this study to evaluate food preferences and its relationship with psychosocial variables. A sample of trained panelists could provide deeper insight into the sensory components and subjective experience of the PFP. Descriptive or qualitative data collection is also worthwhile when assessing novel food products [172,173]. Further, objective evaluations of the food item could have supplemented study outcomes. While subjective measurements of food are indicative of consumer preference, objective measurements can reliably predict the quality of samples [174]. Because the study ran subjects over five months, objective measurements may have allowed for greater batch consistency throughout the study. The various design flaws of the exposure and survey may have led to additional discrepancies in subject participation. Participants who felt the survey was insufficient, not relevant, too lengthy, or minimized their autonomy may have provided less thoughtful feedback such as less extreme answering [175]. Lastly, the location and physical spacing of the study location may have also disrupted outcomes. Participants were asked to evaluate sensory and social variables in the presence of other subjects and the investigators, which could have created unwarranted pressure through the lack of privacy. However, running participants individually was not a realistic option for the protocol.

The small sample size resulted in reduced statistical power. As mentioned in the methods, power analyses indicated a sample size of 98 was required to detect effects of the video exposure with 80% power. Post-hoc G*power analysis indicated that the post-processing sample size of 71 provided 75% power, with alpha at 0.05, to detect a medium effect ($\eta^2 = 0.06$). Per the results, it appeared that the intended primary outcomes (ANCOVA models) did not only have insufficient power, but also violated normality assumptions. Some argue ANCOVA analyses are robust enough to this violation. Yet, the covariate violated additional heterogeneity assumptions which are critical to the integrity of ANCOVA models [176]. While appropriate assumptions were met for the

ANOVA models, the reduced power and logically inconsistent exposure outcomes suggest that some analyses discussed here may be attributed to statistical error. This limitation is most severe to the quality of this. Subject recruitment was not reliable as numerous people indicated interest but did not arrive at the designated sign-up time. Addressing recruitment concerns with participant incentives was not feasible, however the array of options was not fully explored by the primary investigator either. Although this project has numerous limitations, the results provide opportunity for application.

Conclusion

The proposition of novel, meat alternatives may be a realistic solution to address the environmental, health, and economic concerns of meat consumption; however, product success is mediated by consumer acceptance and the psychological and social factors that impact consumer preferences. Creating a product that satisfies consumers and considers individual predispositions to internal (meat attachment) and external influences (social normative messages) is a complex objective requiring a multidisciplinary approach. First, one must produce a product that provides an adequate and enjoyable sensory experience for a wide array of consumers [169]. Then, an assessment of internal and external barriers and drivers is necessary to ensure a broad perspective is considered alongside the consumer analysis [177,178]. Lastly, one must consider the desirability and appropriateness of the product in the consumer's food environment [91,93]. Maintaining the balance of these components ensures new product solutions can effectively and sustainably address the concern of meat consumption.

The study presented here demonstrates that the sensory acceptance of a 100% ground chicken patty versus a meat-TVP blended, plant-forward patty depends on the specific sensory sensations, as well as the internal and external context perceived by the individual. Incorporation of TVP into a meat-blended product was found equally acceptable overall, compared to a full-meat

product, with discrepancies seen for certain sensory characteristics. Focusing on the sensations most significant to consumer meat preferences and acceptance testing will allow future studies using TVP to discover insights that grant a competitive edge to blended, plant-forward, meat alternative products. A deeper analysis of psychological and social variables is still necessary to determine the most critical and effective means to reduce meat consumption on a large scale. Social normative messages may be crucial to eating behavior and frequency but may not be as significant for the sensory perception of foods. Individual affinities and relationships with meat may also continue to play an underlying role in certain populations. Overall, the intricate combination of variables put to study here reflects a current, realistic means to examine the processes that directly address the environmental, economic, and health-related concerns of meat consumption.

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Appendices

Appendix A – Recruitment Survey

Primary exclusion criteria in the recruitment survey.

Q13

Do you have any **known or suspected food allergies** to **any** of the following items in the list below?

A. Vegetable Broth
B. Chicken Broth
C. Soy
D. Chicken
E. Processed Meats (i.e., bacon, hot dogs, sausage)
F. Garlic
G. Onion
H. Carrots
I. Celery
J. Ground Mustard
K. Sage
L. Salt
M. Black Pepper
N. Red Pepper Flakes
O. Brown Sugar
P. Granulated Sugar
Q. Olive Oil
R. Coconut Oil

- ○ Yes
- ○ Maybe
- ○ No

Appendix B – Consent Form

Subject Consent to Take Part in a Study of
Experiment 1: Public Evaluation of Food Marketing
Experiment 2: Food Sampling, Consumer Evaluation of Alternative Proteins
University of the Incarnate Word

Authorized Study Personnel: **Benjamin Garza, BS, MS Student**
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Mariana Aramburu, BS, MS Student
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Key Information: Your consent is being sought for two research studies. If you agree to participate in these studies, the projects will involve:

- Procedures that include evaluating a brief marketing video and taste testing a breakfast food
- One visit is required for participation
- This visit will take 25-35 minutes total
- There are minimal risks associated with this study: Because food is being consumed, the standard choking hazard and potential exposure to food allergens is possible
- You will not be paid for your participation
- Your participation is voluntary, and you may decide not to participate at any time

Invitation: You are invited to volunteer as one of 100 subjects in the research projects named above. The information in this form is meant to help you decide whether you want to participate. If you have any questions, please ask.

Why are you being asked to be in this research study? You are being asked to be in this study because you are above 18 years old and a student enrolled in the University of the Incarnate Word who is often subject to food marketing and eating, and you **do not meet** any exclusion criteria. Exclusion criteria include currently eliminating meat-products from your diet or have any known or suspected food allergies to the list provided. At the end of the study, we will explain in greater detail what we hope to learn from this research.

What is the reason for doing this research study? The purpose of this research is two-fold, to evaluate consumer interpretation and preference of food-related marketing and conduct a sensory evaluation of a newly developed, protein food product.

What will be done during this research study? Each study contains one separate phase. In phase one, you will watch a brief, 30-second video and evaluate its marketing techniques. This will only take 5 minutes. In phase two, you will conduct a sensory evaluation of a food product and complete additional survey items. You will be instructed how to conduct and fill out the food evaluation form,

focusing on the product's appearance, aroma, texture, flavor, and juiciness. Then, you will complete a brief demographic survey. The second phase of the study has more steps and will take closer to 10-20 minutes. Lastly, you will be debriefed and given the opportunity to ask questions or address concerns.

All data gathered from surveys and comment sections will be completely anonymous. However, I may quote your written comments (using a pseudonym) in presentations or articles resulting from this work.

What are the possible risks of being in this study? Your participation in this study does not involve any physical or emotional risk to you beyond that of everyday life. Choking hazards and exposure to allergens or food-borne pathogens are the most common risks associated with this study. To minimize these risks, a study monitor will be present in the immediate room with baseline knowledge of CPR and EpiPen availability. Upon recruitment, subjects will be asked if they have or suspect any food allergens noting any known irritation they may cause. As with all research, there is a chance that confidentiality of the information we collect from you could be breached – we will take steps to minimize this risk, as discussed in more detail below in this form.

What are the possible benefits to you? You are not expected to receive any benefits from being in this study.

What are the possible benefits to other people? The benefits to science and/or society may include a better understanding of public perception of food-marketing messages and sensory evaluation of novel food items. This research may refine how researchers and health societies communicate food information with the public. The results may also contribute to advancing sensory evaluation techniques that consider individual differences in evaluations of novel foods.

What will being in this research study cost you? There is no cost to you to be in this research study.

Will you be compensated for being in this research study? You will not be paid for your participation in this research study.

How will information about you be protected? Everything we learn about you in the study will be confidential. The only persons who will have access to your research records are the study personnel, the Institutional Review Board (IRB), and any other person, agency, or sponsor as required by law. If we publish the results of the study, you will not be identified in any way.

The data will be stored electronically on a secure server and will only be seen by the research team during the study and for 1 year after the study is complete.

What will happen if you decide not to be in this research study or decide to stop participating once you start? You can decide not to be in this research study, or you can stop being in this research study at any time, for any reason. You do not have to answer any question you do not want to answer. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator or with the University of the Incarnate Word. You will not lose any benefits to which you are entitled.

Deciding not to be in the study or deciding to withdraw will not affect your class standing or grades at the University of the Incarnate Word.

If you decide to withdraw from the study, any information collected from the participant will not be used.

What should you do if you have a problem or question during this research study? If you have a problem as a direct result of being in this study, you should immediately contact one of the researchers listed at the beginning of this consent form.

Should you experience a health-related emergency because of participation in the study, please contact/visit the University of the Incarnate Word Health Services at (210)-829-6017. For student injuries or illness emergencies after-hours please contact the UIW Police (210)-829-6030 or visit an emergency clinic (e.g., CareNow Urgent Care (210)-998-6677).

If you have additional questions about your rights or wish to report a problem that may be related to the study, please contact the University of the Incarnate Word Institutional Review Board office at 210-805-3555 or 210-805-3565.

Consent for future use of data

Initial one of the following to indicate your choice:

_____I give permission for my deidentified data to be used in the future for additional analysis or other relevant research studies. I understand that no additional informed consent for this use will be sought. I understand that my deidentified data can be stored indefinitely.

_____I give my permission for my data to be used for this research study only. I do not give permission for any future use beyond the scope of this research study. I understand that my data will be destroyed within 2 year(s) after completion of this study.

Consent

Your signature indicates that you (1) consent to take part in this research study, (2) that you have read and understand the information given above, and (3) that the information above was explained to you, and you have been given the chance to discuss it and ask questions. You will be given a copy of this consent form to keep.

_____
Name of Participant

_____ _____
Signature of Participant Date

_____
Name of Principal Investigator/Designee

_____ _____
Signature of Principal Investigator/Designee Date

Appendix C – Normative Messaging Video and Evaluation

Frames from the video exposure. The second frame represents the experimental condition.

Appendix D – Recipe

FMP: FULL-MEAT PATTY RECIPE

Ingredients

- 1 teaspoon dried sage
- 1 teaspoon salt
- ½ teaspoon ground black pepper
- ¼ teaspoon dried marjoram
- 1 tablespoon brown sugar
- 1/2 tablespoon garlic powder
- 1/4 teaspoon crushed red pepper flakes.
- ~1.5 lb. ground chicken
- 2 tablespoons olive oil

Steps

1. Measure out and combine the seasonings in a small dish.
2. Mix half of the olive oil, seasonings, and chicken in a large bowl.
3. Shape eight-nine (100g chicken) patties with your hands, careful not to over manipulate the patty. Season exterior with salt and pepper.
4. Heat a skillet over medium-high heat with remaining olive oil.
5. Cook sausage patties on each side for 2-3 minutes until browned or the internal temperature reads 165F.

PFP: BLENDED PLANT-FORWARD PATTY RECIPE

Ingredients

- 1 cup of TVP
- ¾ cup of chicken broth
- 1 teaspoon dried sage
- 1 teaspoon salt
- ½ teaspoon ground black pepper
- ¼ teaspoon dried marjoram
- 1 tablespoon brown sugar
- 1/2 tablespoon garlic powder
- 1/4 teaspoon crushed red pepper flakes.
- ~1 lb. ground chicken
- 2 tablespoons olive oil

Steps

1. Boil chicken broth and pour over dry TVP, giving it 5 minutes to soak.
2. Measure out and combine the seasonings in a small dish.
3. After the liquid is absorbed, mix TVP, half of the olive oil, seasonings, and chicken in a large bowl.
4. Shape eight-nine (100g: 50g TVP, 50g chicken) patties with your hands, careful not to over manipulate the patty. Season exterior with salt and pepper.
5. Heat a skillet over medium-high heat with remaining olive oil.
6. Cook sausage patties on each side for 2-3 minutes until browned or the internal temperature reads 165F.

Appendix E – Nutrient Analysis

A.

Nutrition Facts

servings per container
Serving size **(100g)**

Amount per serving
Calories **130**

	% Daily Value*
Total Fat 4g	5%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 40mg	13%
Sodium 290mg	13%
Total Carbohydrate 5g	2%
Dietary Fiber 2g	7%
Total Sugars 3g	
Includes 1g Added Sugars	2%
Protein 21g	
Vitamin D 0mcg	0%
Calcium 35mg	2%
Iron 2mg	10%
Potassium 265mg	6%

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

B.

Nutrition Facts

servings per container
Serving size **(100g)**

Amount per serving
Calories **140**

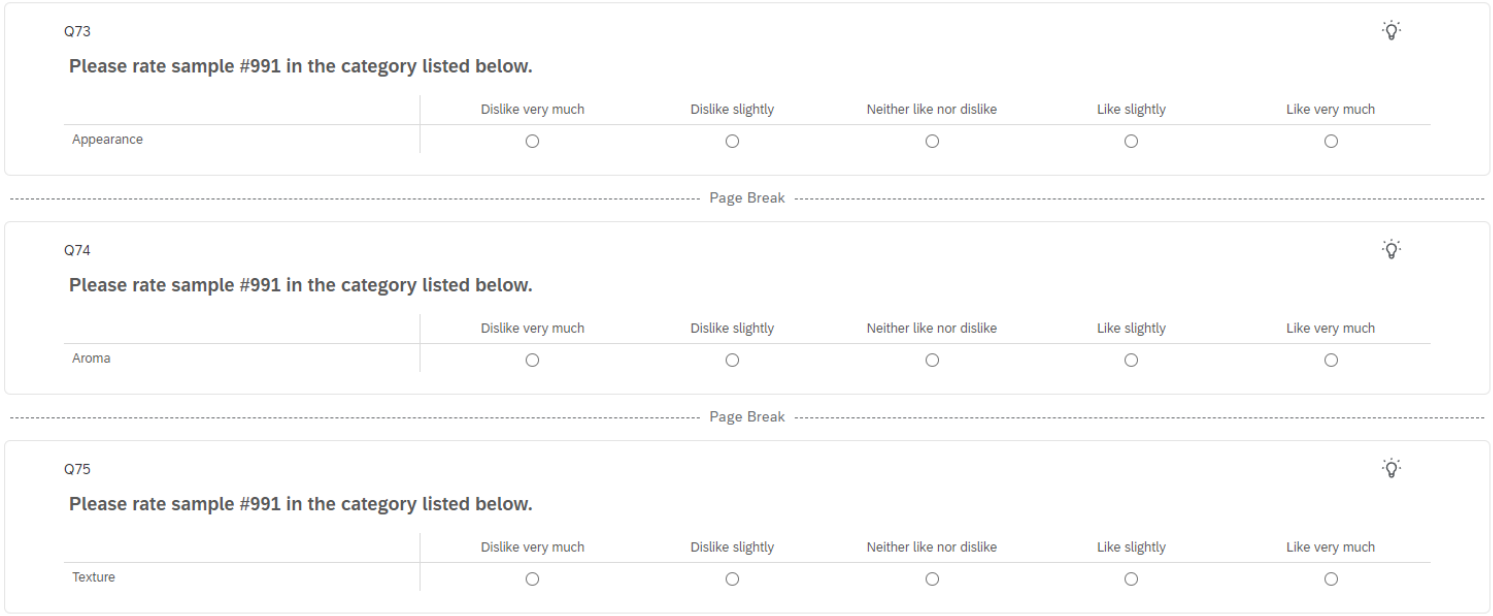
	% Daily Value*
Total Fat 5g	6%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 55mg	18%
Sodium 380mg	17%
Total Carbohydrate 2g	1%
Dietary Fiber 0g	0%
Total Sugars 2g	
Includes 2g Added Sugars	4%
Protein 21g	
Vitamin D 0mcg	0%
Calcium 4mg	0%
Iron 1mg	6%
Potassium 11mg	0%

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

Supplemental Figure 1. Nutrient analysis of PFP (A) and FMP (B). Analysis and label output by ESHA's Food Processor Nutrition Analysis software version 11.9.14.

Appendix F – Sensory Evaluation

Snapshot of the Likert-style items from the sensory evaluation portion of the survey.



Appendix G – Meat Attachment Questionnaire

Snapshot of the items making up the Meat Attachment Questionnaire.

Q25

Please read the following statements and select the response that best agrees with you.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
To eat meat is one of the good pleasures in life	○	○	○	○	○
Meat is irreplaceable in my diet	○	○	○	○	○
According to our position in the food chain, we have the right to eat meat.	○	○	○	○	○
I feel bad when I think of eating meat.	○	○	○	○	○
I love meals with meat.	○	○	○	○	○
To eat meat is disrespectful towards life and the environment.	○	○	○	○	○
To eat meat is an unquestionable right of every person.	○	○	○	○	○
A good steak is without comparison.	○	○	○	○	○

Please read the following statements and select the response that best agrees with you.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I would feel fine with a meatless diet.	○	○	○	○	○
I'm a big fan of meat.	○	○	○	○	○
If I couldn't eat meat I would feel weak.	○	○	○	○	○
If I was forced to stop eating meat I would feel sad.	○	○	○	○	○
Meat reminds me of diseases.	○	○	○	○	○
By eating meat I'm reminded of the death and suffering of animals.	○	○	○	○	○
Eating meat is a natural and undisputable practice.	○	○	○	○	○
I don't picture myself without eating meat regularly.	○	○	○	○	○

Appendix H – Correlation Matrix

Table 1. Bivariate Pearson correlations between primary outcome variables

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. MAQ	-											
2. C -Appearance	-.262*	-										
3. C - Aroma	.262*	.153	-									
4. C - Texture	.208	.057	.417**	-								
5. C - Flavor	.209	.240*	.413**	.466**	-							
6. C - Juiciness	-.016	.184	.237	.239*	.228	-						
7. C - Overall	.201	.136	.619**	.459**	.667**	.270*	-					
8. SM - Appearance	-.053	.222	.107	.059	.080	.088	.057	-				
9. SM - Aroma	-.127	.385**	.272*	.193	.311**	.195	.153	.073	-			
10. SM - Texture	-.046	.006	.063	.078	.037	.168	.063	-.091	.259*	-		
11. SM - Flavor	.029	.266*	.294*	.171	.199	.209	.382**	-.053	.379**	.437**	-	
12. SM - Juiciness	-.078	.375**	.254*	.091	.104	.129	.092	.377**	.381**	.261*	.395**	-
13. SM – Overall	-.160	.355**	.002	.116	.176	.125	.139	.076	.465**	.541**	.584**	.437**

C – Control; SM – Social Messaging Exposure. *Indicates $p < .05$. **Indicates $p < .01$.

Appendix I – Photos

FMP: Full-meat patty (control)

PFP: Plant-forward patty (experimental)