The Impact of New Products on Ethical Beliefs*

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Abstract

Does technological change affect ethical beliefs? We study the case of synthetic alternatives to meat products using an incentivized survey experiment. A model of motivated beliefs predicts that the existence of an improved alternative will increase objections to meat production on moral grounds; moreover, this effect should be stronger the larger the improvement in the alternative option. We find that informing consumers of a new alternative diminishes moral concerns with conventional animal farming, but those who are experimentally nudged to view the new alternative relatively more positively do indeed report more moral concern for animal welfare. The findings suggest a backlash effect in which people react to innovation by increasing their support for existing practices, but one that depends on how positively they view the alternative.

1. Introduction

When new technologies spread, former practices sometimes come to appear morally repugnant. For example, attitudes toward child labor and smog in urban areas changed in Western countries simultaneously with increased mechanization and advancements in combustion technology, respectively (Edmonds 2008, Reitze 1999). A simple story can make sense of this pattern: When a transaction raises potential ethical concerns, models of cognitive dissonance or motivated beliefs imply that consumers may resolve this dilemma by downplaying the ethical implications of their choice (Hestermann et al. 2020, Bénabou and Tirole 2016, Rabin, 1994). The more appealing the transaction, the less likely consumers are to entertain objections to it. The invention of an alternative makes it easier to make a different choice, which can in turn lead to increased willingness to consider concerns with the established way of doing things.

In this study, we examine whether information about a new alternative causes individuals to change their moral beliefs about conventional meat products, which we measure using a new set of incentivized choices. We randomly assign 6,000 individuals in the U.S. who are part of a nationally representative panel to read about a conventional, plant-based, or "clean" (i.e. cultured, *in vitro*, lab-grown, or cultivated) meatball.[1] Cultured meat, the term we use going forward, is chemically identical meat grown from animal cell cultures without slaughtering the animal and is currently undergoing taste tests or special releases in very small quantities. Our experiment communicates that this is a new product not yet on the market, and we use a realistic description developed in coordination with a prominent cultured meat company.[2] Some of those assigned to learn about cultured meat are randomly selected to read negative comments from other respondents about the new

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[1] In our questionnaire, we use the term "clean meat." As companies developing synthetic meat products have grown in the past several years, the common term for the product has changed. At the time of survey design, clean meat was the common industry term, though now "cultivated" and "cultured" are somewhat more common. A second experiment used the term "cultured meat" and obtained similar results.

[2] While coordinating with a cultured meat company was essential for developing realistic experimental materials, their sharing of material on cultured meat was the extent of their involvement and they did not have the right to review our results.

product, and all respondents assigned to learn about cultured meat read either an article defending it or a placebo article. We then show respondents a video of an undercover investigation into a large pig farm that supplies Walmart, and we measure respondents' moral concerns, willingness to donate to a farmed-animal protection organization, relative willingness-to-pay for conventional meat and plant-based meat in an actual choice, and, for those informed about cultured meat products, relative willingness-to-pay for conventional meat and cultured meat.

Our experiments provide a unique opportunity to isolate the effects of awareness of and interest in a real emerging technology on moral attitudes and economic behavior. To offer some intuition, we adapt a simple model from Hestermann et al. (2020). Under reasonable assumptions, we show that the existence of a new meat alternative should weakly increase moral concern with conventional animal farming and weakly decrease willingness to pay for conventional meat relative to a plant-based alternative. Moreover, more positive attitudes toward the alternative should enhance this effect; an alternative they do not buy will not have any effect. Our main, pre-registered, analysis finds that those we experimentally nudge to have more positive attitudes toward a alternative have more moral concerns with current meat production as measured by both stated beliefs and willingness to pay. However, information about the alterantive on its own reduces those moral concerns, consistent with a backlash effect, or what in the psychology literature is known as "reactance" (Brehm and Brehm 2013). Prior literature finds that motivated beliefs can lead people to avoid information (Serra-Garcia and Szech 2021; Huck, Szech and Wenner 2015); we find evidence of information avoidance but show that a backlash effect can also generate a powerful opposing effect.

This study contributes to a growing body of work that considers the economics of animal welfare. Hestermann et al. (2020) study theoretically whether concern for animal welfare can be hindered by the consumption of animal products. Our simple extension of their model implies that improved alternatives can increase concern for animal welfare. Indeed, in perhaps the most closely related paper, Espinosa and Treich (2021) conduct a lab experiment

3

with French students in which a new meat substitute for fois gras is presented which reduces students' pro-meat arguments.[3] In contrast to this study, we consider a replacement for a more standard product that consumers may not feel to be as ethically problematic: a meatball. We also focus on a representative sample of participants in the U.S. This sample could react differently to the questions compared to a student sample, including for the incentivized WTP questions. Our experimental sample is also quite large, enabling us to consider what one might *a priori* expect to be smaller effects in this broader population.

Our experiment also informs the study of motivated beliefs and cognitive dissonance. Bénabou and Tirole (2016) provide a nice survey of the existing literature. Our finding on the effect of positive attitudes toward cultured meat on moral beliefs are in line with theories of cognitive dissonance and motivated beliefs (*e.g.*, Bénabou and Tirole 2016, Rabin 1994), however, our finding on the effect of exposure to cultured meat suggests that there may also be a countervailing backlash effect when participants do not like the new product. Building on a literature from psychology (Brehm and Brehm 2013) on a type of backlash effect, Boissonnet and Ghersengorin (2022) characterize a common choice pattern in which consumers "protest" a perceived reduction in their choice set which would be consistent with our results. Our setting also enables us to consider whether a vegetarian substitute, which consumers may see as less threatening to their existing options, has the same effect. It does not, suggesting that reactance may depend on attributes of the new technology.

Finally, this study contributes to the broader literature on how technological change and economic growth affect morality and social norms. Some work has suggested that technologies in widespread use shape social attitudes, as in the case of agricultural practices favoring exclusive male employment or greater time patience (Galor and Ozak 2016, Alesina et al. 2013). With regard to animal welfare in particular, several recent technologies have rendered previous practices toward animals obsolete and, in some quarters, repugnant: the Model T and automobile nearly extinguished horse-drawn carriages, and fossil fuels eliminated the need for the use of whale oil (Shapiro 2018). Our study shows that the effect

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[3]They also run a hypothetical version of the experiment on a nationally-representative sample of 1,200 people in France.

of a new technology on moral attitudes critically depends on key details surrounding how it is received.

2. Cultured Meat: A New Technology on the Horizon

In the final week of 2020, the Singaporean restaurant 1880 served just over 40 customers chicken meat produced without slaughtering a chicken for \$23 per person, a first for a business open to the public (RTN 2021, Business Wire 2020). This product followed on the heels of a competitor cultured meat product that was served for free in a promotion in Israel in October 2020 (Waltz 2021). Cultured meat regularly attracts great media attention and public excitement (*e.g.*, Bray 2021, Browne 2021). Despite these recent developments, however, cultured meat is off the market for nearly all consumers.

Cultured meat products come from actual animal tissue cells, an innovation over the plant-based sources that constitute other meat alternatives (*e.g.*, tofu, tempeh). While the production process continues to be refined, it involves taking a small number of cells from a living animal, producing a cell line, and cultivating the cells into a tissue using a bioreactor-fed protein, carbohydrates, and other nutrients (Waltz 2021). Cultured meat products' typical marketing sells them as a close substitute to conventional meat products in terms of nutrition and taste. For this reason, the availability of cultured meat products could reduce the perceived cost, including non-monetary costs, of avoiding conventional animal products.

Cultured meat could lower farming's environmental footprint. The Food and Agriculture Organization estimates that animal agriculture causes 14% of greenhouse gas emissions (Gerber et al 2013). Shifting to cultured meat products could drastically reduce such emissions. Current estimates suggest cultured meat requires 99% fewer greenhouse gas emissions, 96% less water and 99% less land than conventionally produced meat (Tuomisto and Teixeira de Mattos, 2011; Tuomisto and Roy, 2012; Mattick et al., 2015). Further, in the

wake of the COVID-19 pandemic, there has been more public discussion of the potential impacts of animal agriculture on human health (Bernstein and Dutkiewicz 2021, Garcés 2020). Animal agriculture can not only lead to new infectious diseases, but the antibiotics fed to animals kept in CAFOs can lead to anibiotic resistance (Shea 2003, Smith 2002).

Cultured meat also has the potential to reduce intensive agriculture, which generates substantial public concern around animal welfare. Global food and agriculture producers slaughtered around 72 billion land animals in 2018 and 150 million tons of aquatic animals in 2013 (Our World in Data 2021a, Our World in Data 2021b). In the U.S., around 98.7% of animals on farms are on what the U.S. Environmental Protection Agency defines as "Confined Animal Feeding Operations" (CAFOs) (Anthis 2019). Animals on CAFOs frequently suffer health problems related to the intensive production, such as bone weakness, skin lesions, and disturbed circadian rhythms for birds; bruising, disease, and lameness for cattle; and stress, food deprivation and poor water quality for fish (Ashley 2006, Bessei 2006, Grandin 2018). Surveyed members of the public express substantial concern for animal welfare, with consumers willing to pay 10-30% more for higher-welfare animal products (Grethe 2017, Johansson-Stenman 2018). Since cultured meat production does not require farm animals,[4] animal suffering on farms would decline substantially.

As important as the direct substitution effects of cultured meat products might be, the indirect effects may be substantial. If new products raise moral and environmental concerns by alleviating cognitive dissonance, this could induce a cycle in which voters approve additional public support for cultured meat, further reducing consumption of traditional meat. The full impact of cultured meat thus requires understanding these dynamics, which we turn to next.

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[4]Currently, some starter serums used in production are derived from animals, however, the same serum can be re-used without additional animals being harmed. This serum thus can be thought of as similar to the inputs to many vaccines which were originally developed using animal cells. For example, the flu vaccine Flucelvax uses a cell culture derived from a cocker spaniel in 1958 (Ledford, 2012).

3. Theoretical Framework

This section clarifies how a simple model of motivated beliefs would predict people respond to information about a novel meat alternative. The model begins from Hestermann et al. (2020) but adds to it the existence of a meat alternative.

Consider a consumer who plays a two-period signaling game with their future self as in Hestermann et al. (2020). In the first period (t=0), the consumer receives a signal about the harms of factory farming and transmits a message to their future self. In particular, they either receive the signal that factory farming causes a little (m_L) or a lot (m_H) of harm. They then send a message $\hat{m} = m_L$ or $\hat{m} = m_H$ to their future self. In the second period (t=1), they receive this message and choose how much conventional meat to consume (c), incurring a moral cost $\omega \tilde{x} c$ to eating meat that depends in part on how harmful they believe eating meat is to animals. The parameter ω represents individual intensity of guilt, and $\tilde{x}$ represents how harmful they believe factory farming is. In the second stage the consumer sets $c^\star$ according to:

$$c^\star = \arg max_{c \in \mathbb{R}_+} U(c) - p_c c - \omega \tilde{x} c$$

where p_c is the price of the conventional meat and U captures their basic preference for eating meat.

Filling out the details of the two-player game shows that consumers who expect to consume more conventional meat are less likely to tell themselves that factory farming is harmful. Let the consumer select a belief to transmit to their future self in a way that balances the value of making the right choice in the second period against their desire not to believe they are harming others others. Specifically, define the indirect utility $V(\tilde{x}) = \max_{c \in \mathbb{R}_+} U(a) - p_c c - \omega \tilde{x} c$. Let the period 1 self's payoff be $kV(x) + (1-k)V(\tilde{x})$, where x is the true signal. As Hestermann et al. (2020) point out, the envelope theorem implies that an increase in the signal of ε lowers the payoff by $(1-k)\omega c^\star \varepsilon$. This implies that those with higher meta consumption $c^\star$ at the optimum will form beliefs that factory farming is

less harmful.

We can enhance the above model to study what happens when a new product gets introduced. Introducing a new meat alternative, a, with price p_a and no moral costs, in the second stage the consumer will instead solve:

$$max_{c,s\in\mathbb{R}_+}U(c,s) - p_c c - p_a a - \omega\tilde{x}c$$

Define $V(\tilde{x})$ analogously to the single-good case. Individuals again have the incentive to engage in self-deception. Now, however, the incentive is altered by the presence of the alternative, which can affect their conventional meat consumption $c^\star$. This allows us to make predictions about what happens when a new product is introduced.

If we consider the introduction of a new product simply as an expansion of the choice set to include a substitute for meat, then a new alternative should make people more willing to harbor concerns with factory farming. To see this, treat the introduction of a product as the lowering of that product's price from a prohibitively high one to a much lower one. If c and a are substitutes, "introducing" a lowers optimal consumption $c^\star$. This decreases the payoff for self-deception.

On the other hand, consumers might see the introduction of a new meat alternative as a change in the available alternative or, if it replaces meat, a contraction in their choice set. If consumers believe that cultured meat would displace plant-based meats or even non-meat options, this might lead them to expect they will consume more meat in the future. Separately, if consumers expect cultured meat will replace conventional meat, they might view its introduction as the loss of an option. In the model presented in this section, not eating meat from animals reduces the motive or self-deception. Boissonnet and Ghersengorin (2022) present an alternative deviation from rational choice in which consumers "protest" against contractions in their choice sets by selecting options similar to those that were previously available. This sort of backlash (or "reactance") effect could perversely increase the drive toward self-deception and lessen concern with factory farming.

4. Experimental Design

Our main study sample consists of 6,000 U.S. residents sampled to be representative of the total U.S. population through the polling firm YouGov.[5] The study is pre-registered with the AEA RCT registry (AEARCTR-0001841), with pre-analysis plans posted to the Open Science Framework (OSF).

4.1. Baseline Questionnaire

In the initial questionnaire, subjects answer three sets of questions: baseline questions before treatment assignment, questions eliciting immediate reactions to the treatment, and questions following the video. After entering basic information about themselves, respondents complete a food frequency questionnaire that asks them to indicate how often they eat each of a list of food categories (*e.g.*, dairy, chicken, fruit). They then indicate on Likert scales their level of agreement with the claim that eating vegetarian food is morally preferable to eating meat via factory farming and their levels of belief and concern that conventional meat production hurts animals and hurts the environment.

4.2. Treatments

Following the baseline questions, all respondents read two paragraphs describing the increase in meat consumption in industrialized countries and concerns around its toll on animals, environmental resources, and public health. Respondents are then randomized into reading an article about a conventional, plant-based or cultured meatball. We stratify the sample into six blocks based on the total servings of meat the participant eats per week as reported in the baseline questionnaire. To study the effect of messaging around cultured

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[5]A second experiment, conducted on 5,175 MTurk workers, supports the main results. The surveys have some small differences but include the same basic interventions and attitude measures. Both surveys include baseline questions about consumption and moral attitudes, exposure to a novel meat alternative, a video investigation of a major pig farm, endline questions about consumption and moral attitudes, and incentivized questions regarding willingness to donate to an animal advocacy organization and relative valuation of conventional and plant-based meat. For the sake of exposition, we describe the survey implemented through YouGov in the main text and identify differences in the MTurk sample in an online appendix. Screenshots of each questionnaire appear in the Online Appendix.

meat, we assign 80% of participants to the cultured meat treatment and 10% to each of the other main treatments.

Participants read two paragraphs about their assigned meat or meat alternative alongside a picture of a meatball. For each treatment arm, the paragraphs describe scientists as developing a product and improving productive efficiency. For the clean and plant-based meat arms, the paragraphs then note that the product avoids the animal welfare, environmental, and public health impacts of animal farming.

Within the cultured meat arm, we then assign half the respondents, again stratified by baseline meat consumption, to read reactions to cultured meat from participants in an earlier study, which describe cultured meat as "disgusting" and "unnatural." We refer to this as the anti-cultured meat priming treatment.[6]

Finally, we randomly assign participants in the cultured meat arm to read one of four somewhat longer and illustrated articles, either a placebo or one of three articles defending cultured meat technology.[7] Participants in the conventional and plant-based arms all view the placebo article. Respondents are asked to indicate their level of interest in the product they viewed and whether they would eat it.

Next, respondents are informed that they will be shown a short, 90-second clip of an undercover investigation from a major meat producer. This video contains graphic footage of the narrow confinement, mutilation and early mortality of animals at a large pig farm that supplies Walmart. Participants are informed they will be asked to answer a question that requires watching the video. Before the video appears, we inform participants that they may be selected to receive a $20 bonus and ask them how much of the bonus they would be willing to give up to avoid watching the video. We use a Becker-DeGroot-Marschak mechanism to incentivize the choice. In particular, for the 0.5% randomly selected for the bonus, we draw a random number from 1 to 20. If the respondent enters a value at least as high as that random number, they receive $20 minus that value as a bonus via YouGov's

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[6]Should cultured meat become commercially available, one may expect conventional meat producers to encourage people to reject it through similar approaches.

[7]These treatments are considered in detail in a separate paper, but none has any effect.

payment system; all other participants view the video. Ultimately, 99.9% of participants watch the video.

4.3. Concluding Questionnaire

After watching the video, respondents again give their responses to the questions asked at baseline about interest in the meat product, moral preference for vegetarian food, and harm to animals and the environment. They again answer the Likert scale questions regarding how likely it is that they reduce their meat consumption in the next few weeks and how easy it would be.

Next, we ask subjects a series of willingness-to-pay (WTP) questions. First, we elicit their WTP for conventional meat relative to a plant-based meat. We present participants with three successive choices between a certain amount of vegetarian ground meat or conventional ground meat to obtain an interval in which their indifference point lies, and we carry out these choices by sending respondents gift cards for the selected items. We inform participants that we will randomly select a subset of respondents and send them the voucher they choose in one randomly drawn question out of the three. Participants in the cultured meat arm complete an additional set of questions regarding their preference for cultured meat versus conventional meat. We advise participants that this latter set of questions is hypothetical and unincentivized.

Finally, we ask subjects how much of a potential $20 bonus they would like to donate to a charity that helps prevent harm to farm animals. Again, participants are informed that we will carry out the choices of a randomly selected subset of participant, to make their choices incentive-compatible.[8]

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[8]Though we do not discuss it in detail in this paper, we conduct a follow-up survey one month after the baseline experiment. We ask the same questions about values, beliefs, willingness to pay for meat and meat alternatives, and willingness to donate to an animal charity as in the survey described here. For details, see the Online Appendix, Section 4.

4.4. Incentivization

We include several incentivized measures of respondents' attitudes and product preferences. Respondents choose how much of a real bonus to donate to an animal-welfare charity; a subsample is randomly selected and their decisions implemented. Participants also make a series of real choices between certain amounts of conventional meat and plant-based meat. The amounts are chosen such that they correspond to the actual dollar amounts of Omaha Steaks gift cards or vouchers for Beyond Meat products (converted to dollars based on the price at the time of the survey). We then mail respondents either gift cards for Omaha Steaks or vouchers for Beyond Meat products based on one randomly selected choice.

Figure 1: YouGov Study
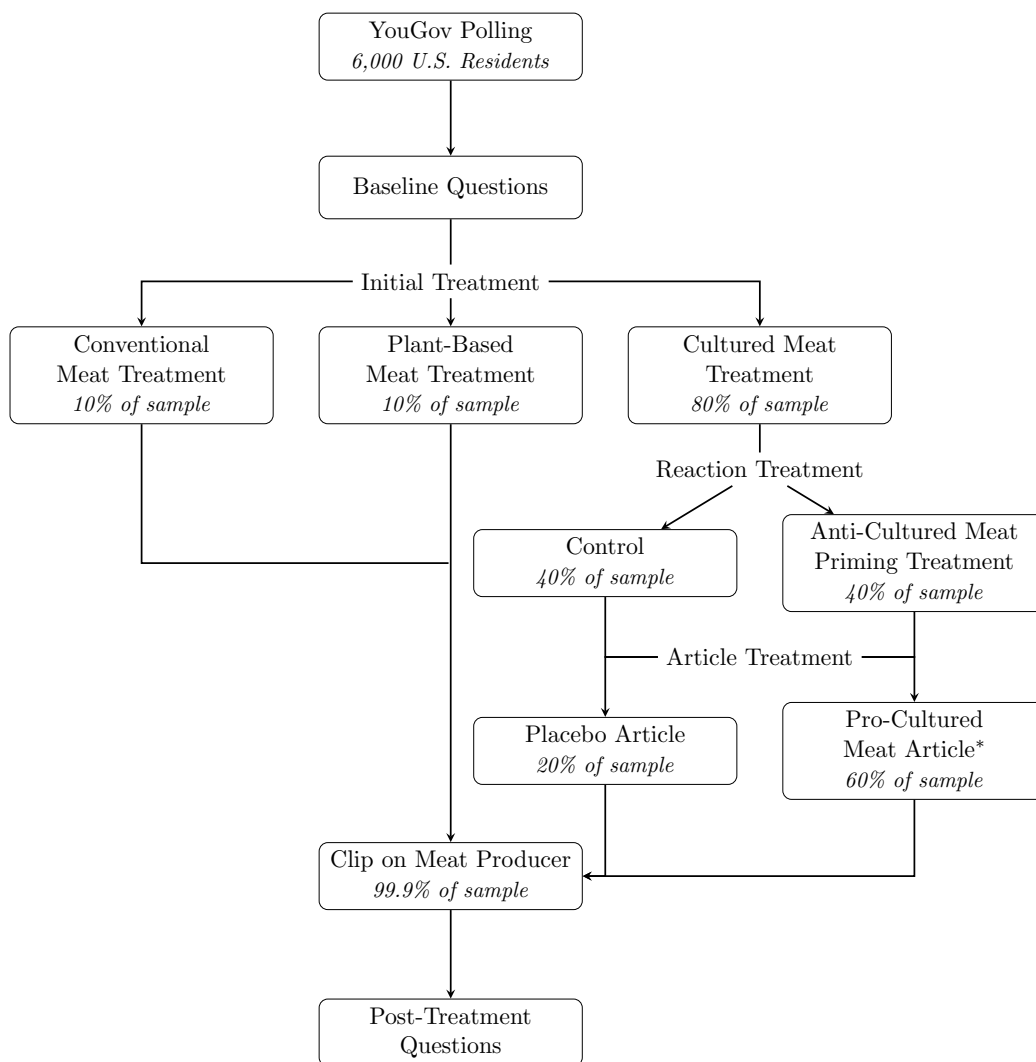
5. Results

In this section we detail the results of our pre-registered analyses, which focus on the effects of exposure to the cultured meat article on moral preferences and willingness to pay. We first provide context for our results by documenting consumers' attitudes toward

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*The pro-cultured meat article is one of three: an article arguing that naturalness is meaningless and not necessarily good ("debunk unnaturalness"), an article arguing that many good and popular things are natural ("embrace unnaturalness"), or an article claiming that many people are interested in cultured meat. The treatments are considered in a companion paper but none has any effects, separately or pooled. The placebo article is an article on the benefits of reading.

cultured meat and the strong effects of anti-cultured meat social priming. Next, we show that positive views of cultured meat increase concern for animal welfare, in line with a model of motivated beliefs, but mere exposure to cultured meat has a seeming backlash effect. An incentivized measure of information avoidance further supports this finding of a backlash effect. We show that the effects of cultured meat information and anti-cultured meat priming generate an increased preference for conventional meat. Finally, we leverage our social priming treatment to show that if respondents viewed cultured meat positively, the backlash effect of exposure to cultured meat would give way to the positive effect predicted by a motivated beliefs model.

5.1. Attitudes toward Cultured Meat and Social Priming

Our first result is that respondents view cultured meat in a largely negative light, and the anti-cultured meat social priming some respondents randomly receive furthers these negative effects or the treated respondents.

The majority of participants in the cultured meat treatment arm have little interest in the product, but they also expect they would eat it. In the first panel of Figure 2, we see that nearly 40% of respondents say they are "not interested at all" in cultured meat, with nearly 20% leaning in that direction. At the same time, a majority of respondents say they would eat the product.

The social priming treatment is an effective instrument for respondents' perception of cultured meat because it has a large effect on how positively they view it. Table 1 displays the first-stage treatment effect of anti-cultured meat priming on this positivity index, and we see a strong effect in the expected direction. This allows us to use the social priming as an instrument for whether respondents view cultured meat as an effective substitute for conventional meat.

Figure 2: Respondents are not interested in cultured meat but expect they would eat it

How interested are you in this product?   Would you eat this product?
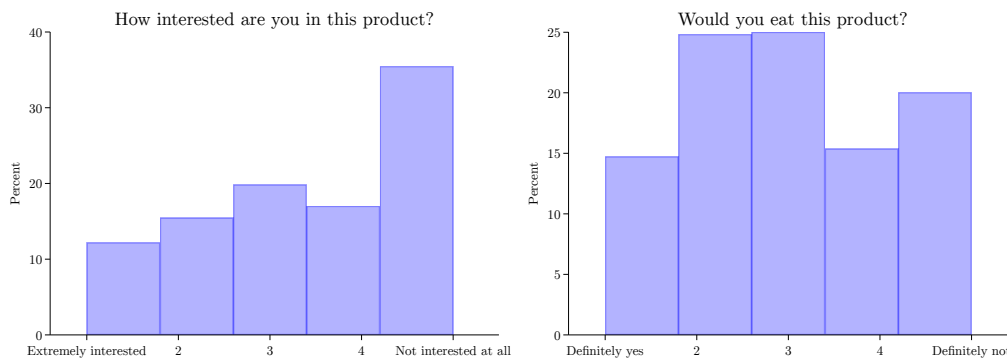
Notes: The left panels plot the share of respondents exposed to cultured meat that express interest in a cultured meat product before additional treatments on a five-point Likert scale from "Not interested at all" to "Extremely interested." The right panels plot the share of respondents who say they would eat a cultured meat product on a five-point Likert scale from "Definitely not" to "Definitely yes."

Table 1: First Stage: Regression of Positivity and Easiness Indices on No Negative Information Treatment

	(1) Change in Positivity	(2) Easiness index
No Anti-Cultured	0.227***	0.219**
Meat Priming	(0.04)	(0.10)
Positivity	-0.095***	0.401***
(Pre-Video)	(0.01)	(0.02)
Observations	4812	4812

Notes: The columns show the effect of not receiving anti-cultured meat social priming on how positively respondents view plant-based eating and how easy they believe it would be to reduce their meat consumption. Positivity is measured by the sum of two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it. Easiness is measured by the sum of two five-point Likert scale questions assessing how easy respondents think it would be to eliminate conventional meat from their diet and to reduce it.

5.2. Moral Attitudes and Consumption

We now present our main results. We first show that exposure to cultured meat leaves respondents significantly less morally concerned with conventional meat. Table 2 displays the effects of the treatments on the view that eating vegetarian is morally preferable (column 1) and the amount of money out of a (real-stakes) $20 bonus they would donate to a farmed animal protection organization (column 4). Contrary to what a simple model of motivated beliefs would predict, information about cultured meat lowers respondents' agreement that eating vegetarian is morally preferable by around a quarter of a point on the five-point Likert scale. While the point estimate for plant-based meat is also negative, it is smaller and not significant. We do not see effects on the incentivized donation question.

Table 2: Regression of Change in Beliefs and Donations on Treatments

	(1) Morally preferable OLS	(2) Morally preferable OLS	(3) Morally preferable 2SLS	(4) Donation OLS	(5) Donation OLS	(6) Donation 2SLS
Cultured Meat	-0.237***			-0.552		
	(0.07)			(0.43)		
Anti-Cultured Meat	-0.043			-0.014		
Priming	(0.04)			(0.24)		
Pro-Cultured Meat	0.022			0.163		
Article	(0.04)			(0.28)		
Veg Meat	-0.082			-0.268		
	(0.08)			(0.48)		
Change in Positivity		0.247***	0.234		0.624***	0.227
		(0.01)	(0.15)		(0.08)	(1.04)
Positivity		0.169***	0.168***		0.705***	0.667***
(Pre-Video)		(0.01)	(0.02)		(0.05)	(0.11)
Observations	6000	4812	4812	6000	4812	4812

Notes: Columns (1) and (4) show the effect of assignment to information about cultured meat, anti-cultured meat social priming, an pro-cultured meat article, and information about plant-based meat on whether respondents view plant-based eating as morally preferable and willingness to donate to an animal charity, respectively. Columns (2) and (5) show the degree to which respondents' baseline positivity about cultured meat and change in positivity between the start and end of the survey predict the respective outcomes. Positivity is measured by the sum of two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it. Columns (3) and (6) instrument for the change in positivity using the anti-cultured meat priming. All columns control for a six-tier categorical variable for the respondent's baseline meat consumption, and columns (1)-(3) control for the baseline value of the outcome.

A key driver of respondents' reaction is how positively they view cultured meat. Columns 2 and 5 of Table 2 show the correlation between the relevant outcome and how positively

respondents view the product, while columns 3 and 6 instrument for how positively respondents' view the product with whether they are exposed to the anti-cultured meat social priming treatment. We see that more positive views toward the meat alternatives correlate with increased moral preference for avoiding conventional meat and increased donations. The instrumental-variables estimate is similar in magnitude for the moral preference Likert scale but not significant.

Two more pieces of evidence show that greater receptivity to cultured meat increases concern with conventional meat consumption. First, Table 3 considers beliefs participants have about harm to animals and the environment caused by conventional meat production. In the first panel, respondents are asked how much they think animals are harmed and how important they think this harm is. Respondents report significantly smaller harms to animals when exposed to the anti-cultured meat social priming. The effects of exposure to cultured meat information are negative but not significant. Again, positivity appears as a potential mediator, and when the anti-cultured meat priming is used as an instrument for positivity, positivity is significantly associated with participants believing that animals experience more harm from conventional meat production. However, this does not translate to increased weights on the importance of this harm, and there are few effects on environmental attitudes.

Second, Table 4 shows that respondents have a positive willingness to pay to avoid watching the video about factory farming, but this is significantly lower after the anti-cultured meat priming. If participants feel a backlash effect, they may not be concerned that the information in the video would cause them to change their consumption or experience any negative utility, and the priming could make them feel even more secure in this belief.

Turning to our consumption measures, we see that exposure to cultured meat and negative social information about it increases respondents' preference for conventional meat compared not only to cultured meat but also to plant-based meat. Using the social priming instrument, however, we find that if respondents viewed cultured meat positively, exposure to cultured meat would lessen their interest in conventional meat, as predicted by motivated

17

Table 3: Regression of Belief Change and Donations on Treatments

Panel A: Animal-related outcomes

	(1) Belief about harm OLS	(2) Belief about harm OLS	(3) Belief about harm 2SLS	(4) Importance of harm OLS	(5) Importance of harm OLS	(6) Importance of harm 2SLS
Cultured Meat	-0.061			-0.081		
	(0.05)			(0.05)		
Anti-Cultured Meat Priming	-0.062**			-0.015		
	(0.03)			(0.03)		
Pro-Cultured Meat Article	0.008			0.007		
	(0.03)			(0.03)		
Veg Meat	-0.040			-0.063		
	(0.06)			(0.06)		
Change in Positivity		0.174***	0.295**		0.190***	0.092
		(0.01)	(0.12)		(0.01)	(0.12)
Positivity (Pre-Video)		0.112***	0.126***		0.097***	0.086***
		(0.01)	(0.01)		(0.01)	(0.01)
Observations	6000	4812	4812	6000	4812	4812

Panel B: Environmental outcomes

	(1) Belief about harm OLS	(2) Belief about harm OLS	(3) Belief about harm 2SLS	(4) Importance of harm OLS	(5) Importance of harm OLS	(6) Importance of harm 2SLS
Cultured Meat	-0.019			-0.070		
	(0.05)			(0.05)		
Anti-Cultured Meat Priming	-0.024			-0.017		
	(0.03)			(0.03)		
Pro-Cultured Meat Article	-0.021			-0.005		
	(0.03)			(0.03)		
Veg Meat	-0.016			-0.059		
	(0.06)			(0.06)		
Change in Positivity		0.159***	0.128		0.165***	0.098
		(0.01)	(0.11)		(0.01)	(0.12)
Positivity (Pre-Video)		0.104***	0.100***		0.095***	0.088***
		(0.01)	(0.01)		(0.01)	(0.01)
Observations	5999	4812	4812	6000	4812	4812

Notes: Columns (1) and (4) show the effect of assignment to information about cultured meat, anti-cultured meat social priming, an pro-cultured meat article, and information about plant-based meat on whether respondents view animal farming as harming animals in the top table and the importance of that harm in the top panel, and analogous questions for the environment in the bottom panel, respectively. Columns (2) and (5) show the degree to which respondents' baseline positivity about cultured meat and change in positivity between the start and end of the survey predict the respective outcomes. Positivity is measured by the sum of two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it. Columns (3) and (6) instrument for the change in positivity using the anti-cultured meat priming. All columns control for a six-tier categorical variable for the respondent's baseline meat consumption, and columns (1)-(3) control for the baseline value of the outcome.

Table 4: Regression of WTP to Avoid Information

	(1) WTP	(2) WTP	(3) WTP
Cultured Meat	-0.485		-0.160
	(0.36)		(0.44)
Anti-Cultured Meat		-0.514**	-0.514**
Priming		(0.24)	(0.24)
Pro-Cultured Meat		-0.088	-0.088
Article		(0.28)	(0.28)
Veg Meat	-0.448		-0.448
	(0.49)		(0.49)
Constant	9.075***	8.884***	9.075***
	(0.44)	(0.41)	(0.44)
Observations	6000	4812	6000

Notes: Column (1) shows the effect of information about cultured meat and information about plant-based meat on respondents willingness to pay to avoid watching a video about factory farming. Column (2) shows the effect of anti-cultured meat social priming and an pro-cultured meat article on the same outcome. Column (3) shows all three effects.

beliefs models.

We first present an unincentivized measure of how consumption responds to the informational treatments before presenting the incentivized measures. Table 5 shows the effects on self-reported beliefs about whether respondents expect to reduce their meat consumption and how much they expect to reduce it. We see a significant, negative effect of the negative social priming on expectations of reducing meat consumption, around a fifth of a point on a ten-point Likert scale. There is again a negative effect of cultured meat information alone, although the effect is not significant. As in other cases, positivity toward cultured meat strongly predicts attitudes, and the results instrumenting for positivity support that this relationship is causal.

Incentivized, real-stakes consumption measures confirm that positive attitudes toward cultured meat have the effect predicted by a motivated beliefs model, but information about cultured meat itself does not. Table 6 displays the effects of treatments on relative willingness to pay for conventional meat compared to plant-based meat. Exposure to cultured meat information increases the relative value of conventional meat by around 10%, significant at the 10% level, compared to plant-based meat. Exposure to the social priming has an equal effect significant at the 1% level for both plant-based meat and (hypothetical)

Table 5: Regression of Change in Beliefs on Treatments

	(1) Expects to reduce consumption OLS	(2) Expects to reduce consumption OLS	(3) Expects to reduce consumption 2SLS	(4) How much expects to reduce OLS	(5) How much expects to reduce OLS	(6) How much expects to reduce 2SLS
Cultured Meat	-0.191			-0.151		
	(0.18)			(0.18)		
Anti-Cultured Meat	-0.212**			-0.199**		
Priming	(0.10)			(0.10)		
Pro-Cultured Meat	-0.106			-0.075		
Article	(0.11)			(0.11)		
Veg Meat	-0.227			-0.132		
	(0.20)			(0.20)		
Change in Positivity		0.447***	1.058**		0.398***	0.986**
		(0.03)	(0.42)		(0.03)	(0.41)
Positivity		0.541***	0.599***		0.494***	0.551***
(Pre-Video)		(0.02)	(0.04)		(0.02)	(0.04)
Observations	6000	4812	4812	6000	4812	4812

Notes: Columns (1) and (4) show the effect of assignment to information about cultured meat, anti-cultured meat social priming, an pro-cultured meat article, and information about plant-based meat on whether respondents expect to reduce their meat consumption and how much they expect to reduce it. Columns (2) and (5) show the degree to which respondents' baseline positivity about cultured meat and change in positivity between the start and end of the survey predict the respective outcomes. Positivity is measured by the sum of two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it. Columns (3) and (6) instrument for the change in positivity using the anti-cultured meat priming. All columns control for a six-tier categorical variable for the respondent's baseline meat consumption, and columns (1)-(3) control for the baseline value of the outcome.

Table 6: Regression of Relative WTP for Conventional vs. Alt Meat on Treatments

	(1) Log WTP (vs. veg) OLS	(2) Log WTP (vs. veg) OLS	(3) Log WTP (vs. veg) 2SLS	(4) Log WTP (vs. cultured) OLS	(5) Log WTP (vs. cultured) OLS	(6) Log WTP (vs. cultured) 2SLS
Cultured Meat	0.114*					
	(0.07)					
Anti-Cultured Meat	0.111***			0.169***		
Priming	(0.04)			(0.04)		
Pro-Cultured Meat	-0.062			-0.032		
Article	(0.04)			(0.04)		
Veg Meat	0.058					
	(0.07)					
Change in Positivity		-0.151***	-0.539***		-0.245***	-0.810***
		(0.01)	(0.16)		(0.01)	(0.17)
Positivity		-0.200***	-0.237***		-0.289***	-0.343***
(Pre-Video)		(0.01)	(0.02)		(0.00)	(0.02)
Observations	5999	4811	4811	4812	4812	4812

Notes: Columns (1) and (4) show the effect of assignment to information about cultured meat, anti-cultured meat social priming, an pro-cultured meat article, and information about plant-based meat on the logarithm of respondents' willingness to pay for conventional meat in units of plant-based meat and in units of cultured meat, respectively, respectively. Columns (2) and (5) show the degree to which respondents' baseline positivity about cultured meat and change in positivity between the start and end of the survey predict the respective outcomes. Positivity is measured by the sum of two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it. Columns (3) and (6) instrument for the change in positivity using the anti-cultured meat priming. All columns control for a six-tier categorical variable for the respondent's baseline meat consumption.

cultured meat. Again, positivity is strongly associated with willingness to pay, and these effects are causal.

As a final measure of the importance of respondents' views of cultured meat, our social priming instrument allows us to show that if respondents were primed to view cultured meat positively, then information about cultured meat would have the effect predicted by a motivated beliefs model. We simulate the reaction of a respondent to cultured meat information by estimating a two-stage least squares regression where we instrument for respondents' positivity (dropping their baseline positivity) using the social priming. We then use the coefficients on cultured meat information and respondents' positivity to estimate the effect of cultured meat information for a respondent who is interested in and would eat cultured meat. Table 7 shows the results. The signs are now consistent with motivated beliefs, and there is a significant positive effect of cultured meat information on incentivized and unincentivized measures of meat avoidance.

6. Discussion

The results we have observed - a negative impact of exposure to cultured meat on concerns for animal welfare but a positive impact driven of positive attitudes - call for an explanation. In a model of motivated beliefs (or, similarly, cognitive dissonance), a new substitute that a participant is not interested in should not affect their beliefs, as they will never choose to eat it. Further, these results do not appear to be a fluke: two other experiments with a total of 5,175 individuals on Amazon's Mechanical Turk (MTurk) yield qualitatively similar results (Online Appendix Tables 1-10).

The results suggest that respondents take the arrival of cultured meat to be something other than an expansion in their choice set. One potential explanation is that respondents view cultured meat as an inferior alternative that will replace other alternatives to conventional meat (including, potentially, foods that do not aim to replace meat but simply substitute for it). This would lead them to want to consumer more meat and, for this reason, become more motivated to believe conventional meat production is ethical. This

Table 7: Predicted Effects of Cultured Meat Information Given Positive Views

	Predicted Effect
Morally preferable	0.183
	(0.47)
Donation	-0.262
	(2.85)
Harms animals	0.683
	(0.47)
Harm is important	0.032
	(0.37)
Harms environ.	0.261
	(0.35)
Harm is important	0.073
	(0.35)
Expects to reduce	2.119*
	(1.24)
How much reduce	2.026*
	(1.22)
Log WTP (vs. Veg)	-1.196**
	(0.56)
WTP to Avoid Info	5.560
	(3.70)
Observations	6000

Notes: Each row shows the estimated effect of information about cultured meat combined with a simulated social prime that makes a respondent positively disposed to cultured meat. We use a two-stage-least-squares procedure to estimate the effects of cultured meat information and, via the social priming instrument, a positive view of cultured meat on each outcome. We then add the effect of cultured meat information to the effect of being positively disposed, defined as averaging a four out of five on the two five-point Likert scale questions assessing respondents' interest in cultured meat and whether they say they would eat it.

explanation does not require anything more than a different interpretation of a model of motivated beliefs.

There is suggestive evidence that a backlash effect is a likely element of the explanation. More specifically, respondents may view the arrival of cultured meat as signifying the undesirable replacement of conventional meat by cultured meat. This is consistent with the data: most respondents express little interest in cultured meat, but most say that they "would" eat it. Respondents may therefore feel incentivized to fight more for conventional meat, or they may simply react accordingly to the perception of an attack. The large effect on expressed moral attitudes is consistent with this emotional reaction. The positive effect of cultured meat information on respondents' preference for conventional meat relative to plant-based meat is also consistent with this explanation but not obviously explicable by the previous explanation.

It is notable that being informed of a vegetarian alternative does not provoke this negative reaction. This suggests that the effect is tied to cultured meat as a new technology. Participants are already familiar with vegetarian meat alternatives and can observe that they have not replaced conventional meat or substantially limited their options. They have more reason to fear that cultured meat might replace conventional meat.

Our results suggest that cultured meat is not a panacea for animal welfare and environmental harms of conventional agriculture. We do not see much evidence that cultured meat leads to a cycle of greater concern for avoiding meat production. It may paradoxically even lead some people to care less about animal welfare. However, given that these effects are driven by how positively participants treat the new alternative, we cannot rule out that a substitute that participants felt much more positively about would lead the average participant to care more about animal welfare.

Finally, we follow up with the participants a month after the initial experiment and find surprisingly durable effects of the relatively light-touch treatments. 81% of the initial sample responded to the follow-up survey. The effects on ethical beliefs and expected consumption largely remain (Online Appendix Tables 11-15).

7. Conclusion

Consumers face a myriad of ethical choices, often selecting the less ethical option and resolving the resulting dissonance through rationalization or willful ignorance. In this study, we examine whether providing consumers with higher quality or more convenient ethical goods reduces these incentives for rationalization, leading consumers to select ethical options more frequently and soften the attitudes and beliefs they hold to justify the less ethical option.

In a representative online panel, we find that cultured meat lessens moral concerns with traditional agriculture, contrary to a model of motivated beliefs. Consistent with motivated beliefs, an experimental nudge to view the product more negatively (as conventional meat producers might be expected to produce) exacerbates this effect. We show that positive views toward cultured meat appear to mediate its effect on moral attitudes. Participants' willingness to pay for conventional, plant-based, and cultured meat is consistent with these findings, and some of the effects persist a month later. While the effect of informing participants about cultured meat on moral attitudes is negative, suggesting there can be a backlash effect, our evidence suggests that if respondents viewed cultured meat positively the predictions of a motivated beliefs model would hold. Our results highlight that the ultimate impacts of a new technology critically depend on how it is received.

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