CONSUMER PERCEPTIONS OF VARIOUS MEATS AND MEAT-SUBSTITUTES: A LAB BASED STUDY

A Thesis

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ABSTRACT

This study explores the appeal of meat alternative burger products as an option for reducing individual and collective meat consumption. Animal meat plays a dominant role in the diet of most consumers in the United States, leading to a host of dietary, environmental, and ethical considerations. Historically, asking consumers to voluntarily abstain from meat consumption has been unsuccessful; self-identified vegetarians have never grown above 10% of the U.S. population. However, the newly available set of burger alternatives represents a significant shift —for the first time, vegan meat substitutes aim to fully replicate the taste and feel of meat in a convincing way and are being marketed as an option for climate and health-conscious eaters.

This study asked participants to taste and rank four burger types: traditional beef, a mushroom/beef blend, pea protein (typically marketed as "Beyond Meat®"), and the Impossible™ Burger. These participants were split into groups based on the level of identifying product information available to them, allowing us to determine the impact of this information on overall "liking" for each sample. Our results show that information typically plays an important role in predicted liking, an effect that is strong and statistically significant for all the samples in this analysis with the marked exception of the

Pea Protein burger. This analysis also offered weak insights into demographic predictors of liking for each sample, showing that males preferred Pea Protein burgers more than females, politically liberal individuals preferred Blended burgers more than non-liberals, and that self-identified conservatives rated Pea Protein burger lower than other demographic groups. These results offer insights into the various ways that each of these burger types can be marketed and targeted to consumers, including the type of language that contributes to their respective appeal. This is important in the context of the marketing of vegan meat products, particularly as a way to reduce demand for environmentally harmful beef.

BIOGRAPHICAL SKETCH

Casey Silver is a New York native, born in Manhattan and raised in the Hudson Valley. She attended Carleton College in Northfield, Minnesota, where she majored in Environmental Studies and first became interested in food systems and vegetarianism. Upon her graduation in 2013, she joined the Peace Corps in Cameroon, where she helped small-scale dairy farmers increase their profitability and further realized the environmental impact of animal agriculture. After working to reduce the prevalence and severity of hunger in Minnesota, she attended graduate school at Cornell University, where she studied Applied Economics & Management at the Dyson School.

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Introduction

1.0 Background

While the importance of reducing humanity's collective meat consumption is well-known [1], those with the will to take action are left with the challenge of persuading U.S. consumers to reduce their individual levels of meat consumption [2], [3]. As of May 2020, many plant-based meat options could be found on grocery store shelves, but only 19% of consumers typically purchased as part of their regular shopping [4]. In contrast, 69% of consumers reported purchasing some form of animal-based meat in the same period. This gap in purchasing shows the stronghold of animal meat on U.S. grocery shoppers, but the rise in plant-based meat industry has been rapid and should not be discounted.

Although consumers are increasingly interested in plant-based meat options [5], [6], little is still known about the impact of information on shaping these preferences. To address this gap in the literature, we designed a lab experiment to examine the impact of presenting groups with varying levels of identifying information for a set of animal meat and plant-based meat burger products. The participants in this study were split into blind and informed tasting groups, allowing the researchers to determine the effect information has on individual liking, dependent on the burger product being tested. The

impact of information varied by product, and there is strong evidence that the desirability of plant-based protein varies greatly between products under both blind and informed conditions. This study focuses exclusively on burgers, as they have been the primary dishes replicated by alternative protein companies and because of their central hold on the U.S. cultural imagination. This study helps inform on the type of messaging and identifying information that could be helpful in the promotion of plant-based meat alternatives.

1.1 Meat Consumption

The connection between animal-based agriculture and a variety of negative environmental outcomes has been well-documented [7]. The challenge of producing enough food for a global population of over 7.6 billion people places our natural resources under significant stress, which is exacerbated by the increasing demand to satisfy caloric needs from animal-based sources [8]. On a calorie-by-calorie basis, the process of producing meat releases more greenhouse gas emissions than do plant-based foods (due to the energy lost at each trophic level), leading to an increased environmental impact as the population of the planet grows wealthier, demanding more meat with this increase in purchasing ability [9], [10]. Ruminants (such as cows) produce the highest level of emissions, leading to a focused effort on diverting diets away

from beef and dairy products as an effective way to shrink carbon emissions and other negative environmental impacts.

The United States has some of the highest levels of meat consumption on a per-capita basis globally [11]. Meat has a unique hold on the hearts and imaginations of most Americans – culturally, meat is used as a key component in celebrations, social gatherings, and many of the most iconic American meals. While shifting the needle of meat and dairy consumption in the United States poses many challenges, there are an array of national benefits that could be expected as a result; from an improvement in water and air quality and numerous population health benefits to the reallocation of crop land and lower grocery bills [12]. This shift would also certainly lead to a decrease in animal suffering, a benefit that impacts communities in various important ways [13], [14].

1.2 Plant-Based and Alternative Proteins

There has never been a shortage of plant-based options for individuals looking to avoid meat products in their diets. However, veggie burgers as a direct substitute for traditional beef burgers only came into existence in the 1970s, when the "VegeBurger", was first sold commercially by Gregory Sams in London [15]. This vegetarian patty, made with seasoned wheat gluten and oats, was targeted at health-conscious consumers, and sold in grocery stores. In

the mid-1980s to early 1990's a slew of competitors followed, building their burgers out of a combination of soy, wheat, and black bean ingredients. These products, many of which are still available today, were sold in both grocery stores and restaurants and were primarily designed for and marketed to vegetarians and vegans, a group that has never collectively exceeded 10% of Americans [16]. The environmental footprint from these groups is limited by their small numbers—changing the behavior of current meat-eaters is necessary to reduce the negative externalities from meat production in a more significant way.

Current trends in consumer preferences illustrate the growing appeal of alternative protein options, particularly among younger people [4]. Mintel Research reports that consumers aged 25-34 are the biggest driver of plant-based protein growth, largely motivated by concerns related to environmental impact. However, consumers overall ranked health concerns and taste preferences as the primary factors motivating their plant-based protein purchases, indicating that even consumers less invested in environmental outcomes may be won over by high quality and good tasting meat-alternatives. In order to succeed in this market space, companies must ensure that their products have less of an environmental footprint than beef and are also comparably delicious [17]. Purchasing trends for alternative proteins also

suggest strong annual growth in recent years. Nearly 50% of survey respondents in March 2020 reported eating alternative-proteins more frequently than they had a year earlier, while only 6% stated that they ate them less frequently [4].

The offerings in the vegetarian meat alternatives category underwent a dramatic shift around 2010, when the urgency around carbon emissions collided with improvements in food science that made imitation protein products more similar in look, feel, and taste to the animal-meat products that they sought to emulate. The launch of the Beyond Burger® in 2015, closely followed by the Impossible™ Burger in 2016, marked the beginning of alternative protein's attempts to appeal to meat eaters by positioning themselves as climate-conscious meat substitutes [18], [19]. Both the Beyond Burger® and the Impossible™ Burger were served to participants in this study.

In tandem with the above developments in non-meat protein came a lower-tech option to reduce meat conception formalized in the "reducetarian" and "flexitarian" movements [20]. These ideologies lack the absolutism of vegetarianism or veganism and instead recognize the value of minimizing the consumption of animal products whenever possible [17]. Along with "Meatless Mondays" and other campaigns designed to reduce the number of meat-based

meals, the world of the meat reduction community has begun to embrace the potential of meat-minimized meals, where a percentage of ground meat is replaced by a vegetable-based filler [21]. This switch works particularly well for burgers, and proponents of these products claim that they deliver consumers the meat that they are demanding while also reducing carbon emissions.

Mushrooms are commonly used to replace some of the ground meat, as their umami flavor and texture closely replicates that of the meat that it is replacing. Lang (2020) found this strategy could have strong appeal to mainstream consumers that not only understand the benefits of a plant-based diet but were unwilling or unable to fully transition away from meat consumption [22]. The authors also identify that consumers make purchasing decisions for plant-based meat substitutes based on a combination of factors including the product's taste, nutrition, sustainability, price, and novelty. Sogari et al. (2020) sought to identify factors influencing college students' willingness to try mushroom/beef blended burgers and determined that students who reported higher levels of concern for sustainability were more likely to purchase these meat-reducing burgers [23]. Our experiment builds on their research by including "The Great Organic Beef & Mushroom Burger", a blended burger available from Applegate Farms, as one of the burger samples to determine if sensory reactions align with stated purchase intentions. This

product represented a willingness from one of the major "sustainable meat" brands to offer consumers an option to reduce their meat consumption while still buying from a trusted company.

There has been relevant and exciting research about European consumers and their levels of acceptance of both alternative protein and cultured meat products, including insect-based proteins [24]. Bryant et al. (2020) has documented increasing levels of consumer interest and acceptance for these novel types of proteins and has explored relative levels of interest between populations in European countries [25], [26].

Many of the newer burger alternatives are specifically designed to appeal to meat-eaters. Based on this, we expected the non-beef samples to perform similarly to the beef sample under blind tasting conditions—that is, there would not be a statistically significant difference between "liking" scores between the burgers. We expected to see differentiation between samples under primarily under informed conditions, and expected that specific demographic variables (namely females, pet owners, youth, and self-identified politically liberal values) may lead a participant to prefer the meat-free samples when compared to their peers. These specific demographics were chosen due a suspicion that they would influence attitudes about meat and environmental impact. Our lab experiment took place in September 2019,

leading us to believe that interest in and preferences for meat substitutes have likely expanded in the time since then.

1.3 Factors Affecting Adoption of Alternative Proteins

This study specifically investigated the effect of key factors on adoption of plant-based meat alternatives. The format of this experiment was specifically designed to analyze the role of identifying information in consumer liking. Our heterogeneous participant pool also allowed us to analyze the impact of demographic factors on relative levels of liking between the samples included in our experiment.

Numerous studies have sought to identify the effect of varying levels and types of information on consumer choice and perception [27], [28]. Many of these studies have relied on a between-subject design to gauge the impact of information between blind and informed choice situation, a format that has been criticized for its lack of real life applicability [29]. Despite these critiques, this experimental design allows researchers to control for exposure to information and determine the importance of identifying information, including product brand. In one such study, Varela et al. (2010) asked participants in Latin America to rate orange-flavored powdered drinks under either blind, informed, or expected (with brand identification but no tasting) conditions [30]. They found that ratings were closest between the expected condition and

the informed condition, suggesting that brand name is a more powerful predictor of product liking than hedonic experience.

In another study, Baixauli et al. (2008) tested consumers' preferences for muffins under varying levels of information about fiber contents [31]. The authors found that level of impact was driven by not only the type of muffin, but as the health consciousness level of the consumer as well. One similar study investigated the impact of information on participant liking for various levels of sweetener replacements in cookies [32]. The authors in the sweetener study used hedonic liking responses to learn that consumers generally are only able to identify differences when all the sucralose was replaced with a sugar substitute. However, consumers were unable to identify a difference when only half of the sucralose was replaced. The authors in this study concluded that the effects of information vary on an individual consumer basis and that "health-promoting information" generally impacts liking of a food product.

Demographics are an issue of interest for both novel food product introduction and meat consumption [33], [34], [35]. Our decision to specifically investigate the role of gender was largely driven by the varied factors regarding vegetarian lifestyle acceptance between men and women, as well as the higher frequency of women choosing to reduce their overall meat consumption [36], [37]. In Merriman et al. (2010), the authors found that men

who chose to adopt a vegetarian diet face less family criticism than did women, which suggests that males are privileged with more autonomy over their bodies than women with respect to lifestyle habits and diet. This finding has further encouraged feminist discussion around the role of ethical vegetarianism. Rosenfeld (2020), for his part, surveyed a large sample of self-identified vegetarians and found that vegetarian women are generally more motivated by prosocial factors, and less likely to "cheat" upon their vegetarian lifestyle by consuming meat. Although our study was forced to exclude strict vegetarians due to the inclusion of meat in the tasting panel, these gendered eating patterns remain relevant to our larger analysis.

The literature related to the political views of meat eaters and vegetarians is also quite rich [38]. In Ruby's broad review of vegetarianism (2012), he shares that vegetarians tend to be more politically liberal and place a higher degree of importance on environmental protection and social justice issue [39]. In a study of German survey respondents, Pfeiler and Egloff (2018) also found vegetarians to be more interested in politics overall, and to be less politically conservative than individuals who consume meat [40].

This noted political divide has become increasingly relevant as more "meaty" meat-alternatives have come to market. The growing market share of improved meat substitutes has not met universal praise, and there is notable

opposition and hesitancy from both sides of the political aisle, specifically around issues of product labeling and health claims [41]. Animal meat producers have expressed concern about potential consumer confusion and have taken steps to promote increased labeling regulations [42], [43]. Several conservative states with high levels of in-state meat production have taken steps to introduce "truth-in-labeling" laws that require producers to label meat alternatives clearly with text that designates them as meat-free or vegan [44]. Relatedly, the National Cattleman's Beef Association (NCBA) went so far as to conduct an online survey that asked 1,800 respondents about the packaging of several meat alternatives, including the two vegetarian burgers tested in our study [45]. This study found that many participants were confused about the composition of several meat-alternative products, particularly when the packaging made claims such as "now even meatier" or featured photos that strongly resembled beef patties. The NCBA is an trade association and lobbying group that works on behalf of American beef farmers, and it stands to reason that this organization has a vested interest in protecting their products against the growing swell of meat-free alternative products [45]. It remains be seen if this stated confusion will linger as plant-based burgers gain market share and increase in popularity and familiarity. This study investigates the responses of consumers to a diverse set of burger products and aims to examine any association in preferences between blind and informed

tastings. It also explores possible preferences among demographic groups, including self-identified political affiliation.

This lab-based study asked participants to rate several meat and alternative-protein burger samples as a way of evaluating their potential role in reducing greenhouse gas emissions and other negative environmental outcomes. To accomplish this, our study sought to understand the following research questions:

1. What effect, if any, does the presentation of identifying information have on each of the burger samples in question?
2. Can any demographic predictors be identified for each of the burger samples being tested? Do these predictors differ by burger sample?

Methods

2.1 Process

To address these questions, we conducted a set of sensory tasting experiments that used a between-subject design of omnivores in the Ithaca, New York region. This design allowed the researchers to compare the responses given by each set of participants under different treatment conditions and to use regression analysis to determine predictors of likability

for each burger sample using predictive marginal means. The experiment took place in the Cornell Sensory Laboratory in September 2019 and asked participants in each of the groups to taste each of the four burger samples, one group under blind conditions and the other after the sample's identities had been revealed.

The experimental treatment in this study was the level of information about the samples provided to each of the treatment groups. The questions were structured to gain information about consumer experiences for each of the burger samples; a narrative summary of the study format is given here. Participants were split into two groups: blind tasting and informed tasting. Both groups completed the "Expected" liking sample, although the blind tasting group completed this after blind tasting and the informed tasters completed it before they tasted the samples. All participants were asked to rate their impressions of both the look and smell of the burger using a RATA/CATA (Rate All That Apply/Check All That Apply) scale [46]. After this initial rating, participants were asked to taste the burger samples and then rate them on a Likert scale. They also identified their most preferred burger overall. They then answered more RATA/CATA questions about the flavor of the burgers. After finishing this sensory evaluation, participants were asked to reveal their emotional profile and then their intention to purchase for

each burger. Finally, participants reported their meat consumption habits and other socio-demographic information, including their highest level of education and current political preferences.

2.2 Participants

Participants were recruited through an email questionnaire through Cornell's Sensory Lab. The sample of 178 participants represents a convenience sample, with student-aged individuals and females being overrepresented relative to the larger population. Participants were asked about their household income levels, but this information was not used in our analysis because it likely refers to parent income, not earned participant income in most cases.

Participants with relevant food allergies or who identified as vegetarian/vegan were excluded from the study. All participants were given a participation fee of $5. The sample demographics are shown in Table 1.

Table 1: Selected participant demographics

		Number (n = 178)	Sample Percentage
Gender	Male	58	32.6%
	Female	116	65.2%
	Did not answer	4	2.2%
Age	18-25	88	48.6%
	25-55	64	36.0%
	55-75	23	12.9%
	Did not answer	3	1.7%
Political Identification	Liberal	81	45.5%
	Moderate	44	24.7%
	Conservative	16	9.0%
	Did not answer	37	20.7%
Pet Owner	Yes	90	50.6%
	No	85	47.8
	Did not answer	3	1.7%

As seen in Table 1, nearly two thirds (65.2%) of the participants identified as female, and nearly half (48.6) of them were younger than 25 years old. This heavy concentration of younger participants is likely driven by the college campus setting of this experiment, which also may explain the plurality of politically liberal participants (45.5%, with 20.7% unidentified). Respondents were almost exactly split over pet ownership, with 50.6% identifying as pet owners.

2.3 Statistical Analyses

To address the research questions listed above we used linear regression models and associated statistical analysis.

The first research question about the impact of information was answered using a regression model that produced expected values for each of the overall liking responses under each burger sample and information treatment using demographic variables as controls. Using predicted marginal means, we conducted a pairwise comparison and identified relevant significant differences at a $p < 0.05$ significance level. Relevant pairwise comparisons were restricted to cross-treatment with sample constant, or cross-sample with treatment held constant. The regression equation can be expressed using equation (1):

$$(1) \qquad y_i = \alpha + \gamma C_i + \beta_0 Treat_i + \vartheta(Treat{*}C_i) + \beta_1 BMI_i + \beta_2 Pets_i + \beta_3 Liberal_i + \beta_4 Conservative_i + \beta_5 Moderate_i + \beta_6 Female_i + \varepsilon_i$$

Where: y represents overall liking score,
$Treat_i$ is a dummy variable where (1) represents informed tasting,
C_i is a vector of burger samples,
BMI_i is a continuous variable for calculated Body Mass Index,
$Pets_i$ is a dummy variable where (1) represents pet ownership,
$Liberal_i$ is a dummy variable where (1) represents self-identified political liberals,
$Conservative_i$ is a dummy variable where (1) represents self-identified political conservatives,
$Moderate_i$ is a dummy variable where (1) represents self-identified political moderates,
$Female_i$ is a dummy variable where (1) represents self-identified females, and
$\boldsymbol{\varepsilon}$ is an error term, all of which have individual effects accounted for by subscript $_i$.

The second research question about demographic factors predicting liking for each burger sample was answered with multivariable linear regressions. We ran one regression for each burger sample; overall liking (Likert scale from 1-9) was the dependent variable, and the demographic variables were used as predictors. These regression equations can be generalized using equation (2):

$$y_i = \alpha + \beta_0 Female_i + \beta_2 Liberal_i + \beta_2 Moderate_i + \beta_3 Conservative_i + \beta 4 Pets_i + \beta_5 BMI_i + \beta_6 Meat\_Score_i + \beta_7 Treat_i + \varepsilon_i \quad (2)$$

Where: y represents overall liking score
$Female_i$ is a dummy variable where (1) represents self-identified females,
$Liberal_i$ is a dummy variable where (1) represents self-identified political liberals,
$Moderate_i$ is a dummy variable where (1) represents self-identified political moderates,
$Conservative_i$ is a dummy variable where (1) represents self-identified political conservatives,
$Pets_i$ is a dummy variable where (1) represents pet ownership,
BMI_i is a continuous variable for calculated Body Mass Index,
$Meat\_Score_i$ is a continuous variable that shows an average of individual's responses to questions gauging meat attachment,
$Treat_i$ is a dummy variable where (1) represents informed tasting, and
$\boldsymbol{\varepsilon}$ is an error term, all of which have individual effects accounted for by subscript $_i$.

Demographic variables included in this analysis were gender, body mass index (BMI), pet ownership, and political beliefs. The researchers also included self-identified "meat attachment", which was calculated as a composite of several questions on the demographic questionnaire. A correlation matrix was

calculated to ensure independence of predictor variables, and variables were excluded at a correlation value above 0.30.

The structure of this initial demographic analysis using multiple regressions was weakened by its inability to include within-respondent comparison data. In practice, because each sample regression was run separately, trends in participant responses could not be compared, limiting the inferences that could be made on the data. To help combat this loss of information, additional predictive marginal means were generated alongside pairwise comparisons for several demographic variables of interest. These variables were limited to gender and political preferences, with self-identified liberal and conservative indicators run separately.

Results

In this section we report analyses from both research questions listed above.

3.1 Effect of Information

Participants in this study were asked to reveal their preferences in several forms over the course of the experiment. In addition to rating each sample individually (on a Likert scale from 1-9), they also ranked each burger when compared to each of the others.

We observed the following results when asked to pick their favorite of the four samples offered (Figure 1). In this chart the absolute number of participants are broken down by their ranked first choice burger.

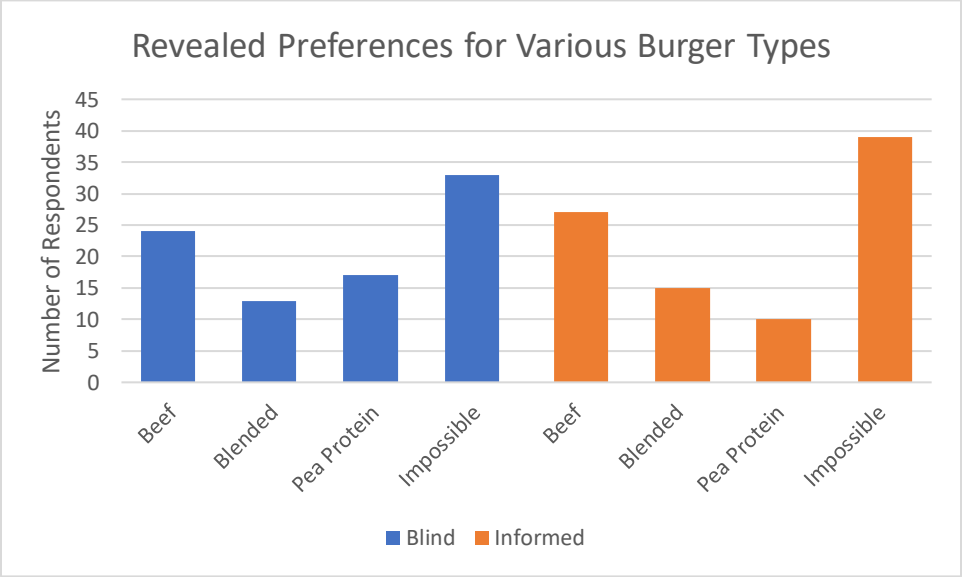

Figure 1: Top choices for survey respondents under varying information conditions

Participants consistently ranked the Impossible Burger as their top choice, with traditional beef burgers coming in second in both treatment groups. There was a slightly higher number of participants in the "informed" treatment (91 vs 87, or 4.5%), which likely explains the higher numbers (seen in all samples other than Pea Protein) between treatments.

We found that for all the samples studied (except Pea Protein), participants ranked the samples more highly on a Likert scale when they were told about the burger's identity. This effect was large and significant for both

the beef and blended burger samples, but it was also quite large for the Impossible™ Burger, albeit without the statistical significance. We are unable to make conclusions about the percentage increase associated with each of these effects due to the potential non-linear Likert scale. These results are reported in Table 2.

Table 2: Effect of information on preferences for each burger sample

Sample	Effect Size (Standard Error)
Beef	.838* (.291)
Blended	1.026* (.291)
Pea-Protein	-.095 (.292)
Impossible	.781* (.291)

*implies significance at $p<0.05$

We also conducted within-treatment analyses to determine burger preferences in either blind or informed tasting conditions. The results of the pairwise comparison (found in Table 3) suggest preferences in line with our above-mentioned ranking preferences. Under both blind and informed conditions participants demonstrated a clear and significant preference for the Impossible burger over the Pea Protein sample. In fact, under informed conditions all other samples were preferred over the Pea Protein sample. Under blinded conditions the Impossible burger was preferred over all other samples. The results of this analysis support the above-mentioned results and highlight the difference in preferences between individuals with varying access to identifying information.

Table 3: Within-treatment predicted effects between burger samples

	Treatment	
Sample 1 vs. Sample 2	Blinded	Informed
Beef vs. Blend	.153(.291)	-.034(.288)
Beef vs. Pea Protein	.375(.291)	1.298(.289)**
Beef vs. Impossible	-.494(.291)*	-.437(.288)
Blend vs. Pea Protein	.212(.291)	1.33(.289)**
Blend vs. Impossible	-.647(.291)**	-.402(.288)
Pea Protein vs. Impossible	-.859(.291)**	-1.735(.289)**

*implies significance at $p<0.1$ **implies significance at $p<0.05$, standard error in parentheses

3.2 Demographic Predictors

We ran multivariate linear regressions within each burger sample using demographic variables as predictors and sample preference rating as the outcome variable. Body Mass Index (BMI) and a combined "meat acceptance" value were included as continuous variables, and gender, political preferences, and pet ownership were included as dummy (binomial) variables. All the regression models have low R^2 values, suggesting noisy data, but several significant predictive variables can still be identified. Table 4 shows the regression outputs in greater detail.

Table 4: Regression models predicting influencing burger sample preferences

	Beef (n=170) R^2=0.070, Adj R^2=0.028 F (7,162) = 1.69, p =0.116		Blended (n=170) R^2=0.088, Adj R^2=0.048 F (7,162) = 2.22, p=0.035		Pea Protein (n=169) R^2=0.106, Adj R^2=0.067 F (7,161) = 2.72, p=0.011		Impossible (n=170) R^2=0.021, Adj R^2=-0.021 F (7,162) = 0.50, p=0.833	
	β	SE	β	SE	β	SE	β	SE
(Constant)	4.54	.887	4.613	.969	6.835	1.070	6.573	.911
Gender (female)	-.046	.298	-.042	.326	-.990**	.360	-.473	.306
Liberal	.489	.384	1.358**	.420	.297	.465	-.200	.395
Moderate	-.037	.424	.843	.454	.555	.501	.185	.427
Conservative	-.767	.554	-.209	.605	-.858	.668	-.209	.569
Pet ownership	-.291	.285	-.130	.311	-.424	.344	.269	.292
BMI	.061*	.032	.014	.035	-.062	.039	-.026	.033
Meat affinity score	-.200	.151	-.135	.165	.193	.183	.159	.155
Information	.790**	.276	.972**	.305	.032	.334	.773*	.283

*implies significance at $p<0.1$ **implies significance at $p<0.05$

Similar to the regression results from the first research question, identifying information was a significant and positive predictor of liking for all burgers other than Pea Protein. Significant predictors of liking for beef burgers were limited to BMI and meat affinity, although surprisingly, a higher reported meat affinity was associated with a lower score for this meat-only sample. Both these predictors were small in magnitude and statistically insignifican6. For blended burgers, liberal political affiliation was a strong predictor of overall liking (p = .002). This effect drops off in both magnitude and significance as participants move towards more conservative views. For Pea Protein burgers, the primary significant predictor of overall liking was gender—females have a strong negative preference for this sample (p = .007).

No significant predictors were found in this analysis for the Impossible™ Burger, and this model was also the regression with the poorest level of overall fit. Interpretation for these regressions is not overly conclusive and suggest that demographics may not be strongly correlated with predicted liking for the samples in this study, at least for the relatively homogenous sample in this study.

Other than beef burgers, all these products have only been released in recent years and may not yet have entrenched associations with any population group. Demographic variables recorded in this study but not included in this analysis include age, racial background, income, and education, along with dietary preferences, number of household members, and any known allergies. Given the charged political nature of the alternative meat movement, it is also possible that an interaction effect may be seen with political views and information, although this was not included in our analysis.

The predictive margin analyses for gender (Table 6) support the results from the original demographic regression. When compared to male respondents, females have a predicted overall liking score of .86 less than Pea Protein samples, leading us to believe that males like these burgers slightly more than females do. Our predictive margins for political preferences also

supported the initial demographic regression results and are split into self-identified liberals and conservatives.

Table 5: Selected Demographic Effects by Burger Sample

Sample	Gender (F=1)	Liberal Identification	Conservative Identification
Beef	-.175	.658	-.460
	(.310)	(.326)	(.528)
Blended	-.1583	1.071*	-.672
	(.310)	(.326)	(.528)
Pea	-.8623*	.217	-1.056*
Protein	(.310)	(.327)	(.528)
Impossible	-.331	-.025	-.130
	(.310)	(.326)	(.528)

* implies significance at $p<.05$, standard errors in parenthesis below

These results show that self-identified liberals have a stronger preference for Blended burgers than non-liberals. They also show that self-identified conservative respondents gave lower preference scores for Pea Protein burgers than non-conservatives, although the small number of respondents in this category must also be taken into consideration.

Discussion

This paper presents new findings about the importance of identifying information for novel meat and meat substitutes in a laboratory setting. We now offer some interpretations of our findings, as well as their implications for researchers, policymakers, and company decision-makers in marketing departments.

One of the most relevant insights from this study is the importance of identifying information in consumer liking. Ground meat has long been subject

to concerns over “mystery meat”, Mad Cow Disease [47] and “pink slime” [48], leading to the appeal of full transparency about product contents [49]. Our study results supported this documented concern, as liking scores increased for all samples within our study (except Pea Protein) when participants were told of the sample’s identity.

A surprising conclusion is the difference in perception and liking between the Pea Protein (often sold as Beyond) burgers and Impossible™ Burgers. These products were released along similar timelines and are often compared to each other as the primary “meaty” burger substitutes targeting both meat-eaters and vegetarians [50]. These products have different base ingredients and formulations, but many consumers may not understand their distinctions. Additionally, they were initially released to consumers in different forms—Impossible Foods chose to distribute its burgers exclusively through restaurants, while Beyond Burgers® were available for purchase in grocery stores and other retail outlets.

Overall, our results suggest that there is much room for growth in the alternative protein space and that the positive trends seen this far will likely continue, particularly for the preferred Impossible™ Burger. Consumers make purchasing decisions based largely on taste preferences, and this study shows that the Impossible™ Burger can certainly compete with beef burgers on taste

quality alone. That said, much of a product's appeal is based on the level and type of information that is provided on its package. It is certainly possible that the specific identifying information provided to participants about the Pea Protein burger did not resonate in the same way as it did for the other burger samples. This may be due to the name "Pea Protein", or its relative unfamiliarity. As a note, the Impossible™ Burger samples were labeled as "Animal-Like Protein", a more generic sounding descriptor that did not specifically identify the protein source and may not have been subject to the same hesitation around novel protein types.

Our findings related to demographic predictors of liking and differentiation between samples were less significant than initially expected. Given the complex political climate around food choices and environmental impact, we anticipated stronger preferences for meat alternatives among specific groups, particularly between political ideologies and across genders. Although we did not find clear evidence of this, it remains important to consider the relative homogeneity of our sample pool. Our results may be skewed due to our exclusion of vegetarians and our convenience sampling of college students. We also chose not to examine the interaction between any demographic variables and specific burger products.

Opportunities for further research include recruiting a larger, more diverse pool of sample participants and replicating these analyses with this larger group. Additionally, the growth of the alternative-protein market in the time since this study was performed (September 2019) may also prove quite informative and an interesting opportunity to investigate consumer preferences due to the pandemic and the associated meat supply chain issues and desire for food products with longer shelf lives.

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