PHD

Exploring the nature of consumer preferences between conventional and cultured meat

Bryant, Chris

Award date:
2020

Awarding institution:
University of Bath

Exploring the nature of consumer preferences between conventional and cultured meat

Christopher John Bryant

A thesis submitted for the degree of
Doctor of Philosophy

University of Bath
Department of Psychology

June 2020

Copyright Notice

Restriction of Access Statement

Access to this thesis/portfolio in print or electronically is restricted until 30 June 2021.

Signed: ____________________
Print name: ____________________
(on behalf of the Doctoral College)

Declaration of Previous Submission

The material presented here for examination for the award of a higher degree by research has not been incorporated into a submission for another degree. Where indicated, chapters may have been submitted to, or accepted or published in, journals.

CHRISTOPHER BRYANT

Declaration of Authorship

I am the author of this thesis, and the work described herein was carried out by myself personally, with the exception of some parts of collaborative chapters. Details of my contribution to each shared authorship chapter is detailed at the start of the chapter.

CHRISTOPHER BRYANT

Contents

COPYRIGHT NOTICE **3**

RESTRICTION OF ACCESS STATEMENT **3**

DECLARATION OF PREVIOUS SUBMISSION **3**

DECLARATION OF AUTHORSHIP **3**

CONTENTS **4**

TABLES AND FIGURES **9**

CHAPTER 1 9
CHAPTER 2 10
CHAPTER 3 12
CHAPTER 4 14
CHAPTER 5 19
CHAPTER 6 22
CHAPTER 7 25
CHAPTER 8 29
CHAPTER 9 32
CHAPTER 10 37
CHAPTER 11 41
CHAPTER 12 42

ACKNOWLEDGEMENTS **43**

LIST OF ABBREVIATIONS **44**

ABSTRACT **45**

1. INTRODUCTION **46**

1.1 ARGUING ABOUT ANIMALS 46
1.2 THE MORAL CASE AGAINST ANIMAL AGRICULTURE 48
1.2.1 Moral foundations *48*
1.2.2 Animal sentience *50*
1.2.3 Animal agriculture *51*
1.3 CULTURED MEAT 56
1.4 CHAPTER OVERVIEW 57

2. METHODOLOGY **60**

2.1 ONTOLOGY & EPISTEMOLOGY 60
2.1.1 Sensual information as the basis of morality *60*
2.1.2 Knowledge as instrumental to moral ends *61*
2.1.3 Ontological ambiguity *62*
2.2 QUANTITATIVE APPROACH 62
2.2.1 Strengths of this approach *62*
2.2.2 Limitations of this approach *64*
2.3 MEASURES 65
2.3.1 Measures of cultured meat acceptance *65*
2.3.2 Attitude measures *66*
2.3.3 Familiarity measures *66*
2.3.4 Other measures *67*
2.3.5 Manipulation and validity checks *67*
2.4 ETHICS 67

3. GOING VEGGIE: SOCIAL AND PSYCHOLOGICAL BARRIERS TO VEGETARIANISM IN AN AIDA MODEL **71**

ABSTRACT 71
3.1 INTRODUCTION 71
3.1.1 Eating animals *71*
3.1.2 The AIDA Model *72*
3.1.3 From ignorance to action: A model of change *73*

3.2 Barriers to awareness 74
3.2.1 Ignorance *75*
3.3 Barriers to interest 75
3.3.1 Avoidance *75*
3.3.2 Status quo bias *76*
3.3.3 Scale insensitivity *77*
3.4 Barriers to desire 77
3.4.1 Cognitive dissonance *78*
3.4.2 Motivated reasoning *78*
3.4.3 Self serving bias *79*
3.4.4 System justification bias *80*
3.4.5 Confirmation bias *80*
3.5 Barriers to action 81
3.5.1 Habit *81*
3.5.2 Willpower *82*
3.6 Sociocultural context 83
3.6.1 Carnism and speciesism *83*
3.6.2 Social norms *84*
3.6.3 Social representations *85*
3.6.4 Social identities *86*
3.7 Conclusion 87
3.7.1 Arguing about animals *87*
3.7.2 Further research *88*
3.7.3 Implications for Advocates *89*
3.8 References 91
4. WE CAN'T KEEP MEATING LIKE THIS: ATTITUDES TOWARDS VEGETARIAN AND VEGAN DIETS IN THE UNITED KINGDOM 101
Abstract 101
4.1 Background 101
4.1.1 The Case against Animal Products *101*
4.1.2. Vegetarianism and Veganism in the UK *102*
4.1.3. Motivations and Constraints *103*
4.2 Methods 104
4.2.1. Participants *104*
4.2.2 Procedure *105*
4.2.3. Data Analysis *105*
4.3. Results 106
4.3.1. Overall Attitudes to Vegetarianism and Veganism *106*
4.3.2. Intentions to Reduce Consumption of Meat and Animal Products *108*
4.3.3 Comparison of Attitudes to Vegetarianism and Veganism *108*
4.3.4. Comparison of Different Demographic Groups *109*
4.4. Discussion 112
4.4.1. More Positive Attitudes towards Vegetarianism than Veganism *112*
4.4.2. Agreement in Principle, Disagreement in Practice *112*
4.4.3. Addressing Objections through Animal Product Alternatives *113*
4.4.4. Limitations *115*
4.4.5. Future Research *115*
4.5 References 116
5. CONSUMER ACCEPTANCE OF CULTURED MEAT: A SYSTEMATIC REVIEW ... 123
Abstract 123
5.1 Introduction 124
5.2 Methodology 124
5.2.1. Framing the question *125*
5.2.2 Identifying relevant publications *126*
5.2.3 Assessing study quality *127*
5.3 Results 127
5.3.1 Consumer acceptance *131*
5.3.2 Common objections to cultured meat *133*

5.3.3 Doubts and uncertainty ... *136*
5.3.4 Positive perceptions ... *137*
5.4 DISCUSSION ... 138
5.4.1 Overall acceptance and demographic variation ... *138*
5.4.2 Objections ... *139*
5.4.3 Perceived benefits ... *140*
5.5 CONCLUSION ... 141
5.6 REFERENCES ... 142
6. A SURVEY OF CONSUMER PERCEPTIONS OF PLANT-BASED AND CLEAN MEAT IN THE USA, INDIA, AND CHINA ... 148
ABSTRACT ... 148
6.1 INTRODUCTION ... 149
6.2 MATERIALS & METHODS ... 150
6.2.1 Participants ... *150*
6.2.2 Procedure ... *150*
6.2.3 Materials ... *151*
6.3 RESULTS ... 152
6.3.1 Descriptive Statistics ... *152*
6.3.2 Cross Country Comparisons ... *153*
6.3.3 Within Country Regressions ... *157*
6.4 DISCUSSION ... 160
6.4.1 Different Strategies for Different Markets ... *161*
6.4.2 Conclusion ... *162*
6.5 REFERENCES ... 164
7. STRATEGIES FOR OVERCOMING AVERSION TO UNNATURALNESS: THE CASE OF CLEAN MEAT ... 169
ABSTRACT ... 169
7.1 INTRODUCTION ... 170
7.2 METHODS & MATERIALS ... 171
7.2.1 Participants ... *171*
7.2.2 Experimental procedure ... *172*
7.2.3 Promotional messages ... *172*
7.2.4 Terminology ... *174*
7.2.5 Measures ... *174*
7.2.6 Statistical analysis ... *176*
7.3 RESULTS ... 176
7.3.1 Perceptions of naturalness ... *177*
7.3.2 Willingness to pay ... *180*
7.3.3 Behavioural intentions ... *181*
7.3.4 Cognitive beliefs ... *181*
7.3.5 Attitude ... *181*
7.3.6 Affect ... *181*
7.3.7 Overall clean meat acceptance ... *182*
7.4. DISCUSSION ... 184
7.4.1 Limitations ... *185*
7.4.2 Future Directions ... *186*
7.5 REFERENCES ... 187
8. THE IMPACT OF FRAMING ON ACCEPTANCE OF CULTURED MEAT ... 193
ABSTRACT ... 193
8.1 INTRODUCTION ... 194
8.1.1 Framing ... *194*
8.1.2 Cultured meat ... *195*
8.2 METHODS ... 197
8.2.1 Participants ... *197*
8.2.2 Procedure ... *197*
8.2.3 Experimental design ... *198*
8.3 RESULTS ... 199

8.3.1 Overall findings ... *199*
8.3.2 Experimental findings ... *201*
8.4. DISCUSSION & CONCLUSION ... 203
8.4.1 Implications ... *203*
8.4.2 Contributions to the field ... *204*
8.4.3 Limitations ... *204*
8.4.4 Future Research ... *205*
8.5 REFERENCES ... 206

9. WHAT'S IN A NAME? CONSUMER PERCEPTIONS OF IN VITRO MEAT UNDER DIFFERENT NAMES ... 214
ABSTRACT ... 214
9.1 INTRODUCTION ... 215
9.1.1 In vitro meat ... *215*
9.1.2 The importance of naming ... *215*
9.1.3 Social representations theory ... *216*
9.1.4 The present study ... *216*
9.2. MATERIAL AND METHODS ... 218
9.2.1 Design and manipulations ... *218*
9.2.2 Participants ... *219*
9.2.3 Measures ... *220*
9.3 RESULTS ... 222
9.3.1 Preliminary analysis ... *222*
9.3.2 Word associations ... *222*
9.3.3 Effect of names on attitudes and behavioural intentions ... *224*
9.3.4 Mediation using word association valence ... *225*
9.4. DISCUSSION ... 226
9.4.1 Immediate associations ... *226*
9.4.2 Attitudes and intentions ... *227*
9.4.3 Applications ... *228*
9.4.4 Limitations ... *229*
9.5 CONCLUSION ... 229
9.6 REFERENCES ... 231
9.7 APPENDICES ... 237

10. CONSUMER ACCEPTANCE OF CULTURED MEAT: AN UPDATED REVIEW ... 240
ABSTRACT ... 240
10.1 INTRODUCTION ... 241
10.2 METHODS ... 242
10.3 STUDIES REVIEWED ... 242
10.4 CONSUMER ACCEPTANCE ... 248
10.4.1 Overall Acceptance Rates ... *248*
10.4.2 Personal and Societal Considerations ... *249*
10.4.3 Comparisons to Other Alternative Proteins and Food Technologies ... *249*
10.4.4 Country Comparisons ... *250*
10.4.5 Demographic Predictors ... *251*
10.5 PERCEIVED BENEFITS ... 252
10.5.1 Problems with Conventional Meat ... *253*
10.5.2 Animals ... *253*
10.5.3 Environment ... *254*
10.5.4 Health ... *254*
10.5.5 Food safety ... *255*
10.5.6 World hunger ... *255*
10.6. BARRIERS TO ACCEPTANCE ... 255
10.6.1 Unnaturalness ... *255*
10.6.2 Safety Concerns ... *256*
10.6.3 Nutrition Concerns ... *257*
10.6.4 Trust ... *257*
10.6.5 Disgust ... *257*
10.6.6 Neophobia ... *258*

10.6.7 Economic Anxieties ... *258*
10.6.8 Ethical Concerns ... *259*
10.7 Key Uncertainties ... 259
10.7.1 Price ... *259*
10.7.2 Sensory experience ... *260*
10.8 Increasing Acceptance ... 260
10.9 Discussion ... 261
10.10. Conclusion ... 262
10.11 References ... 264
11. CULTURE, MEAT, AND CULTURED MEAT ... 267
Abstract ... 267
11.1 Introduction ... 268
11.2 Media Coverage ... 268
11.3. Religion ... 269
11.3.1 Judaism ... *269*
11.3.2 Islam ... *270*
11.3.3 Hinduism ... *271*
11.3.4. Buddhism ... *271*
11.4 Regulation ... 272
11.4.1 European Union ... *272*
11.4.2 United States ... *273*
11.5 Economic Impacts ... 273
11.5.1 Agricultural employment ... *273*
11.5.2 Consolidating food production ... *274*
11.5.3 Consumer inequality ... *275*
11.6 Conclusion ... 275
11.7 References ... 277
12. DISCUSSION ... 283
12.1 Contribution ... 283
12.1.1 Summary of studies ... *283*
12.1.2 Market selection, heuristic framing, and systematic arguing ... *284*
12.2 Implications ... 286
12.2.1 Diffusion of innovations ... *286*
12.2.2 Language and the fate of animals ... *288*
12.2.3 Classification as meat or non-meat ... *288*
12.2.4 A caution about regulation ... *290*
12.2.5 Farming and rural communities ... *291*
12.2.6 An end to dissonance ... *292*
12.2.7 The ethics of entomophagy ... *292*
12.2.8 Other products of cellular agriculture ... *293*
12.3 Limitations ... 294
12.3.1 Hypothetical preferences ... *294*
12.3.2 Neglecting alternative strategies ... *294*
12.3.3 Limited qualitative insights ... *296*
12.4 Future research ... 296
13. REFERENCES ... 298
APPENDICES ... 312
Appendix A: Data management plan ... 312
Overview ... *312*
Defining your data ... *312*
Looking after your data ... *312*
Archiving your data ... *313*
Sharing your data ... *313*
Implementing your plan ... *314*

Tables and Figures

Since many of the tables and figures are included and numbered in papers, table and figure numbering is not necessarily in order over different chapters. Therefore, I have restarted table and figure numbering for each chapter.

Chapter 1

Table 1.1: Changes in wellbeing when moving from today to zero animal agriculture.

	Population	Average Change in Wellbeing	Species Multiplier	TOTAL CHANGE
Consumers	7,781,534,000	-10	1	-77,815,340,000
Agricultural workers and communities	2,500,000,000	-50	1	-125,000,000,000
Farmed cows	1,504,745,163	+27	0.475	+19,298,356,715
Farmed pigs	977,323,610	+27	0.5	+13,193,868,735
Farmed meat chickens	16,659,727,291	+56	0.4	+373,177,891,318
Farmed egg hens	7,193,386,800	+51	0.4	+146,745,090,720
Farmed fish	111,299,464,370	+44	0.25	+1,224,294,108,070
TOTAL				+1,573,893,975,559

Table 2.1: Measures used in empirical studies.

Study	Method	Sample	Key findings
Arora, Brent and Jaenicke (2020)	Survey	394 Mumbai adults	There are distinct groups of consumers who prefer each of four different protein sources: chana (21%), conventional meat (27.5%), plant-based meat (32%) or cultured meat (19.6%). Consumers were willing to pay a small premium for cultured meat compared to conventional meat.
Bryant, Anderson, Asher, Green and Gasteratos (2019)	Experimental	1,185 US adults, census balanced	The arguments that cultured meat is natural, and that naturalness should not matter tend not to persuade consumers, and resulted in lower acceptance than discussing general benefits without addressing naturalness. Arguing for the unnaturalness of conventional meat was relatively effective, though this argument may not be politically feasible for a co-operative market strategy.
Bryant and Barnett (2019)	Experimental	185 adults recruited online	The name used to describe cultured meat has a significant effect on consumers' attitudes and behavioural intentions, with 'clean meat' resulting in significantly more positive attitudes than 'lab-grown meat' ('cultured meat' and 'animal-free meat' were not significantly different from either of the first two names). This effect was mediated by the positivity of word associations, suggesting that the mechanism is associative.
Bryant and Dillard (2019)	Survey	480 US adults, generally representative	A frame focused on the high-technology/scientific nature of cultured meat resulted in significantly less positive attitudes and intentions compared to frames focused on the societal benefits of cultured meat, or its similarity to conventional meat.
Bryant, Szejda, Parekh, Deshpande and Tse (2019)	Experimental	3,030 adults in the US, India, and China, generally representative	There are substantial markets for cultured meat (and plant-based meat) in China, India, and the USA, and acceptance of both is significantly higher in China and India compared to the USA. While some demographic predictors of acceptance such as being a meat-eater and being left-leaning predicted cultured meat acceptance across countries, specific attitudinal predictors varied. Disgust predicted cultured meat rejection in the USA only, whilst acceptance in China was driven by perceived healthiness and safety, and ethical considerations were uniquely predictive of acceptance in India.
Circus and Robison (2019)	Survey	139 UK adults, convenience samples, disproportionately meat reducers	Cultured meat was preferred to insects, but plant-based meat was preferred to cultured meat. Meat attachment was positively related to cultured meat acceptance. People generally held congruent views with respect to societal views of, and personal willingness to eat cultured meat.
Dupont and Fiebelkorn (2020)	Survey	718 German children and adolescents (mean age 13.67, 57% female)	Participants preferred cultured meat burgers to insect burgers, though they broadly found both disgusting. Attitudes towards specific product formats are important for children. Those higher in neophobia and disgust sensitivity were less likely to want to eat cultured meat.
Egolf, Hartmann and Siegrist (2019)	Survey	313 Swiss adults, nat rep	Cultured meat rejection was predicted by disgust. Although cultured meat was considered the most beneficial of three food technologies included, it was more accepted than GMOs but less accepted than a synthetic food additive.
Geipel, Hadjichristidis and Klesse (2018)	Experimental	161 MTurk participants (mostly female, young) German-speaking	Consumers are more likely to say they would eat cultured meat when asked about it in a foreign language (vs. their native language). The effect was mediated by disgust.
Gomez-Luciano, de Aguiar, Vriesekoop and Urbano (2019a)	Survey	729 adults in the UK, Spain, Brazil, and the Dominican Republic	Meat alternatives were generally more appealing to to higher income groups, and cultured meat was more appealing to the European countries than the non-European countries. Perceived healthiness, nutrition, and safety were important predictors of willingness to pay for cultured meat across countries.
Gomez-Luciano, Vriesekoop and Urbano (2019b)	Survey	401 adults from the Dominican Republic and Spain	Participants generally preferred cultured meat to insects, but preferred plant-based meat to cultured meat. Cultured meat was generally rated worse than alternatives on perceived healthiness, safety, nutrition, sustainability, and price. Being male and having higher education were predictors of choosing alternative proteins.

Grasso, Hung, Olthof, Verbeke and Brouwer (2019)	Survey	1,825 community-dwelling older adults (65+) in the UK, the Netherlands, Poland, Spain, and Finland	Cultured meat was the least preferred alternative protein, chosen by just 6% of participants compared to plant-based protein (58%), single-cell protein (20%) and insect-based protein (9%). Compared to the UK, participants were in the Netherlands (23%) and Finlalnd (14%) were more likely to eat cultured meat, whilst those in Spain (5%) and Poland (39%) were less likely. Anticipated price and taste were predictors of cultured meat acceptance, as well as food fussiness and green eating behaviour.
Koch, van Ittersum and Bolderdijk (2018)	Experimental	145 Dutch participants	Cultured meat was perceived to violate norms, which caused moral disgust and subsequent rejection by consumers.
Lupton and Turner (2018)	Online focus group discussion	30 Australian adults	Participants recognised the benefits of cultured meat for society, but generally considered it unnatural, not fresh, not nutritious, potentially harmful, and lacking in taste. Cultured meat was considered less natural and less nutritious than insects.
Mancini and Antonioli (2019)	Survey	525 Italian adults, generally representative	The majority (54%) were willing to try cultured meat. People generally agreed with the positive external effects of cultured meat (for animals, the environment, and food security) but gave lower ratings to its intrinsic characteristics (safety, taste, and nutrition). Predictors of acceptance included youth, higher education, higher familiarity, and being a meat-eater.
Mancini and Antonioli (2020)	Experimental	525 Italian adults, generally representative	Providing consumers with additional positive information about cultured meat increased acceptance, including willingness to buy, but not willingness to try.
Michel and Siegrist (2019)	Survey	632 German participants	Subjective importance of naturalness predicted cultured meat acceptance. Those who consider naturalness to be important are less likely to consider cultured meat natural, and are less likely to consume cultured meat.
Rolland, Markus and Post (2020)	Experimental	193 adults who lived close to Maastricht	Acceptance of cultured meat was increased by the provision of positive information, and by a (simulated) tasting experience. Of three conditions, information about the personal benefits of cultured meat led to a significantly higher improvement in attitudes than information about the quality and taste, though information about the societal benefits produced an improvement in attitudes no different from the other two conditions. All participants ate what they believed was a cultured meat burger, and rated it as better tasting than a conventional burger despite a lack of objective difference.
Shaw and Mac Con Iomaire (2019)	Focus groups	312 Irish adults Convenience sample, roughly stratified to include young and old rural and urban participants	Participants generally characterised cultured meat as unnatural, and had related safety concerns. They expressed trust in Irish meat, and distrust in food companies and food labelling regulations. In particular, they showed concern about the implications of cultured meat for Irish farmers. Participants generally expected cultured meat to have an inferior taste and texture, and expected it to be cheaper than conventional meat. Environmental benefits were seen as most important, whilst safety was the biggest concern. Characteristics associated with acceptance included being younger, being male, and living in an urban area.
Specht, Rumble and Buck (2020)	Twitter analysis	2,763 Tweets from inside the USA over a 6 month period	Tweets discussing cultured meat generally discussed eight themes: legality and marketing, sustainability,; acceptance, business, animal concerns, science and technology, health concerns, and timeline. Influencers discussing this topic included philanthropists, government officials, journalists and writers, and animal advocates. Interested groups included top news and tech influencers, vegan groups, and agricultural interests, as well as media personalities Joe Rogan. Discourse was found to be driven by specific events in the media.
Tucker (2018)	Focus groups	69 New Zealand participants in 19 focus groups	Generally, participants considered cultured meat unnatural, and not 'real meat', though some acknowledged potential environmental benefits.

Valente, Fiedler, Heidemann and Molento (2019)	Survey	626 Brazilians Snowball sample from two towns, disproportionately female and well-educated	Many participants perceived problems with conventional meat, principally around animal welfare but also with respect to the environment and human health. Though 81% knew little or nothing about cellular agriculture, 39% said they would eat cultured meat with no conditions and a further 24% said it depends on factors such as taste, healthiness, price, and further information. Just 15% said they would not eat cultured meat (22% said don't know). The biggest motivators were animal welfare, the environment, health, and trying alternatives, whilst the major concerns were affordability, healthiness, ethics, and a lack of research.
Van der Weele and Driessen (2019)	Focus groups	~45 people in the Netherlands, including older and younger groups	Overall, reflecting on cultured meat caused people to reveal deep ambivalence about eating animals. Younger people generally wondered about whether they would eat cultured meat; older people wondered about the transition at a societal and historical level. Generally, the conversations revealed a lot of ambivalence about eating meat.
Weinrich, Strack and Neugebauer (2020)	Survey	713 German adults, generally representative	Participants were moderately prepared to accept cultured meat: 57% would try it, 30% would buy regularly. Attitudes were structured in three dimensions: the strongest predictor of acceptance was perceived ethical benefits, followed by emotional objections, and optimism about global diffusion.
Wilks, Phillips, Fielding and Hornsey (2019)	Survey	1,193 US adults, generally representative	Food neophobia, political conservatism, and distrust of food scientists predicted rejection. Food hygiene sensitivity, food neophobia and conspiratorial ideation predicted absolute rejection. Naturalness sensitivity did not predict either measure of acceptance.
Zhang, Li and Bai (2020)	Survey	1,004 urban Chinese consumers	Despite most respondents having limited knowledge of cultured meat, most do not oppose it. Over 70% are willing to taste or purchase cultured meat, and consumers are willing to pay an average of 2.2% more than for conventional meat. Predictors of cultured meat acceptance included being younger, being male, having a higher level of education, and having higher trust in the government's regulation of food safety.

Chapter 3

Figure 3.1: The AIDA model.

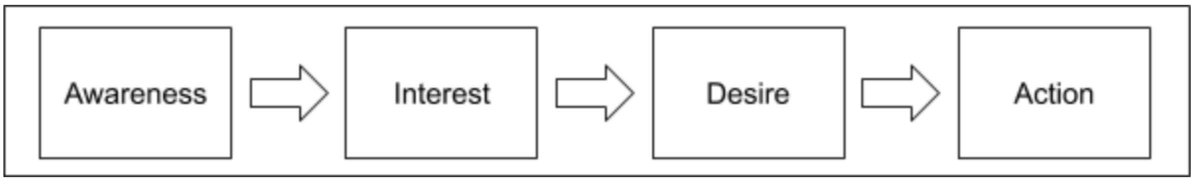
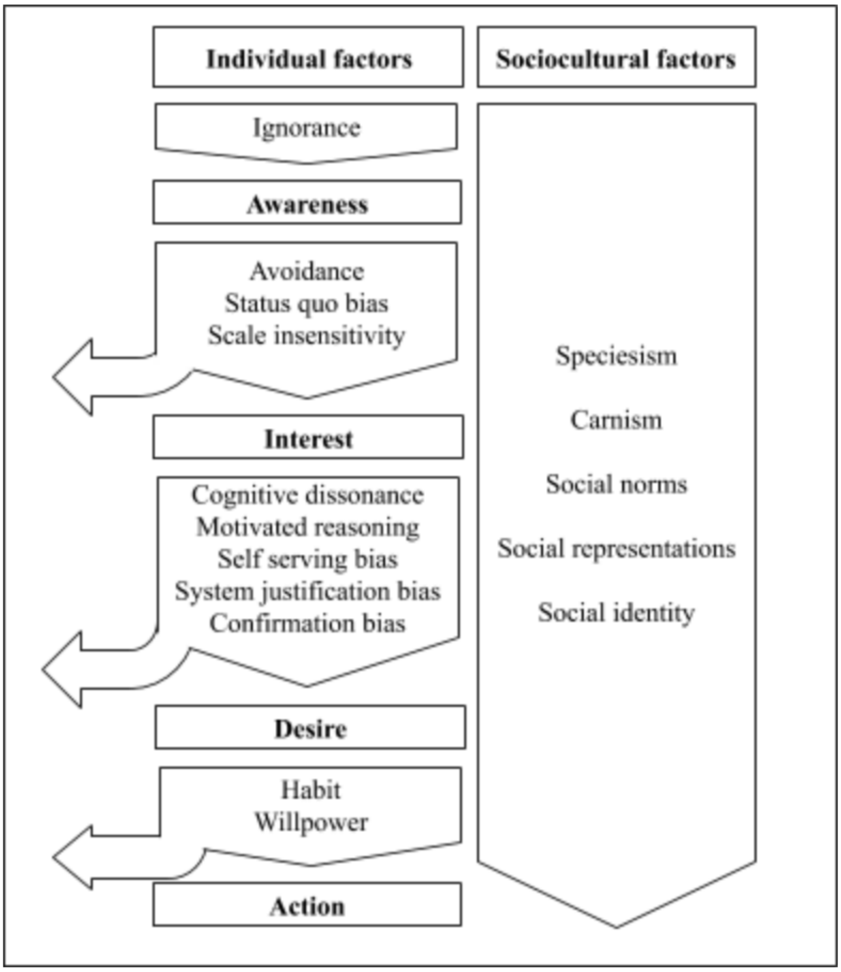


Table 3.1: The AIDA stages applied to a product purchase and a vegetarian commitment.

	Deciding to buy a product	**Deciding to become vegetarian**
Awareness	Knowledge that the product exists	Knowledge that farm animals are abused for animal products
Interest	Learning about the benefits of the product and its value to them	Engaging with farm animal suffering as a relevant issue
Desire	Developing a favourable view of the product	Appreciating animal suffering, being persuaded of veganism
Action	Buying the product	Stopping buying animal products

Figure 3.2: The individual and sociocultural factors to overcome in becoming vegetarian.



Chapter 4

Table 4.1: Survey results indicating levels of vegetarianism and veganism in the UK.

Table 1. Survey results indicating levels of vegetarianism and veganism in the UK.

Survey	Sample	Vegan	Vegetarian	Pescatarian	Flexitarian	Willing/Intending to Reduce Meat Consumption
[18]	'More than 2000' UK residents	2%	6%	4%	-	25%
[19]	9933 adults (age 15+)	1.1%	2.3%	-	-	-
[20]	1715 UK adults (age 18+)	-	7%	-	-	34%
[21]	2023 UK adults (age 18+)	1%	6%	9%	-	20%
[22]	2000 UK adults	1.3%	6.9%	4.1%	-	10%
[23]	UK, further information not given	1%	3%	3%	14%	29%
[17]	UK, information not given	7%	14%	-	31%	-
[24]	2241 adults (aged 16+) in England, Wales and Northern Ireland	1%	3%	-	-	-
[25]	3118 adults (aged 16+) in England, Wales and Northern Ireland	<1%	3%	-	-	-
[26]	3453 adults (aged 16+) across the UK	-	2%	-	3%	-
[27]	3231 adults (aged 16+) across the UK	-	2%	-	3%	-
[28]	3163 adults (aged 16+) across the UK	-	3%	-	4%	-

Figure 4.1: Mean ratings of each aspect of vegetarianism and veganism.

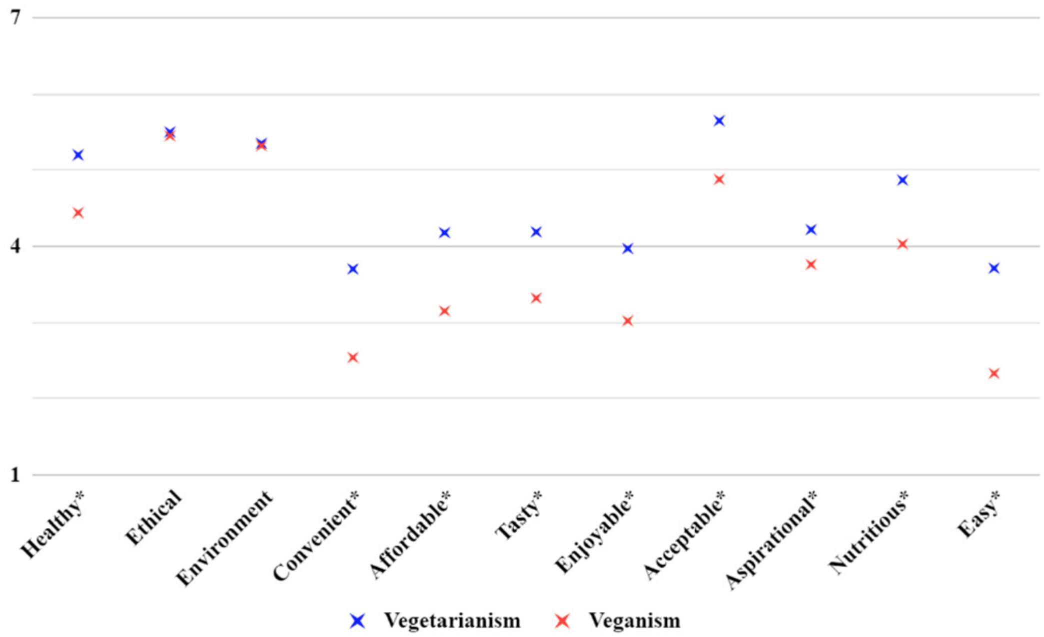


Figure 4.2: The proportion of respondents with positive, negative or neutral views about aspects of vegetarianism.

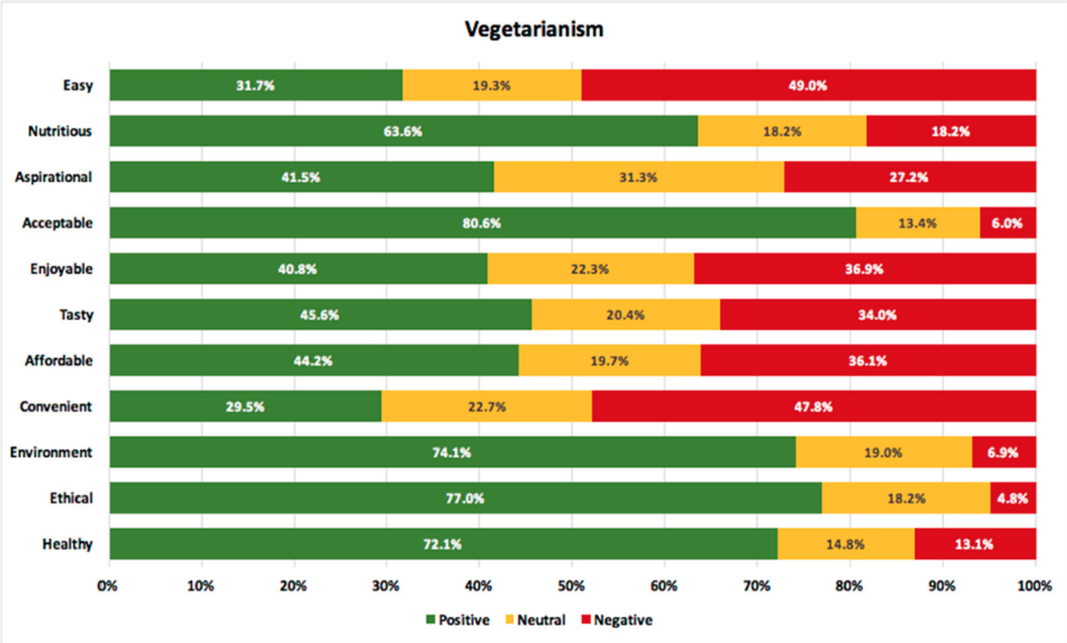


Figure 4.3: The proportion of respondents with positive, negative or neutral views about aspects of veganism.

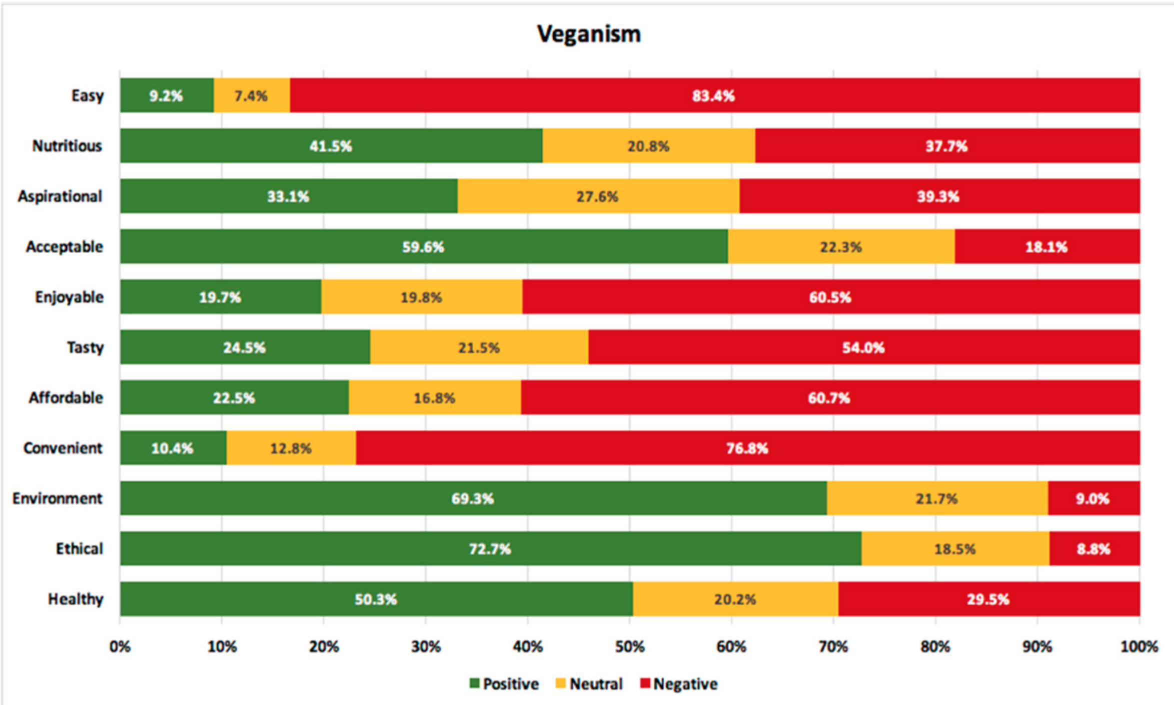


Table 4.2: Intended consumption of meat and animal products within one month.

Response	Meat	Animal Products
Eliminate (1)	0.1%	0.2%
Greatly decrease (2)	3.5%	2.4%
Slightly decrease (3)	13.0%	11.3%
Maintain the same (4)	81.0%	84.3%
Slightly increase (5)	1.9%	1.5%
Greatly increase (6)	0.5%	0.3%
Mean (SD)	3.83 (0.537)	3.85 (0.483)

Table 4.3: Mean ratings for aspects of vegetarianism and veganism with Wilcoxon signed rank tests.

Aspect	Vegetarianism Mean (SD)	Veganism Mean (SD)	Wilcoxon Signed Rank Tests
Healthy	5.20 (1.44)	4.44 (1.73)	*$Z = -15.249$, $p < 0.001$
Ethical	5.50 (1.28)	5.45 (1.51)	$Z = -1.618$, $p = 0.106$
Environment	5.35 (1.29)	5.32 (1.50)	$Z = -0.836$, $p = 0.403$
Convenient	3.70 (1.52)	2.54 (1.44)	*$Z = -19.610$ $p < 0.001$
Affordable	4.18 (1.70)	3.15 (1.76)	*$Z = -17.175$, $p < 0.001$
Tasty	4.19 (1.71)	3.32 (1.66)	*$Z = -16.838$, $p < 0.001$
Enjoyable	3.97 (1.68)	3.02 (1.65)	*$Z = -18.026$, $p < 0.001$
Acceptable	5.65 (1.33)	4.88 (1.54)	*$Z = -16.095$, $p < 0.001$
Aspirational	4.22 (1.56)	3.76 (1.74)	*$Z = -9.609$, $p < 0.001$
Nutritious	4.87 (1.50)	4.03 (1.74)	*$Z = -15.944$, $p < 0.001$
Easy	3.71 (1.59)	2.33 (1.40)	*$Z = -20.569$, $p < 0.001$

* indicates the difference between vegetarianism and veganism was significant at $p = 0.05$.

Table 4.4: Perceptions of vegetarianism and veganism with significant gender differences.

Diet	Aspect	Male Rating (Mean, SD)	Female Rating (Mean, SD)	Mann-Whitney U Test
Vegetarianism	Convenient	3.58 (1.535)	3.82 (1.496)	U = 11,158,5 $p = 0.005$
	Tasty	4.00 (1.649)	4.38 (1.745)	*U = 10,739,4 $p < 0.001$
	Enjoyable	3.75 (1.612)	4.19 (1.728)	*U = 10,490,7 $p < 0.001$
	Nutritious	4.77 (1.458)	4.97 (1.533)	U = 11,302,7 $p = 0.014$
Veganism	Affordable	3.29 (1.756)	3.01 (1.755)	U = 11,208,1 $p = 0.008$
	Tasty	3.21 (1.656)	3.43 (1.661)	U = 11,430,4 $p = 0.030$
	Easy	2.42 (1.459)	2.23 (1.339)	U = 11,533,5 $p = 0.047$

* indicates that the difference was significant at the level of $p = 0.002$, deduced using a Bonferroni correction.

Table 4.5: Perceptions of vegetarianism and veganism significantly correlated with age, political views, education and income.

		Spearman's Rank-Order Correlation			
Diet	**Aspect**	**Age**	**Political Views**	**Education**	**Income**
Vegetarianism	Healthy	-	*$r = -0.131$, $p < 0.001$	-	-
	Ethical	-	*$r = -0.188$, $p < 0.001$	-	-
	Environment	-	*$r = -0.131$, $p < 0.001$	-	-
	Convenient	$r = 0.073$, $p = 0.022$	$r = -0.099$, $p = 0.004$	-	-
	Affordable	-	$r = -0.103$, $p = 0.003$	$r = 0.080$, $p = 0.011$	-
	Tasty	-	$r = -0.086$, $p = 0.012$	-	-
	Enjoyable	$r = 0.063$, $p = 0.048$	$r = -0.085$, $p = 0.013$	-	-
	Acceptable	-	*$r = -0.168$, $p < 0.001$	-	-
	Aspirational	-	*$r = -0.156$, $p < 0.001$	$r = 0.066$, $p = 0.037$	-
	Nutritious	-	*$r = -0.168$, $p < 0.001$	-	-
	Easy	$r = 0.084$, $p = 0.008$	$r = -0.069$, $p = 0.044$	-	-
Projected change in meat consumption		-	$r = -0.099$, $p = 0.003$	$r = 0.067$, $p = 0.034$	-
Veganism	Healthy	*$r = -0.121$, $p < 0.001$	*$r = -0.128$, $p < 0.001$	-	-
	Ethical	$r = -0.073$, $p = 0.022$	*$r = -0.206$, $p < 0.001$	*$r = 0.105$, $p = 0.001$	-
	Environment	-	*$r = -0.197$, $p < 0.001$	-	-
	Convenient	-	*$r = -0.067$, $p = 0.049$	-	-
	Affordable	*$r = 0.128$, $p < 0.001$	-	-	-
	Tasty	-	$r = -0.076$, $p = 0.026$	-	$r = -0.069$, $p = 0.038$
	Enjoyable	-	*$r = -0.103$, $p = 0.002$	-	-
	Acceptable	-	*$r = -0.139$, $p < 0.001$	-	-
	Aspirational	$r = -0.086$, $p = 0.006$	*$r = -0.144$, $p < 0.001$	$r = 0.069$, $p = 0.029$	-
	Nutritious	-	*$r = -0.164$, $p < 0.001$	-	-
	Easy	$r = 0.071$, $p = 0.024$	-	-	-
Projected change in animal product consumption		-	-	$r = 0.075$, $p = 0.018$	-

* indicates that the difference was significant at the level of $p = 0.002$, deduced using a Bonferroni correction.

Chapter 5

Table 5.1: Inclusion and exclusion criteria used for article selection.

Inclusion criteria	**Exclusion criteria**
• Full text paper published in peer-reviewed journal • Papers presenting the results of primary empirical studies • Quantitative or qualitative studies • Focus on consumer attitudes towards cultured meat • English language	• Non-peer-reviewed sources • Papers which do not present primary research (review papers, discussion papers, etc.) • Focus on other aspects of cultured meat (production processes, media coverage, etc.) with no consumer behaviour focus • Papers focusing on vegetarianism, veganism, plant-based meat alternatives, organic meat, high animal welfare meat

Figure 5.1: Process for identifying and excluding records based on Moher, Liberati, Tetzlaff, Altman, and PRISMA Group (2009).

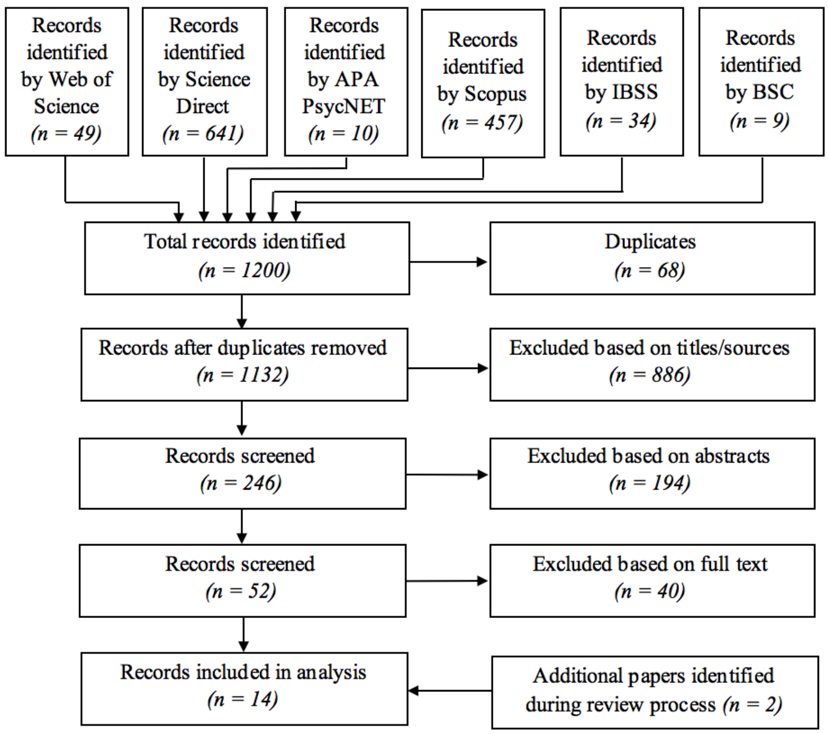


Table 5.2: Summary of studies included in the review.

Study	Design	Country & sample	Description given to participants	Main findings
Bekker, Fischer, Tobi, and van Trijp (2017)	Experimental	Netherlands: 190, 194, 192 university students (three experiments)	Text description. Used the term 'cultured meat'. Discussed the production method, environmental impact, taste, and artificiality. Descriptions were experimentally manipulated to be positive/negative.	Positive and negative information about cultured meat (or a related product) influenced explicit, but not implicit, attitudes towards it in the direction of the information. There was less effect for more familiar participants.
Hocquette et al. (2015)	Survey	France and international: 1,890 educated people; many scientists and meat industry workers, including people personally known to authors	Presentation/text description. Used the terms 'in vitro meat', and 'lab or factory grown meat'. Some participants were told in a presentation about the production method, environmental, animal welfare, and food security benefits. Most participants read text about the production method, potential health benefits, and extensive production challenges.	Most respondents believed that the meat industry had substantial environmental and animal welfare problems, and believed that cultured meat was feasible and realistic. However, only a minority chose eating cultured meat as their first choice to mitigate problems related to meat production. Most thought it would not be healthy or tasty, and thought consumers would not accept it. Nonetheless, many were in favour of supporting further research into cultured meat.
Siegrist and Sütterlin (2017)	Experimental	Switzerland: 244, 253 online participants from research panel (two experiments)	Text description. Used the term 'in vitro meat'. Discussed the production method, environmental and animal welfare benefits, and potential health risks.	Health risks from cultured meat were judged to be less acceptable than health risks from conventional meat. This effect was fully mediated by perceived naturalness.
Siegrist, Sütterlin, and Hartmann (2018)	Experimental	Switzerland: 204, 298 online participants from research panel (two experiments)	Text description. Used the terms 'in vitro meat' and 'red meat' (description was experimentally varied). Discussed the production method, environmental and animal welfare benefits, artificiality, and stated that the taste was comparable to conventional meat.	Cultured meat has lower acceptance than conventional meat because of its perception as unnatural. Discussing cultured meat increased acceptance of conventional meat. Non-technical descriptions of cultured meat lead to higher acceptance than technical descriptions, largely explained by perceived unnaturalness and disgust.
Slade (2018)	Experimental	Country not specified: 533 online participants recruited through a research organisation	Text description. Used the term 'cultured meat'. Very brief description discussing the production method only.	A minority of participants (11%) chose cultured meat over conventional meat or plant-based meat. Preference for cultured meat was higher amongst men, younger people, more educated people, those who consume meat substitutes, and those with high concern for the environment.
Verbeke, Sans, and Van Loo (2015)	Exploratory experimental (before/after testing)	Netherlands: 180 online participants, mainly students	Text description. Used the terms 'in vitro meat' and 'cultured meat'. Basic information discussed the production method only. Additional information discussed environmental benefits, health benefits, and food safety benefits.	The provision of additional information about the benefits of cultured meat increased acceptance compared to providing basic information only. Price and sensory expectations are major obstacles to acceptance.
Wilks and Phillips (2017)	Survey	USA: 673 adults recruited through MTurk; broadly representative of country population	Text description. Used the terms 'in vitro meat', 'cultured meat', 'synthetic meat', and 'schmeat'. Discussed the production method and challenges, and animal welfare.	Most respondents were willing to try cultured meat, though only one third were willing to eat it regularly or as a replacement for conventional meat. Men were more receptive than women, as were liberals compared to conservatives. The primary concerns were price, taste, and unnaturalness.
Bekker, Tobi, and Fischer (2017)	'Freelist' word association task	Netherlands: 30 graduate students (10 each from Netherlands, China, Ethiopia)	Text description. Used the term 'cultured meat'. Discussed the production method and challenges, as well as environmental, animal welfare, and food safety benefits.	Most associations related to the future and societal impact. Cultured meat was generally conceived of as comparable to conventional meat in terms of physical properties and contents, though some participants conceived of it as not 'real' meat. This varied between participants of different countries, depending on how liberal their definition of meat was.
Laestadius and Caldwell (2015)	Online comment analysis	USA: 462 commenters making 814 comments on US news stories	No description given – participants were reacting to news stories which described cultured meat.	Overall, comments were more negative than positive. Positive comments mainly related to animal welfare, the environment, and public health benefits, whereas negative comments related to cultured meat being unnatural and unappealing.
Laestadius (2015)				Both positive and negative comments were grounded in similar values (including animal welfare, sustainability, justice, naturalness, and maximising scarce resources) but interpreted cultured meat differently. Themes similar to above.
O'Keefe, McLachlan, Gough,	Focus groups	UK: 40 participants in 6 focus groups in Manchester	No information about description given in the paper.	Overall, a sense of scientific progress underpinned a positive discussion of cultured

Mander, and Bows-Larkin (2016)				meat. Much of the discussion related to sustainability, though the main perceived benefit was to animal welfare. Many had questions about the safety and nutrition of the product, and overall agreed it would have to be cheaper than conventional meat to gain acceptance.
Tucker (2014)	Focus groups	New Zealand: 69 participants in 19 focus groups across NZ	Exact description not given in the paper. Participants were shown an image and given a 'brief description… including the positive and negative aspects and implications' (p. 171)	There was an overall negative view of cultured meat, although some (particularly males, younger people, middle income people, and city dwellers) were positive. The main perceived benefits were animal ethics and increased protein productivity, whereas the main perceived drawbacks were sensory characteristics, unnaturalness, and perceived unhealthiness.
Verbeke, Marcu, et al. (2015)	Focus groups	UK, Belgium, Portugal: 174 online participants, 109 focus group participants	Video. Used the term 'synthetic meat'. Discussed the production method and challenges, and animal welfare benefits.	Initial reactions related to disgust and unnaturalness. Participants perceived few personal benefits, but acknowledged societal to the environment and food security. Personal and societal risks related to health, safety, and adverse social and economic effects. Further considerations concerned inevitable scientific progress, governance and risk control, and the need for regulation and clear labelling.
Marcu et al. (2015)				Participants' sense-making strategies included anchoring to more familiar technologies, using metaphors and commonplace arguments to close off debate, and establishing polarities. Conversely, some asked questions and engaged in pragmatic consideration of the possible costs and benefits.

Chapter 6

Figure 6.1: Histogram showing distribution of likelihood of purchasing clean meat.

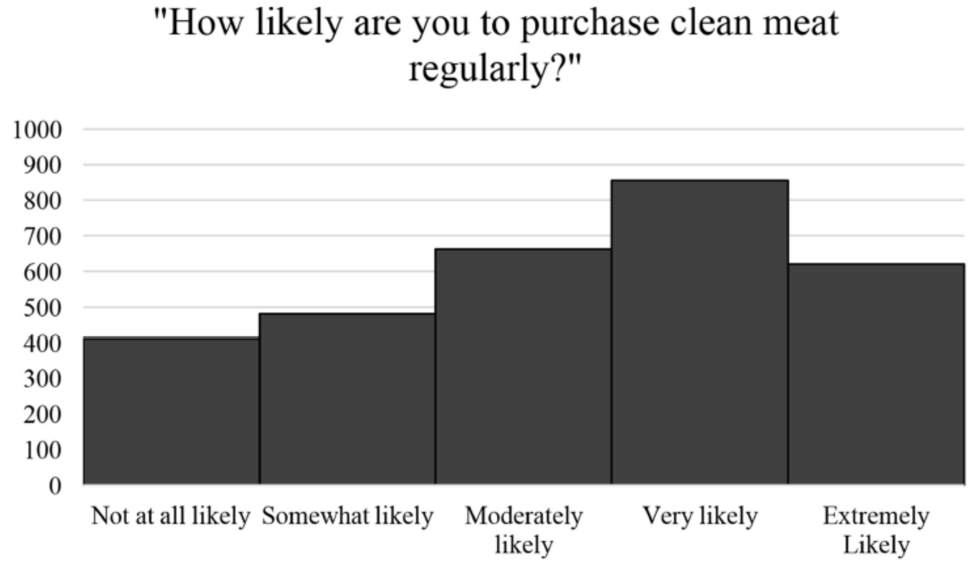


Figure 6.2: Histogram showing distribution of likelihood of purchasing plant-based meat.

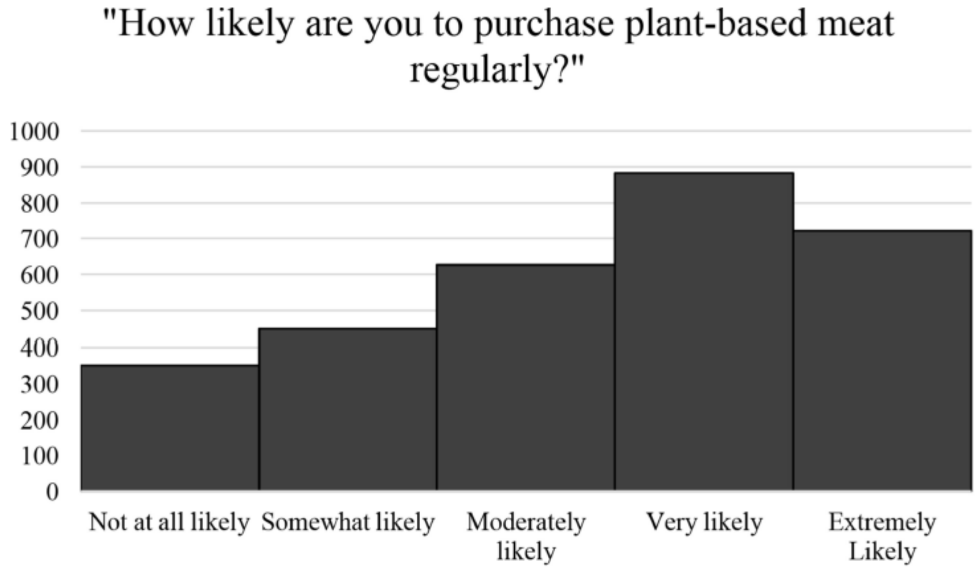


Figure 6.3: Histogram showing distribution of food neophobia scale.

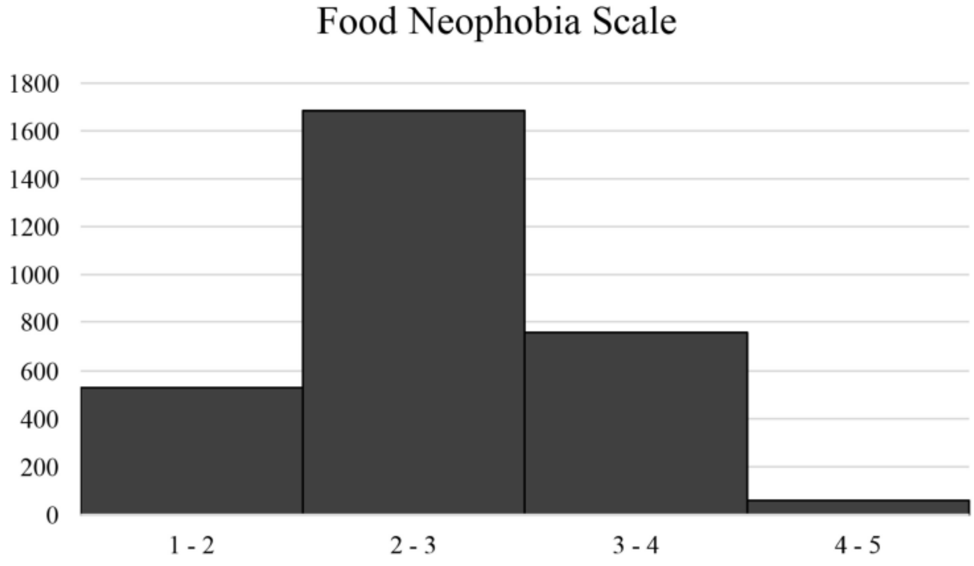


Figure 6.4: Histogram showing distribution of meat attachment questionnaire.

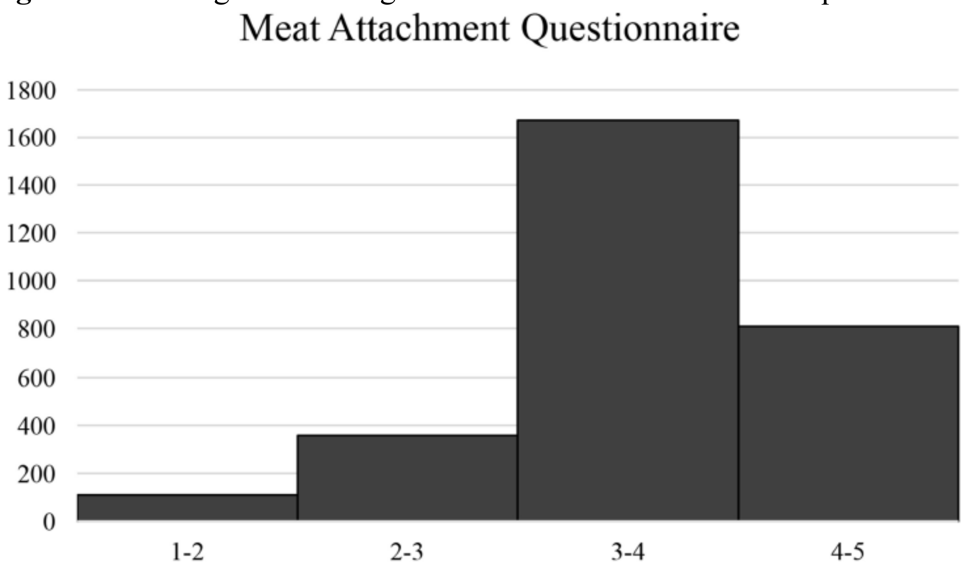


Table 6.1: ANOVA results showing omnibus results and pairwise comparisons.

	USA	China	India
Likelihood of purchasing clean meat	2.72[a] (1.35)	3.52[b] (1.14)	3.52[b] (1.30)
Likelihood of purchasing plant-based meat	2.78[a] (1.40)	3.63[b] (1.10)	3.73[b] (1.19)
Food neophobia	2.52[a] (0.84)	2.51[a] (0.51)	2.60[b] (0.56)
Meat attachment	3.76[a] (0.81)	3.70[a] (0.54)	3.28[b] (0.78)

Mean scores are shown, with standard deviations in parentheses.

Table 6.2: Regression models showing significant predictors (standardized β) of intention to purchase clean meat in the USA, China, and India.

Variable	USA		China		India	
	$R^2 = 0.504$, Adjusted $R^2 = 0.500$ $[F_{(7, 979)} = 128.624, p < 0.001]$		$R^2 = 0.501$, Adjusted $R^2 = 0.494$ $[F_{(13, 1005)} = 77.560, p < 0.001]$		$R^2 = 0.552$, Adjusted $R^2 = 0.548$ $[F_{(10, 1011)} = 124.660, p < 0.001]$	
	β	p	β	p	β	p
(Constant)		0.016		0.827		0.125
Gender: Female			0.103	<0.001		
Gender: Other			0.052	0.022		
Diet	−0.066	0.004	−0.066	0.004	−0.141	<0.001
Frequency of meat consumption			0.087	<0.001	0.058	0.032
Political views	0.079	0.001			0.021	0.314
Income					0.093	<0.001
Familiarity with CM	0.160	<0.001	0.283	<0.001	0.256	<0.001
Food neophobia	−0.082	<0.001	−0.093	<0.001	−0.031	0.167
Meat attachment			0.046	0.077	0.134	<0.001
Attitude: Healthiness			0.106	0.001		
Attitude: Ethics					0.167	<0.001
Attitude: Appeal	0.254	<0.001	0.121	<0.001	0.160	<0.001
Attitude: Excitement			0.092	0.002		
Attitude: Nutrition			0.099	0.001		
Attitude: Necessity			0.116	<0.001	0.163	<0.001
Attitude: Goodness	0.209	<0.001	0.094	0.002		
Attitude: Disgust	0.188	<0.001				

Table 6.3: Regression models showing significant predictors (standardized β) of intention to purchase plant-based meat in the USA, China, and India.

Variable	USA		China		India	
	$R^2 = 0.503$, Adjusted $R^2 = 0.500$ $[F_{(7, 979)} = 141.672, p < 0.001]$		$R^2 = 0.396$, Adjusted $R^2 = 0.390$ $[F_{(10, 1008)} = 66.065, p < 0.001]$		$R^2 = 0.441$, Adjusted $R^2 = 0.435$ $[F_{(11, 1010)} = 72.527, p < 0.001]$	
	β	p	β	p	β	p
(Constant)		0.139		0.087		0.116
Gender: Female			0.107	<0.001		
Gender: Other			0.058	0.019		
Diet			−0.065	0.009	−0.156	<0.001
Frequency of meat consumption					0.089	0.002
Education					0.057	0.019
Political views	0.071	0.003			0.039	0.101
Income					0.076	0.002
Familiarity with PBM	0.141	<0.001	0.279	<0.001	0.234	<0.001
Food neophobia	−0.073	0.002	−0.109	<0.001	−0.063	0.012
Meat attachment	−0.033	0.185	0.071	0.013		
Attitude: Healthiness			0.139	<0.001		
Attitude: Appeal	0.206	<0.001	0.128	<0.001		
Attitude: Excitement	0.234	<0.001			0.125	<0.001
Attitude: Taste			0.153	<0.001		
Attitude: Sustainability			0.138	<0.001	0.113	<0.001
Attitude: Necessity					0.142	<0.001
Attitude: Goodness					0.173	<0.001
Attitude: Disgust	0.221	<0.001				

Chapter 7

Table 7.1: Promotional messages given to participants in each experimental condition.

Condition	Message
Introductory passage (shown to all participants)	Clean meat is real meat, grown from animal cells without the need to raise and slaughter farm animals. It has significant benefits for the environment, animals, and human health. Products include chicken (as shown), beef, and more!
Clean meat is natural	Clean meat products are made using a natural process very similar to the way yogurt and beer are fermented. This is a method which has been used in food manufacturing for thousands of years. The development of clean meat resembles how muscles naturally grow within an animal very closely. In fact, this process of cell growth is present in all natural life. Clean meat has many benefits for human health, animals, and the environment. But best of all, it's all-natural!
Conventional meat is unnatural	Production of conventional meat today is far from natural. Animals are fed antibiotics and hormones so that they grow much faster and larger than they would in nature. Unsanitary farming conditions increase the risk of contamination from feces, as well as viruses and bacteria. The meat also contains additives, artificial coloring, and preservatives, and is often treated with radiation. Clean meat avoids all of those issues. It has many benefits for human health, animals, and the environment. But best of all, it's just meat!
Challenging the appeal to nature	You might think that clean meat is unnatural, but naturalness does not necessarily mean goodness. Indeed, most modern food (including rice, tomatoes, milk, and – yes – meat) has been manipulated by people to make it suit our needs, and it is tastier and more nutritious as a result. On the other hand, some plants (like many types of poisonous mushroom) are completely natural but can easily kill you. Clean meat has many benefits for human health, animals, and the environment. It's a perfect example of humans improving on nature!
Control	There are many reasons to eat clean meat: It requires much less water to produce and will cause far less climate change than conventionally-produced meat; it doesn't require animals to suffer or die; it can feed far more people from the same amount of land; and it has the same or better nutritional content as conventionally-produced meat.
	In sum, clean meat has many benefits for human health, animals, and the environment. But best of all, it's delicious real meat!

Table 7.2: Behavioural intention questions.

Question	Response options
1. Would you be willing to try clean meat?	Definitely no (1) to Definitely yes (5)
2. Would you be willing to buy clean meat regularly?	
3. Would you be willing to eat clean meat as a replacement for conventionally-produced meat?	
4. How willing would you be to eat clean meat compared to plant-based substitutes (e.g. soy)?	

Table 7.3: Cognitive belief measures.

Question	Response options
To what extent do you agree or disagree that…	
1. Eating clean meat is likely to be healthy?	Strongly disagree (1) to Strongly agree (5)
2. Clean meat is likely to be safe for human consumption?	
3. Clean meat is more environmentally friendly than conventionally-produced meat?	
4. Clean meat is likely to look, taste, smell, and feel the same as conventionally-produced meat?	
5. Clean meat will have benefits for society?	

Table 7.4: Items, response options, and reliability measures for composite variables.

Measure	Items	Response options	Reliability
Attitude	1. For me to eat clean meat would be…* 2. For me to eat clean meat would be…	1. Extremely good (1) to Extremely bad (7) 2. Extremely unpleasant (1) to Extremely pleasant (7)	α = .88
Affect	Indicate the extent to which each of the following describes your feelings about eating clean meat: 1. Disgusted* 2. Excited 3. Anxious* 4. Comfortable 5. Ethical 6. Immoral*	Not at all (1) to Extremely (7)	α = .75

* Denotes item was reverse scored. Within these measures, the sequence of items was randomised to control for order effects.

Table 7.5: Persuasion checks

Question	Response options
1. Clean meat is unnatural.	Strongly disagree (1) to Strongly agree (5)
2. Conventionally-produced meat is unnatural.	
3. It is important for meat to be natural.	

Table 7.6: Outcome variables in each experimental condition, and overall.

Measure	Overall mean	Condition means: Clean meat is natural	Conventional meat is unnatural	Challenging appeal to nature	Control	ANOVA: F	p
Persuasion checks (5-point scale)							
Perceived unnaturalness of clean meat	2.98	3.01_a	2.91_a	3.03_a	2.99_a	0.57	.64
Perceived unnaturalness of conventional meat	2.58	2.55_a	2.82_b	2.48_a	2.48_a	6.54	< .001
Perceived importance of naturalness	3.80	3.94_a	3.82_{ab}	3.69_b	3.77_{ab}	3.57	.01
Behavioural intentions (5-point scale)							
Willingness to try clean meat	3.88	3.81_a	3.98_a	3.81_a	3.91_a	1.92	.13
Willingness to buy clean meat regularly	3.47	3.45_a	3.57_a	3.38_a	3.49_a	2.02	.11
Willingness to eat clean meat as a replacement for conventional meat	3.54	3.48_a	3.65_a	3.45_a	3.57_a	2.51	.06
Willingness to eat clean meat compared to plant-based substitutes (for 381 participants who ate them)	3.67	3.66_a	3.77_a	3.48_a	3.74_a	1.54	.21
Willingness to eat clean meat compared to plant-based substitutes (for 804 participants who did not eat them)	3.81	3.76_a	3.91_a	3.77_a	3.79_a	1.11	.35
Cognitive beliefs (5-point scale)							
Perceived healthiness of clean meat	3.64	3.61_{ab}	3.78_a	3.53_b	3.65_{ab}	4.14	.01
Perceived safety of clean meat	3.71	3.68_{ab}	3.83_a	3.63_b	3.73_{ab}	2.73	.04
Perceived environmental friendliness of clean meat	4.03	4.04_{ab}	4.09_a	3.87_b	4.10_a	5.10	.002
Perceived similarity in taste of clean meat to conventional meat	3.57	3.58_{ab}	3.65_a	3.46_b	3.60_{ab}	2.46	.06[5]
Perceived benefits to society of clean meat	3.79	3.75_a	3.82_a	3.71_a	3.87_a	1.84	.14
Attitude & Affect							
(Positive) attitude (7-point scale)	4.88	4.78_{ab}	5.07_c	4.70_a	4.98_{bc}	5.31	.001
(Positive) affect (5-point scale)	3.47	3.41_a	3.55_a	3.42_a	3.49_a	1.95	.12

[5] Pairwise comparisons can still be made without a significant omnibus F test if appropriate corrections are made for family-wise error (Hsu, 1996)

Figure 7.1: Willingness to pay for clean meat relative to conventional meat.

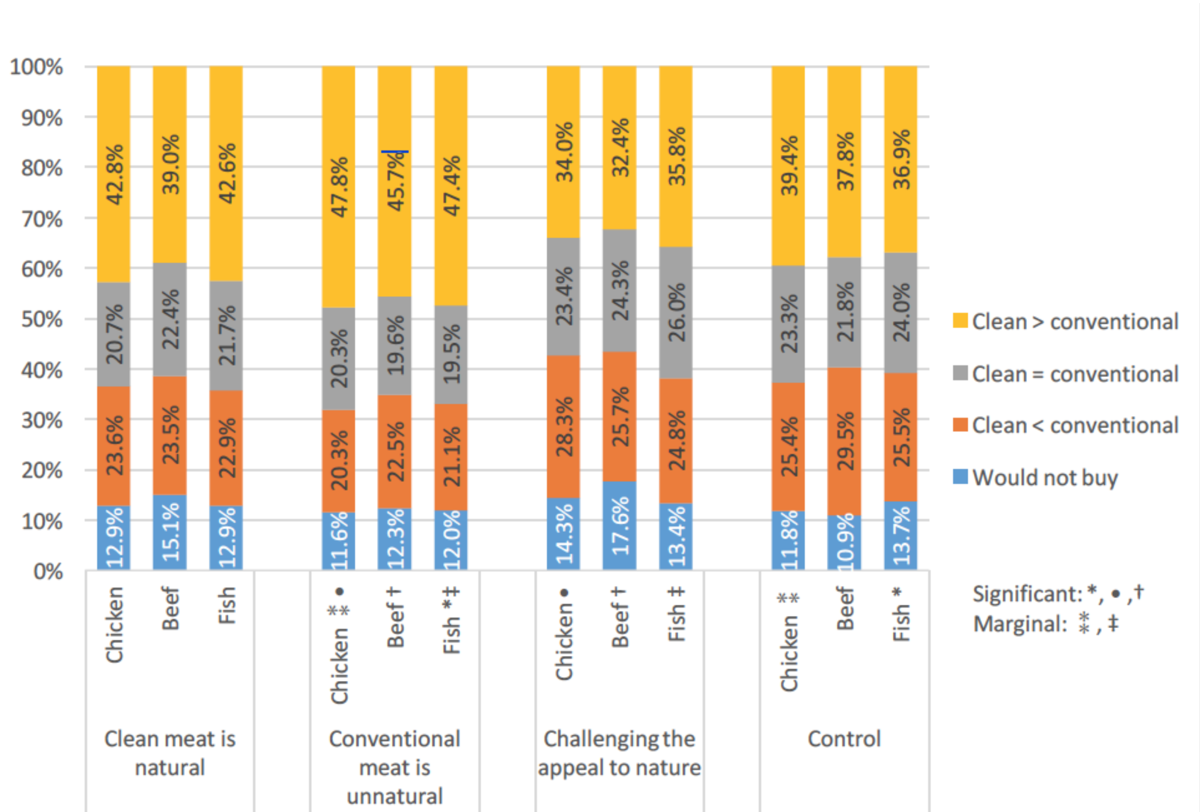


Table 7.7: Regression for overall clean meat acceptance.

	B	*SE*	*t*	*p*
Intercept	0.05	.04	1.43	.15
Contrast: Clean meat is natural vs. Control	-0.07	.05	-1.42	.16
Contrast: Conventional meat is unnatural vs. Control	-0.002	.05	-0.05	.96
Contrast: Challenge vs. Control	-0.13	.05	-2.64	.01
Perceived unnaturalness of clean meat	-0.49	.02	-26.43	< .001
Perceived unnaturalness of conventional meat	0.12	.02	6.55	<.001
Perceived importance of naturalness	-0.04	.02	-2.06	.04

Note. All ordinal/continuous variables are standardized.

Chapter 8

Table 8.1: Demographic breakdown of participants

		Number	Percentage
Gender	Male	276	57.5
	Female	202	42.1
	Other	2	0.4
Age	18–25	92	19.2
	26–35	229	47.7
	36–45	84	17.5
	46–55	38	7.9
	Over 55	37	7.7
Region	Northeast	109	22.7
	South	185	38.5
	Midwest	81	16.9
	West	105	21.9
Diet	Omnivore	422	87.9
	Pescatarian	35	7.3
	Vegetarian	14	2.9
	Vegan	9	1.9

Table 8.2: Text and images presented to participants in each condition.

Societal benefits

Clean meat has many benefits for society like reducing harm to the environment and helping animals.

High-tech

Clean meat is made using highly advanced technology in a state of the art laboratory.

Same meat

Clean meat tastes like conventional meat, is increasingly affordable and can be healthier to eat.

Table 8.3: Word associations given by participants learning about cultured meat.

Category	No. of words	Percentage	Example words
Artificial	73	15.2	Fake, unnatural, artificial
Science	54	11.3	Scientific, laboratory, chemicals
Positive	50	10.4	Good, awesome, super
Natural	40	8.3	Natural, no hormones, unprocessed
Unusual	35	7.3	Weird, strange, different
Food	27	5.6	Beef, calories, steak
Healthy	26	5.4	Fat-free, healthy, good for health
Clean	25	5.2	Sterilized, washed, soap
Disgust	24	5.0	Disgusting, yuck, gross
Other	18	3.8	Options, jars, grown
Taste	16	3.3	Tasty, bland, delicious
Food technology	14	2.9	GMOs, cultured meat, laboratory meat
Interesting	12	2.5	Interesting, intriguing
Animals	10	2.1	Chicken, fish, pig
Ethical	10	2.1	Ethical, cruelty-free, humane
Fear	10	2.1	Unsafe, danger, creepy
Negative	9	1.9	Abomination, dystopia, never
Safety	7	1.5	Safe, safety, passes regulation
Uncertainty	7	1.5	Confusing, why, unobtainable
Environment	5	1.0	Sustainable, biofriendly, green
Special diet	5	1.0	Vegetarian, Halal, Kosher
Cost	3	0.6	Expensive, pricey, cost
Total	480	100	

Table 8.4: ANOVAS showing differences between experimental conditions in attitudes and beliefs.

Variable	ANOVA (2, 477)	Societal benefits M (σ)	High tech M (σ)	Same meat M (σ)
Attitude	$F = 5.711$, $p = 0.004$	3.45_a (1.13)	3.11_b (1.32)	3.55_a (1.20)
Belief that cultured meat is healthy	$F = 5.093$, $p = 0.007$	3.43_{ab} (0.98)	3.23_b (1.12)	3.60_a (1.00)
Belief that cultured meat is safe	$F = 3.247$, $p = 0.040$	3.56_{ab} (1.08)	3.40_b (1.12)	3.71_a (1.01)
Belief that cultured meat is good for the environment	$F = 3.336$, $p = 0.036$	3.98_a (0.99)	3.40_b (1.08)	3.97_a (0.94)
Belief that cultured meat tastes the same as conventional meat	$F = 3.003$, $p = 0.051$	3.27_a (1.07)	3.40_{ab} (1.08)	3.56_b (1.06)
Belief that cultured meat has benefits for society	$F = 0.760$, $p = 0.468$	3.70_a (1.02)	3.63_a (1.08)	3.78_a (1.02)
Concern about cost	$F = 0.935$, $p = 0.393$	2.70_a (1.19)	2.53_a (1.09)	2.57_a (1.19)
Concern about taste	$F = 0.534$, $p = 0.587$	2.38_a (1.05)	2.26_a (1.06)	2.36_a (1.22)
Concern about naturalness	$F = 2.055$, $p = 0.129$	2.40_a (1.19)	2.14_a (1.18)	2.36_a (1.24)
Concern about safety	$F = 1.064$, $p = 0.346$	2.15_a (1.15)	1.99_a (1.15)	2.16_a (1.16)

Table 8.5: ANOVAS showing differences between experimental conditions in behavioral intentions.

Variable	ANOVA (2, 477)	Societal benefits M (σ)	High tech M (σ)	Same meat M (σ)
Willingness to try cultured meat	$F = 9.808$, $p < 0.001$	3.79_{a} (1.10)	3.30_{b} (1.55)	3.85_{a} (1.62)
Willingness to eat cultured meat regularly	$F = 7.313$, $p = 0.001$	3.50_{a} (1.10)	3.03_{b} (1.33)	3.48_{a} (1.21)
Willingness to replace conventional meat	$F = 5.488$, $p = 0.004$	3.37_{a} (1.16)	3.03_{b} (1.36)	3.49_{a} (1.24)
Willingness to eat compared to plant-based meat substitutes	$F = 4.834$, $p = 0.008$	3.42_{ab} (1.20)	3.10_{b} (1.27)	3.51_{a} (1.23)

Chapter 9

Table 9.1: Various names used to refer to IVM in academia, advocacy groups, and the media.

Name	Source(s)	Reception
Cultured meat	Bekker, Fischer, Tobi, and van Trijp (2017)*	Participants in this experimental study had slightly negative explicit attitudes towards cultured meat overall, and negative implicit attitudes.
	Hart Research Associates (2017)*	Focus group participants had overall negative reactions to cultured meat, in particular to this name.
	The Grocer (2017)*	16% of UK consumers in this survey said they would eat '"cultured meat" grown in a laboratory'
Lab-grown meat	Pew Research (2014)*	20% of US consumers in this survey said they would eat 'meat that was grown in a lab'
	The Washington Post (2016)	
Animal-free meat	Bhat and Bhat (2011)	We do not have any empirical data on consumer responses to the use of this term
	Next Nature (2011)	
Clean meat	The Good Food Institute (2017)	In a choice experiment and self-reported measures of purchase intent, consumers preferred 'clean meat' to other terms such as 'meat 2.0', 'cultured meat', and 'pure meat' (though overall there was no significant difference with 'safe meat')
	Animal Charity Evaluators (2017)	In a choice experiment, consumers were significantly more likely to prefer 'clean meat' over conventional meat compared to 'cultured meat'
In-vitro meat	Verbeke, Sans, and Van Loo (2015)*	24% of Dutch participants in this experimental study were 'surely' willing to try 'In vitro meat, which is also called "cultured meat"'
	The Huffington Post (2014)	
	Hocquette et al. (2015)*	Between 9.2% and 19.2% of survey respondents thought that consumers would buy in vitro meat
Synthetic meat	Verbeke, Marcu, et al. (2015)*	European focus group participants perceived many societal benefits for the environment and for animals, but few personal benefits. They also worried about many aspects of synthetic meat, including the effect on human health, and the impact on farming livelihoods and rural landscapes.
	Marcu et al. (2015)*	
Artificial meat	YouGov (2013)*	19% of UK consumers in this survey said they would eat 'artificial meat that can be grown in a laboratory'
	Time (2016)	
Shmeat	National Geographic (2014)	We do not have any empirical data on consumer responses to the use of these terms
Frankenmeat	NBC News (2013)	
Test tube meat	CNN (2014)	
	The Daily Mail (2016)	

** Indicates that the source is a study of consumer acceptance; for these sources, we also describe how IVM was received by study participants.*

Table 9.2: Items, response options, and reliability measures for the quantitative measures used.

Measure	Items	Response Options	Reliability
Attitude	Eating [X] is likely to be healthy. [X] is likely to look, taste, smell, and feel the same as conventional meat. I think I could tell the difference between [X] and conventional meat. [X] is likely to contain chemicals or ingredients which should be avoided. [X] is likely to be safe for human consumption. I would trust [X]. [X] is unnatural. [X] is appealing to me. I feel positive about the development of [X]. The idea of [X] is disgusting. I feel comfortable about the idea of eating [X]. I would be anxious about eating [X]. Eating [X] would conflict with my values. I feel that I would have control over my decision to eat [X] or not. The production of [X] is a necessary scientific development. Others would disapprove of me eating [X]. [X] will have benefits for our society. Production of [X] is wise. Production of [X] is necessary. [X] is more environmentally friendly than conventional meat. Producing [X] poses a risk to society.	Strongly disagree (1) to Strongly agree (5)	α = .947
Behavioural intentions	I would be willing to try [X]. I would buy [X] regularly. I would eat [X] instead of conventional meat. I would rather eat [X] than soy-based meat substitutes or Quorn. I would pay more for [X] than for conventional meat.	Strongly disagree (1) to Strongly agree (5)	α = .918

Table 9.3: Frequency and valence of associations in each category given for each name.

	Total	Animal Free Meat	Clean Meat	Cultured Meat	Lab Grown Meat
Artificial/unnatural	59 (8.2%) 46, -1.24	20 (10.5%) 14, -1.10	5 (2.7%) 5, -0.60	9 (4.8%) 9, -1.22	25 (15.7%) 18, -1.48
Science	52 (7.2%) 32, 0.54	17 (8.9%) 10, 0.71	6 (3.2%) 4, -0.50	18 (9.6%) 11, 0.78	11 (6.9%) 7, 0.45
Type of meat	51 (7.1%) 31, 1.00	8 (4.2%) 4, 1.00	21 (11.4%) 11, 1.19	14 (7.5%) 10, 0.79	8 (5.0%) 6, 0.88
Health/Nutrition	51 (7.1%) 42, 1.43	15 (7.9%) 13, 1.60	29 (15.7%) 22, 1.38	5 (2.7%) 5, 1.00	2 (1.3%) 2, 2.00
Disgust	43 (6.0%) 28, -1.51	9 (4.7%) 6, -1.78	3 (1.6%) 2, -1.67	9 (4.8%) 8, -1.67	22 (13.8%) 12, -1.32
Tasty	38 (5.3%) 29, 1.45	5 (2.6%) 5, 1.20	20 (10.8%) 16, 1.45	7 (3.7%) 4, 1.71	6 (3.8%) 4, 1.33
Unusual/novel	38 (5.3%) 31, 0.18	11 (5.8%) 11, 0.09	1 (0.5%) 1, 1.00	11 (5.9%) 8, 0.55	15 (9.4%) 11, -0.07
Positive	37 (5.1%) 26, 1.35	5 (2.6%) 4, 1.40	11 (5.9%) 11, 1.27	10 (5.3%) 6, 1.40	11 (6.9%) 5, 1.36
Vegetarian/Vegan	34 (4.7%) 23, 0.41	29 (15.3%) 19, 0.41	2 (1.1%) 1, 1.00	-	3 (1.9%) 3, 0.00
Meat preparation	33 (4.6%) 26, 0.73	2 (1.1%) 2, -0.50	14 (7.6%) 12, 0.93	16 (8.6%) 11, 0.63	1 (0.6%) 1, 2.00
Texture or characteristics	29 (4.0%) 22, -0.03	4 (2.1%) 4, 0.00	7 (3.8%) 6, 0.57	13 (7.0%) 9, -0.08	5 (3.1%) 3, -0.80
Clean	29 (4.0%) 27, 1.28	2 (1.1%) 2, 1.00	20 (10.8%) 19, 1.40	4 (2.1%) 4, 1.25	3 (1.9%) 2, 0.67
Uncertainty/ scepticism	27 (3.7%) 19, -0.96	12 (6.3%) 9, -0.83	2 (1.1%) 2, -1.00	8 (4.3%) 4, -1.38	5 (3.1%) 4, -0.60
Natural	25 (3.5%) 16, 1.68	3 (1.6%) 3, 1.67	20 (10.8%) 11, 1.70	2 (1.1%) 2, 1.50	-
Threats to health	24 (3.3%) 19, -1.46	3 (1.6%) 3, -1.00	3 (1.6%) 3, -1.67	6 (3.2%) 4, -1.17	12 (7.5%) 9, -1.67
Animal welfare	21 (2.9%) 19, 1.14	7 (3.7%) 6, 1.43	7 (3.8%) 6, 1.00	5 (2.7%) 5, 0.80	2 (1.3%) 2, 1.50
Miscellaneous	19 (2.6%) 16, 0.42	4 (2.1%) 3, 0.75	4 (2.2%) 4, 0.50	6 (3.2%) 6, 0.33	5 (3.1%) 3, 0.20
Animals/body parts	17 (2.4%) 14, 0.76	2 (1.1%) 2, 0.00	5 (2.7%) 5, 0.80	9 (4.8%) 6, 0.89	1 (0.6%) 1, 1.00
Food	17 (2.4%) 16, 0.71	8 (4.2%) 7, 0.38	2 (1.1%) 2, 1.00	5 (2.7%) 5, 0.80	2 (1.3%) 2, 1.50
Negative	17 (2.4%) 13, -0.76	3 (1.6%) 3, -0.67	-	10 (5.3%) 7, -0.80	4 (2.5%) 3, -0.75
Alternative names	16 (2.2%) 11, 0.75	3 (1.6%) 3, 1.00	1 (0.5%) 1, -2.00	5 (2.7%) 4, 1.00	7 (4.4%) 3, 0.86
Price	16 (2.2%) 15, -0.94	2 (1.1%) 2, -1.50	1 (0.5%) 1, -1.00	7 (3.7%) 6, -0.57	6 (3.8%) 6, -1.17
Environment	15 (2.1%) 12, 0.93	7 (3.7%) 6, 1.29	1 (0.5%) 1, -2.00	6 (3.2%) 4, 1.00	1 (0.6%) 1, 1.00
Not tasty	13 (1.8%) 11, -1.46	9 (4.7%) 7, -1.33	-	2 (1.1%) 2, -2.00	2 (1.3%) 2, -1.50
Grand Total	**721 (100%) 185, 0.31**	**190 (100%) 49, 0.19**	**185 (100%) 48, 0.99**	**187 (100%) 48, 0.28**	**159 (100%) 40, -0.30**

Table 9.4: Mean scores and standard deviations of dependent variables across experimental conditions.

	Animal Free Meat	Clean Meat	Cultured Meat	Lab Grown Meat
Attitude	3.34_{a} (0.81)	3.43_{a} (0.74)	3.22_{ab} (0.81)	2.76_{b} (0.89)
Behavioural Intentions	3.08_{ab} (1.05)	3.35_{a} (0.98)	3.17_{ab} (1.00)	2.58_{b} (1.35)

Figure 9.1: Results of the mediation analysis for ‘lab grown meat’ (dummy coded 0) vs. ‘clean meat’ (dummy coded 1) on behavioural intentions.

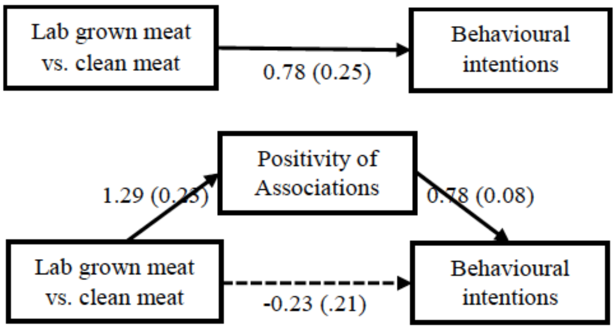


Figure 9.2: Results of the mediation analysis for ‘lab grown meat’ (dummy coded 0) vs. ‘clean meat’ (dummy coded 1) on attitudes.

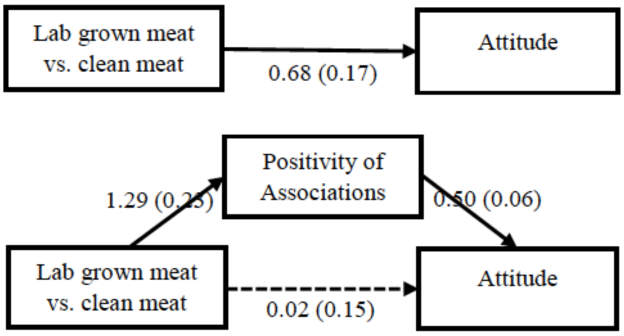
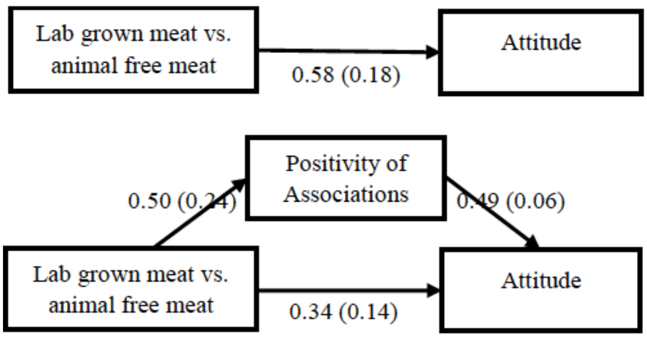


Figure 9.3: Results of the mediation analysis for ‘lab grown meat’ (dummy coded 0) vs. ‘animal free meat’ (dummy coded 1) on attitudes.



Appendix 9A: Items used in the attitude measure with previous studies/justifications.

No.	Item	Previous Studies
1	Eating [X] is likely to be healthy.	Magnusson and Hursti (2002); Tenbült, de Vries, Dreezens, and Martijn (2005)
2	[X] is likely to look, taste, smell, and feel the same as conventional meat.	Cardello (2003); Tan, Verbaan, and Stieger (2016)
3	I think I could tell the difference between [X] and conventional meat. *	Cardello (2003); Tan et al. (2016)
4	[X] is likely to contain chemicals or ingredients which should be avoided. *	The Grocer (2017) found that 56% of respondents cited this as a concern
5	[X] is likely to be safe for human consumption.	Frewer, Howard, Hedderley, and Shepherd (1997); Tanaka (2004); Titchener and Sapp (2002)
6	I would trust [X].	Eiser, Miles, and Frewer (2002); Tanaka (2004)
7	[X] is unnatural. *	Frewer et al. (1997); Tenbült et al. (2005); Townsend and Campbell (2004)
8	[X] is appealing to me.	None. Added for completeness.
9	I feel positive about the development of [X].	Honkanen and Verplanken (2004)
10	The idea of eating [X] is disgusting. *	Townsend and Campbell (2004)
11	I feel comfortable about the idea of eating [X].	None. Added for completeness.
12	I would be anxious about eating [X]. *	Frewer, Howard, Hedderley, and Shepherd (1999); Frewer, Howard, and Shepherd (1998)
13	Eating [X] would conflict with my values. *	Honkanen and Verplanken (2004)
14	I feel that I would have control over my decision to eat [X] or not.	Magnusson and Hursti (2002); Saba and Vassallo (2002)
15	The production of [X] is a necessary scientific development.	Frewer et al. (1997); Frewer et al. (1998); Tenbült et al. (2005)
16	Others would disapprove of me eating [X]. *	Saba and Vassallo (2002)
17	[X] will have benefits for society.	Magnusson and Hursti (2002); Scholderer and Frewer (2003)
18	Production of [X] is wise.	Bredahl (2001); Grunert, Bech-Larsen, Lähteenmäki, Ueland, and Åström (2004); Scholderer and Frewer (2003)
19	Producing [X] is ethical.	Magnusson and Hursti (2002); Townsend and Campbell (2004)
20	Producing [X] poses a risk to society. *	Frewer et al. (1998); Savadori et al. (2004)
21	[X] is more environmentally friendly than conventional meat.	None. Added for completeness.

Chapter 10

Table 10.1: Inclusion and exclusion criteria.

Inclusion criteria	**Exclusion criteria**
1. Focus on consumer perceptions of cultured meat 2. Presents original empirical data 3. Published in a peer reviewed journal 4. Published since 2018 (inclusive) 5. English language	1. Sources which do not discuss consumer perceptions of cultured meat 2. Review articles which do not include original empirical data 3. Book chapters, conference papers, and unpublished theses and white papers 4. Articles already reviewed in Bryant and Barnett (2018)

Figure 10.1: Process for identifying relevant literature.

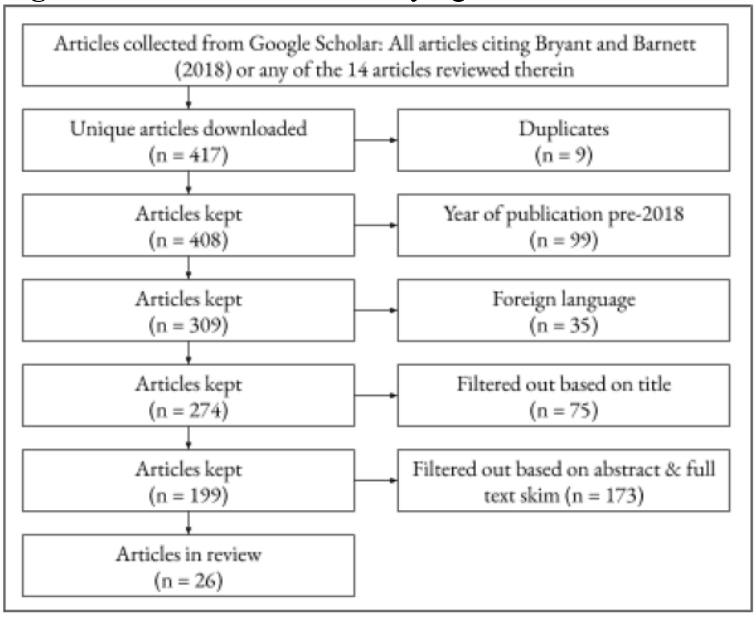


Table 10.2: Key details of 26 studies included in the review.

Study	Method	Sample	Key findings
Arora, Brent and Jaenicke (2020)	Survey	394 Mumbai adults	There are distinct groups of consumers who prefer each of four different protein sources: chana (21%), conventional meat (27.5%), plant-based meat (32%) or cultured meat (19.6%). Consumers were willing to pay a small premium for cultured meat compared to conventional meat.
Bryant, Anderson, Asher, Green and Gasteratos (2019)	Experimental	1,185 US adults, census balanced	The arguments that cultured meat is natural, and that naturalness should not matter tend not to persuade consumers, and resulted in lower acceptance than discussing general benefits without addressing naturalness. Arguing for the unnaturalness of conventional meat was relatively effective, though this argument may not be politically feasible for a co-operative market strategy.
Bryant and Barnett (2019)	Experimental	185 adults recruited online	The name used to describe cultured meat has a significant effect on consumers' attitudes and behavioural intentions, with 'clean meat' resulting in significantly more positive attitudes than 'lab-grown meat' ('cultured meat' and 'animal-free meat' were not significantly different from either of the first two names). This effect was mediated by the positivity of word associations, suggesting that the mechanism is associative.
Bryant and Dillard (2019)	Survey	480 US adults, generally representative	A frame focused on the high-technology/scientific nature of cultured meat resulted in significantly less positive attitudes and intentions compared to frames focused on the societal benefits of cultured meat, or its similarity to conventional meat.
Bryant, Szejda, Parekh, Deshpande and Tse (2019)	Experimental	3,030 adults in the US, India, and China, generally representative	There are substantial markets for cultured meat (and plant-based meat) in China, India, and the USA, and acceptance of both is significantly higher in China and India compared to the USA. While some demographic predictors of acceptance such as being a meat-eater and being left-leaning predicted cultured meat acceptance across countries, specific attitudinal predictors varied. Disgust predicted cultured meat rejection in the USA only, whilst acceptance in China was driven by perceived healthiness and safety, and ethical considerations were uniquely predictive of acceptance in India.
Circus and Robison (2019)	Survey	139 UK adults, convenience samples, disproportionately meat reducers	Cultured meat was preferred to insects, but plant-based meat was preferred to cultured meat. Meat attachment was positively related to cultured meat acceptance. People generally held congruent views with respect to societal views of, and personal willingness to eat cultured meat.
Dupont and Fiebelkorn (2020)	Survey	718 German children and adolescents (mean age 13.67, 57% female)	Participants preferred cultured meat burgers to insect burgers, though they broadly found both disgusting. Attitudes towards specific product formats are important for children. Those higher in neophobia and disgust sensitivity were less likely to want to eat cultured meat.
Egolf, Hartmann and Siegrist (2019)	Survey	313 Swiss adults, nat rep	Cultured meat rejection was predicted by disgust. Although cultured meat was considered the most beneficial of three food technologies included, it was more accepted than GMOs but less accepted than a synthetic food additive.
Geipel, Hadjichristidis and Klesse (2018)	Experimental	161 MTurk participants (mostly female, young) German-speaking	Consumers are more likely to say they would eat cultured meat when asked about it in a foreign language (vs. their native language). The effect was mediated by disgust.
Gomez-Luciano, de Aguiar, Vriesekoop and Urbano (2019a)	Survey	729 adults in the UK, Spain, Brazil, and the Dominican Republic	Meat alternatives were generally more appealing to to higher income groups, and cultured meat was more appealing to the European countries than the non-European countries. Perceived healthiness, nutrition, and safety were important predictors of willingness to pay for cultured meat across countries.
Gomez-Luciano, Vriesekoop and Urbano (2019b)	Survey	401 adults from the Dominican Republic and Spain	Participants generally preferred cultured meat to insects, but preferred plant-based meat to cultured meat. Cultured meat was generally rated worse than alternatives on perceived healthiness, safety, nutrition, sustainability, and price. Being male and having higher education were predictors of choosing alternative proteins.

Grasso, Hung, Olthof, Verbeke and Brouwer (2019)	Survey	1,825 community-dwelling older adults (65+) in the UK, the Netherlands, Poland, Spain, and Finland	Cultured meat was the least preferred alternative protein, chosen by just 6% of participants compared to plant-based protein (58%), single-cell protein (20%) and insect-based protein (9%). Compared to the UK, participants were in the Netherlands (23%) and Finlalnd (14%) were more likely to eat cultured meat, whilst those in Spain (5%) and Poland (39%) were less likely. Anticipated price and taste were predictors of cultured meat acceptance, as well as food fussiness and green eating behaviour.
Koch, van Ittersum and Bolderdijk (2018)	Experimental	145 Dutch participants	Cultured meat was perceived to violate norms, which caused moral disgust and subsequent rejection by consumers.
Lupton and Turner (2018)	Online focus group discussion	30 Australian adults	Participants recognised the benefits of cultured meat for society, but generally considered it unnatural, not fresh, not nutritious, potentially harmful, and lacking in taste. Cultured meat was considered less natural and less nutritious than insects.
Mancini and Antonioli (2019)	Survey	525 Italian adults, generally representative	The majority (54%) were willing to try cultured meat. People generally agreed with the positive external effects of cultured meat (for animals, the environment, and food security) but gave lower ratings to its intrinsic characteristics (safety, taste, and nutrition). Predictors of acceptance included youth, higher education, higher familiarity, and being a meat-eater.
Mancini and Antonioli (2020)	Experimental	525 Italian adults, generally representative	Providing consumers with additional positive information about cultured meat increased acceptance, including willingness to buy, but not willingness to try.
Michel and Siegrist (2019)	Survey	632 German participants	Subjective importance of naturalness predicted cultured meat acceptance. Those who consider naturalness to be important are less likely to consider cultured meat natural, and are less likely to consume cultured meat.
Rolland, Markus and Post (2020)	Experimental	193 adults who lived close to Maastricht	Acceptance of cultured meat was increased by the provision of positive information, and by a (simulated) tasting experience. Of three conditions, information about the personal benefits of cultured meat led to a significantly higher improvement in attitudes than information about the quality and taste, though information about the societal benefits produced an improvement in attitudes no different from the other two conditions. All participants ate what they believed was a cultured meat burger, and rated it as better tasting than a conventional burger despite a lack of objective difference.
Shaw and Mac Con Iomaire (2019)	Focus groups	312 Irish adults Convenience sample, roughly stratified to include young and old rural and urban participants	Participants generally characterised cultured meat as unnatural, and had related safety concerns. They expressed trust in Irish meat, and distrust in food companies and food labelling regulations. In particular, they showed concern about the implications of cultured meat for Irish farmers. Participants generally expected cultured meat to have an inferior taste and texture, and expected it to be cheaper than conventional meat. Environmental benefits were seen as most important, whilst safety was the biggest concern. Characteristics associated with acceptance included being younger, being male, and living in an urban area.
Specht, Rumble and Buck (2020)	Twitter analysis	2,763 Tweets from inside the USA over a 6 month period	Tweets discussing cultured meat generally discussed eight themes: legality and marketing, sustainability,; acceptance, business, animal concerns, science and technology, health concerns, and timeline. Influencers discussing this topic included philanthropists, government officials, journalists and writers, and animal advocates. Interested groups included top news and tech influencers, vegan groups, and agricultural interests, as well as media personalities Joe Rogan. Discourse was found to be driven by specific events in the media.
Tucker (2018)	Focus groups	69 New Zealand participants in 19 focus groups	Generally, participants considered cultured meat unnatural, and not ‘real meat’, though some acknowledged potential environmental benefits.

Valente, Fiedler, Heidemann and Molento (2019)	Survey	626 Brazilians Snowball sample from two towns, disproportionately female and well-educated	Many participants perceived problems with conventional meat, principally around animal welfare but also with respect to the environment and human health. Though 81% knew little or nothing about cellular agriculture, 39% said they would eat cultured meat with no conditions and a further 24% said it depends on factors such as taste, healthiness, price, and further information. Just 15% said they would not eat cultured meat (22% said don't know). The biggest motivators were animal welfare, the environment, health, and trying alternatives, whilst the major concerns were affordability, healthiness, ethics, and a lack of research.
Van der Weele and Driessen (2019)	Focus groups	~45 people in the Netherlands, including older and younger groups	Overall, reflecting on cultured meat caused people to reveal deep ambivalence about eating animals. Younger people generally wondered about whether they would eat cultured meat; older people wondered about the transition at a societal and historical level. Generally, the conversations revealed a lot of ambivalence about eating meat.
Weinrich, Strack and Neugebauer (2020)	Survey	713 German adults, generally representative	Participants were moderately prepared to accept cultured meat: 57% would try it, 30% would buy regularly. Attitudes were structured in three dimensions: the strongest predictor of acceptance was perceived ethical benefits, followed by emotional objections, and optimism about global diffusion.
Wilks, Phillips, Fielding and Hornsey (2019)	Survey	1,193 US adults, generally representative	Food neophobia, political conservatism, and distrust of food scientists predicted rejection. Food hygiene sensitivity, food neophobia and conspiratorial ideation predicted absolute rejection. Naturalness sensitivity did not predict either measure of acceptance.
Zhang, Li and Bai (2020)	Survey	1,004 urban Chinese consumers	Despite most respondents having limited knowledge of cultured meat, most do not oppose it. Over 70% are willing to taste or purchase cultured meat, and consumers are willing to pay an average of 2.2% more than for conventional meat. Predictors of cultured meat acceptance included being younger, being male, having a higher level of education, and having higher trust in the government's regulation of food safety.

Table 10.3: Representative surveys of cultured meat acceptance.

Study	Sample	Acceptance Rate
Bryant et al. (2019a)	1,185 adults in the US. Census balanced.	66.4% would try; 48.9% would eat regularly; 55.2% would eat instead of conventional meat
Bryant et al. (2019b)	3,030 adults in the US, India, and China.	US: 29.8% very or extremely likely to purchase China: 59.3% India: 48.7%
Bryant & Dillard (2019)	480 adults in the US.	64.6% would try; 24.5% would buy regularly; 48.5% would eat instead of conventional meat
Gomez Luciano et al. (2019a)	729 adults in the UK, Spain, Brazil, and the Dominican Republic.	Would purchase, UK: 20%; Spain: 42%; Brazil: 11.5%; Dominican Republic: 15%
Mancini & Antonioli (2019)	525 adults in Italy.	54% would try; 44% would buy; 23% would pay a premium
Weinrich, Strack & Neugebauer (2020)	713 adults in Germany.	57% would try; 30% would buy

Chapter 11

Table 11.1: Cultured meat acceptance in Judaism.

Judaism (n = 23)			
	Currently eat	Find cultured meat appealing	Difference
Beef	87.0%	69.6%	- 17.4%
Poultry	91.3%	69.6%	- 21.7%
Pork	60.9%	60.9%	0%
Lamb/Goat	65.2%	60.9%	- 4.3%

Table 11.2: Cultured meat acceptance in Islam.

Islam (n = 193)			
	Currently eat	Find cultured meat appealing	Difference
Beef	64.8%	57.5%	- 7.3%
Poultry	74.6%	48.7%	- 25.9%
Pork	30.1%	27.5%	- 2.6%
Lamb/Goat	81.3%	67.9%	- 13.4%

Table 11.3: Cultured meat acceptance in Hinduism.

Hinduism (n = 730)			
	Currently eat	Find cultured meat appealing	Difference
Beef	18.2%	18.9%	+ 0.7%
Poultry	67.5%	68.1%	+ 0.6%
Pork	18.5%	19.6%	+ 1.1%
Lamb/Goat	61.4%	64.4%	+ 3.0%

Table 11.4: Cultured meat acceptance in Buddhism.

Buddhism (n = 139)			
	Currently eat	Find cultured meat appealing	Difference
Beef	87.8%	81.3%	- 6.5%
Poultry	82.0%	61.2%	- 20.8%
Pork	81.3%	73.4%	- 7.9%
Lamb/Goat	69.8%	65.5%	- 4.5%

Chapter 12

Table 12.1: Effect sizes observed in different empirical studies.

Study	**Effect size on behavioural measure**	**Effect size interpretation (Cohen, 1998)**	**Type of comparison**
Explaining (Bryant et al., 2019b)	$\eta^2 = .005$	No significant effect	Systematic
Naming (Bryant & Barnett, 2018)	$\eta^2 = .061$	Medium	Heuristic
Framing (Bryant & Dillard, 2019)	$\eta^2 = .030$	Small - medium	Heuristic
Cross-country (Bryant et al., 2019a)	**Between countries:** $\eta^2 = .081$ **Within countries:** USA adjusted $R^2 = .500$ China adjusted $R^2 = .494$ India adjusted $R^2 = .548$	**Between countries:** Medium **Within countries:** Large	Market

Figure 12.1: Rogers' (2003) diffusion of innovations model.

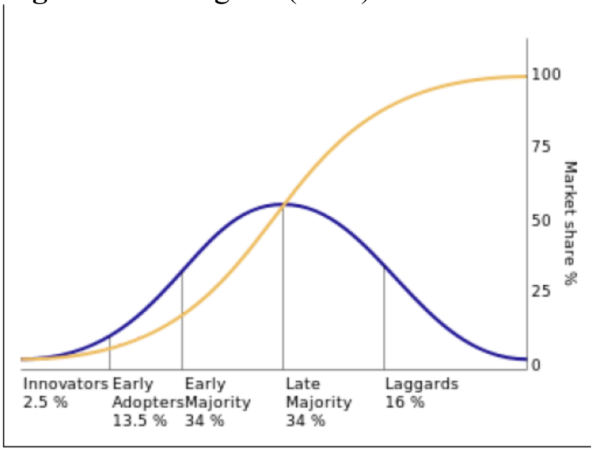
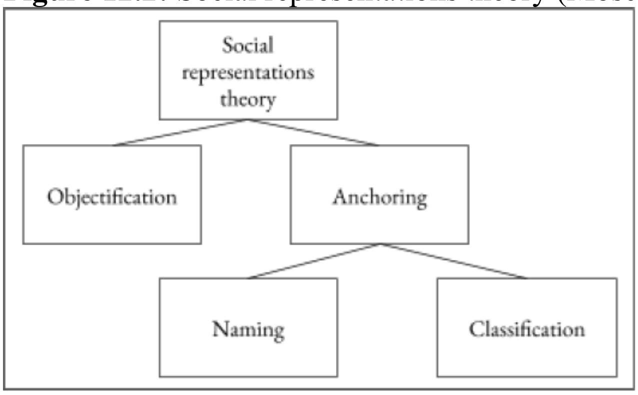


Figure 12.2: Social representations theory (Moscovici, 2001)



Acknowledgements

I am extremely grateful to a number of wonderful people who have helped and supported me through this journey.

I am grateful to my supervisor, Julie Barnett, whose vast expertise, tenacious work ethic, and good humour have made my doctorate a fantastic experience. Truly this has been a very enjoyable partnership, and long may it continue.

I am grateful to my friends and colleagues at the University of Bath, especially those with whom I have shared an office. I consider myself very fortunate to have worked with such thoughtful, intelligent, and kind people. I learned from you all.

I am grateful to my co-authors, collaborators, friends, and colleagues in the Effective Altruism movement and the animal advocacy movement. It lifts my heart to know that such brilliant and determined people are working to make the world a better place. Thank you for encouraging me and each other to do more for the animals.

I am grateful to my family for believing in me and encouraging me. I am blessed to have always had an extremely loving and supportive family, and I hope that my contribution to the world will make them proud.

I am grateful to my friends who have supported me, laughed with me, and questioned me about when I will be getting a proper job. I am truly glad to know so many genuine, funny, insightful and warm people, and I am thankful to you all.

I am grateful to my girlfriend, Melisa, with whom I have shared the PhD journey through rough times and smooth. You have always been loving and understanding, and I am blessed to have met somebody so kind and gentle with whom to share my life.

List of Abbreviations

AIDA	Awareness interest desire action
ANOVA	Analysis of variance
BSE	Bovine spongiform encephalopathy
CM	Cultured meat
EFSA	European Food Safety Authority
EU	European Union
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
GM	Genetically modified
GMO	Genetically modified organism
IPCC	International Panel on Climate Change
IVM	In vitro meat
MANOVA	Multiple analysis of variance
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
OSF	Open Science Framework
PBM	Plant based meat
UK	United Kingdom
US(A)	United States (of America)
USDA	United States Department of Agriculture
VNP	Very new product
WHO	World Health Organization
WTP	Willingness to Pay

Abstract

For millennia, we have killed animals for meat. Now, as the ethical, environmental, and public implications of our industrial system of animal farming become clearer, we must look for ways to reduce consumption of animal products which are likely to achieve traction amongst a meat-loving population.

This thesis argues for the immorality of animal agriculture, and shows that a range of social and psychological factors impede clear reasoning on this topic. It is demonstrated that many people agree with the ethics of veganism, but are unwilling to reduce their meat consumption in practice.

Cultured meat is introduced as a potential solution. Cultured meat, grown in vitro from animal cells can allow us to continue consuming real animal meat whilst circumventing the worst consequences of meat production today. The literature on consumer acceptance of cultured meat is reviewed and areas for further investigation are identified.

The empirical work in this thesis includes a cross-country survey on cultured and plant-based meat in India, China, and the USA, where major potential markets are identified. A series of experimental studies explore the best ways to name, frame, and explain cultured meat to maximize consumer acceptance and displace demand for animals.

The thesis then reviews the deluge of empirical literature which has been added to the field during this doctorate, and discusses the social implications of cultured meat in terms of religions, regulators, the media, and the broader economy. The concluding section identifies strategies for bringing cultured meat to market and discusses the findings in terms of some theoretical frameworks.

1. Introduction

In this section, I will first outline my reasons to focus on animal suffering as the basis for my argument as opposed to other arguments against animal farming. Second, I will make the moral case against animal agriculture, arguing that morality is necessarily linked to the wellbeing of conscious creatures, and animal farming causes more suffering than wellbeing overall. Finally, I will review the social and psychological barriers to clear reasoning about farm animal suffering within the AIDA decision-making framework.

Before beginning my discussion of the morality of eating animals, I will outline some of the other reasons that we ought to eat far less meat than we tend to. Even from a human-centric perspective, our current meat production systems are directly causing and exacerbating some of the most pressing environmental and public health concerns of our time.

Greenhouse gases from livestock systems account for 15% of human-caused emissions, which is a higher proportion than all of the world's transport systems combined (Bailey, Froggart & Wellesley, 2014). Beyond the direct emissions, calorie-hungry livestock demand vast crops to feed them; livestock systems are now the primary driver of deforestation in the Amazon (Garcia, Ramos Filho, Mallmann & Fonseca, 2017; Ibrahim, Porro & Mauricio, 2010). Animal farming is also extremely water intensive, and is responsible for up to one third of fresh water consumption (Mekonnen & Hoekstra, 2012; Gerbens-Leenes et al., 2013; Herrero et al., 2013). Beyond this, animals produce an incredible amount of waste; it is estimated that a dairy farm with 2,500 cows produces the same amount of waste as a city of over 400,000 people (Haines & Staley, 2004).

Public health is another concern which is exacerbated by industrial animal agriculture. Livestock are a common vessel for zoonotic diseases, bringing us avian flu, swine flu, and BSE in recent memory (Klous, Huss, Heederik & Coutinho, 2016). Additionally, animal agriculture is rife with antibiotic abuse - the conditions on farms are such that animals frequently become sick, and one industry solution is to keep them continually medicated with preventative and growth-enhancing antibiotics (Cheng, Chen, Su & Yan, 2013; Mathew, Cissel & Liamthong, 2007; Oliver, Murinda & Jayarao, 2011). The result is an increase in antibiotic resistant pathogens which can affect humans, exacerbating one of the major public health concerns of our time (Mathew, Cissel & Liamthong, 2007).

Personal health, too, is impacted by overconsumption of meat and animal products. In particular, the World Health Organization classified red and processed meats as carcinogenic many years ago; they are in the same categories of cancer-causing substances as asbestos and tobacco, respectively (World Health Organization, 2015). Meat consumption has also been associated with an increased risk of heart disease (Zhong et al., 2019) and diabetes (Feskens, Sluik & van Woudenbergh, 2013), while plant-based diets are shown to reduce cholesterol and blood pressure (Ferdowsian & Barnard, 2009; Jenkins et al., 2008).

1.1 Arguing about animals

In justifying my opposition to animal agriculture in academic contexts, I am often advised to avoid pressing too firmly on arguments about animal suffering. To do so is to implicate one's audience in a fairly confrontational way. It is far more polite to talk about the environmental damage done by rearing animals, or the negative health consequences of consuming too many animal products. Discussion of the animal suffering entailed in our food system is generally expected to be a rather apologetic footnote to a related environmental argument. Stating the bare facts about what we routinely do to animals will raise eyebrows at most academic conferences.

I recognise that there are plenty of other arguments one could rely on to argue against animal agriculture. There are good reasons to avoid animal products relating to climate change, deforestation, water consumption, eutrophication, species extinction, antibiotic resistance, heart disease, diabetes, obesity, and cancer (FAO, 2006, 2011; Feskens, Sluik & van Woudenbergh, 2013; IPCC, 2018; Margulis, 2004; Poore & Nemecek, 2018; Rouhani, Salehi-Abargouei, Surkan & Azadbakht, 2014; Willett et al., 2019; WHO, 2015). Frankly, I consider it convenient that such reasons exist, since they appear to give many people who are not concerned with animal suffering the impetus to consume fewer animal products (Bryant, 2019a).

However, I have chosen not to base my argument on the many environmental and health related harms done by overconsumption of animal products. These arguments have been well made in recent high quality well-publicised research (IPCC, 2018; Poore & Nemecek, 2018; Willett et al., 2019). I have decided, instead, to focus on the ethics of animal suffering.

At this point, the omnivorous reader may feel their attention waning. They might think, "OK, I understand that there are animal rights advocates, but this is not really *my* issue." For many, the automatic response to this topic being broached is to code the conversation as somehow irrelevant to them. It is easy to see why one might be tempted to do this: in thinking about this issue, some uncomfortable truths threaten to confront the committed carnivore. However, I have decided to base my argument on animal suffering instead of environmental or health arguments for three main reasons.

First, the distinction between these arguments against animal farming is a practical matter. The aims of an environmentalist or a health advocate might reasonably diverge from those of an animal advocate with respect to specific animal product consumption. In particular, the latter should focus on reducing consumption of chicken and fish primarily, whilst the former two would be most concerned about red meat and dairy (Bryant, 2019a). In any instances where such a distinction becomes relevant, it is important to be explicit about one's motives.

Secondly, it is possible that we could develop ways to address all of the environmental and health concerns associated with animal agriculture, and continue to confine and slaughter animals against their will. Indeed, efforts are underway to do just that. Research has investigated ways of reducing cows' methane emissions and altering the nutritional profile of their meat by changing and supplementing their diets (Dugan et al., 2011; Hulshof et al., 2012). If such efforts amount to sustainable and healthy meat, there will still be a strong moral case for dismantling animal agriculture in my view.

Thirdly, and perhaps most importantly, I believe it to be true that animal agriculture causes needless animal suffering, and that this is a bad thing. In a recent talk that I gave, I gave a brief description of what happens to pigs in the UK. I noticed a gentleman in the audience shaking his head solemnly. At the time, I did not know if he was conveying horror at the reality of what happens to pigs, or horror at the reality of me talking about it. It turned out to be the latter. The gentleman later advised me to 'tone down' what I say about animals. I asked him if he thought anything I had said was incorrect, and, as is often the case in such a situation, he did not.

I find it regrettable that alleviating animal suffering is not generally considered a legitimate project by itself, and therefore research which addresses animal suffering is often conducted under the guise of pro-environmental or health research. Indeed, many people seem to be unwilling to recognise animal suffering as a real problem at all. I therefore view it as an important project to argue for the legitimacy of research seeking to reduce animal suffering per se.

For these reasons, I have chosen to argue against animal farming primarily on the basis of animal suffering. I understand that there are perfectly good environmental or health arguments one could deploy against our current system of animal agriculture, and I also understand that it is uncomfortable to think about the reality of animal suffering in factory farms and slaughterhouses. Therefore, I offer to the omnivorous reader a sincere apology for imposing upon them some of the grizzly and dissonance-provoking content herein.

1.2 The moral case against animal agriculture

FORMALISED ARGUMENT

A. A being is morally relevant if and only if it is sentient such that it can suffer (1.3.1)
B. Animals can experience suffering (1.3.2)
C. ∴ Animals are morally relevant beings.

D. An action is morally good/bad to the extent that it decreases/increases net suffering (1.3.1)
E. Animal agriculture causes net suffering to morally relevant beings (1.3.4)
F. ∴ Animal agriculture is morally bad.

Here, I make the case the moral case against animal agriculture. First, I discuss the foundations of morality, arguing that actions are morally good/bad to the extent that they tend to decrease/increase suffering. Second, I argue that any being which is sentient and capable of suffering should be considered morally relevant. Third, I demonstrate that the animals we use for food are sentient and capable of suffering, and are therefore morally relevant. Fourth, I argue that animal agriculture, although it provides some benefits to humans, causes immensely more suffering to animals. I argue that animal agriculture tends to increase suffering to morally relevant beings, and is therefore immoral.

I will note here that this thesis is predominantly about meat, although there are also ethical issues in the production of milk and eggs, as I shall discuss in this chapter. However, I have tended to use ‘vegetarian’ and ‘vegan’ interchangeably in this thesis – this is because the average reader is likely to be (a) more familiar with vegetarianism than with veganism, and (b) insensitive to the difference. While some chapters (e.g. Chapter 4) make a deliberate distinction between vegetarianism and veganism, others (e.g. Chapter 3) hope to move things in the direction of meat reduction more broadly, and therefore use the terms interchangeably.

1.2.1 Moral foundations

It is a commonly held view that research should, as far as possible, be conducted in a value-free way. This view can be traced to Weber (1919) and Durkheim (1938), who urged social scientists to put their own values aside in the pursuit of truth. This concern appears to be based on Hume’s (1739) observation that many writers conflate ‘is’ and ‘ought’, mistakenly deriving normative statements from empirical ones. Bryman (2016) states that positivists are committed to phenomenalism - the idea that knowledge must be based on information obtained through the senses - and that this commitment requires a distinction between the empirical and the normative ‘because the truth of normative statements cannot be confirmed by the senses.’ (Bryman, 2016).

However, I do not subscribe to the view that there is a clear line to be drawn between 'is' and 'ought'. On the contrary, it appears that we can only talk about how things ought to be with reference to how things, in fact, are or could be. That is to say, the conditions of the physical and social world affect conscious creatures, inflicting more or less suffering or wellbeing. The conditions which overall are conducive to more suffering are worse, and the conditions which are conducive to more wellbeing are better. What would be a valid basis for normative statements, if not the change in conditions that affect the wellbeing of conscious creatures via their senses? As Harris (2011) has argued, if good and bad are to mean anything, surely they relate to the wellbeing of conscious creatures.

Indeed, the idea that research can and should be conducted in a value-free way has increasingly fallen out of favour in modern social science, and is sometimes seen as naive. As Bryman (2016) states, our values can influence every stage of research, from the choice of research area to interpretations of data and conclusions. However careful one might be with one's study design and interpretation of data, even deciding on an area of inquiry implies that one values knowledge in this area (Hammersley, 2017). The decision to study interventions to reduce smoking, for example, comes with the assumption that reducing smoking would be a good thing. One could easily study ways of increasing smoking with just as much rigour and objectivity. Each of these projects come with value judgements baked in.

Rather than insisting that research be conducted in a value-free way, it is now seen as more realistic to accept that researchers hold certain values, and to embrace 'philosophical self-reflection' as a way of scrutinising one's own values and making them explicit to one's audience (Bryman, 2016; Lynch, 2000). In this spirit, I shall confess to a particular view of morality, which I make the case for here.

What is morally bad?

In discussing values in research, Hammersley (2017) proposes that we have 'value principles', and that from these, we arrive at 'value judgements' based on an empirical view of the world. In other words, we may view certain outcomes as morally bad in principle, and therefore judge specific actions to be bad based on reasoning that these actions are likely to produce these bad outcomes. As the author explains, this framework allows for different opinions on what outcomes we should value (value principles). Moreover, it allows for different opinions on what specific actions are wrong (value judgements) even given the same set of value principles . Such a disagreement would presumably arise from a disagreement about the relevant empirical facts of a given case.

Here, I make the case for the value principle that suffering is bad. From this principle, one can look at empirical facts and make a value judgement about the morality of a given practice based on its likely impact on overall suffering. In this case, given the principle that suffering is bad, it is straightforward to make a purely empirical argument that animal farming is bad.

As Harris (2011) has argued, to discuss morality is to discuss the impact of actions on the wellbeing of conscious creatures. Creating conditions which cause suffering is surely the basis for saying that anything is morally wrong. This applies to specific actions like targeting cultural sites in war and to general outcomes like contributing to climate change. In each case, we are only tempted to say that the action is wrong because it causes suffering to conscious beings. We say that it is wrong to target cultural sites in war not because the sites are inherently valuable, but because people value the sites such that they would suffer if they were targeted. Similarly, it is not inherently bad for the climate to change - it is bad specifically because this will have a negative impact on the conscious inhabitants of the planet. We are not concerned about climate change on Mercury, because there is nobody there to suffer as a result.

A detractor of this view might claim not to care about suffering at all. Harris (2018) invites anybody who sincerely claims to hold this view to ‘place your hand on a hot stove and report back.’ Others might claim to value something other than reducing suffering - duty, loyalty, and beauty are some examples (Singer, 1991). However, these values are not incommensurate with valuing a reduction in suffering. Indeed, as Gloor (2019) has argued, most views focused on reducing suffering are pluralistic, and can afford valuing other things. Moreover, it seems that anything else one could claim to value is still contingent on the wellbeing of conscious creatures. What is the value of fulfilling a duty if there is nobody to whom one is obliged? What is the value of beauty without a beholder? It only makes sense to value these things because their absence would cause some form of suffering.

Others might view morality as relative. Indeed, different cultures around the world appear to value markedly different things. Similarly, we can observe how some practices which are now considered immoral were once a normal part of our culture - for example, granting fewer rights to women and ethnic minorities. The fact that these practices are/were generally considered acceptable in a certain society or at a certain time in history is not evidence that they are/were moral - it is merely a description of public opinion. Clearly, this opinion can be incorrect. In the case of historical examples, the ability to say this is a sign of moral progress: these things are acceptable until they are not.

There are well-discussed objections to classical utilitarianism. For example, a utilitarian might reasonably be asked whether a surgeon would be morally justified in killing one healthy patient to use his organs to save five other people. However, this situation would mean living in a world where a routine visit to the doctor could mean death. Such a world would likely lead to fewer people risking a visit to the doctor, and many people suffering curable illness as a result. This would likely mean more suffering than could be alleviated by taking organs without consent to save lives in some cases. This example illustrates the value of rule utilitarianism - a system of ethics based on rules which tend to increase aggregate wellbeing generally even if they decrease it in some narrow cases.

Suffering is bad. More suffering is worse than less suffering, and if we ought to do anything in this life, it is to behave in a way which tends to reduce suffering as much as possible.

A. **Actions are generally bad to the extent that they increase suffering.**

I have argued here that suffering is bad, and therefore actions which tend to increase suffering are morally bad. Implied in this framework is a being who suffers, as I have discussed. The capacity for suffering and wellbeing is necessary for a being to be considered morally relevant in this framework. If a being is incapable of experiencing suffering or wellbeing, it is nonsensical to talk about moral transgressions against them. We do not consider it immoral to shoot characters in video games, for example, because these characters are not sentient.

B. **A being is morally relevant if and only if they can suffer.**

1.2.2 Animal sentience

It is not uncommon for utilitarian texts to talk about the wellbeing of people. I depart from this quite deliberately, referring instead to the wellbeing of conscious beings. This is in recognition of non-human animals’ capacity to experience pain and pleasure. They can suffer, and therefore they are morally relevant in any utilitarian calculus.

For many readers, the claim that non-human animals can suffer will be uncontroversial. Most readers would accept that a cat or a dog can exist in various states of joy or anguish, and that these states have implications for their wellbeing. However, for the reasons explored in the following section, people may be slower to assign this capacity to a pig or a cow (Caldwell, 2017).

Nonetheless, the sincere belief that farm animals do not have the capacity to suffer appears to be relatively rare (Reese, 2017). Needless to say, holding this belief would have conclusions which most people find unlikely and morally objectionable. Somebody who believed this would presumably be indifferent about the morality of a pig being needlessly tortured.

Griffin and Speck (2004) review the evidence on animal consciousness, and find strong evidence to support the view that animals are conscious. They argue that (a) there are no known neural correlates of consciousness which are unique to humans, (b) animal responses to novel challenges suggest a versatility which implies conscious thinking, and (c) reports on animal communication show evidence for animals having subjective experiences. The authors conclude that it is 'far more likely than not that animal consciousness is real and significant.' Indeed, there is close to perfect consensus amongst scientists that animals are conscious, as declared in the Cambridge Declaration on Consciousness (Low et al., 2012).

In particular, evidence suggests that cows, pigs, and chickens all have impressive cognitive, emotional and social abilities (Bekoff, 2015, 2017a, 2017b). They can learn to carry out novel tasks, discriminate between complex stimuli, and exercise self-control. They have individual personalities, demonstrate a range of emotions, and maintain complex social lives. However, these factors are ultimately not necessary for moral consideration. As Jeremy Bentham (1789) is often quoted, 'The question is not, "Can they reason?", nor "Can they talk?" but, "Can they suffer?"'

C. **Farm animals can suffer.**
D. **Therefore farm animals are morally relevant.**

1.2.3 Animal agriculture

Here, I make the case that animal agriculture causes more suffering than would exist in a counterfactual world without animal agriculture. I consider first the suffering inflicted on farm animals in common UK farming practices. Second, I discuss the utility which comes from animal farming. Finally I present a system for comparing these outcomes and argue that overall, animal agriculture increases net suffering to morally relevant beings, and is therefore immoral.

1.2.3.1 Farm animal suffering

If a picture speaks a thousand words, a video speaks a thousand pictures. It is difficult to elicit through written word the moral shock one experiences from watching slaughterhouse footage. If the reader is inclined towards speculation about the degree of animal suffering entailed in meat production, I encourage them to find slaughterhouse footage on YouTube. In the absence of this, I shall attempt to paint a picture. The following three paragraphs are quite graphic.

First, let us consider a pig born into life on an intensive farm in the UK, as are the majority of pigs in the UK (Rivera, 2017). He is born to a mother who is locked in a cage so small that she can only lie on her side. She has been locked in this cage for several days, and will remain there for days to come. The newborn pig will have his teeth cut without painkillers, and although it is illegal, it is not unlikely that he will also have his tail cut off, again without painkillers. If he keeps his tail, his siblings will probably gnaw it off in the coming weeks as they are imprisoned in close proximity with no stimulation or access to the outside. Within six months of being born, he will be gassed to death or shot in the head. (Compassion in World Farming, 2012a; Lymbery & Oakeshott, 2014; Viva!, n.d.a)

Now let us consider a chick born into the egg industry in the UK. If the chick is a male, he is of no value because he cannot lay eggs. He will be killed the same day, gassed to death or thrown into a mincer. If the chick is female, she is valuable and she will be allowed to live. She will have her beak cut off without painkillers. She will then live her life in a cage in a large warehouse with tens of thousands of other birds. She will share her cage with up to 80 others, each with an area of 750cm^2 - about the size of a kitchen chopping board. She will be unable to go outside or even properly spread her wings. Her cagemates will likely attack her, driven to aggression by overcrowding and lack of stimulation. She will be exposed to constant light to make her lay eggs up to 20 times more frequently than she would in nature. After a little more than a year, she is spent, and is gassed to death (Compassion in World Farming, 2012b; Lymbery & Oakeshott, 2014; Viva!, n.d.b).

Now let us consider a calf born into the dairy industry in the UK. If the calf is a male, he is of no value because he cannot produce milk. He will be shot in the head the day he is born. If the calf is female, she is valuable and she will be allowed to live. She will be taken away from her mother within a few days of being born. Mother and daughter often cry for days after this happens. She will be locked in an individual cell for up to 8 weeks, often unable to communicate with any other calves. During this time, she will have her horn buds burnt off with caustic soda, her tail removed with a hot iron, and an extra teat cut off with a knife. When she is about 9 months old, she will be branded with a hot iron. To produce milk, she must first become pregnant. Therefore, when she is 15 months old, she will be restrained while a farmer inserts his hand and forearm into her anus, holds her cervix, and inseminates her using an artificial insemination ‘gun’. Like a human, her pregnancy is about 40 weeks. If she gives birth to a male, he will be shot in the head the day he is born. If she gives birth to a female, her calf will be taken away within a few days to be imprisoned and mutilated. She will then live in a cage inside a warehouse. Several times a day, she will be ushered with electric shocks into a milking parlour, where she will be milked by a machine. Within two months of giving birth, she will again be restrained and impregnated. She will again have her baby taken away or shot in the head. This will happen several times before she is 6 years old, when she herself will be shot in the head and have her throat slit. Often, she will die without ever having been outside. (Compassion in World Farming, 2012c; Lymbery & Oakeshott, 2014; Viva!, n.d.c)

This is all standard practice in these industries. The majority of animal products come from farms like this, because this is the most efficient way to process animals. It really is difficult to imagine the constant physical and mental pain these animals are in. If we are to take animal suffering seriously, it should be clear that industrial animal agriculture is one of the worst moral failings of our time. One can only hope for a day when my grandchildren learn about these atrocities in history classes and wonder how we let it go on for so long.

It is common to hear carnists argue that farm animals only get to exist at all because we want to eat them, and therefore it is not immoral to bring them into existence. However, it is clear to me from these descriptions that these lives are short, brutal, and filled with suffering. If I could choose between a life on a factory farm, and never having been born in the first place, the choice would be clear.

***E.* Animal agriculture causes great suffering to animals.**

1.2.3.2 The utility to humans

Of course, animal agriculture is not without its benefits. Animal farming provides enjoyable food to billions of people, and is the basis for many millions of livelihoods.

First, it is estimated that at least 866 million people work in agriculture globally (Global Agriculture, n.d.). It is not clear how many of these work directly in animal agriculture, but many farmers who grow crops will sell these to be fed to animals. Many of these people will be in poor parts of the world where there are few other economic opportunities, and many rural communities may be dependent on animal agriculture (Kurrer & Lawrie, 2018; Ritchie & Roser, 2020). Furthermore, agricultural workers tend to have lower than average educational attainment, so their opportunities for employment are further limited (Eurostat, 2017).

Second, most people in the world eat animal products. They get nutrition from eating animal products and, more importantly for those who have a choice, they enjoy it (Hosie, 2017). It may be true beyond a reasonable doubt that animals on factory farms experience dreadful suffering; unfortunately for them, it is also true that they are delicious. As I have argued, giving up animal products, for most people, represents a huge personal sacrifice (Bryant, 2019b). We can reasonably expect that, in a world without bacon, most people would consider themselves worse off.

1.2.3.3 Utilitarian calculation

It is reasonable to be skeptical of the feasibility and validity of straightforwardly comparing the suffering inflicted on animals to the benefits obtained by humans in animal farming. Indeed, there are many difficult-to-quantify variables of relevance (How do we measure suffering or wellbeing? How do we compare subjective experiences across species?) However, given some reasonable assumptions about feelings, emotions, and desires we are likely to have in common with farm animals, we can be reasonably confident that slitting their throats constitutes a reduction in wellbeing. Nevertheless, there have been serious attempts to measure and estimate the variables of relevance, as I will discuss below.

In this calculation, I have followed the principles of MacAskill (2015), who argues that we should use conservative estimates of relevant variables in order to avoid the false positive conclusion that an intervention would effectively increase wellbeing. In this case, the results of the analysis is not close, even with conservative numbers, but I note that using the most conservative numbers decreases the chance of concluding a false positive, but increases the chance of concluding a false negative (i.e. failing to conclude that an intervention could reduce suffering, when in reality it could.)

This analysis represents the change in utility in a situation where animal agriculture stopped tomorrow. There are three relevant variables to calculating a change in utility here: how many beings are affected, the degree of suffering or wellbeing, and each beings' relative ability to experience suffering subjectively. Although some of these variables are difficult to estimate, we can build a reasonable model given some conservative assumptions.

The population of animals on factory farms is based on estimates by Sentience Institute (2019) while the consumer population is based on Worldometer (2020b) and the population of agricultural workers is from Global Agriculture (n.d.) - the model assumes that each of these workers has, on average, 2 family members who their income supports.

The species multiplier figures are based on Tomasik (2018) who provides estimates of the relative sentience of different animals as it pertains to this question. I have assigned the most sentient species (pig) half the value of a human (in reality, it is likely that all the relevant neural correlates of sentience in a pig are closer to a human than a fish, but I am conservatively allowing for some degree of species bias towards humans here.)

I want to address the concern that comparing humans to animals in this way is inappropriate - one might say that humans are just fundamentally different from animals, so this is comparing apples to oranges. While I disagree that the differences between humans and animals are fundamental rather than a matter of scale, I agree that the analogy to apples and oranges is a fair one. Personally, I have always found this metaphor for an unreasonable comparison irksome: it seems to me that apples and oranges are, in fact, quite comparable. They are very similar in a number of highly relevant ways - they are both fruit, they have a similar size, shape, function, and even nutritional content. For these reasons, it is perfectly appropriate to compare apples to oranges, just not to treat them exactly the same. We can put either of them in a fruit salad, but we should not make an orange pie. In the same way, we can show kindness to both humans and animals, but we should not let cows vote.

The change in wellbeing figures are based on Sarek, Savoie and Moss's (2019) ratings of the wellbeing of various animals. They have compiled evidence to support a range of ratings, from -100 to +100 of the quality of life of various animals 'from humans in Canada to battery caged chickens in the United States'. This accounts for a range of factors affecting the life, as well as the probability that the animal can feel pain. In this model, I have assumed that the farm animals move from their current (negative) wellbeing value to zero (since they cease to exist, therefore have no experience). I have assumed that consumers move down the scale an average of 10 points, which I consider generous given that 200 points on this scale is the difference between perfect pleasure and perfect pain. I have assumed that workers and their families will move down the scale 50 points, which again is generous - this is about the difference between a human in a rich country and a human in a poor country, according to Sarek, Savoie and Moss (2019).

By moving from today's animal agriculture to zero animal agriculture, we might estimate the following changes in wellbeing (Table 1).

Table 1: Changes in wellbeing when moving from today to zero animal agriculture.

	Population	Average Change in Wellbeing	Species Multiplier	TOTAL CHANGE
Consumers	7,781,534,000	-10	1	-77,815,340,000
Agricultural workers and communities	2,500,000,000	-50	1	-125,000,000,000
Farmed cows	1,504,745,163	+27	0.475	+19,298,356,715
Farmed pigs	977,323,610	+27	0.5	+13,193,868,735
Farmed meat chickens	16,659,727,291	+56	0.4	+373,177,891,318
Farmed egg hens	7,193,386,800	+51	0.4	+146,745,090,720
Farmed fish	111,299,464,370	+44	0.25	+1,224,294,108,070
TOTAL				+1,573,893,975,559

As shown in the Table 1, this change would arguably be a bad thing from a human-centric view. However, as we can also see, the sheer number of animals means that the alleviation of their suffering far outweighs the suffering that an end to animal agriculture would inflict on humans, even when we discount their suffering by 50% or more. The difference is vast, and for this reason we can be fairly confident that the total suffering is greater under the present system, even under reasonable uncertainty about many of the parameters involved.

As I outlined in the previous section, this analysis does not include any consideration of the environmental and public health impacts of animal agriculture. In this way, it is even more conservative in its conclusion that animal agriculture is causing more harm than good. In my assumption that every consumer on Earth would be made substantially worse off by this transition, I am ignoring the likely reductions we would see in rates of obesity, diabetes, heart disease, and bowel cancer, all of which are linked with animal product consumption (Rouhani et al., 2014; Willett et al., 2019; WHO, 2015). I am also ignoring the impact of discontinuing animal production on climate change, deforestation, pandemics, and antibiotic resistance, all of which are caused by farming animals (Caniça, Manageiro, Abriouel, Moran-Gilad & Franz, 2019; IPCC, 2018; Mathew et al., 2007; Oliver et al., 2011). When one considers the impact of these additional factors on human and animal wellbeing, the utility in our world compared to a vegan world starts to look like no contest.

F. **Animal agriculture does relatively little good for humans.**
G. **Animal agriculture causes net suffering, therefore is morally bad.**

So far, I have highlighted some of the psychological barriers to giving appropriate moral weight to farm animal suffering, and made the moral case against animal agriculture. At this point, the issue is becoming clear: there are grave moral problems with the way we treat animals in modern agriculture, but the market demands cheap meat. This is another version of the ‘meat paradox’ (Bastian & Loughnan, 2017) - people both love and eat animals.

I have argued that our treatment of animals is a serious moral failing, and one which most people overlook. Without intervention, this problem is going to get worse: although meat consumption is falling in many Western countries, consumers rising out of poverty elsewhere means that demand for meat is increasing overall, leading the Food and Agriculture Organisation (2011) to forecast a 73% rise in demand by 2050.

Some meat alternatives exist, including ever-improving plant-based substitutes (see Millman, 2019), entomophagy (eating insects), and meat-reduced diets. However, as Welin et al. (2012, p. 301) point out, ‘That the public, to a large extent, prefers to remain meat eaters instead of turning to a vegetarian diet is a statement of fact.’ Some of these meat alternatives may be a promising option for reducing demand for meat in the short term, but it is likely that some level of demand for beef, for example, will persist well into the future, and may never be entirely displaced by plant-based alternatives. One proposed solution to this problem is cultured meat.

1.3 Cultured Meat

Cultured meat is meat grown from animal cells in a cell culture (Post, 2012). The process involves taking a biopsy from a live animal and isolating certain types of cells. These cells are then placed inside a bioreactor to provide them with the energy and nutrition they require to multiply and differentiate. Muscle and fat cells can be grown onto a scaffold, giving structure, and ultimately replicating conventional meat down to a cellular level (Post et al., 2020). Cultured has all of the same components, taste, and nutritional value as meat from a slaughtered animal. While the concept of cultured meat dates back many decades, a public tasting of the first cultured meat hamburger in London in 2013 showed the world that a better way of producing meat could be within reach (Shapiro, 2018). Currently being developed in laboratories across Europe and America, cultured meat is forecast to be available to consumers by 2022 (Foote, 2020).

Although early prototypes have used foetal bovine serum as a growth medium (and therefore still required cows to be slaughtered), research to replace this with a plant-based alternative has made great strides in recent years (Post et al., 2020). This, combined with work on ‘immortal’ cell lines, aims to make the process completely animal-free (Post et al., 2020). Cultured meat, therefore, could represent a way to provide consumers with real animal meat without the need for any animals to suffer.

There are environmental advantages to cultured meat compared to conventional meat, also. There is considerable variation in the figures in published life cycle analyses of cultured meat (Lynch & Pierrehumbert, 2019). However, there is agreement that, compared to conventional beef farming, cultured meat will produce far fewer greenhouse gas emissions whilst requiring far less water and land - three of the major environmental problems associated with animal farming (Lynch & Pierrehumbert, 2019; Mattick et al., 2015; Tuomisto, 2019; Tuomisto & De Mattos, 2011; Sun, Yu, & Lin, 2015).

Furthermore, cultured meat can offer us significant benefits in terms of public health. The coronavirus is the latest example of a public health crisis with its roots in our use of animals for food - recent years have seen headlines about bird flu, swine flu, and bovine spongiform encephalopathy (BSE) (Degreef & Scholliers, 2019). As well as transmitting diseases directly to humans, farm animals contribute to antibiotic resistance. Keeping animals in cramped dirty conditions is conducive to a lot of disease - 80% of antibiotics sold in the USA are used for livestock (Martin, Thottathil & Newman, 2015), and farmers often take insufficient precautions in giving them to their animals (Friedman et al, 2007; Sawant et al, 2005). Evidence has shown that these practices increase antibiotic resistance in diseases which also affect humans (McEwan, 2006; Mathew et al, 2007). The World Health

Organisation (2018) says that antibiotic resistance is ‘one of the biggest threats to global health, food security, and development today.’

In addition, cultured meat provides a level of adaptability not afforded by conventional meat. Products could be made healthier by modifications which would be impossible in meat from animals: one possibility is the substitution of saturated fat for healthy omega-3 oils in beef, enhancing the nutritional profile of the meat (Baumann & Bryant, 2019; Hultin, 2017; Zaraska, 2016). There could be benefits to those following religiously-restricted diets, too. Although competing interpretations are offered in different religions, writers have already discussed the possibility of Kosher cheeseburgers or Halal pork (Bryant, 2020, Hamdan, Post, Ramil & Mustafa, 2018; Kenigsberg & Zivotofsky, 2020). This ability to produce customised meat products which cater to specific dietary requirements is a major potential advantage of cultured meat technology.

Finally, cultured meat may have benefits in terms of long term food security. In the long term, resource and labour efficiencies mean that cultured meat may be able to be produced more cheaply than conventional meat (Nahimas, 2018). This could increase access to protein energy from meat for the global poor, which Latham (1997) has claimed is the most important nutritional problem in many developing countries. Additionally, helping to avert the worst impacts of climate change could protect food systems for populations in poor parts of the world (Connolly-Boutin & Smit, 2016).

In summary, cultured meat could help to alleviate many of the issues associated with conventional meat production. Modern animal agriculture imposes heavy burdens on our environment, public health, food security, and collective morality. Yet, animal products are very popular, and large parts of the population giving them up is unlikely. Producing meat and other animal products using cellular agriculture techniques could enable us to reconcile our desire for meat with our concerns about sustainability and ethics.

However, given the consumer-driven backlash against genetically modified foods in Europe, concerns about consumer acceptance of cellular agriculture abound (Mohorčich & Reese, 2019). To address this, this thesis will explore consumer acceptance of cultured meat.

1.4 Thesis Overview

In this thesis, I will investigate cell cultured meat as a potential alternative to meat from animals. Although animal products are increasingly under scrutiny for their impact on the environment and public health, my critique of animal agriculture is a moral one. I argue that morality is necessarily linked to the suffering of conscious creatures, and that since farm animals can suffer, their treatment on farms constitutes a moral disaster. Further, I highlight how social and psychological biases prevent us from clear moral reasoning on this topic (Chapter 3).

In my first empirical study, I demonstrate that the meat-eating public largely view vegetarianism and veganism as ethical and good for the environment (Chapter 4). However, practical factors including convenience, affordability, and taste pleasure meant that most were unwilling to give up meat. I argue that this gap between moral ideals and behavioural intentions demonstrates the need for practical alternatives to animal products which meet consumers’ needs.

Next, I introduce the concept of cultured meat - meat grown from animal cells (Post, 2012). I argue that cultured meat represents a potential way to satisfy consumer demand for meat whilst circumventing many of the ethical, environmental and public health problems associated with animal farming. Whilst this technology may be a way to 'have our steak and eat it', there is some uncertainty around consumer acceptance.

Therefore, we conduct a systematic review of the empirical literature on consumer acceptance of cultured meat (Chapter 5). We find that, while overall rates of acceptance are highly uncertain, demographic patterns in survey data indicate higher interest amongst some consumer groups. Consumers largely see the benefits of cultured meat as accruing to animals and the environment, whilst many are wary of the safety and/or unnaturalness of cultured meat. There is some evidence that perceptions of cultured meat can be influenced by the provision of additional information, though many questions about the optimal strategy remained. Furthermore, very little is known about the rates of cultured meat acceptance around the world.

This is the impetus for my second empirical study, in which we compare acceptance of cultured meat and plant-based meat in the USA, India, and China (Chapter 6). As well as finding significantly higher acceptance of cultured meat in India and China compared to the USA, we find that food neophobia predicted cultured meat rejection across cultures, while prior familiarity predicted acceptance. This suggests that cultured meat acceptance will vary hugely across space (i.e. in different countries) and time (i.e. in the future). We also observe that disgust, a response noted frequently in the literature, only predicts cultured meat rejection in the USA, suggesting a need for cultural adaptation of promotional messages.

I then present a series of experimental studies focused on increasing acceptance of cultured meat. I investigate the impact of naming, framing, and explaining cultured meat in different ways to maximise acceptance.

In my third empirical study, we show that directly addressing the issue of naturalness with messages attempting to debunk the naturalistic fallacy or argue that cultured meat is, in fact, natural was ineffective (Chapter 7). In both cases, participants' beliefs on the importance of naturalness/the naturalness of cultured meat were unaffected, and these messages were less effective than a message which did not mention naturalness, but focused on other benefits of cultured meat. Most effective in this study was, in fact, another fallacious *(tu quoque)* argument - that conventional animal farming is also unnatural.

Having largely failed to persuade people of the naturalness of cultured meat through systematic argumentation (explaining), I turn instead to a more heuristic approach (framing). In my fourth empirical study, we demonstrate that, although media coverage of cultured meat has been largely positive, framing cultured meat as a highly scientific laboratory-based technology was conducive to less positive attitudes than focusing on other elements such as its similarity to conventional meat or its ethical and environmental benefits (Chapter 8). However, since one cannot easily affect media framings (particularly for cultured meat, which is arguably newsworthy *because* it is a scientific innovation), other methods to foreground its benefits in the public consciousness are required.

Therefore, my fifth and final empirical study demonstrates the impact of naming (Chapter 9). We demonstrate that names which emphasize the artificiality of cultured meat (e.g. 'lab-grown meat') resulted in significantly more negative perceptions of cultured meat compared to names which emphasized its benefits (e.g. 'clean meat'). Other names ('cultured meat' and 'animal-free meat') were somewhere in between these. However, nomenclature has implications for industry stakeholders, including those with interests in animal rearing. Ultimately, I argue that the name 'cultured meat' represents a name which is clear, fair, and likely to be acceptable to all stakeholders. It also remains relatively uncontaminated by public politicisation of the nomenclature debat, and whilst it may not perform as strongly as ‘clean meat’ on short-term measures of positive affect, the long term implications for industry trust if the prevailing term could be interpreted as misleading could be dire.

Finally, I review the empirical literature on cultured meat acceptance two years on (Chapter 10). We find that, since our 2018 systematic review, the number of peer-reviewed empirical studies on this topic has more than doubled. The newer literature largely confirms many of the trends and prevailing perceptions observed in our original review, though more recent research advances towards a clearer consensus on overall potential market size and moves beyond hypothetical survey questions to in-person consumer testing. As well as this, recent research provides further answers to questions this thesis has sought to answer about what acceptance of cultured meat across countries and how this can be influenced by messaging interventions. Further, I speculate on how this new food technology might interact with existing institutions including religions, the media, regulatory systems, and the broader economy (Chapter 11).

Taken altogether, the empirical findings in this thesis provide some valuable lessons for cultured meat advocates (Chapter 12). First, the magnitude of effect was by far the largest in the cross-country study, indicating that identifying and accessing the right markets and identifying the right consumers could be a more important route to success than attempting to persuade consumers who are not convinced of cultured meat in more limited markets. Second, the magnitude of effect in the studies influencing the heuristic pathway (naming and framing) was larger than the effect in the study attempting to influence the systematic pathway (explaining), which indicates that optics are likely to play a more important role in consumer decision-making than reason. Thirdly, acceptance of cultured meat will ultimately depend on its treatment by institutions including the media, existing food companies, and regulatory bodies more than persuading consumers directly, which indicates the value of maintaining a rigorous systematic argument in favour of cultured meat as well as avoiding frames and nomenclature which are conducive to negative heuristics around the concept.

2. Methodology

In this chapter, I will outline my methodological approach, justify this with respect to my ontological and epistemological views, and discuss details of methodological issues including the measures and participants included. Each empirical chapter contains its own methods sections, but this chapter will discuss more generally my methodological decisions and approach.

2.1 Ontology & Epistemology

The empirical work in this thesis is almost entirely quantitative, and much of it is experimental. Although the methods of the positivist are typically thought of as objective and uncontaminated by researchers' values (Bryman, 2016), I will set out to show here that the values derived from the moral argument I outlined in the previous chapter are, in fact, the basis of my decision to use a primarily quantitative approach.

2.1.1 Sensual information as the basis of morality

As I have discussed above (Section 1.3.1), the idea that research conducted within the positivist paradigm should be value-free is based on the idea that there is a distinction between what 'is' (the business of scientists) and what 'ought' to be (not the business of scientists) (Bryman, 2016; Hume, 1789). However, this is a distinction which I am prone to reject. If morality is to have any meaningful basis, it must surely be the wellbeing of conscious creatures, which can only be affected by information they perceive through their senses.

One can imagine a blind man who has never had the ability to see. This man has never seen colours, and never having experienced their qualia (i.e. the subjective experience of a phenomena by an agent), only has a descriptive understanding of the concept of colours. Because he cannot experience the colour of his shirt via his senses, the blind man is presumably indifferent to what colour his shirt is - it has no bearing on his wellbeing because he cannot experience it through his senses. We can imagine conditions where the colour of the blind man's shirt would become relevant to his wellbeing (if he were wearing the wrong team's colours in a rowdy football crowd, say). However, this would only be possible if this information could be experienced by some other conscious creature via their senses, who then acts to impact on the blind man's wellbeing by giving him a punch on the nose. If everybody was blind, the colour of the man's shirt would be truly irrelevant - it would not even make sense to talk about colours.

Extending this idea further, we can imagine a sense that we all lack. Just as the blind man lacks sight and therefore cannot understand colours, it is possible that we all lack some sixth sense and therefore cannot understand some other qualia. Because no human has this sense, it is impossible for us to observe or measure this qualia. This is not analogous to observing infrared light or high-pitch noises through technology which enhances our existing senses - rather, I am talking about a frequency which exists in the universe, but we do not have the apparatus to perceive at all. This would be similar to colour in a world where no human has sight.

Would it be possible for such a frequency to impact on our wellbeing? Just as the blind man is indifferent to the colour of his shirt, we are surely all indifferent to frequencies which we cannot perceive through our senses. We are only concerned with frequencies which we have the ability to perceive via our senses. If I am to impact another person's wellbeing, I am limited to actions which impact what they see, hear, taste, smell, or feel. There is nothing else I could do which would enter their awareness, and therefore have any impact on their wellbeing.

I have argued here that (a) suffering and wellbeing are the basis of morality, and (b) suffering and wellbeing can only be affected by information perceived via the senses. If both of these things are true, then information which can be perceived via the senses (and therefore studied using the methods of the positivist) form the basis of morality. Far from Bryman's (2016) assertion that values must be removed from positivist research because they do not relate to information observable via the senses, this view implies that such information is the only sensible basis for values.

2.1.2 Knowledge as instrumental to moral ends

I have laid out in the first chapter my view on morality. This includes the idea that the physical and social world impacts the wellbeing of conscious creatures, and that states of the world in which aggregate wellbeing is higher are generally preferable. One can see how this philosophy interacts with social science, particularly in the context of a market economy. In this case, animal suffering is the direct result of demand for animal products. One can seek to understand consumer psychology, develop interventions to reduce the overall demand for animal products and, in turn, reduce animal suffering. Generating a detailed understanding of consumer perceptions of animal product alternatives, as I will argue, is one way for research to contribute to this goal.

Indeed, there is a good deal of social science with this objective. Any research which seeks to understand and inform behaviour change strategies presumably values (at least implicitly) outcomes associated with the behaviour it is seeking to change. There is plenty of research focused specifically on how to reduce animal product consumption, much of it predicated on the objective of reducing animal suffering (Bryant, 2019a).

When cellular agriculture products (including cultured meat) become available, they will replace some amount of the demand for conventional animal products. Surveys in the UK have indicated that between 16% and 19% of adults say they would eat cultured meat (Surveygoo, 2018; Tatum, 2017; YouGov, 2013). If we were to interpret this as replacing 16-19% of the demand for meat from farmed animals, this could mean sparing 16-19% of the 1,107,726,000 land animals we kill each year (Animal Clock, 2019). That amounts to between 177,236,160 - 210,467,940 conscious creatures spared a life of suffering every single year. This is 3-4 times larger than the human population of the UK, which is just 66,040,000 (ONS, 2019).

The numbers involved make it difficult to appreciate the scale of the suffering to be prevented here, as I have discussed above. More interestingly, because of the numbers involved, moving the needle of consumer acceptance by a single percentage point, from 19% to 20%, would spare a further 11,077,260 lives of suffering. This is in the UK alone, a country responsible for less than 2% of the animals killed for food worldwide. Moving this needle globally would save billions of lives of suffering.

Therefore, I primarily see knowledge about human behaviour as instrumental to constructing reliable ways of altering human behaviour to reduce suffering. For example, knowledge about opinions of vegetarian and vegan diets is valuable for its instrumental purpose of advertising and/or understanding these opinions such that we might achieve the goal of reducing animal suffering. As I have argued above, the real value of anything ultimately comes down to its impact on the wellbeing of conscious creatures.

2.1.3 Ontological ambiguity

Although my approach has been broadly positivist, there is clear value in some constructionist perspectives when thinking about the issue of cultured meat. Concepts such as intersubjectivity (Crossley, 1996) and the social creation of shared meanings have real practical implications for the future of cultured meat. For example, it is debated in religious circles whether cultured meat will be considered Halal and Kosher (Hamdan, Post, Ramli & Mustafa, 2018; Kenigsberg & Zivotofsky, 2019), and in policy circles whether cultured meat should be able to be marketed as 'meat' (Froggart & Wellesley, 2019). Both of these questions depend, in part, on whether cultured meat is considered 'meat' or something other than meat.

Some take the view that cultured meat is meat, because it is physically identical to conventional meat down to the cellular level. Others defend this position on the basis that cultured meat will have the function as conventional meat, and will be socially understood to be meat. However, others argue that meat is defined as muscle taken from a slaughtered animal, and that cultured meat is therefore not meat. In practice, most people have never heard of cultured meat (Bryant et al., 2019b) and this leaves plenty of space for interpretation. This disagreement has led Stephens and Ruivenkamp (2016) to label cultured meat 'ontologically ambiguous'.

In summary, I reject the distinction between 'is' and 'ought', arguing to the contrary that what ought to be only makes sense in terms of our sensory interpretations of what is. I am primarily concerned with a moral view which prioritises the reduction of overall suffering, and I see knowledge about human behaviour as instrumental to creating ways of reliably influencing behaviour to reduce suffering via the market economy. Although I have taken a broadly positivist approach, I have found value in constructionist perspectives, particularly with respect to understanding the ontological ambiguity of cultured meat through the lens of intersubjectivity. As I will explain in the following section, I judged quantitative methods to be the best way for me to contribute to knowledge on this topic, and the consequent moral good.

2.2 Quantitative Approach

The empirical work in this thesis is almost entirely quantitative, and much of it is experimental. I have chosen to rely primarily on quantitative methods for several reasons, which I shall explain here. Quantitative research attempts to measure phenomena and establish relationships between them, whereas the goal of qualitative research is to explore phenomena in depth and rich detail (Bryman, 2016). While the quantitative researcher is likely concerned with generalisability and inferential statistics, the qualitative researcher is concerned with detail, interpretation, and reflexivity (Bryman, 2016; Punch, 2013).

2.2.1 Strengths of this approach

Firstly, there are already several qualitative studies on this topic, and their findings converge substantially on similar themes. My systematic review of the existing literature on consumer acceptance of cultured meat identified several papers based on focus groups and online comment analysis (Verbeke et al., 2015; O'Keefe et al., 2016; Tucker, 2014; Laestadius & Caldwell, 2015). Whilst each of these studies emphasize different aspects of the discourse on cultured meat, familiar themes of unnaturalness, food safety, animal welfare, and environmental considerations were observed universally in studies from around the world (Tucker, 2014; Verbeke et al., 2015; O'Keefe, 2016). More recent qualitative studies on the topic have yielded few surprises (Circus & Robinson, 2019; Shaw & Mac Con Iomaire, 2019).

In November of 2019, I was afforded the opportunity to witness this thematic saturation first hand. Although I did not carry out qualitative studies as part of my PhD, I was involved in hosting public discourses on food technology as part of a project for the Food Standards Agency. This involved two day-long workshops in the UK with around 30 participants in total. Having spent a lot of time reading focus group reports of similar conversations, the familiarity of what I heard at these workshops was striking. I felt vindicated in the view that the existing qualitative research in the field is close to exhaustive in its typology of human responses to cultured meat, and there would be little value in adding to it.

Secondly, quantitative studies, and in particular randomised controlled trials, are generally seen as more robust in terms of the hierarchy of evidence (Brighton, Bhandari, Tornetta & Felson, 2003). This means that their findings and recommendations may be taken more seriously by policymakers and other stakeholders (Boaz, Grayson, Levitt & Solesbury, 2008). Although my primary focus is on developing messages to change consumer behaviour, producing evidence which has a good chance of impacting the decisions of policymakers and/or other institutional decision-makers may actually have the potential to do even more good. This is because institutional and government decisions have much broader consequences than the decisions of individual consumers (MacAskill, 2015). Therefore, an opportunity to influence policymaking via the production of evidence which is generally considered highly robust is an opportunity to alleviate more animal suffering. Despite some critiques of the quantitative experimental approach, policymakers still tend to find quantitative research more useful in decision making (Talbot & Talbot, 2014).

Thirdly, as well as being more useful to decision-makers, I want my research to be useful to more decision-makers. In other words, it is important to me that the findings of my research be generalisable to the behaviour of as many consumers/decision-makers as possible. This is for the simple reason that findings which are generalisable to more people will affect more animals. This concern is evident in my choice of study populations - I deliberately surveyed consumers in China, India, and the USA because together, they are home to over one third of the world's population (Worldometer, 2020a), and as their populations' incomes rise, they will consume more meat (Delgado, 2003). Therefore, producing generalisable survey data on consumer perceptions of animal product alternatives in these markets is likely to affect many more animals than qualitative work, which generally entails using non-generalisable samples. I am sensitive to my own scale insensitivity (see 1.2.6), and find comfort in a planned quantitative approach which commits me in advance to working on research which will be most effective in terms of the raw numbers. As Snowden and Martin (2011) have argued, qualitative work can aim at a different kind of theoretical generalisability - indeed, the insights from early qualitative work on cultured meat have been extremely useful in developing my plans for what to study.

Fourth, as Brighton et al. (2003) argue, compared to other study designs, experimental studies where participants are randomly allocated to different conditions have the advantage of controlling for known and unknown baseline differences in relevant factors. Therefore, studies of this kind are unique in their ability to isolate different variables and infer causality with respect to their effect on outcomes of interest. Beyond simply being *considered* more robust by policymakers, studies of this kind actually *are* more robust in certain ways, or at least are more robust for answering certain types of question. In this case, I am interested in testing the effect of specific types of message framing on consumer acceptance of cultured meat so that I can produce reliable ways of influencing consumer behaviour. The descriptions of cultured meat given to participants in focus groups and surveys undoubtedly have a substantial impact on their subsequent attitudes towards it, and yet these factors have been rarely considered or controlled for in the existing literature (Bryant & Barnett, 2018). Therefore, I relied on quantitative experimental methods to isolate and evaluate the impact of different messages about cultured meat in order to inform producers and advocates, and further the moral goal of reducing animal suffering.

Overall, my use of quantitative and experimental methods was motivated by my objective to maximise the number of animals helped through my research. I see knowledge about consumer acceptance of cultured meat as instrumental to increasing cultured meat's ability to displace demand for conventional meat, thereby reducing animal suffering. To this end, I have chosen to use quantitative methods because there is already plenty of converging qualitative evidence in the space, quantitative evidence may be taken more seriously by decision-makers, the findings are generalisable to larger populations, and experimental methods are unique in their ability to isolate and evaluate the impact of different messages in a way which can reliably impact behaviour.

2.2.2 Limitations of this approach

There are, of course, limitations to an almost entirely quantitative approach. In one sense, I am concerned with peoples' subjective interpretations and the creation of shared social meanings around cultured meat. Because these interpretations and perceptions are likely to be complex, multifaceted, and socially constructed, one could argue that such concerns are best investigated using qualitative, deliberative methods.

Firstly, collecting data, as I have done, exclusively in the form of online surveys does not afford the same level of data 'richness' one would achieve from more detailed qualitative inquiry (Easton, McComish & Greenberg, 2000). Indeed, experimental studies are intended to isolate the effect of a narrow set of variables, a paradigm which risks ignoring other (potentially more important) factors. In this case, the impact of using different messages to explain cultured meat is studied precisely and in great detail. However, it is possible that this narrow focus has resulted in a limited understanding of the broader processes which contribute to public understanding of food technology more generally.

Secondly, online surveys are especially likely to have poor ecological validity. All of the extant literature on consumer acceptance of cultured meat asks participants to project how they would behave with respect to some hypothetical product which does not yet exist. This may be even more likely than average online surveys to result in poor ecological validity. As I have observed, ostensibly similar surveys on this topic have yielded very different acceptance rates (Bryant & Barnett, 2018). This implies that asking consumers about their attitudes towards cultured meat is likely to result in findings which are relatively poor at reflecting true consumer behaviour, which will only be observable in the future when such products are available.

Thirdly, the participants in online surveys may be non-representative in certain ways. I have focused on representativeness and generalisability, often using nationally representative samples in terms of age and gender. However, online surveys are inevitably skewed towards those people who take online surveys (Bethlehem, 2010). This means that certain sections of the population are systematically under-represented - in one study, I found that participants in China and India were disproportionately well-educated city-dwellers with relatively high incomes (Bryant et al., 2019b). Given that studies have found some of these characteristics could be associated with attitudes towards cultured meat, I cannot be certain that the findings of these studies are strictly generalisable. Indeed, the practicalities of recruiting research participants often mean that true probability sampling is close to impossible (Bryman, 2016).

Finally, quantitative research of the kind in this thesis only considers central tendencies, and therefore fails to identify which consumers are especially skeptical or enthusiastic about the concept. It is likely that when cultured meat first comes to market it will only be available in small quantities at a premium price (Askew, 2019). Therefore, the initial market strategy is likely to be one of identifying which small group of consumers is willing to pay a premium price. Developing messages which are overall more persuasive to a representative group of consumers may not be important until cultured meat is more widely available.

Although I used quantitative methods almost exclusively, some of my studies did include a qualitative element in the form of word association tasks (Bryant & Barnett, 2019; Bryant & Dillard, 2019). The use of word association tasks allowed me to get a qualitative sense of respondents' first impressions of cultured meat, and this is a technique which has been used in subsequent research on novel meat products (Szejda, Dillard & Urbanovich, 2019).

In summary, I have relied primarily on a research paradigm of objectivism and positivism, but have found constructivist and interpretivist concepts useful, given the subject matter. Clearly, a detailed understanding of individuals' interpretations and associations around cultured meat is useful; I have built on the detailed understanding provided by qualitative researchers before me, and used these accounts to develop quantitative and generalisable studies which aim to inform strategy to displace as much demand for conventional meat as possible. I have favoured quantitative methods due to their generalisability to large populations, their ability to isolate and test the effect of specific variables, their potential for impact on policymakers, and thematic saturation in the extant qualitative literature. This approach, however, may have led to findings which have a narrow focus that may exclude some relevant concepts, have limited ecological validity, are imperfect in terms of representativeness, and may have limited applicability due to their focus on central tendencies rather than early adopters.

2.3 Measures

In this section, I will discuss the measures I have used to assess cultured meat acceptance, as well as other measures used in my different studies.

2.3.1 Measures of cultured meat acceptance

Previous research on consumer acceptance of cultured meat has used various measures to assess participants' attitudes towards the concept. The most common type of measure employed, and the main one which I have adopted in my studies here, is Likert scales (Verbeke, Sans & Van Loo, 2015; Wilks & Phillips, 2017). Other studies have used a sliding scale to the same end (Siegrist & Hartmann, 2018; Siegrist, Sutterlin & Hartmann, 2018), while others still have used choice experiments where participants choose between cultured and conventional meat options (Slade, 2018; Good Food Institute, 2016).

Although my early work called for research in the area to standardise outcome measures in order to make different studies more comparable (Bryant & Barnett, 2018), there was some variation in the measures I used subsequently (see Table 1). I consistently used five point Likert scales, but the specific measures reported in each study varied between single item outcome measures (e.g. cultured meat purchase intent) and reliable scales comprising several items (including willingness to try, willingness to replace conventional meat, and willingness to pay more). This is primarily because, in discussions with collaborators, my views on the most important outcome measures changed over time. In my more recent work, I have reported purchase intent as the key outcome variable, since this represents the outcome of most interest to cultured meat producers. That said, I have been consistent in collecting the same measures in each of my studies, only varying the key measure reported.

2.3.2 Attitude measures

As well as behavioural measures of acceptance, I collected a range of attitudinal data in each study. This was also done with a range of 5- and 7-point Likert scales. As well as single-item generic approval measures such as 'For me, to eat clean meat would be… extremely good - extremely bad', I included a range of measures related to specific perceptions of cultured meat noted in the qualitative literature - in particular in Verbeke et al. (2015a). Some scales measured specific judgements about cultured meat such as anticipated healthiness, safety, sensory properties, and benefits for society. Others measured emotional responses such as disgust, fear, and excitement.

Most studies used these measures as dependent variables measured across experimental groups (Bryant et al., 2019b; Bryant & Dillard, 2019; Bryant & Barnett, 2019), often finding evidence that these attitudes and beliefs were sensitive to changes in terminology, framing, and explanations. However in the cross-country survey, attitudinal measures were used as predictors in regressions where the target variable was cultured meat purchase intent (Bryant et al., 2019b). These regression models were quite robust, accounting for between 49.4% - 54.8% of the observed variation in cultured meat purchase intent. Whilst some attitudes and beliefs (including the generic 'appeal') predicted purchase intent in all countries, there were interesting patterns in which predictors were significant in different countries. For example, disgust, which was identified as a key driver of consumer responses in much of the previous Western-skewed literature, was only a significant predictor in the US responses. Meanwhile, health and nutrition were uniquely strong drivers of purchase intent in China, whilst India was the only nation in which the perceived ethical benefits drove purchase intentions (see Bryant et al., 2019a). Using attitudinal data in this way enabled us to identify not just differences in attitudes between countries, but differences in which attitudes will drive purchase intent.

2.3.3 Familiarity measures

Familiarity with cultured meat was identified as an important variable to include, as quantitative work in the field had already shown this to be a associated with higher acceptance, though as I observed in my systematic review, this was yet to be tested statistically (Bekker et al., 2017a; Bryant & Barnett, 2018; Wilks & Phillips, 2017). Several subsequent analyses (including Bryant et al., 2019a) have verified the importance of familiarity using quantitative techniques.

Indeed, in the absence of reliable longitudinal data, this data-point has been an important one for projecting future cultured meat acceptance. In general, people develop more positive attitudes towards stimuli after more exposure to them (Zajonc, 2001), and this appears to be the case with cultured meat. If people become more comfortable with the idea the more they hear about it, this bodes well for future acceptance.

An alternative explanation for this relationship between familiarity and acceptance is a kind of selection bias whereby people who like food, technology, or animal welfare might be more disposed to have read about cultured meat. As has been noted, the tone of media coverage of cultured meat has been relatively positive (Goodwin & Shoulders, 2013). The Sentience Institute has recently begun collecting longitudinal survey data on acceptance of cultured meat and other food technologies, and in time, we will be able to parse the question of whether acceptance of cultured meat rises over time with familiarity, as well as identify the impact of any changes in media coverage.

2.3.4 Other measures

As well as various attitudes and behavioural intentions towards cultured meat, my studies contained various additional measures, and some demonstrated that these were related to cultured meat acceptance. Some of these, such as food neophobia and meat attachment, were based on validated measures from psychological literature (Pliner & Hobden, 1992; Graça et al., 2015). Others were more specific quantifiable measures for different forms of analysis, such as an amount of money the participant would be willing to pay for cultured meat products (Bryant et al., 2019a). In the cross-country survey, we asked about specific types of cultured meat that respondents might eat. Although we did not report on thata data in the published study, it is available in the Open Access dataset, and I have subsequently cross-referenced this with the data on religion to generate insights on how cultured meat might be viewed in major religions (Bryant, 2020a).

One measure I have adopted in several studies is word association. This had been used previously in qualitative research on cultured meat acceptance (Bekker et al., 2017b), and I have found it to be a useful way of eliciting first impressions, as well as a way to gather open responses which was not too demanding in terms of qualitative analysis. It also proved useful as a validity check in one study, where several dozen responses were removed due to copy/paste threads being detected in the qualitative response fields (this was indicative of an automated survey response rather than a human).

2.3.5 Manipulation and validity checks

One study in particular (Bryant et al., 2019a) contained a manipulation check to test whether the interventions had had the desired effect on participants. In arguing about naturalness, participants saw different messages - (a) cultured meat is natural, (b) conventional meat is unnatural, (c) naturalness should be irrelevant to food acceptance, and (d) cultured meat has other benefits. After reading the manipulation, they answered questions about their perceived naturalness of conventional meat and cultured meat, and their perceived importance of naturalness. As it turns out, these measures were important, because they revealed that interventions (a) and (c) had been unsuccessful in affecting participants' views of naturalness, and subsequently resulted in unchanged attitudes to cultured meat.

The other experimental studies (Bryant & Barnett, 2019; Bryant & Dillard, 2019) contained more straightforward manipulations which targeted heuristic perceptions rather than arguments per se. Therefore, although participants in these studies varied in what they saw, there was no specific belief targeted which would be appropriate to measure with a manipulation check.

2.4 Ethics

All of the empirical research in this thesis received ethical approval from the University of Bath Department of Psychology's research ethics committees, with the exception of one study (Bryant & Dillard, 2019), which was conducted with an external collaborator and instead was approved by Portland State University's Research Integrity Office.

Diener and Crandall (1978) have categorised ethical considerations into four components: harm to participants, lack of informed consent, invasion of privacy, and deception. Since my empirical research consisted entirely of online surveys in which participants were mainly asked about their opinions of cultured meat, there was little scope for causing participants harm. In one study conducted as part of my placement at the vegan charity Viva!, survey participants were shown an image of confined and mutilated pigs. This was judged by the

Psychology Research Ethics Committee to have potential to cause psychological distress to participants, and therefore a warning about this image was included in the information and consent page.

All studies asked for participants' consent to take part and provided debriefings. Participants' data privacy was maintained in accordance with my Data Management Plan (see Appendix A). For some studies, participants gave consent for the anonymised data to be made Open Access, though for some of the earlier studies I conducted, I did not include this. I have subsequently been advised by the University of Bath's Library Research Data Service that, although publishing anonymised data does not break any laws around data protection, it could nonetheless be considered unethical to make this data available without participants' consent (see Appendix A).

Another ethical concern of this research has to do with deception. Most of my studies were experimental, and participants did not know that the information they were given was experimentally manipulated until after the fact. I highlighted this in some ethics applications, and was subsequently advised that this need not be considered deception if participants are debriefed at the end of the study (see Appendix A).

***

One of the difficulties one encounters when writing about issues of farm animal suffering is a straightforward unwillingness to acknowledge or engage with the issue. If one takes the view that farm animal suffering is worth considering, the extent to which others appear to disagree with this view is remarkable. Presently, research which aims to reduce meat consumption for the purpose of reducing farm animal suffering is considered a niche interest; often such work must purport to be primarily about environmental or health outcomes.

Why is it controversial to claim that buying animal products causes animal suffering, and that this is bad? Why do so many intelligent people reliably fail to think clearly about this issue? The answers to these questions implicate a range of social and psychological factors which serve to reassure individuals and society that rearing and killing animals for food is morally permissible. I explore these factors in my first study.

<table>
<tr><th colspan="10">This declaration concerns the article entitled:</th></tr>
<tr><td colspan="10">Going Veggie: Social and Psychological Barriers to Vegetarianism in an AIDA model</td></tr>
<tr><td colspan="10">Publication status (tick one)</td></tr>
<tr><td>Draft manuscript</td><td></td><td>Submitted</td><td>X</td><td>In review</td><td></td><td>Accepted</td><td></td><td>Published</td><td></td></tr>
<tr><td>Publication details (reference)</td><td colspan="9">Bryant, C., Prosser, A., Barnett, J. (2020). Going Veggie: Social and Psychological Barriers to Vegetarianism in an AIDA model. Appetite.</td></tr>
<tr><td colspan="10">Copyright status (tick the appropriate statement)</td></tr>
<tr><td colspan="3">I hold the copyright for this material</td><td>X</td><td colspan="5">Copyright is retained by the publisher, but I have been given permission to replicate the material here</td><td></td></tr>
<tr><td>Candidate's contribution to the paper (provide details, and also indicate as a percentage)</td><td colspan="9">The candidate contributed to / considerably contributed to / predominantly executed the…

Formulation of ideas:

Predominantly (90%). I wrote each section and conceptualised the model, and had input from Annayah and Julie on overall structure and general editing. I wrote the manuscript and presented it to the journal.</td></tr>
<tr><td>Statement from Candidate</td><td colspan="9">This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.</td></tr>
<tr><td>Signed</td><td colspan="5">C S Bryant</td><td colspan="2">Date</td><td colspan="2">29 June 2020</td></tr>
</table>

3. Going veggie: social and psychological barriers to vegetarianism in an AIDA model

Abstract

We conceptualise the journey to vegetarianism in an AIDA model where individuals move from ignorance to (A)wareness, (I)nterest, (D)esire, and (A)ction. At each stage, we explore the psychological barriers to progressing towards vegetarianism, discuss how they manifest, and explore ways to overcome them. Additionally, we consider sociocultural factors which consititute an ambient bias towards meat consumption at each stage of the process. We argue that, while many people are ignorant of the cruel practices entailed in animal farming, many deliberately avoid thinking about the issue, are unable to appreciate the scale of the issue, and simply tend to favour the status quo. When engaging with the issue of farm animal suffering, meat-eaters are largely driven by cognitive dissonance, which manifests as motivated reasoning aimed at protecting one's image of oneself and one's society. This is facilitated by confirmation bias and complicit media which cater to the preferred views of their meat-eating audience. Even once convinced of vegetarianism, habit and willpower present further barriers to acting on those beliefs. This is all in the context of a speciesist and carnistic culture where meat consumption is normal, farming is noble, and vegetarians are 'others'. We locate and elucidate each of these biases within and alongside an AIDA model and e discuss the implications of this model for animal advocates and for further research.

3.1 Introduction

3.1.1 Eating animals

If we are to make moral progress, we must be critical of realities we take for granted and question our 'moral blind spots' (Austin, 2012) asking which of our practices future generations will consider reprehensible. Throughout history, many practices which are considered immoral today were practised and condoned widely. This might be viewed optimistically as an indicator of how much moral progress we have made in a relatively short space of time (Hermann, 2019). On the other hand, the fact that some atrocities were so recently widely accepted might serve as a stark warning that society likely has egregious moral blind spots today (Austin, 2012).

When asked about possible moral blind spots of today, many prominent thinkers point to industrial animal agriculture (Jones, 2018). Aside from the devastating effects of animal agriculture on public health and the environment (IPCC, 2018; Martin, Thottathil & Newman, 2015; Poore & Nemecek, 2018; Willett et al., 2019), the moral case against the animal suffering it entails is straightforward.

First, it is extremely likely that farmed animals are conscious and can suffer. Griffin and Speck (2004) found that the evidence strongly supports this view: (a) there are no known neural correlates of consciousness which are unique to humans, (b) animal responses to novel challenges suggest a versatility which implies conscious thinking, and (c) reports on animal communication show evidence for animals having subjective experiences. Indeed, there is virtual scientific consensus on animal consciousness, as laid out in the Cambridge Declaration on Consciousness (Low et al., 2012).

Second, buying animal products directly funds the imprisonment, mutilation, and slaughter of animals - all of these things are entailed in the industrial production of milk and eggs, as well as meat (Joy, 2011). Third, it is perfectly possible for the vast majority of Western consumers to live healthily without consuming animal products - in fact, reducing animal product consumption would benefit most such peoples' health (Melina, Craig & Levin, 2016; Willett et al., 2019). Therefore, industrial animal agriculture inflicts extreme suffering on conscious animals with little benefit to humans. Indeed, when we consider the catalytic effect of animal farming on climate change, antibiotic resistance, and pandemics, we might reasonably conclude that it represents a net negative for humans as well as for animals. Industrial animal agriculture causes unnecessary suffering, and can reasonably be called immoral.

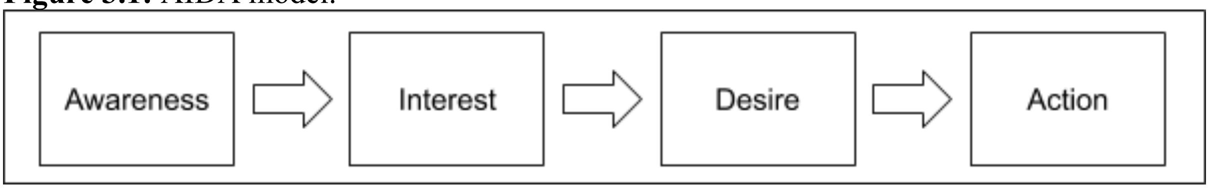
Indeed, this is a practice that most people, including those who purchase the products of animal agriculture, view as morally dubious: 70% of Americans have some level of discomfort when thinking about what happens to animals in the food system (Reese, 2017). Despite this, the vast majority of people also financially support factory farming every day (Ipsos, 2016). Researchers have dubbed this the 'meat paradox' - people both love animals, and pay for their slaughter (Loughnan, Bastian & Haslan, 2010). While some people choose not to support industrial animal agriculture, the vast majority of people still consume animal products (Ipsos, 2016).

While animals continue to suffer on factory farms, the environmental and public health cases against animal farming have become more pressing than ever. However, it is clear that individuals differ in their propensity to reduce their meat consumption - whilst some are simply ignorant of the case for meat reduction, others resist the arguments, and others still acknowledge the case without taking significant action. Therefore, a framework to conceptualise individuals' journeys towards vegetarianism is necessary. For models intended to move people from ignorance to decisive action, advocates can look to marketing literature.

3.1.2 The AIDA Model

The AIDA model in marketing describes the process a person goes through when they develop the conviction to take action, usually buying a product or service (Hassan, Nadzim, Zaleha & Shiratuddin, 2015; Sinh, 2013). First, a subject develops an awareness of a product (A), then an interest in how it could benefit them (I), cultivates a desire to buy it (D), and finally takes action (A) (Sinh, 2013). Although the model has traditionally been applied to the advertising of products (e.g. Hadiyati, 2016), it also describes the chronological process a person would go through in being persuaded to make other kinds of consumption decisions, such as becoming vegetarian (see Figure 3.1).

Figure 3.1: AIDA model.



While it is the job of the advertiser to persuade people to buy their product, it is the job of the animal advocate to persuade people not to buy theirs. This may seem disanalogous in some ways, but if one views forgoing meat as an ongoing cost, vegetarianism essentially has a similar dynamic to a subscription service. In both cases, their advocates need to make their audiences aware of the concept and the issues which necessitate it, get them interested in the idea, make them want to take action, and finally follow through and maintain this on an ongoing basis. Table 3.1 shows how these processes are somewhat parallel.

Table 3.1: The AIDA stages applied to a product purchase and a vegetarian commitment.

	Deciding to buy a product	Deciding to become vegetarian
Awareness	Knowledge that the product exists	Knowledge that farm animals are abused for animal products
Interest	Learning about the benefits of the product and its value to them	Engaging with farm animal suffering as a relevant issue
Desire	Developing a favourable view of the product	Appreciating animal suffering, being persuaded of veganism
Action	Buying the product	Stopping buying animal products

Of course, moving an individual through this process to the decision to forgo animal products is not necessarily straightforward. In this paper, we aim to explore the social and psychological barriers to individuals moving through the AIDA process towards vegetarianism. It is hoped that conceptualising vegetarianism in this way will help animal advocates to locate different individuals at different stages of the process, understand the psychological biases those individuals are likely to be prone to, and deploy ways to overcome those biases.

3.1.3 From ignorance to action: A model of change

There are an array of psychological biases which push against the efforts of animal advocates at each stage of moving an individual through the AIDA process towards vegetarianism. As well as these individual biases, the sociocultural context for consumers in the West is one where animal consumption is the norm, and those who refrain from it are 'othered'. Our model seeks to clarify the psychological biases acting on individuals at each stage of the AIDA process, as well as the sociocultural factors which provide an ambient bias in favour of eating meat.

A deeper understanding of the social, cultural, and individual psychological factors which support the meat paradox, and the relationships between them, may help animal advocates to more effectively cultivate awareness of farm animal suffering, raise public interest in addressing the issue, increasing desire for change, and the conviction to take action. The model is shown in Figure 3.2.

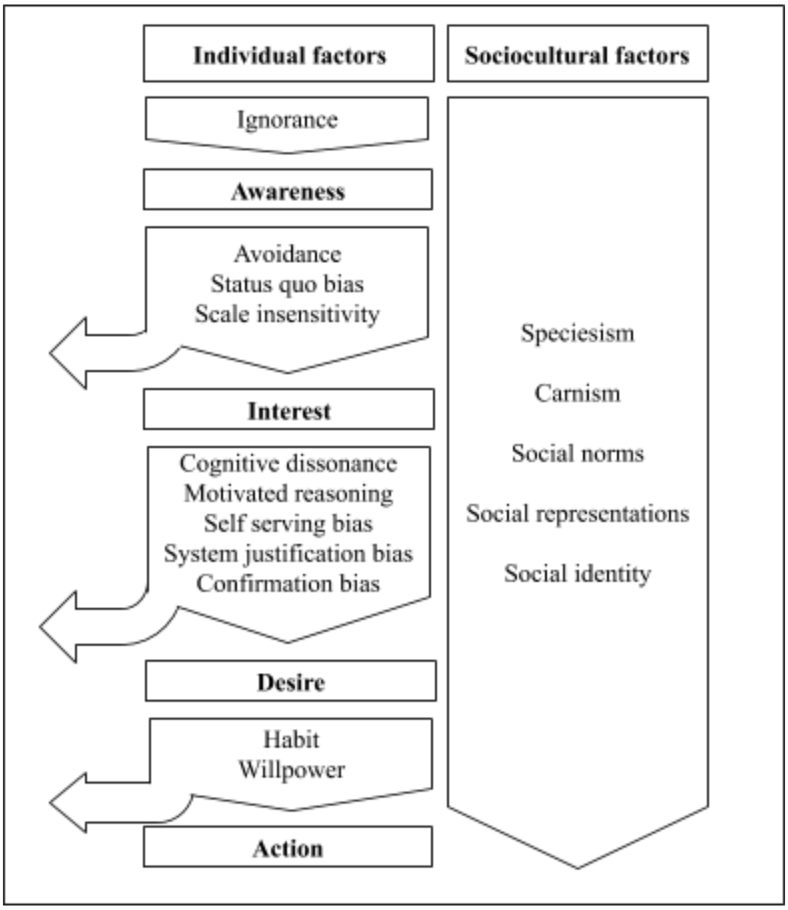


Figure 3.2: The individual and sociocultural factors to overcome in becoming vegetarian.

As shown in Figure 3.2, we have categorised the biases discussed herein as individual factors and sociocultural factors. Within the individual factors, there are different biases and limitations to consider at different stages: somebody who has never thought about the ethics of animal farming will find different communications compelling compared to somebody who already has the desire to go vegetarian, but has not yet done it (Cooney, 2014a). The sociocultural factors, meanwhile, represent the social context and culture of meat consumption which affect all of our thinking on the issue of animal ethics throughout the AIDA model. As shown, individuals may move through the AIDA process, or they may leave the process and stop engaging with the issue, represented by the arrows leaving the process.

In this paper, we discuss each of the psychological factors which represent barriers chronologically at each specific stage of the AIDA process towards vegetarianism. We then discuss the sociocultural factors which represent ambient barriers to vegetarianism and appreciating animal suffering throughout and beyond the process. We argue that animal advocates should conceive of each individual as being at a different stage of this process, and therefore requiring different communications to move them to the next stage and, importantly, having different psychological obstacles to overcome. We additionally consider the social context in which this process occurs.

3.2 Barriers to awareness

The first stage of the AIDA model is awareness. Prior to this, individuals are simply not aware of the issue - it may be something that has never occurred to them to think about. In the case of animal farming, many individuals are unaware of the scale and welfare conditions of animal farming. Achieving awareness in this case simply means learning and understanding that most animals are raised in factory farming conditions.

3.2.1 Ignorance

Several survey findings suggest that the public are mostly ignorant about the issue of animal farming (Cornish, Raubenheimer & McGreevy, 2016). In one report of UK workshops on animal welfare, most participants admitted to knowing very little about how chickens were farmed for meat (Hall & Sandilands, 2007). Similarly, the majority of respondents to a US survey could not name a single source to obtain information about animal welfare (McKendree, Croney & Widmar, 2014). Recent research has found that the public are largely uninformed and often inconsistent with respect to their views on this topic (Alonso, González-Montaña & Lomillos, 2020).

Not only are people unaware of facts around animal farming, but their assumptions tend to be incorrect. Reese (2017) found that 58% of U.S. consumers think 'most farm animals are treated well'. In reality, over 99% of US farm animals live on factory farms (Reese, 2017). Evidently, most consumers hold objectively incorrect beliefs about the welfare of farmed animals. This may be due to sincere ignorance, or willful ignorance - the latter is discussed further in the avoidance section below.

Knowledge about animal welfare has been linked with concern for animal welfare. Interestingly, this link appears to be bidirectional (Cornish, Raubenheimer & McGreevy, 2016; Eurobarometer, 2006; Heleski & Zanella, 2006). In other words, concern about animal welfare causes people to seek information about animal welfare, and exposure to information about animal welfare increases concern about animal welfare. In fact, knowledge about animal welfare is a stronger predictor of concern for animal welfare than demographic factors (Eurobarometer, 2006).

For some portion of the population, simple ignorance of common farming practices truly is the only barrier to veganism. This is evident from the numerous people who go 'vegan overnight' after learning about farm animal suffering (Lindstorm, 2017). As well as those who are literally ignorant of the facts, it is likely that many more are willfully ignorant or feigning ignorance to avoid taking responsibility (Harper & Henson, 2001). These people may engage in avoidance.

3.3 Barriers to interest

Once one becomes aware of the issue, they may move to the second stage of the AIDA model: interest. In the case of vegetarianism, this represents taking the issue of animal suffering seriously, thinking that there is a problem to be addressed, and engaging with the arguments. However, in the case of vegetarianism, there are several barriers to individuals developing an interest in the issue.

3.3.1 Avoidance

Avoidance is the attempt to disengage with a stressor in order to mitigate the negative emotional consequences of dealing with it directly (Gautam & Passi, 2014; Roth and Cohen, 1986). Evidence suggests that meat-eaters tend to avoid thinking about farm animal suffering, and some have argued that society is partly structured to make such avoidance easier (Loughnan & Bastian, 2017).

Evidence suggests that meat-eaters tend to actively avoid thinking about the animal origins of meat. One survey found that 67% of consumers said they did not think about farm animal suffering when purchasing meat (Signicom, 1997). Moreover, Kunst and Hole (2016) found that meat which resembles an animal evokes more empathy in meat-eaters than processed and packaged meat. Many meat-eaters might love sausages, but find seeing a whole skewered pig upsetting. The study also demonstrated that replacing 'beef/pork' with 'cow/pig' on menus lead to increased willingness to order a vegetarian option instead. Just the name of the animal was enough to put people off eating it.

Joy (2011) makes the case that society facilitates the avoidance of thinking about farm animal suffering in a number of ways. Certainly, serious discussions of farm animal suffering are generally absent from mainstream media (see Section 4.5). As Rothgerber (2014a) has argued, the physical isolation of factory farms and slaughterhouses means that such places are out of sight and out of mind. Similarly, packaged meat usually does not resemble an animal, and we use euphemisms like 'beef' and 'pork' to refer to the body parts of some animals (Kunst & Hole, 2016). Notably, the species for which we use such euphemisms in English are mammals, considered closest to humans in terms of their cognitive and emotional capacities (Caldwell, 2017). This may reflect our increased discomfort with the idea of eating these animals.

Many studies examining the effectiveness of different pro-vegetarian materials have found evidence of avoidance amongst meat-eaters (Bryant, 2019a). Cooney (2014b) looked at the impact of using different photos on the effectiveness of vegetarian literature. They compared photos of animal suffering, happy animals, people, and food. The study found that images of animal suffering were the most effective in encouraging people to want to eat less meat. However, they also attracted the least attention. People tended to avoid images which showed the animal suffering in meat production.

Similarly, Faunalytics (2012) studied the effectiveness of different pro-vegetarian videos. They tested four videos focused on either animal cruelty, animal individualisation, envrionmental arguments, or health arguments. Again, they found evidence that a focus on animal cruelty was the most effective in terms of reducing intended animal product consumption, but they also observed that viewers of this video compared to the others more frequently stopped watching before the end of the video.

3.3.2 Status quo bias

For anyone who is not born a vegetarian, eating meat represents the status quo from which vegetarianism is a departure. In general, people have a preference for the status quo, even when alternative choices could be superior (Kahneman, Knetsch, & Thaler, 1991; Samuelson & Zeckhauser, 1988). The effect of this bias is pleasingly illustrated by Thaler (2009), who observes the difference in post-mortem organ donation rates between two neighbouring countries. In Germany, just 12% of people donate their organs after they die. In her neighbouring Austria, a country uncannily similar in culture, the figure is 99%. The difference is what happens as the default. Germans must opt in to donate their organs after death, whereas Austrians must opt out if they do not want to donate. Even with an issue which may be hugely consequential (such transplants are often a matter of life or death), and which one might think is particularly emotive, most people just stick with the default choice either way.

There is further satisfying naturalistic evidence of the status quo bias in the car insurance market in the US (Johnson, Hershey, Meszaros & Kunreuther, 1993). In neighbouring Pennsylvania and New Jersey, two types of policy were offered. Pennsylvanians were offered as a default a more expensive policy with fewer restrictions on their rights to sue, whilst New Jersey residents were offered by default a cheaper policy with more restrictions on their rights to sue. In both states, the majority opted for the default choice.

Just as most Pennsylvanians have not necessarily decided to choose a more expensive car insurance policy and most Germans have not developed a strongly held opposition to organ donation, most meat-eaters have not performed a careful moral analysis before deciding to eat meat - it is just how things are (see Section 6). As we have demonstrated above, most meat-eaters prefer to avoid thinking about farm animal suffering, and the result is that many stick with the status quo of consuming meat.

A thought experiment illustrates how inertia maintains meat consumption for many people. One can imagine having been raised vegetarian in a predominantly vegetarian society (for example, some parts of India (Buncombe, 2019)). Having only ever eaten plants and lived in a culture where this is normal, it seems unlikely that one would be inclined to kill an animal for food. The fact that one might imagine a reluctance to start eating meat when one has not previously done so might indicate that one's current preference for meat consumption is due in some part to simply the way things have always been. In fact the argument that humans have always eaten meat is often explicitly deployed in defence of meat consumption (Piazza et al., 2015; Lowe 2016) - of course, always having done something in the past is no indication of its morality.

3.3.3 Scale insensitivity

It is bound to be difficult, in psychological terms, to properly appreciate the scale of the suffering caused by industrial animal agriculture. This is due to an interesting misalignment in the way we tend to think about morality and scale. Hsee and Rottensteich (2004) demonstrated that, when people rely on feelings, rather than calculation, they are largely insensitive to the scale of the stimulus, apart from reacting to its mere presence or absence. One implication of this is that particularly emotive stimuli are likely to elicit a response that fails to adequately account for the scale of the pain or pleasure demonstrated. We fail to appreciate the difference in scale when we react emotionally.

In an experimental study Boyle, Desvousges, Johnson, Dunford and Hudson (1994) asked three groups of participants how much they would pay to prevent the deaths of 2,000, 20,000, or 200,000 birds affected by an oil spill. Although the difference between the outcomes was an order of magnitude in each case, participants in each of the three conditions showed no significant differences in the amount they were willing to donate. Similarly, Kogut and Ritov (2005) have demonstrated that a single identifiable victim elicits more distress than a group of victims, and the presence of additional victims makes people no more likely to contribute to alleviating suffering. It seems that we are largely insensitive to the scale of emotional stimuli.

It is difficult to appropriately scale our emotional responses to very large-scale suffering. This renders most of us unable to truly appreciate the scale of suffering involved in animal agriculture. If one learns that we slaughtered one million pigs last year in the UK, one is likely to experience this as a remote statistic rather than imagining the fear the animals experience in the moments before they have a knife pushed into their throats. Moreover, if one learns that the real figure is not one million, but ten million (Animal Clock, 2020), one's emotional reaction is unlikely to be any different.

3.4 Barriers to desire

If somebody overcomes these barriers, they move to the interest stage of the AIDA model. From here, the person engages with vegetarianism as a relevant issue, but they do not necessarily agree with its arguments (i.e. they do not yet desire to be vegetarian). The animal advocate tries to move their audience from interest to desire by convincing them of vegetarianism. However, this is the stage at which people generally have the fiercest resistance to vegetarianism, seemingly driven by cognitive dissonance.

3.4.1 Cognitive dissonance

Despite all of these psychological mechanisms working against us as we think about farm animal suffering, most people, when pressed, will concede that the way we treat animals in the food system is regrettable. For example, Reese (2017) found that 70% of US consumers had ‘some discomfort with the way animals are used in the food industry’. This survey also found paradoxically high support for animal rights policies. Notably, 49% of U.S. consumers support a ban on factory farming. Incredibly, 47% support a ban on slaughterhouses, whilst fully one third support a complete ban on animal farming. This is in a population where the vegetarian population is under 10% (Gallup, 2018).

Research on the attitudes of meat-eaters in the UK towards vegetarianism and veganism has demonstrated a similar phenomenon: 73% of respondents rated veganism as being on the ‘ethical’ side of a 1-7 scale, with around one third selecting the highest ‘ethical’ rating possible (Bryant, 2019b). Ratings for vegetarianism (generally considered more positively, and less differentfrom respondents’ own diets) were even higher.

While this research has focused on the West, Anderson and Tyler (2018) found that Brazil, Russia, India, and China (the ‘BRIC’ countries) had comparable levels of concern for animal welfare to the US, and in some cases higher concern. Therefore it seems that similar proportions of the population around the world think there are harmful and morally relevant consequences of eating meat. However, with the exception of India, vegetarianism in these countries is extremely low (Anderson & Tyler, 2018).

Therefore, billions around the world are actively taking part in a system of needless imprisonment, maiming and slaughter, which, by their own standards, is unethical (see Reese, 2018). It is likely no exaggeration to say that this is one of the deepest and most widespread moral dissonances of our time.

3.4.2 Motivated reasoning

According to Kunda (1990, p. 480), ‘There is considerable evidence that people are... likely to arrive at conclusions that they want to arrive at, but their ability to do so is constrained by their ability to construct seemingly reasonable justifications for these conclusions.’ Somebody who eats meat, and who does not want to stop eating meat, has a lot to lose when it comes to thinking about the ethics of animal farming. Eating meat is cheap and convenient, and it would be difficult to avoid (Bryant, 2019b). Eating meat is also just nice; there is considerable evidence that our evolutionary history more or less renders this inevitable (Zaraska, 2016). For most people, stopping eating meat would be a major personal sacrifice in terms of enjoyment and convenience (Piazza et al., 2015).

This leads to extremely motivated reasoning on the topic of farm animal suffering. The result is that many omnivores, most of whom scarcely think about animal ethics (Signicom, 1997), often appear confident in dismissing clear evidence of animal abuse as purely agenda-driven (Buddle, Bray & Ankeny, 2018). The literature on this topic has tended to focus on individuals’ motivations to see themselves as good people, and view their own behaviour as ethical. Indeed, there is considerable evidence to support the view that self-serving biases play a central role in thinking on this topic. However, we argue here that reasoning around meat consumption is also motivated by a desire to see society as ethical and just. In both cases, motivated reasoning is supported by confirmation bias, with a general preference for media coverage which affirms one's existing views (Puglisi & Snyder, 2015).

3.4.3 Self serving bias

People are generally motivated to see themselves in positive ways, and to present themselves positively to others (Shepperd, Malone & Sweeny, 2008). This results in a number of self-serving biases, which distort one's thinking to increase self-esteem (Myers, 2015). Seeing oneself as a good person is a major motivation which affects reasoning on moral topics in which one's behaviour is implicated. As Campbell and Sedikides (1999) have shown, threats to an individual's self image increase self-serving biases. The literature indicates that this desire for a positive self-image consonant with one's behaviour is a major source of motivated reasoning on the topic of farm animal suffering (Bastian & Loughnan, 2017).

It is difficult to overstate what is at stake in the omnivore's dilemma. When thinking about this topic, the omnivore can (a) attempt to justify the suffering inflicted on farm animals, (b) give up animal products, or (c) simply live with the dissonance of knowing that one is supporting needless animal cruelty. It seems that, for most people, (b) and (c) are unacceptable. Accordingly, Loughnan, Bastian and Haslam (2014, p. 104) argue that omnivores experiencing 'the meat paradox' alter their beliefs about themselves ('the eater'), about animals ('the eaten'), and about meat consumption ('the eating').

First, with respect to beliefs about themselves, omnivores tend to underestimate the frequency with which they consume meat, particularly when they are in dissonance-inducing situations (Rothgerber, 2014a). This is an issue for research on animal product consumption, because the moralised nature of the issue likely increases social desirability bias in self-reported behaviour and attitudes (Peacock, 2018). The tendency to hold unlikely beliefs about oneself with respect to meat consumption is demonstrated neatly by Reese (2017). His survey found that while 58% of U.S. consumers think that 'most farm animals are treated well', 75% think that the animal products they personally usually buy are 'from animals that are treated humanely'. This difference represents a self-serving bias, since people assume their own behaviour is more moral than that of others. (As discussed, the majority of people are wrong on both counts, since it is estimated that fewer than 1% of the animals killed for foods are produced outside factory farms in the USA (Reese, 2017)).

Second, with respect to beliefs about animals, Loughnan, Bastian and Haslam (2010) demonstrate how eating meat can change these. In an experimental study, people answered questions about cows' ability to feel pain and the morality of killing them. Before answering, participants were given a snack of either nuts or beef jerky. Those given beef jerky assigned significantly less moral status to cows, and showed significantly lower concern for animals in general. Lower regard for animals appears to have been exacerbated, in this case, by recent meat consumption. It is reasonable to extrapolate, therefore, that more frequent meat-eaters are likely to be subject to this bias more often and to a larger extent.

Third, with respect to beliefs about meat consumption, Rothgerber (2014a) shows that meat-eaters experiencing dissonance reduce their perceived choice in the matter. The author demonstrated that many omnivores who confronted this dilemma claimed that they had little choice in whether to eat meat. Similarly, Piazza et al. (2015) identify necessity as one of 'the four Ns' which are frequently used to justify meat consumption. Attributing one's shortcomings to circumstances beyond one's own control is a common self-serving bias - this is referred to in the literature as establishing an external locus of control (Twenge, Zhang & Im, 2004).

There is evidence, therefore, of omnivores exhibiting self-serving biases when reasoning about animal product consumption. One might argue that vegans are just as likely to have such a bias in the opposite direction: surely they are motivated to believe that their choices are more ethical than those of the omnivore. However, those who deploy this argument put the cart before the horse: typically, vegans have changed their diets because of their beliefs rather than changing their beliefs because of their diets (Radnitz, Beezhold & DiMatteo, 2015). Therefore, vegans are less likely to be engaging in self-serving biases when reasoning about animal product consumption, principally because their conclusions entail an ongoing sacrifice and often ongoing reflection.

3.4.4 System justification bias

System justification theory posits that people are motivated to justify the existing social order (Jost, Banaji & Nosek, 2004). In contrast to self-serving biases in which individuals are seen as motivated to believe positive things about themselves, system justification theory sees individuals as motivated to believe positive things about their society, principally that the society is just. This is similar to Furnham's (1993) concept of 'just world beliefs' - a bias in which people assume justice will be done, sometimes by mysterious or spiritual means. Some psychological literature talks about 'existence bias' - Eidelman and Crandall (2012, p.270) state that 'people treat existence as a *prima facie* for goodness'. In other words, we assume that there must be a good reason for things to be the way they are. Of course, unless we resist this heuristic, we will conclude that we ought to oppose change of any sort, and we will be incapable of detecting moral blind spots of any kind.

In this case, reading about the suffering of farm animals, and considering that this is happening to millions of animals right now can be overwhelming. If one properly feels the weight of this, it quickly becomes galling that society is complicit in this. We want to believe that there is order and justice to the world, and that such outcomes, if they truly were so terrible, would simply not be allowed to happen. Most people want to believe that there must be a good justification for us doing this, even if we do not have it immediately to hand.

For many people, the very fact that meat-eating is so widespread serves as evidence that it is morally acceptable. As Leenaert (2017) puts it, 'Most people eat meat because most people eat meat.' Normality is another of Piazza et al.'s (2015) four Ns which represent common justifications given for meat-eating. However, the fact that most people eat meat is, of course, not evidence that it is morally justifiable.

With respect to our beliefs about our society, it is comforting to believe that we must have a real justification for condoning the imprisonment and slaughter of billions of animals. The alternative - the idea that there really is no good justification, and that we are causing intense suffering on an industrial scale for no good reason - is simply too dire for most to consider. How could one feel comfortable in a society which allows such needless suffering?

Indeed, those who recognise this suffering often are not comfortable. In Herzog's (1993, p.115) interviews with animal rights activists, he writes that the activists '...talked about their frustration that public attitudes about the treatment of animals were not changing rapidly enough. They spoke of their sense of guilt when their behaviour did not match their ideals. Many were laboring under a heavy moral burden that other people do not bear.' This unpleasant sense of *weltschmerz* is one proposed mechanism for the link between vegetarianism and depression (Herzog, 2018). It is far more comfortable for an individual to believe that this suffering is not a problem, and that society and the world is just.

3.4.5 Confirmation bias

We have shown here that individuals are motivated to believe positive things about themselves and the societies to which they belong. We have also shown that individuals demonstrate biases in service of these beliefs. Another way this is done is through selectively paying attention to information which affirms, rather than refutes, one's existing worldview. This is known as confirmation bias (Klayman, 1995; Nickerson, 1998).

There exists plenty of evidence of confirmation bias with respect to information about farm animal welfare. Meat-eaters tend to avoid images of animal cruelty (Cooney, 2014b), and often assume that evidence of animal abuse is agenda-driven and not trustworthy (Lentz et al., 2018). Meanwhile, the information consumers pay most attention to on labels of animal products are expiry date, species name, weight, and price - information about the production method (e.g. free-range) receives far less attention (Verbeke & Ward, 2006; Verbeke et al., 2008; Verbeke, 2009).

Given that the vast majority of the population eat animals, it is unsurprising that media coverage of veganism and related issues has tended to have a negative tone. Cole and Morgan (2011) found that UK newspapers tended to frame veganism as defying commonsense, discredit veganism as difficult or impossible in practice, and portray vegans as capricious extremists. One can see how all of these messages are appealing to a meat-eater who is seeking justification for their behaviour. However, one can also see how none of them actually represent an argument against veganism. Rather, the media rely on readers accepting these ideas uncritically, and it seems that most meat-eaters are happy to do this because it serves their interests (Buddle, Bray & Ankeny, 2018).

Cole and Morgan (2011) show how the media covers veganism in a way which caters to audiences' confirmation bias. However, perhaps more important than what the media says about veganism is what it does not say. According to agenda-setting theory (McCombs & Shaw, 1972), the media does not tell the public what to think per se, but rather what to think about. Topics which receive more prominent media coverage are generally considered more important by the public (Dearing & Rogers, 1988). The lack of media coverage of veganism and animal rights therefore enables most people to continue ignoring these topics. Since media coverage of an issue is typically prompted by specific events related to the issue (Botelho & Kurz, 2008; Marks, Kalaitzandonakes, Allison & Zakharova, 2003), one can expect that more coverage could result from new research publications, undercover investigations of farms, and co-ordinated commercial events such as Veganuary.

3.5 Barriers to action

If somebody is able to overcome these biases and they are convinced of the moral argument for vegetarianism, they are at the third stage of the AIDA model: desire. This means that they want to go vegetarian, though they may not yet have taken any action. For most people, the biases discussed thus far are sufficient to prevent them from ever reaching this stage (Reese, 2017). However, moving from the desire to be vegetarian to action (i.e. actually becoming vegetarian) is, unfortunately, also not straightforward.

3.5.1 Habit

With the best of intentions, it is trivially easy to act otherwise out of habit, particularly with respect to a behaviour so long ingrained and so frequently performed as choosing food. Even someone who is utterly convinced of the arguments for veganism may not change their behaviour out of habit. As Wood and Rünger (2016) argue, habits represent the default responses in choice scenarios, and drive choices more frequently than deliberate goal pursuit. The authors elaborate that habitual behaviours often entail a short-term change in goal priorities - this is reflected in food choice data consistently showing taste and convenience to be stronger drivers of food choice than factors such as ethical concerns or health (Fotopoulos, Krystallis, Vassallo & Pagiaslis, 2009; Januszewska, Pieniak & Verbeke, 2011). Loughnan and Bastian (2017) have argued that meat consumption, like other morally dubious behaviours, becomes habitual, and we tend to engage in such behaviours with 'little reflection and relatively high frequency' (p. 284).

Food choices are likely to be affected by habit, because they are often made in the same context, and are therefore subject to the same environmental cues (Wood, Labrecque, Lin & Rünger, 2014). For example, choosing one's lunch might occur in the same cafeteria or shop display which prompts default selection of one's usual choice. Further features of habitual behaviours include choices made with limited thought and rigidity (Sefer & Spiering, 2011, Smith & Graybiel, 2013), features which again are likely to apply to food choice.

Eating meat seems to qualify as a habitual behaviour in many respects: it is carried out repeatedly in the same environment, often with limited rigid thought, and usually under the sway of short term goals rather than long term ones. Therefore, when one already desires to become a vegetarian, tools to overcome habitual food choices are necessary. Fortunately, researchers have developed tools to help motivated individuals overcome these habitual choices. Camp and Lawrence (2019) demonstrate the efficacy of a computerised 'Response Inhibition Training' task in which subjects respond to pictures of plant foods, but do not respond to pictures of meat. This 'response inhibition training' has been demonstrated as an effective tool to reduce propensity to carry out a variety of bad habits, including meat consumption (Lawrence et al., 2015; Adams et al., 2017). Other promising research has shown that selection of vegetarian options increases significantly when these dishes are presented as the default (Campbell-Arvai, Arvai & Kalof, 2014; Hansen, Schilling & Malthesen, 2019). This is an example of an intervention which food outlets could adopt, or regulators could require, to help consumers overcome the habitual selection of meat.

3.5.2 Willpower

Willpower has been discussed in psychological literature variously as self-regulation or self-control. Metcalfe and Mischel (1999, p.3) characterise the research on this topic as suggesting a 'hot/cool-system' whereby the impulsive and reflexive 'hot' system attempts to drive an individual based on emotionally salient stimuli (such as meat they find appealing) and the contemplative unemotional 'cool' system attempts to drive the individual on the basis of their reasoned intentions. The authors argue that the result in a given situation depends on a number of environmental and individual factors. It is likely that this dynamic is at play with respect to resisting meat - indeed, some experimental work uses tempting food as a willpower-depleting stimulus (Baumeister & Vohs, 2003).

Individuals may vary in how much willpower they can summon to avoid meat. For example, individuals vary with respect to their attitudes towards harming farm animals (Caviola et al., 2019) - some people are higher in empathy than others (Hogan, 1969) and are presumably more disposed to care about animal suffering. These people may naturally have more willpower to avoid animal products. The salience of animal suffering is likely relevant here, also. Cooney (2014a) found that proximity to a companion animal was cited by 26% of vegetarians and vegans as a major source of influence to change their diet. For these people who interact with a companion animal daily, the possibility of animal suffering is presumably much more salient than for people who scarcely interact with animals.

Additionally, individuals may vary in how much willpower they require to avoid meat. Individuals have different levels of meat attachment (Graças, Calheiros & Oliveira, 2015): in particular, those with a high hedonistic value derived from meat and high dependence on meat will require more willpower to continually avoid meat (Lentz, Connelly, Mirosa & Jowett, 2018). For people with low meat attachment scores, giving up meat is less of a sacrifice, and therefore requires far less willpower. Moreover, since we know taste, price, and convenience are major barriers to vegetarianism (Schenk, Rossel & Scholz, 2018; Bryant, 2019) we can infer that people with access to high quality affordable alternatives to animal products make less of a sacrifice when giving up meat, and therefore require less willpower to change their consumption.

Whilst habitual purchase of meat can be characterised as automatic, and is thus well-addressed through Lawrence et al.'s Responses Inhibition Training, lack of willpower describes a situation where the individual has interrupted the automatic process to consider their food choice, but nonetheless chooses meat. Gollwitzer and Sheeran (2006) found strong evidence for the effectiveness of implementation intentions in overcoming this situation. That is to say, one can increase adherence to an intended behaviour (e.g. being a vegetarian) by planning in detail when one anticipates challenges (e.g. immediately before mealtimes), where one is likely to be (e.g. at home, or at work), and how one will deal with these challenges to behave in line with their goal (e.g. having tasty pre-prepared vegetarian food ready and available). Planning implementation intentions is likely to significantly increase motivated individuals' ability to adhere to a vegetarian diet.

3.6 Sociocultural context

Sections 2-5 described the cognitive biases individuals face at each stage of the AIDA model with respect to vegetarianism. As Figure 3.2 shows, these individual factors are accompanied by a host of sociocultural factors which work against the individual moving through the process at each stage. These are broader social realities that individuals exist within, and which act upon the individual's intentions.

3.6.1 Carnism and speciesism

Individual decisions are unavoidably taken in a socio-cultural context. In this way, individuals may be blind to the social processes affecting their thinking and decision making. In the case of animal product consumption, there is an overwhelming culture of meat-eating in most Western countries, supported by a pervasive ideology known as carnism (Joy, 2011). The carnist worldview considers a small group of animals appropriate for human consumption or use. The idea of factory farming most species of animals seems bizarre and cruel, yet we appear to find it acceptable to factory farm cows, pigs, sheep, and some species of birds and fish. It is difficult to overstate the power and prevalence of carnism at every level of society. The exploitation and killing of these animals is a deeply embedded part of our cultures, our rituals, and our traditions.

Carnism is rooted in speciesism - discrimination on the basis of species (Singer, 1975). Recently, psychologists have studied speciesism in greater detail, developing reliable scales for its measurement and demonstrating that it correlates with racism, sexism, and other discriminatory attitudes (Caviola, Everett & Faber, 2019). Likewise, Dhont and Hodson (2014) found higher acceptance of animal exploitation and greater belief in human supremacy amongst those with right-wing ideologies and higher social dominance orientation.

Upon first encountering the concept of speciesism, one may be tempted to reject the idea that it is analogous to other forms of discrimination. It is intuitive to think that there are good reasons to discriminate on the basis of species - for example, it is common to argue that non-human animals have inferior cognitive abilities, have lower levels of sentience, or lack moral agency. However, as Caviola, Everett and Faber (2019) argue, none of these appear to be good reasons to reduce our moral concern for beings within the same species. We would not condone affording fewer rights to a mentally impaired human who lacks cognitive abilities or moral agency - we may even increase our moral concern for such a person. Therefore, membership of a different species, rather than mental deficiencies per se, appears to be the basis for radically different treatment of some animals.

Views of this kind are often mistaken for a belief that humans and animals are morally equivalent. Of course, one does not need to believe this in order to believe that animals have sufficient moral value to be spared a life of suffering on a factory farm before a painful death. Nonetheless, comparisons of animal and human suffering are often difficult to stomach. Mika (2006) found evidence that activist messages comparing animal agriculture to slavery and rape were likely to put people off engaging with the message. While it is possible that humans have a richer conscious experience than farm animals comprising 'higher order thoughts' (Carruthers, 1992; 2000), there is evidence that animals, like humans, can (and, in most farming systems, do) experience physical and emotional pain and distress. Nonetheless, in order to escape our in-group bias, it is useful not to consider comparisons between animals and humans, but instead to consider comparisons between different species of animals.

As Caviola, Everett and Faber (2019) discuss, there is evidence of arbitrary and radical variations in our treatment of different species of animals across cultures and time. It is well-known that cows are considered holy by many people in India (Attanasio & Augsburg, 2018), and beef consumption in some parts is rare (Devi, Balanchar, Lee & Kim, 2014). This example is not unique: other animals which we factory farm were considered holy or sacred in different times throughout history. The Irish Druids considered pigs to be sacred, to the extent that their priests were known as 'swine' (Bonwick, 1894). In the Ancient Roman senate, 'sacred chickens' were used as omens to forecast the society's future (de Jacourt, 1765). If the chickens ate grain enthusiastically, it was considered a harbinger of good news. If they were hesitant to eat the grain or refused, it was considered an indicator of bad news. Amusingly, Roman senators seem to have lost sight of the purpose of this test, as they are reported to have manipulated the outcome by deliberately starving the sacred chickens for several hours before consulting them.

As well as animals which we eat, but are or were considered sacred in other cultures, there are examples of the reverse. Horses, which now enjoy generally high status and are sometimes seen as pets in the West, were in the past regularly used for food (Gade, 1976). In the West, dogs are our friends, companions, and pets. However, dogs are commonly killed for food in Asia (Czajkowski, 2014), most famously at the Yulin dog meat festival, where they are publicly tortured with bludgeons and blowtorches to make their meat taste better (Giordano, 2019).

Perhaps the clearest example of speciesism for many is a comparison between dogs and pigs. Intuitively, these species seem very similar. Indeed, empirical evidence strongly suggests that pigs and dogs have very similar cognitive and emotional capacities - in fact, pigs are generally considered to be more intelligent (Broom, Sena & Moynihan, 2009; Mendl, Held & Byrne, 2010; Low et al., 2012). It is difficult, when one looks, to find the difference which makes it acceptable to put a pig, but not a dog, into a gas chamber for food.

3.6.2 Social norms

One of the major implications of a carnistic culture is that meat-eating is normal: those who choose not to eat meat are deviating from a social norm on which there appears to be overwhelming consensus. There are at least two ways in which the normality of meat consumption could be a barrier to adopting vegetarianism.

First, an individual might infer from the overwhelming normality of meat consumption that, since so many people engage in this practice, there must be a good justification for it (Piazza et al., 2015). Moreover, since it is so normal, there is little or no social cost to eating meat, so there is no external motivation to pay attention to the issue. This may serve as a form of avoidance (a barrier to developing interest in the issue) or a form of motivated reasoning (a barrier to developing the desire to go vegetarian).

Second, an individual might actually have accepted the arguments for vegetarianism, but decide that going vegetarian will violate the social norm, and therefore carry a social cost. Deciding to avoid meat out of personal preference, taste, or concern for one's own health is a very different proposition from a moral objection (Rothgerber, 2014a) - the latter carries the implication that other people ought not to eat meat, too. Bringing animal slaughter to the attention of a meat-eater is a fairly confrontational act - this is likely to feel especially uncomfortable for those inclined towards vegetarianism, who may be conflict-averse as a result of tending to be more agreeable and introverted than average (Cooney, 2014c; Keller & Siegrist, 2015; Kesller et al., 2016; Mõttus et al., 2013). Therefore, a desire not to 'rock the boat' may stop people from going vegetarian even if they accept the arguments.

Cooney (2014a) reported on survey responses including some meat-eaters who said they wanted to go vegetarian, and some who said they did not want to. They observed that the most common reason given by omnivores who did not want to go vegetarian was, by far, taste. Conversely, the most common reasons given by omnivores who did want to go vegetarian but had not done so was convenience, followed closely by family, and then cost. These data appear to support the idea that people tend to have different concerns at different stages of the transition towards vegetarianism: those who are pre-desire (i.e. they do not want to go vegetarian) were concerned with taste, whereas those who were pre-action (i.e. they already had the desire to go vegetarian) were concerned with more pragmatic factors about how to execute the transition. This is also reflected in the findings of Bryant and Dillard (2020) who studied the intentions of students who watched a presentation arguing for plant-based eating. The results indicated that students who developed an intention to reduce their animal product consumption were more likely to report practical factors as their primary barrier to acting, whereas those who did not intend to act were more likely to report taste as their main concern.

These two levels of distortion by social norms are analogous to those observed by Asch (1951) in his classic conformity experiments. Of the subjects who yielded to group pressure and modified their responses, some reported afterwards that they thought the group majority must be correct, whilst others knew they were wrong but did not want to break social cohesion. The distortion occurs in one case at the level of judgement, and in the other merely at the level of behaviour.

3.6.3 Social representations

Moscovici (1961) argues that one of the key ways we make sense of our shared social world is with social representations. Social representations are our abstract shared renderings of concepts in the world. These representations serve to establish order so that individuals can orient themselves when interacting with the world (Moscovici, 1961). Most people within the same culture likely have similar subjective depictions of the concepts of meat, farmers and farm animals, and vegetarianism.

Funk, Sutterlin and Siegrist (2020) experimentally investigated the stereotypes subjects attributed to a host who served a vegetarian (vs. meat) menu. Their findings indicated that, compared to a host serving a meat menu, the vegetarian host was seen as significantly more concerned with animal welfare and personal health, as well as trend conscious and alternative. The traits attributed to the vegetarian host in this study demonstrate some of the associations we have with vegetarianism, and portray to some extent our social representations of vegetarians. They are concerned with animal welfare and their health to an unusual extent, and are trendy and alternative - they are not, according to this representation, like normal people.

Our social representation of meat, on the other hand, is one of valorisation and fetishization. Meat is often seen as central to dishes (Melendrez-Ruiz, Chambaron, Buatois, Monnery-Patris & Arvisenet, 2019) and is associated with wealth and power (Aveli, 2013; Rothgerber, 2013; Ruby & Heine, 2011). Communal meat consumption plays a central role in many of our traditions, including Sunday roasts, Easter lamb and Christmas turkey, and may develop warm associations with family gatherings (Abarca & Colby, 2016). Although many consumers are ambivalent about meat production on reflection (Van der Weele & Driessen, 2020), common social representations of meat do not consider animal ethics, possibly because they are created socially and therefore aim partly to facilitate social cohesion.

Finally, our social representations of farmers and farm animals are crafted by the language used in relation to animal farming. As Croney and Reynnells (2008) argue, in English, euphemisms and metaphors like ‘crops’ ‘units’, and ‘harvest’ replace words like ‘herds’, ‘animals’ and ‘slaughter’ to make the process seem less violent. As the authors put it, ‘Semantic obfuscations rampant in the language of modern farm animal production reflect underlying ambivalence about transparency relative to many standard industry practices.’ (Croney & Reynnells, 2008, p.387) In other words, if common representations of animal farming were an accurate representation of what the process entails, consumers ‘might consequently refuse (as is their right) to purchase particular products, thus potentially causing significant short-term industry losses.’ (Croney & Reynnells, 2008, p.387). Clearly, there are financial incentives to controlling the social representation of farming.

Recent research has looked at ways that social representations can be influenced to create behavioural change. Jaspal and Nelrich (2020) have argued that, in order to create positive responses to the COVID-19 crises, social representations of the disease and its mitigation strategy must avoid the perception of extreme threats, be understandable to a range of communities, and provide clear behavioural prescriptions. In a similar way, advocates of meat reduction could use this framework to understand how the relevant concepts are generally understood, and how this could be influenced.

3.6.4 Social identities

When an identity is made salient, individuals are more likely to exhibit behaviours in line with that identity. Chattaraman, Lennon and Rudd (2010) found that bicultural subjects could be induced to prefer one brand or another (each associated with one of their cultural identities) by priming them to view one identity as more salient. Identities affect our behaviours in a variety of contexts, including food.

As Fischler (1988, p. 275) tells us, ‘Food is central to our sense of identity. The way any given human group eats helps it assert… the otherness of whoever eats differently.’ Identities are usually much more salient for groups which represent minorities or deviations from the norm. The construction of the category ‘vegetarian’ likely contributes to greater dietary adherence, both in vegetarians and in meat-eaters (Blake, Bell, Freedman, Colabianchi & Liese, 2013; Carfora, Caso & Conner, 2011; Kurz, Prosser, Rabinovich & O’Neill, 2019).

Krpan and Joutsma (2020) experimentally manipulated the labelling of meat-free options in a menu selection-based hypothetical choice task. They found that labelling meat-free options as ‘vegetarian’ led to significantly lower selection of these dishes compared to labelling them as ‘environmentally friendly’ or ‘refreshing’. This could be an indication that the label ‘vegetarian’ is uniquely off-putting to people who do not identify as vegetarian. Such a label may be taken to imply ‘for vegetarians only’.

As well as forming part of our social identity, food which we associate with childhood memories and cultural traditions can form an important part of our personal identities (Fischler, 1988). People typically prefer foods they are more familiar with (Raudenbush & Frank, 1999), so many people maintain consumption of childhood dishes well into adulthood (Demory-Luce et al., 2004). Researchers have observed that mothers typically reproduce the food practices of their mothers, embedding food practices in families (Knight, O’Connell & Brannen, 2014).

One interesting trend with respect to dietary identity is the emergence of ‘flexitarianism’ and ‘reducetarianism’ (Sachs, 2019). These are identities which express that one actively seeks to reduce, though does not entirely eliminate, their consumption of meat and animal products. Flexitarians vary in the extent to which they consider their diet central to their identity, and in their beliefs about carnism (Rosenfeld, Rothgerber & Tomiyama, 2019). For example, whilst many flexitarians are concerned about their health and the environment, they are less likely to be primarily concerned with animal suffering compared to vegetarians and vegans (Cooney, 2014a). Such concerns may be seen as the domain of vegetarians and vegans, and not relevant to other identities.

Beyond viewing identities as static phenomena, Breakwell (2014) characterises identity as a process. In this framework, people behave consistently with existing and past versions of themselves (accommodation), whilst maintaining the possibility of changing (accommodation) and ultimately identity is a negotiated process of consistency and change (balance). This framework highlights the potential importance of continuity when considering the impact of identity changes on self-efficacy and self-esteem (Vignoles, Regalia, Manxi, Golledge & Scabini, 2006).

3.7 Conclusion

In this paper, we have examined psychological barriers to vegetarianism at each stage of the AIDA framework, as well as sociocultural factors which tend to hinder the process of reducing meat consumption. It is important for animal advocates to be aware of where their audience might be in this process - somebody who has never spent time thinking about animal welfare is going to require a different approach from somebody who is already convinced of vegetarianism, but is yet to take action. Moreover, people at each stage of this process and beyond are subject to sociocultural biases which limit our thinking about animal suffering. Together, these biases allow the majority of otherwise ethical and compassionate people to support and be complicit in animal cruelty on an industrial scale.

3.7.1 Arguing about animals

Many of the central psychological processes involved in thinking about farm animal suffering are based on cognitive dissonance between caring about animals and eating them. If the meat-eater accepts the ethical argument for veganism, they must accept not only that they personally pay for unnecessary animal suffering, but that their society and everyone they know is complicit in this systematic cruelty. Evidently, these psychological barriers are sufficient for many people to be completely unmoved by moral arguments about animal suffering when it comes to reducing their own animal product consumption. For this reason, advocates have broadened their message to include environmental and health arguments. However, there are good reasons why advocates should not shy away from focusing on animal suffering.

Firstly, experimental evidence suggests that messages focused on animal suffering are on average more likely to lead to behavioural change than messages focused on health or the environment (Faunalytics, 2012; Doebel, Gabriel & Cooney, 2015). Indeed, Cooney (2014a) found that health was the most commonly given motivation by meat-reducers, whilst the majority of vegetarians and vegans said they were primarily motivated by animal rights.

Importantly, arguments about the environment and human health diverge somewhat from arguments about animal suffering in their conclusions. Whilst red meat and dairy tend to have worse effects on the environment and human health (Ritchie & Roser, 2020), their production typically entails much less animal suffering compared to the production of chicken and fish, which tend to be kept in far greater numbers and in far worse conditions (Tomasik, 2018). Therefore, advocates who deploy these arguments should be wary of a rebound effect whereby consumers reduce their consumption of red meat and dairy only to replace it with white meat, increasing animal suffering overall (Bryant, 2019). Happily, some evidence suggests this does not tend to happen, and meat reducers rather tend to reduce all types of meat consumption rather than increasing some (Vegan Outreach, 2016). Nevertheless, it is important to develop the legitimacy of arguing on the basis of animal suffering, especially given ongoing research to mitigate the environmental and health costs of meat consumption (Dugan et al., 2011; Hulshof et al., 2012). That said, arguing on the basis of health and the environment is still useful to the extent that it produces the outcome of interest, i.e. reducing meat consumption.

3.7.2 Further research

Conceptualising the journey to vegetarianism in this way highlights some areas in which research has a good understanding of human psychology on this issue, as well as areas which warrant further investigation.

First, it is not known how many people tend to be at each stage of the AIDA model with respect to vegetarianism. Although survey data can give us clues, it seems that this is somewhat contradictory - surveys find that most people are at once ignorant of and uncomfortable about the conditions of farmed animals (Reese, 2017). It is unclear, therefore, whether mass communications aimed at shifting diets should assume these people are ignorant (and therefore should seek primarily to raise awareness) or already have some desire to give up meat (and therefore should seek primarily to facilitate behaviour change). In reality, it is likely that people may progress along this process as and when they think about animal farming, but most of the time are not thinking about it, and are defaulting to avoidance (as indicated by the arrows exiting the process in Figure 3.2).

Second, interventions can be developed to overcome specific barriers to specific stages of this process. For example, just as response inhibition can help overcome habitual meat selection in people who already have the desire to go vegetarian, certain arguments may be reliably more persuasive than others in moving somebody from interest to desire - i.e. persuading them to accept the arguments for vegetarianism. There may also be framings and topics which are more or less conducive to agreement on the principles of vegetarianism. Future research might measure agreement with vegetarianism in principle as an outcome measure (as well as actual or intended behaviour change). This may be more of a reliable measure, given substantial shortcomings in behavioural intention reporting on this topic (Peacock, 2018).

Third, some evidence suggests that education and training can mitigate cognitive biases (Dunbar et al., 2014). Advocates could therefore investigate effective ways to bring their audience's attention to psychological phenomena such as motivated reasoning and status quo bias to encourage them to reflect more critically on their views on animal products.

Clearer thinking on this topic could be the first step to alleviating suffering for millions of animals.

The animal advocate has a formidable task in moving their audience from ignorance to action in the face of so many social and psychological barriers. It is hoped that this paper will help advocates and researchers to locate, investigate, and overcome the barriers when advocating vegetarianism in their pursuit of a more compassionate world. Overall, there is a need for more empirical research to confirm various aspects of this model, from the validity of its overall structure to the efficacy of specific interventions to move individuals from one stage to the next. In particular, longitudinal research which uses the AIDA model as a framework can inform us about how and why individuals move from ignorance to action.

3.7.3 Implications for Advocates

Based on this AIDA model of transition to vegetarianism, animal advocates should recognise the different levels of interest in the idea, segment the audience accordingly, and tailor their messages to the audience depending on their existing level of interest in vegetarianism. While images of animal cruelty may be effective in moving somebody from awareness of vegetarianism to interest, response inhibition training and implementation intentions are more effective tools for moving somebody from desire to action. Moreover, advocates should be aware of the cognitive and cultural biases acting on individuals as they contemplate the issue of vegetarianism and move from awareness to action.

First, raising awareness of farm animal suffering is likely to be a valuable activity because so many people are simply ignorant of the issues (Reese, 2017). This could include exposing people to the reality of farm animal suffering through public protests or media which shows the animal suffering entailed in farming. For some people, such messages will be their first encounter with the idea that farm animals suffer to make food - for others, they might be an important reminder of something they had been doing their best to ignore. In any case, further deliberation and action is contingent on farm animal suffering being in the audience's awareness.

Second, building interest in the issue requires advocates to overcome avoidance, status quo bias, and an insensitivity to the scale of suffering involved. Advocates should consider placing messages where they are difficult to avoid, for example billboards and TV adverts (Bryant, 2019b). Further, they can take advantage of times of change in audiences' lives to overcome status quo bias - for example, students moving to university may represent an audience who are particularly open to change, as they are already undergoing a large change of another kind (see Verplanken, Roy & Whitmarsh, 2018). Campaigns such as Veganuary capitalise on the New Year as a time for change to overcome the inertia around dietary change. Moreover, scale insensitivity means that advocates should avoid focusing on how *many* animals are killed for food, and instead focus on how *badly* the animals are treated. The quality is likely to be more salient than the quantity. Indeed, highlighting the scale of animal agriculture could demotivate individuals, who might feel like their own food choices are a drop in the ocean.

Third, cultivating in their audience a desire to change their diet may require animal advocates to contend with their audience's cognitive dissonance and some extremely motivated reasoning. This conversation can be a frustrating one, and often it will be apparent to an advocate that they are speaking to somebody who is not going to change their mind if they discover new evidence. Understanding the dissonance and motivated reasoning at play here may help advocates to approach the conversation more constructively. For example, it may be helpful to frame the conversation hypothetically at first so that the audience's own behaviour is not forefronted in a way which makes them feel implicated. Moreover, it may be useful to ask what evidence would change someone's mind on this topic - this might encourage somebody to be reflective if their view is insensitive to evidence. It could be helpful to simply explain cognitive dissonance and motivated reasoning so that the person can understand why they are thinking about the issue as they are. It should be noted that the efficacy of any of these techniques has not been verified.

Fourth, inspiring action - which might include committing to a meat-free day each week, a month-long vegan challenge, or becoming a vegetarian - is the crucial part of the process. If somebody does not change their actions, it is of very little consequence to the pig in their sandwich whether they were aware of, interested in, or desired to go vegetarian. If somebody truly desires to go vegetarian, they can increase their chances of success by using response inhibition training to decrease their habitual meat selection and implementation intentions to plan to avoid meat. Advocates can point their audiences towards such tools, as well as other sources of continuing inspiration and guidance.

Finally, the social and cultural context in which such conversations are had is challenging to say the least for the animal advocate. Beyond being extremely normal to consume meat and animal products, the radically different treatment and outright commodification of some species of animals is such a part of our cultural fabric that it becomes invisible. Meanwhile, narrowly constructed social identities silo vegetarians and vegans into dietary categories of 'the other' whilst the relevant social representations create reassuring stories of jolly farmers rearing happy animals to produce hearty food. These barriers can be overcome to some extent by encouraging people to think about different cultural contexts - for example, dog consumption in China demonstrates that our radically different treatment of pigs and dogs is arbitrary. Moreover, Joy (2011) has popularised the concept of 'carnism' partly to clarify that carnism - not just vegetarianism - is an active choice. In general, we can expect that the more people eschew meat and animal products, the weaker the cultural consensus on the morality of animal consumption will become.

3.8 References

Abarca, M. E., & Colby, J. R. (2016). Food memories seasoning the narratives of our lives. *Food and Foodways 24*(1-2), 1-8.

Alonso, M. E., González-Montaña, J. R., & Lomillos, J. M. (2020). Consumers' concerns and perceptions of farm animal welfare. *Animals, 10*(3), 385.

Anderson, J., & Tyler, L. (2018). Attitudes Toward Farmed Animals in the BRIC Countries. Faunalytics. Available at https://osf.io/preprints/pzuxh/

Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgments. *Organizational influence processes*, 295-303.

Attanasio, O., & Augsburg, B. (2018). Holy cows or cash cows? The economic return to livestock in rural India. *Economic Development and Cultural Change, 66*(2), 307-330.

Austin, M. (2012, October 1). *Moral Blind Spots.* Psychology Today. Accessed March 19 2020 at https://www.psychologytoday.com/intl/blog/ethics-everyone/201210/moral-blind-spots

Avieli, N. (2013). Grilled nationalism: Power, masculinity and space in Israeli barbeques. *Food, Culture & Society, 16*(2), 301-320.

Bastian, B., & Loughnan, S. (2017). Resolving the meat-paradox: A motivational account of morally troublesome behavior and its maintenance. *Personality and Social Psychology Review, 21*(3), 278-299.

Blake, C. E., Bell, B. A., Freedman, D. A., Colabianchi, N., & Liese, A. D. (2013). The eating identity type inventory (EITI). Development and associations with diet. *Appetite, 69*, 15-22.

Bonwick, J. (1894). *Irish Druids and old Irish religions*. Griffith, Farran.

Botelho, D., & Kurtz, H. (2008). The introduction of genetically modified food in the United States and the United Kingdom: A news analysis. *The Social Science Journal, 45*(1), 13-27.

Boyle, K. J., Desvousges, W. H., Johnson, F. R., Dunford, R. W., & Hudson, S. P. (1994). An investigation of part-whole biases in contingent-valuation studies. *Journal of Environmental Economics and Management, 27*(1), 64-83.

Breakwell, G. M. (2014). *Identity process theory: clarifications and elaborations.* In Identity Process Theory: Identity, social action and social change, 20-37.

Broom, D. M., Sena, H., & Moynihan, K. L. (2009). Pigs learn what a mirror image represents and use it to obtain information. *Animal Behaviour, 78*(5), 1037-1041.

Bryant, C. J. (2019a, September 3). *A Guide to Effective Animal Campaigning.* The Vegan Society. Accessed 03 February 2020 at https://www.vegansociety.com/about-us/research/research-news/project-update-guide-effective-animal-campaigning

Bryant, C. J. (2019b). We Can't Keep Meating Like This: Attitudes towards Vegetarian and Vegan Diets in the United Kingdom. *Sustainability, 11*(23), 6844.

Buddle, E. A., Bray, H. J., & Ankeny, R. A. (2018). Why would we believe them? Meat consumers' reactions to online farm animal welfare activism in Australia. *Communication Research and Practice, 4*(3), 246-260.

Buncombe, A. (2019). *The vegetarian town: They wouldn't hurt a fly but the Jains upset Palitana with meat-free plea.* The Independent. Available at https://www.independent.co.uk/news/world/asia/the-vegetarian-town-they-wouldn-t-hurt-a-fly-but-the-jains-upset-palitana-with-meat-free-plea-9588087.html

Caldwell, K. (2017). *Perceptions of Farmed Fish Intelligence and Ability to Feel Pain and Pleasure.* Accessed 19 March 2020 at https://mercyforanimals.org/perceptions-of-farmed-animal-intelligence

Campbell, W. K., & Sedikides, C. (1999). Self-threat magnifies the self-serving bias: A meta-analytic integration. *Review of general Psychology, 3*(1), 23-43.

Carfora, V., Caso, D., & Conner, M. (2017). Correlational study and randomised controlled trial for understanding and changing red meat consumption: The role of eating identities. *Social Science & Medicine, 175*, 244-252.

Carruthers, P. (1992). *The animals issue: Moral theory in practice*. Cambridge: Cambridge University Press.

Carruthers, M. (2000). *The craft of thought: Meditation, rhetoric, and the making of images, 400-1200* (Vol. 34). Cambridge: Cambridge University Press.

Caviola, L., Everett, J. A. C., & Faber, N. S. (2019). The moral standing of animals: Towards a psychology of speciesism. *Journal of Personality and Social Psychology, 116*(6), 1011.

Chattaraman, V., Lennon, S. J., & Rudd, N. A. (2010). Social identity salience: Effects on identity-based brand choices of Hispanic consumers. *Psychology & Marketing, 27*(3), 263-284.

Cole, M., & Morgan, K. (2011). Vegaphobia: derogatory discourses of veganism and the reproduction of speciesism in UK national newspapers 1. *The British Journal of Sociology, 62*(1), 134-153.

Conrad, S. J. (2012). Are we morally obliged to become vegans?. In *Climate change and sustainable developmen*t (pp. 367-372). Wageningen Academic Publishers, Wageningen.

Cooney, N. (2014a). *Diet Change and Demographic Characteristics of Vegans, Vegetarians, Semi-Vegetarians, and Omnivores.* Available at http://www.humaneleaguelabs.org/static/reports/2014/04/diet-change-and-demographic-characteristics1.pdf

Cooney, N. (2014b). *Report: What Cover Photos Make People Most Interested In Reading Pro-Veg Literature?* Available at http://www.humaneleaguelabs.org/static/reports/2014/08/cover-photos-study-humane-league-labs.pdf

Cooney, N. (2014c). *Veganomics: The Surprising Science on What Motivates Vegetarians, from the Breakfast Table to the Bedroom.* Brooklyn: Lantern Books.

Cornish, A., Raubenheimer, D., & McGreevy, P. (2016). What we know about the public's level of concern for farm animal welfare in food production in developed countries. *Animals, 6*(11), 74.

Czajkowski, C. (2014). "Dog meat trade in South Korea: A report on the current state of the trade and efforts to eliminate it". *Animal Law. 21*: 29–151.

de Jacourt, L. (1765). *Encyclopédie*.

Dearing, J., & Rogers, E. (1988). Agenda-setting research: Where has it been, where is it going. *Communication Yearbook, 11*(1), 555-594.

Demory-Luce, D., Morales, M., Nicklas, T., Baranowski, T., Zakeri, I., & Berenson, G. (2004). Changes in food group consumption patterns from childhood to young adulthood: the Bogalusa Heart Study. *Journal of the American Dietetic Association, 10*4(11), 1684-1691.

Devi, S. M., Balachandar, V., Lee, S. I., & Kim, I. H. (2014). An outline of meat consumption in the Indian population-A pilot review. *Korean journal for food science of animal resources, 34*(4), 507.

Doebel, S., Gabriel, S., & Cooney, N. (2015). *Report: Is Animal Cruelty, Environmental or Purity ("Abolitionist") Messaging More Effective At Inspiring People To Change Their Diet?* Accessed 19 March 2020 at http://www.humaneleaguelabs.org/static/reports/2015/09/animal-cruelty-vs-22abolitionist22-messaging.pdf

Dugan, M., Aldai, N., Aalhus, J., Rolland, D., & Kramer, J. (2011). Trans-forming beef to provide healthier fatty acid profiles. *Canadian Journal of Animal Science, 91*(4), 545-556.

Dunbar, N. E., Miller, C. H., Adame, B. J., Elizondo, J., Wilson, S. N., Lane, B. L., ... & Lee, Y. H. (2014). Implicit and explicit training in the mitigation of cognitive bias through the use of a serious game. *Computers in Human Behavior, 37*, 307-318.

Eidelman, S., & Crandall, C. S. (2012). Bias in favor of the status quo. *Social and Personality Psychology Compass, 6*(3), 270-281.

Eurobarometer. (2006). *Attitudes of EU citizens towards Animal Welfare.* European Commission. Accessed 20 March 2020 at https://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_270_en.pdf

Faunalytics. (2012). *Comparing effectiveness of videos and ads*. Accessed 19 March 2020 at https://animalcharityevaluators.org/advocacy-interventions/interventions/online-ads/comparing-effectiveness-of-videos-and-ads/

Fischler, C. (1988). Food, self and identity. *Information (International Social Science Council), 27*(2), 275-292.

Gade, D. W. (1976). Horsemeat as human food in France. *Ecology of Food and Nutrition, 5*(1), 1-11.

Gallup. (2018, August 1). *Snapshot: Few Americans Vegetarian or Vegan.* Accessed 17 September 2019 at https://news.gallup.com/poll/238328/snapshot-few-americans-vegetarian-vegan.aspx

Gautam, R., & Passi, S. (2014). Assessing the Role of Coping Styles as Mediators for Hope and Optimism in Measuring Academic Motivation among First Generation Learners. *The International Journal of Indian Psychology, 2*(1), 78-93.

Giordano, C. (2019). Yulin Dog Meat Festival: Dogs blow-torched alive in footage from China. The Independent. Available at https://www.independent.co.uk/news/world/asia/yulin-dog-meat-festival-video-china-blow-torch-animal-cruelty-a8969361.html

Hall C, Sandilands V (2007) *Animal Welfare 16*, 499-512.

Harper, G., & Henson, S. (2001). *Consumer concerns about animal welfare and the impact on food choice.* EU FAIR CT98-3678, Centre for Food Economics Research, The University of Reading.

Hassan, S., Nadzim, A., Zaleha, S., & Shiratuddin, N. (2015). Strategic use of social media for small business based on the AIDA model. *Procedia-Social and Behavioral Sciences, 172*, 262-269.

Heleski, C. R., & Zanella, A. J. (2006). Animal science student attitudes to farm animal welfare. *Anthrozoös, 19*(1), 3-16.

Hermann, J. (2019). The dynamics of moral progress. *Ratio, 32*(4), 300-311.

Herzog, H. (1993). “The Movement Is My Life: The Psychology of Animal Rights Activism”. *Journal of Social Issues, 49*(1), 103-119.

Herzog, H. (2018, December 04). *The Baffling Connection Between Vegetarianism and Depression.* Accessed 20 January 2020 at https://www.psychologytoday.com/gb/blog/animals-and-us/201812/the-baffling-connection-between-vegetarianism-and-depression

Hsee, C. K., & Rottenstreich, Y. (2004). Music, pandas, and muggers: on the affective psychology of value. J*ournal of Experimental Psychology: General, 133*(1), 23.

Hulshof, R. B. A., Berndt, A., Gerrits, W. J. J., Dijkstra, J., Van Zijderveld, S. M., Newbold, J. R., & Perdok, H. B. (2012). Dietary nitrate supplementation reduces methane emission in beef cattle fed sugarcane-based diets. *Journal of Animal Science, 90*(7), 2317-2323.

IPCC. (2018). *Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Intergovernmental Panel on Climate Change.

Ipsos Mori. (2016). *Vegan Society Poll.* Available at https://www.ipsos.com/ipsos-mori/en-uk/vegan-society-poll

Jaspal, R., & Nerlich, B. (2020). Social representations, identity threat, and coping amid COVID-19. *Psychological Trauma: Theory, Research, Practice, and Policy.* Advance online publication. http://dx.doi.org/10.1037/tra0000773

Johnson, E. J., Hershey, J., Meszaros, J., & Kunreuther, H. (1993). Framing, probability distortions, and insurance decisions. *Journal of risk and uncertainty, 7*(1), 35-51.

Jost, J. T., Banaji, M. R., & Nosek, B. A. (2004). A decade of system justification theory: Accumulated evidence of conscious and unconscious bolstering of the status quo. *Political Psychology, 25*(6), 881-919.

Joy, M. (2011). *Why we love dogs, eat pigs, and wear cows: An introduction to carnism*. Conari press.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic perspectives, 5*(1), 193-206.

Klayman, J. (1995). Varieties of confirmation bias. *Psychology of Learning and Motivation, 32*, 385-418.

Knight, A., O'Connell, R., & Brannen, J. (2014). The temporality of food practices: intergenerational relations, childhood memories and mothers' food practices in working families with young children. *Families, Relationships and Societies, 3*(2), 303-318.

Kogut, T., & Ritov, I. (2005). The "identified victim" effect: An identified group, or just a single individual?. *Journal of Behavioral Decision Making, 18*(3), 157-167.

Krpan, D., & Houtsma, N. (2020). To veg or not to veg? The impact of framing on vegetarian food choice. *Journal of Environmental Psychology, 67*, 101391.

Kurz, T., Prosser, A. M., Rabinovich, A., & O'Neill, S. (2019). Could Vegans and Lycra Cyclists be Bad for the Planet? Theorizing the Role of Moralized Minority Practice Identities in Processes of Societal-Level Change. *Journal of Social Issues.*

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin, 108*(3), 480.

Kunst, J. R., & Hohle, S. M. (2016). Meat eaters by dissociation: How we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite, 105*, 758-774.

Leenaert, T. (2017). *How to create a vegan world: A pragmatic approach.* New York: Lantern Books.

Lentz, G., Connelly, S., Mirosa, M., & Jowett, T. (2018). Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite, 127*, 230-241

Lindstorm, E. (2017). *The Skeptical Vegan.* New York: Skyhorse Publishing.

Loughnan, S., Bastian, B., & Haslam, N. (2014). The psychology of eating animals. *Current Directions in Psychological Science, 23*(2), 104-108.

Loughnan, S., Haslam, N., & Bastian, B. (2010). The role of meat consumption in the denial of moral status and mind to meat animals. *Appetite, 55*(1), 156-159.

Low, P., Panksepp, J., Reiss, D., Edelman, D., Van Swinderen, B., & Koch, C. (2012). *The Cambridge declaration on consciousness.* In Francis Crick Memorial Conference (Vol. 7).

Lowe, D. (2016). Common Arguments for the Moral Acceptability of Eating Meat: A Discussion for Students. *Between the Species, 19*(1), 7.

Marks, L. A., Kalaitzandonakes, N. G., Allison, K., & Zakharova, L. (2003). Media coverage of agrobiotechnology: Did the butterfly have an effect?. *Journal of Agribusiness, 21*(345-2016-15206), 1-20.

Martin, M. J., Thottathil, S. E., & Newman, T. B. (2015). Antibiotics overuse in animal agriculture: a call to action for health care providers. *American Journal of Public Health 105*(12), 2409-2410.

McCombs, M. E., & Shaw, D. L. (1972). The agenda-setting function of mass media. *Public Opinion Quarterly, 36*(2), 176-187.

McKendree, M. G., Croney, C. C., & Widmar, N. O. (2014). Effects of demographic factors and information sources on United States consumer perceptions of animal welfare. *Journal of Animal Science, 92*(7), 3161-3173.

Mendl, M., Held, S., & Byrne, R. W. (2010). Pig cognition. *Current Biology, 20*(18), 796-798.

Mika, M. (2006). Framing the issue: Religion, secular ethics and the case of animal rights mobilization. *Social Forces, 85*(2), 915-941.

Myers, D.G. (2015). *Exploring Social Psychology (7th Ed.)* New York: McGraw Hill Education.

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of general psychology, 2*(2), 175-220.

Peacock, J. (2018). *Measuring Change in Diet for Animal Advocacy.* Accessed 19 March 2020 at http://www.humaneleaguelabs.org/static/reports/E009R01-measuring-diet-animal-advocacy.pdf

Piazza, J., Ruby, M. B., Loughnan, S., Luong, M., Kulik, J., Watkins, H. M., & Seigerman, M. (2015). Rationalizing meat consumption. The 4Ns. *Appetite, 91*, 114-128.

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science, 360*(6392), 987-992.

Puglisi, R., & Snyder Jr, J. M. (2015). Empirical studies of media bias. In *Handbook of media economics* (Vol. 1, pp. 647-667). North-Holland.

Radnitz, C., Beezhold, B., & DiMatteo, J. (2015). Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. *Appetite, 90*, 31-36.

Raudenbush, B., & Frank, R. A. (1999). Assessing food neophobia: The role of stimulus familiarity. *Appetite, 32*(2), 261-271.

Reese, J. (2018). *The End of Animal Farming: How Scientists, Entrepreneurs, and Activists are Building an Animal-free Food System.* Boston: Beacon Press.

Ritchie, H. & Roser, M. (2020). *Environmental impacts of food production.* Our World in Data. Available at https://ourworldindata.org/environmental-impacts-of-food

Rosenfeld, D. L., Rothgerber, H., & Tomiyama, A. J. (2019). Mostly vegetarian, but flexible about it: investigating how meat-reducers express social identity around their diets. *Social Psychological and Personality Science*, 1948550619869619.

Roth, S., & Cohen, L. J. (1986). Approach, avoidance, and coping with stress. *American psychologist, 41*(7), 813.

Rothgerber, H. (2013). Real men don't eat (vegetable) quiche: Masculinity and the justification of meat consumption. *Psychology of Men & Masculinity, 14*(4), 363.

Rothgerber, H. (2014a). Efforts to overcome vegetarian-induced dissonance among meat eaters. *Appetite, 79*, 32-41.

Rothgerber, H. (2014b). A comparison of attitudes toward meat and animals among strict and semi-vegetarians. *Appetite, 72*, 98-105.

Ruby, M. B., & Heine, S. J. (2011). Meat, morals, and masculinity. *Appetite, 56*(2), 447-450.

Sachs, A. (2019, November 13). *Want to cut down on animal products but just can't give up bacon? Reducetarians won't judge.* The Washington Post. Available at https://www.washingtonpost.com/lifestyle/wellness/want-to-cut-down-on-animal-products-but-just-cant-give-up-bacon-reducetarians-wont-judge/2019/11/11/a51d2b9c-ffee-11e9-8bab-0fc209e065a8_story.html

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty, 1*(1), 7-59.

Schenk, P., Rössel, J., & Scholz, M. (2018). Motivations and constraints of meat avoidance. *Sustainability, 10*(11), 3858.

Scott, E., Kallis, G., & Zografos, C. (2019). Why environmentalists eat meat. *PloS one, 14*(7), e0219607.

Reese. J. (2017, November 20). *Survey of US Attitudes Towards Animal Farming and Animal-Free Food October 2017.* Sentience Institute. Accessed 17 September 2019 at https://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017

Shepperd, J., Malone, W., & Sweeny, K. (2008). Exploring causes of the self-serving bias. *Social and Personality Psychology Compass, 2*(2), 895-908.

Signicom (1997). *Dierenwelzijn in de bio-industrie [Animal welfare in the organic industry].* Signicom: Amsterdam.

Singer, P. (1975). *Animal Liberation*. New York: New York Review.

Sinh, N. H. (2013). The hierarchy model of advertising effects: A debate. *International Integration 8*(18), 92-96.

Thaler, R. (2009, September 26). *Opting in vs. Opting Out.* The New York Times. Accessed 20 March 2020 at https://www.nytimes.com/2009/09/27/business/economy/27view.html

Tiplady, C. M., Walsh, D. A. B., & Phillips, C. J. (2013). Public response to media coverage of animal cruelty. *Journal of Agricultural and Environmental Ethics, 26*(4), 869-885.

Tomasik, B. (2018). *How Much Direct Suffering is Caused By Various Animal Foods?* Accessed 20 September 2019 at https://reducing-suffering.org/how-much-direct-suffering-is-caused-by-various-animal-foods/

Twenge, J. M., Zhang, L., & Im, C. (2004). It's beyond my control: A cross-temporal meta-analysis of increasing externality in locus of control, 1960-2002. *Personality and Social Psychology Review, 8*(3), 308-319.

Vegan Outreach. (2016). *Booklet Comparison Study.* Accessed 19 March 2020 at https://veganoutreach.org/ppr-2016/

Verbeke, W. (2009). Stakeholder, citizen and consumer interests in farm animal welfare. *Animal Welfare, 18*(4), 325-333.

Verbeke, W., Pieniak, Z., Brunso, K., Scholderer, J., & Olsen, S. O. (2008). *Evaluating consumer information needs in the purchase of seafood products.* In: Børresen T (ed) Improving Seafood Products for the Consumer pp 63-84. Woodhead Publishing Limited: Cambridge, UK.

Verbeke, W., & Ward, R. W. (2006). Consumer interest in information cues denoting quality, traceability and origin: An application of ordered probit models to beef labels. *Food quality and preference, 17*(6), 453-467.

Verplanken, B., Roy, D., & Whitmarsh, L. (2018). Cracks in the wall: Habit discontinuities as vehicles for behaviour change. In *The Psychology of habit* (pp. 189-205). Springer, Cham.

Vignoles, V. L., Chryssochoou, X., & Breakwell, G. M. (2002). Evaluating models of identity motivation: Self-esteem is not the whole story. *Self and Identity, 1*(3), 201-218.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Jonell, M. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447-492.

Zaraska, M. (2016). *Meathooked: The history and science of our 2.5-million-year obsession with meat.* New York: Basic Books.

We have seen that a range of social and psychological phenomena commonly obfuscate reasoning on the topic of farm animal suffering. Many of the central mechanisms in this process are underpinned by cognitive dissonance and motivated reasoning (Rothgerber, 2020). The reality is that meat-eaters derive a lot of utility from consuming animal products, and are therefore interested in avoiding challenges to, and constructing justifications for, this behaviour. Most people do not *want* to be persuaded to go vegetarian.

A more detailed understanding of how meat-eaters view vegetarian and vegan diets can help highlight what consumers see as their benefits and drawbacks. Knowledge about these factors can help to inform the interventions which might most effectively overcome the barriers to reducing animal product consumption, and identify areas for advocates to focus messaging on. Therefore, my second study investigates perceptions of vegetarian and vegan diets.

This declaration concerns the article entitled:	
We Can’t Keep Meating Like This: Attitudes Towards Vegetarian and Vegan Diets in the United Kingdom	
Publication status (tick one)	Draft manuscript [ ] · Submitted [ ] · In review [ ] · Accepted [ ] · Published [X]
Publication details (reference)	Bryant, C. J. (2019). We can’t keep meating like this: Attitudes towards vegetarian and vegan diets in the United Kingdom. *Sustainability*, *11*(23), 6844.
Copyright status (tick the appropriate statement)	I hold the copyright for this material [X] · Copyright is retained by the publisher, but I have been given permission to replicate the material here [ ]
Candidate’s contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** 100% **Design of methodology:** 100% **Experimental work:** 100% **Presentation of data in journal format:** 100%
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.
Signed	
Date	29 June 2020

Data Access Statement: The full dataset can be accessed at https://osf.io/rkdaz/

Ethics: This study received ethical approval from the University of Bath Psychology Research Ethics Committee.

4. We Can't Keep Meating Like This: Attitudes towards Vegetarian and Vegan Diets in the United Kingdom

Abstract

Animal agriculture is implicated as a major cause of greenhouse gas emissions, animal suffering and public health problems. This survey asked 1000 UK meat-eaters about their beliefs about vegetarian and vegan diets, and their intended consumption of meat and animal products one month in the future. One in six intended to reduce their meat consumption in the next month, and 14% intended to reduce their consumption of animal products. The majority agreed that vegetarian and vegan diets are ethical, good for the environment and healthy. The majority also agreed that both vegetarianism and veganism were socially acceptable. However, there were three consistent negative beliefs about vegetarian and vegan diets: that they are difficult, that they are not enjoyable and that they are expensive. Moreover, perceptions of vegan diets were significantly more negative than perceptions of vegetarian diets on most aspects. Significant differences in perceptions of each diet were observed between genders, by age, political inclination, level of education, and income. It is argued that most meat-eaters agree with the ethical and environmental arguments in favour of vegetarianism/veganism but do not follow these diets because of practical reasons relating to taste, price and convenience. New alternatives to animal products are discussed as a possible way to address these practical barriers. Finally, the case is made for more research on developing high-quality, low-cost and widely available animal product alternatives.

4.1 Background

4.1.1 The Case against Animal Products

Global animal agriculture is a substantial contributor to environmental degradation, human health problems and animal suffering. First, animal agriculture exacerbates a number of serious environmental issues. According to recent comprehensive environmental analyses, rearing animals for food is a major cause of eutrophication, acidification, freshwater withdrawal, deforestation and climate change [1,2]. It is estimated that 14.5% of anthropic greenhouse gas emissions are associated with animal agriculture [3]. Additionally, due to the demand put on land for rearing animals or growing their feed, animal agriculture is responsible for up to 91% of deforestation in the Amazon [4]. The implications of these emissions and land use for climate change are dire. The inefficiency of converting plant calories to animal calories means that animal rearing is resource-intensive, and this contributes to global food insecurity [5,6]. This is especially concerning given that demand for animal products is forecast to increase dramatically as the global population grows and becomes more affluent [7].

In addition to environmental concerns, many have ethical objections to using animals for food [8]. In particular, a drive for economic efficiency has led to increasingly inhumane conditions for farmed animals over the last number of decades [9]. It is estimated that globally, over 90% of farmed animals live their lives on factory farms [10] where they are kept in cages, routinely mutilated without painkillers, and painfully slaughtered [11]. This represents billions of animals every year [10]. If we take this suffering seriously, the sheer scale and intensity surely means that today's animal agriculture represents one of the largest moral failings of our time.

There are also concerns around the effect of excessive animal product consumption on human health, though the evidence here is less clear due to the difficulty of studying the health effects of different diets [2]. Nonetheless, there are several epidemiological studies which show a correlation between animal product consumption and various health problems, including cardiovascular disease, type 2 diabetes, cancer and overall mortality [12–16]. This has led to the view that a substantial reduction in animal product consumption is necessary for a global shift towards healthier diets [2].

There are good arguments for individuals to move towards vegetarianism or veganism for ethical, environmental and health reasons. Indeed, some data suggest that an increasing number of consumers in the UK are doing precisely that.

4.1.2. Vegetarianism and Veganism in the UK

There are several surveys estimating the number of vegans, vegetarians, pescatarians and flexitarians in the UK in the last decade (see Table 4.1). With the exception of one outlier here [17], representative surveys generally estimate the number of vegans at around 1%−2% of the adult population, vegetarians around 2%−7% and pescatarians 3%−9%. The estimates for those who are flexitarian and/or have some desire to reduce their meat consumption vary more because those are less well-defined categories, and different surveys use different questions.

Table 4.1. Survey results indicating levels of vegetarianism and veganism in the UK.

Survey	Sample	Vegan	Vegetarian	Pescatarian	Flexitarian	Willing/ intending to reduce meat consumption
[18]	'More than 2000' UK residents	2%	6%	4%	-	25%
[19]	9933 adults (age 15+)	1.1%	2.3%	-	-	-
[20]	1715 UK adults (age 18+)	-	7%	-	-	34%
[21]	2023 UK adults (age 18+)	1%	6%	9%	-	20%
[22]	2000 UK adults	1.3%	6.9%	4.1%	-	10%
[23]	UK, further information not given	1%	3%	3%	14%	29%
[17]	UK, information not given	7%	14%	-	31%	-
[24]	2241 adults (aged 16+) in England, Wales and Northern Ireland	1%	3%	-	-	-
[25]	3118 adults (aged 16+) in England, Wales and Northern Ireland	<1%	3%	-	-	-
[26]	3453 adults (aged 16+) across the UK	-	2%	-	3%	-
[27]	3231 adults (aged 16+) across the UK	-	2%	-	3%	-
[28]	3163 adults (aged 16+) across the UK	-	3%	-	4%	-

Whilst surveys rarely put the number of vegetarians and vegans in the UK above 10%, many recent surveys have found that a substantial number intend to, or are willing to, reduce their meat consumption. Existing research provides some insight on the reasons why people feel compelled to give up eating meat, and the barriers they face in doing so [29].

4.1.3. Motivations and Constraints

Recent research has identified the major motivations and constraints around vegetarian and vegan diets [30]. The main motivations to move towards a vegetarian or vegan diet are animal welfare, the environment and personal health, whilst the major barriers are sensory enjoyment of animal products, convenience and financial cost [30]. Mullee et al. [31] found that, when asked about possible reasons for eating a more vegetarian diet, the most popular option chosen by omnivores and semivegetarians was their health. The environment and animal welfare were chosen by fewer participants, and for omnivores, these reasons ranked below ‘to discover new tastes’, ‘to reduce weight’, and ‘no reason’. This finding has been replicated elsewhere [32,33] and implies that, for those not currently reducing their meat consumption, potential personal benefits are more important than environmental or ethical benefits. More specifically, consumers often recognise health benefits such as decreased saturated fat intake, increased fruit and vegetable intake and disease prevention [32,34]. On the other hand, some worry about not getting enough protein or iron from a vegetarian diet [35].

Interestingly, this prioritisation of health motives appears to be reversed for vegetarians and vegans. According to a survey published by Humane League Labs [36], whilst health and nutrition reasons for reducing animal product consumption are the most commonly cited by omnivores and semivegetarians, animal welfare is the most common reason given by vegetarians and vegans. This is logical, because improving one’s health or reducing one’s environmental impact can be achieved by consuming incrementally fewer animal products; viewing animal products as the product of animal suffering and exploitation, however, is more conducive to eschewing them altogether.

In a systematic review of consumer perceptions of sustainable protein consumption, Hartmann and Siegrist [37] found that it is common for consumers to underestimate the ecological impact of meat consumption. This has been observed in many different studies [33,38–40] and may imply a lack of knowledge about the environmental impact of meat consumption. Alternatively, this could reflect that consumers are generally unwilling to reduce their meat consumption [40] and are subsequently motivated to minimise their perceptions of the negative consequences of their choices [41].

Indeed, such motivated reasoning appears to be evident with respect to animal welfare issues. Most people eat meat but disapprove of harming animals, a conflict that has been dubbed ‘the meat paradox’ [42]. Rothgerber [43] identified a number of ways in which dissonance around harming animals arises in meat-eaters, and a number of strategies which are used to reduce this dissonance. Dissonance-reducing strategies include denial of animal mind, denial of animals’ ability to feel pain and dissociating meat from its animal origin [43]. This motivated reasoning results in a number of odd conclusions, such as lower mental capacity being ascribed to food animals compared to nonfood animals and increased denial of animal mind when one anticipates immediate meat consumption [44].

One can understand the motivation to continue eating animal products; the literature has identified several considerable constraints to adopting a vegetarian or vegan diet. Studies have consistently found that the strongest of these is simply enjoyment of eating meat [34,45,46]. This was by far the number one reason for not being vegetarian in a recent UK survey [47] and was the biggest constraint for online survey respondents who indicated that they do not want to go vegetarian or vegan [36]. Despite the many potential benefits, the taste of meat and animal products is enough of a barrier to prevent dietary change for most people.

The second most important barrier is convenience, with many consumers saying vegetarian dishes are difficult to prepare and that there is a lack of options when eating out [33,38,48]. Humane League Labs [36] found that a lack of options when eating out was the most common factor that people said made it difficult to eat meat-free meals, whilst Schenk, Rössel and Scholz [30] have argued that the additional time, knowledge and effort required to buy and prepare vegetarian or vegan food is especially a barrier to those newly transitioning diets.

Finally, for some, there is a financial barrier [49], although there is considerably less consensus on this in the literature [30]. A UK survey found that the high cost of meat substitutes was a barrier for 58% of consumers, though this survey conducted by VoucherCodesPro [47] may have been inclined to focus on financial considerations. Another study found that a vegetarian diet is actually cheaper than one containing meat, but that a vegan diet is most expensive of all [22]. This may be due to the relatively high cost of plant-based milks and other specialist products.

The present study investigates UK meat-eaters' views of various aspects of vegetarianism and veganism. Whilst the common motivators and constraints to vegetarian and vegan diets are well documented, there is a paucity of open data assessing how meat-eaters evaluate the relevant aspects of each of these diets. This study seeks to address this gap by providing quantitative evaluations of the relevant aspects of vegetarian and vegan diets. Additionally, there is currently no quantitative comparison of these factors with respect to vegetarianism versus veganism. Therefore, this study compares ratings of common motivators and barriers between vegetarian and vegan diets. Finally, little is known about how these evaluations of vegetarian and vegan diets vary amongst different demographic groups. Therefore, this study examines the overall mean ratings of each of these factors and investigates how these views vary between different demographics.

4.2 Methods

4.2.1. Participants

Meat-eaters living in the UK aged 18 and over were recruited (n = 1000). Participants were recruited through the online research platform, Prolific, and each participant was paid £0.45 for a 5 min survey. Recruiting participants through this type of online platform has its limitations, including the possibility of recruiting an unrepresentative sample, and asking questions in a contrived setting which may not be ecologically valid [50]. Nonetheless, this sampling technique does offer low cost and fast recruitment of specifiable samples, and the use of Prolific as a recruitment tool in academic research is therefore increasingly common and generally considered acceptable [51–53]. Although recruitment was for meat-eaters only using a filter on Prolific, there was a small number of vegetarians in the original dataset, as defined by their own survey responses (n = 25); these participants were removed, and their responses were replaced with more meat-eaters. The final sample was 49.8% male and 49.8% female (0.3% did not disclose gender, 0.1% 'other'), and the mean age was 34.02 (SD = 11.67).

4.2.2 Procedure

This study received ethical approval from the University of Bath's Department of Psychology Ethics Committee (PREC 18-219). The full anonymised dataset is available via OSF (see Supplementary materials).

First, participants read some brief information about the study and gave their consent to take part. They were then given definitions of vegetarianism and veganism: "*People who follow a vegetarian diet do not eat meat, poultry, or fish."* and *"People who follow a vegan diet do not eat meat, poultry, or fish. They also do not eat eggs or dairy (milk, cheese, yoghurt, etc.)."* They were then asked to give their opinions about 11 different aspects of vegetarian and vegan diets using 7-point bipolar scales. The order of these scales and the order in which participants were asked about vegetarianism and veganism were randomised to control for order effects. Next, participants answered questions about their intended consumption of meat and their intended consumption of animal products 'one month from today'. On 6-point scales, participants could indicate that they would eliminate, greatly reduce, slightly reduce, maintain about the same, slightly increase or greatly increase their consumption of both meat, and animal products generally. Similar scales have been used in previous research [54,55].

It is worth noting that this measure is conservative. Compared to asking about intentions to reduce consumption in general, defining a specific action and a specific, short time period is likely to make participants reflect critically about their own likely behaviour. Additionally, as participants answered this question, they saw the phrase 'Thank you for being honest!' which was intended to mitigate the social desirability effect (i.e., over-reporting of intentions to reduce animal product consumption).

Finally, participants gave demographic information, including their age, gender, political orientation, education and income. They also indicated whether they ate 'at least occasionally' beef, lamb, pork, chicken, fish, eggs and dairy. Participants were then debriefed and compensated.

4.2.3. Data Analysis

Data were analysed using SPSS version 25. First, the dataset was cleaned to verify that participants met the inclusion criteria of being aged 18 or over and being a meat-eater. All respondents were aged 18 or over, but 25 indicated that they did not eat meat. These participants were removed from the study and replaced with new respondents. Furthermore, I analysed the time taken to complete the questionnaire. The mean time was 201 seconds, and the minimum time was 65 seconds. No participants were excluded on the basis of completion time or other data quality checks.

Shapiro–Wilk tests indicated that the ratings of the different aspects of vegetarianism and veganism were non-normally distributed, and therefore, nonparametric statistical tests were used.

The Wilcoxon signed rank test was used to compare ratings of different aspects of vegetarianism against veganism. This is a nonparametric test used to compare related groups, similar to a paired *t*-test.

The Mann–Whitney U test was used to compare responses between genders; this is a nonparametric test used to compare two independent groups, similar to an independent t-test.

Finally, Spearman's rank order correlation was used to investigate correlations of the outcome measures with age, political views, education level and income level. This is a nonparametric measure of correlation used to indicate the strength of a relationship between two variables, similar to Pearson's correlation coefficient.

The significance level of $p = 0.05$ was chosen for all tests. However, since some of these involved testing multiple variables, results which are significant at a level of $p = 0.002$ (Bonferroni-corrected) are also highlighted.

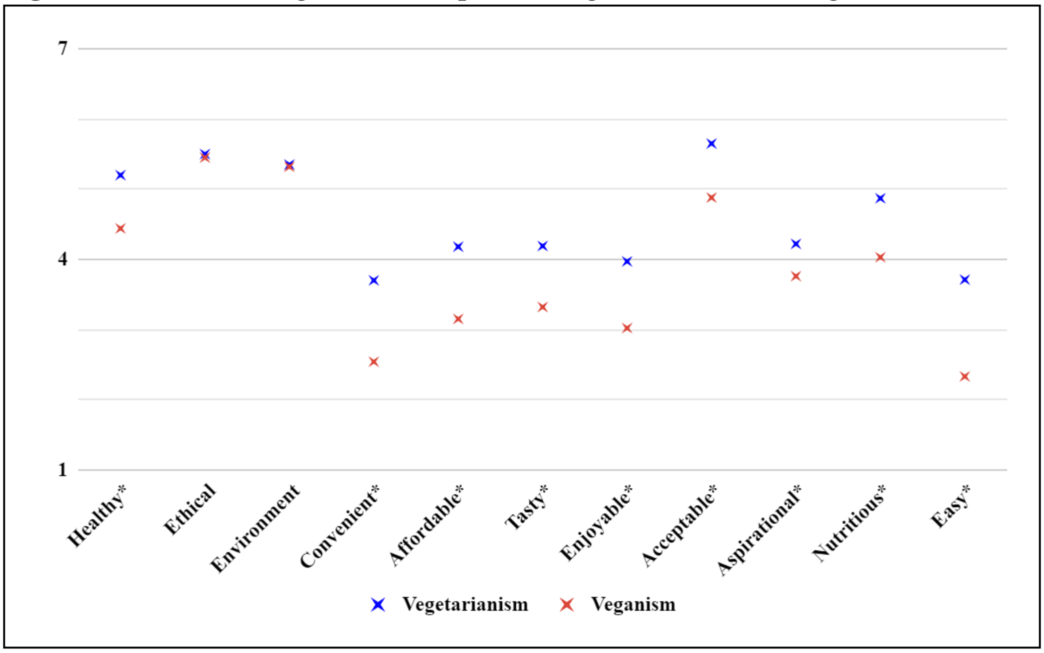
4.3. Results

4.3.1. Overall Attitudes to Vegetarianism and Veganism

The purpose of these analyses is to assess what meat-eaters in the UK think about various aspects of vegetarian and vegan diets overall.

Figure 4.1 shows the mean scores for each aspect of vegetarianism and veganism. Each aspect was rated on a 1−7 scale, where 1 represents the most negative view of this aspect, 7 represents the most positive view, and 4 is the midpoint. Displaying the data in this way allows us to see which aspects are, on average, rated positively, negatively or neutrally.

Figure 4.1: Mean ratings of each aspect of vegetarianism and veganism.



Figures 4.2 and 4.3 show the proportion of respondents who gave positive (5−7 on the scale), negative (1−3 on the scale) or neutral (4 on the scale) ratings for each aspect of vegetarianism and veganism.

Figure 4.2: The proportion of respondents with positive, negative or neutral views about aspects of vegetarianism.

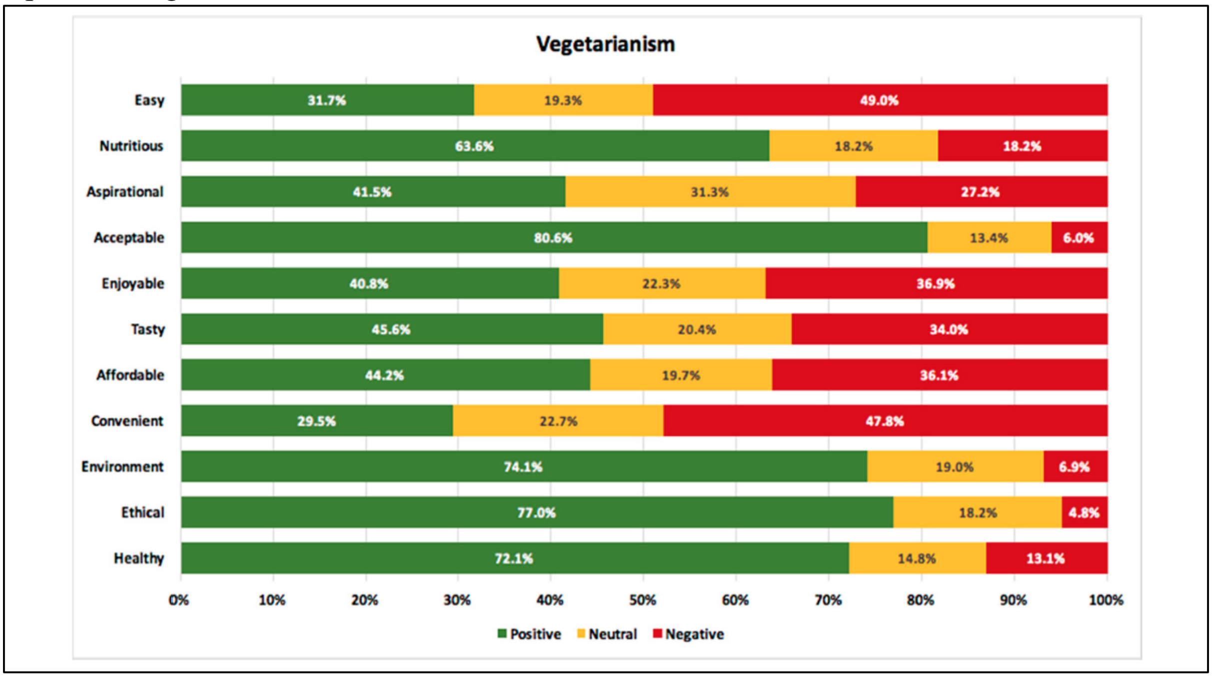
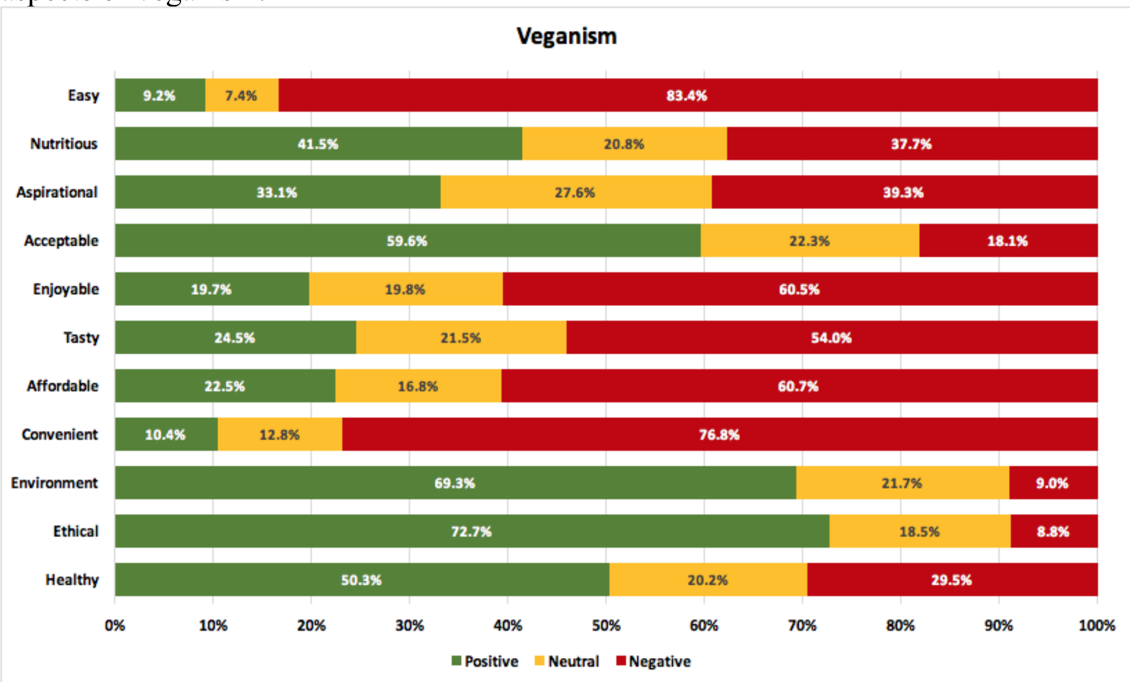


Figure 4.3: The proportion of respondents with positive, negative or neutral views about aspects of veganism.



As shown in Figure 4.1, the factors which are usually considered motivations for going vegetarian or vegan are, indeed, rated positively on average. On measures of health, nutrition, environmental impact and ethics, meat-eaters rated vegetarian and vegan diets positively on average. In addition, Figures 4.2 and 4.3 demonstrate that a majority of meat-eaters had positive views of these aspects of vegetarianism and veganism. That is to say, most meat-eaters agree that vegetarian and vegan diets are ethical, healthy and good for the environment. A notable exception is the nutrition of vegan diets, which just 41.5% rated positively and 37.7% rated negatively.

Conversely, the factors which are usually considered constraints to adopting a vegetarian or vegan diet are, on average, rated as neutral or negative and are particularly negative with regard to veganism (see Figure 4.1). Ease, convenience, taste, enjoyableness and affordability of veganism were all rated negatively, on average. The average ratings for vegetarianism were more neutral, though ease and convenience were still rated negatively. As shown in Figures 4.2 and 4.3, the majority of meat-eaters had negative views of these aspects of veganism, and most had negative or neutral views of these aspects of vegetarianism.

In terms of the aspects relating to the social perspectives of each diet, the data overall suggest that meat-eaters on average think that vegetarianism and veganism are socially acceptable, but most stop short of calling them aspirational. As shown in Figures 4.2 and 4.3, the majority have positive views of the social acceptability of both vegetarianism and veganism. However, the majority have negative or neutral views of these diets in terms of considering them aspirational. As with other factors, views of veganism are more negative than views of vegetarianism.

4.3.2. Intentions to Reduce Consumption of Meat and Animal Products

Table 4.2 shows how respondents rated their intended change in consumption of meat and animal products. This was a more conservative measure of intended change in consumption than has been used in previous research, in that it specifies a timeframe of one month within which respondents said they intended to change their consumption.

Table 4.2. Intended consumption of meat and animal products within one month.

Response	Meat	Animal Products
Eliminate (1)	0.1%	0.2%
Greatly decrease (2)	3.5%	2.4%
Slightly decrease (3)	13.0%	11.3%
Maintain the same (4)	81.0%	84.3%
Slightly increase (5)	1.9%	1.5%
Greatly increase (6)	0.5%	0.3%
Mean (SD)	3.83 (0.537)	3.85 (0.483)

As shown in Table 4.2, the majority of respondents said that their consumption of meat and animal products would be about the same in one month. However, a sizeable minority said they would slightly decrease their consumption of meat and animal products. Further, 3.5% said they would greatly decrease their consumption of meat, whilst 2.4% said they would greatly decrease their consumption of animal products. Just 0.1% and 0.2% said they would completely eliminate their consumption of meat and animal products, respectively. Some said they would slightly increase their consumption of meat and animal products, whilst a small number said they would greatly increase their consumption of meat and animal products.

4.3.3 Comparison of Attitudes to Vegetarianism and Veganism

In order to test whether these differences in perceptions of vegetarianism and veganism were statistically significant, Wilcoxon signed rank tests were conducted on the ratings for each aspect of vegetarianism and veganism. The mean ratings, standard deviations and the results of the Wilcoxon signed rank tests are shown in Table 4.3.

Table 4.3. Mean ratings for aspects of vegetarianism and veganism with Wilcoxon signed rank tests.

Aspect	Vegetarianism Mean (SD)	Veganism Mean (SD)	Wilcoxon signed rank tests
Healthy	5.20 (1.44)	4.44 (1.73)	* *$Z = -15.249$, $p < 0.001$
Ethical	5.50 (1.28)	5.45 (1.51)	$Z = -1.618$, $p = 0.106$
Environment	5.35 (1.29)	5.32 (1.50)	$Z = -0.836$, $p = 0.403$
Convenient	3.70 (1.52)	2.54 (1.44)	*$Z = -19.610$ $p < 0.001$
Affordable	4.18 (1.70)	3.15 (1.76)	*$Z = -17.175$, $p < 0.001$
Tasty	4.19 (1.71)	3.32 (1.66)	*$Z = -16.838$, $p < 0.001$
Enjoyable	3.97 (1.68)	3.02 (1.65)	*$Z = -18.026$, $p < 0.001$
Acceptable	5.65 (1.33)	4.88 (1.54)	*$Z = -16.095$, $p < 0.001$
Aspirational	4.22 (1.56)	3.76 (1.74)	*$Z = -9.609$, $p < 0.001$
Nutritious	4.87 (1.50)	4.03 (1.74)	*$Z = -15.944$, $p < 0.001$
Easy	3.71 (1.59)	2.33 (1.40)	*$Z = -20.569$, $p < 0.001$

* indicates the difference between vegetarianism and veganism was significant at $p = 0.05$.

As shown in Table 4.3 (and Figure 4.1), vegan diets are viewed significantly more negatively than vegetarian diets on almost every aspect. The only aspects in which there are no significant differences in opinions of the two diets are in how ethical they are and how good for the environment they are. In other words, meat-eaters on average perceive no additional benefits in terms of animals and the environment of a vegan diet compared to a vegetarian diet, whereas they do see a vegan diet as worse in other ways. This may be because respondents consider a vegan diet to be further from their own diet and therefore rate it less favourably to reduce dissonance.

4.3.4. Comparison of Different Demographic Groups

It is also informative to consider how perceptions of different aspects of vegetarianism and veganism might vary between different demographics.

First, Mann–Whitney U tests were used to compare the ratings of each aspect of vegetarianism and veganism between men (n = 498) and women (n = 498). The variables for which men differed significantly from women are displayed in Table 4.4. Since this analysis involved multiple comparisons (for 22 different variables), listed here are all differences which are significant at $p = 0.05$, and additionally indicated with a * those which are significant at $p = 0.002$ (this is based on a Bonferroni correction of $p = 0.05 \div 22 = 0.002$).

Table 4.4. Perceptions of vegetarianism and veganism with significant gender differences.

Diet	Aspect	Male Rating (Mean, SD)	Female Rating (Mean, SD)	Mann-Whitney U Test
Vegetarianism	Convenient	3.58 (1.535)	3.82 (1.496)	U = 11,158,5 p = 0.005
	Tasty	4.00 (1.649)	4.38 (1.745)	*U = 10,739,4 p < 0.001
	Enjoyable	3.75 (1.612)	4.19 (1.728)	*U = 10,490,7 p < 0.001
	Nutritious	4.77 (1.458)	4.97 (1.533)	U = 11,302,7 p = 0.014
Veganism	Affordable	3.29 (1.756)	3.01 (1.755)	U = 11,208,1 p = 0.008
	Tasty	3.21 (1.656)	3.43 (1.661)	U = 11,430,4 p = 0.030
	Easy	2.42 (1.459)	2.23 (1.339)	U = 11,533,5 p = 0.047

* indicates that the difference was significant at the level of p = 0.002, deduced using a Bonferroni correction.

As shown in Table 4.4, women tended to have more positive views of vegetarianism and veganism compared to men. This is in line with previous research which has indicated that men tend to consume more meat and are less likely to be vegetarian or vegan compared to women [56,57]. Notable exceptions here were that men rated veganism as easier and more affordable compared to women.

Secondly, Spearman correlation analyses were used to examine which ratings were significantly correlated with age, political views, levels of education and income. The variables which were significantly correlated with these factors are shown in Table 4.5. Positive r values indicate that this aspect of vegetarianism or veganism was viewed more positively by older respondents, more right-wing respondents, respondents with higher levels of education and respondents with higher levels of income; negative r values indicate the opposite. Again, since this analysis involved multiple comparisons (for 22 different variables), differences listed here are significant at p = 0.05, and additionally indicated with a * those which are significant at p = 0.002 (this is based on a Bonferroni correction of p = 0.05 ÷ 22 = 0.002). Cells are empty for correlations which were not significant at p = 0.05.

Table 4.5. Perceptions of vegetarianism and veganism significantly correlated with age, political views, education and income.

		Spearman's Rank-Order Correlation			
Diet	**Aspect**	**Age**	**Political Views**	**Education**	**Income**
Vegetarianism	Healthy	-	*$r = -0.131$, $p < 0.001$	-	-
	Ethical	-	*$r = -0.188$, $p < 0.001$	-	-
	Environment	-	*$r = -0.131$, $p < 0.001$	-	-
	Convenient	$r = 0.073$, $p = 0.022$	$r = -0.099$, $p = 0.004$	-	-
	Affordable	-	$r = -0.103$, $p = 0.003$	$r = 0.080$, $p = 0.011$	-
	Tasty	-	$r = -0.086$, $p = 0.012$	-	-
	Enjoyable	$r = 0.063$, $p = 0.048$	$r = -0.085$, $p = 0.013$	-	-
	Acceptable	-	*$r = -0.168$, $p < 0.001$	-	-
	Aspirational	-	*$r = -0.156$, $p < 0.001$	$r = 0.066$, $p = 0.037$	-
	Nutritious	-	*$r = -0.168$, $p < 0.001$	-	-
	Easy	$r = 0.084$, $p = 0.008$	$r = -0.069$, $p = 0.044$	-	-
Projected change in meat consumption		-	$r = -0.099$, $p = 0.003$	$r = 0.067$, $p = 0.034$	-
Veganism	Healthy	*$r = -0.121$, $p < 0.001$	*$r = -0.128$, $p < 0.001$	-	-
	Ethical	$r = -0.073$, $p = 0.022$	*$r = -0.206$, $p < 0.001$	*$r = 0.105$, $p = 0.001$	-
	Environment	-	*$r = -0.197$, $p < 0.001$	-	-
	Convenient	-	*$r = -0.067$, $p = 0.049$	-	-
	Affordable	*$r = 0.128$, $p < 0.001$	-	-	-
	Tasty	-	$r = -0.076$, $p = 0.026$	-	$r = -0.069$, $p = 0.038$
	Enjoyable	-	*$r = -0.103$, $p = 0.002$	-	-
	Acceptable	-	*$r = -0.139$, $p < 0.001$	-	-
	Aspirational	$r = -0.086$, $p = 0.006$	*$r = -0.144$, $p < 0.001$	$r = 0.069$, $p = 0.029$	-
	Nutritious	-	*$r = -0.164$, $p < 0.001$	-	-
	Easy	$r = 0.071$, $p = 0.024$	-	-	-
Projected change in animal product consumption		-	-	$r = 0.075$, $p = 0.018$	-

* indicates that the difference was significant at the level of $p = 0.002$, deduced using a Bonferroni correction.

As shown in Table 4.5, older people tended to view some aspects of vegetarianism and veganism more positively than younger people. Higher age correlated with increased ratings of ease for both diets, as well as increased ratings of convenience and enjoyableness for vegetarianism. However, older participants tended to rate veganism as less healthy, less ethical, and less aspirational than younger participants.

Political views were the demographic factor most strongly correlated with opinions of vegetarianism and veganism. Every aspect of each diet was viewed more positively by more left-wing people with the exception of ease and affordability of veganism. Left-wing people were also significantly more likely to say they would reduce their meat consumption.

Education was positively correlated with various opinions of vegetarianism and veganism; in particular, those with higher levels of education viewed vegetarianism as more affordable and viewed veganism as more ethical. Higher education was also correlated with viewing both vegetarianism and veganism as more aspirational, and with increased likelihood to say they would reduce their consumption of meat and animal products.

Income level had few correlations with opinions of vegetarianism and veganism. The only significant aspect associated with income was that higher-income respondents viewed veganism as less tasty.

Whilst these attitudinal measures showed some significant differences based on gender and age, intentions to change consumption of animal products showed no significant differences on this basis.

4.4. Discussion

4.4.1. More Positive Attitudes towards Vegetarianism than Veganism

The analyses demonstrated that veganism is rated as significantly less positive than vegetarianism on every aspect except for ethics and the environment, where no significant difference was observed. This reflects findings from elsewhere, which have highlighted a perception of veganism as over-the-top and excessively restrictive [58–60]. It may be that vegan diets are considered further from meat-eaters' own, and more difficult to follow, and therefore, meat-eaters are more inclined to use the dissonance-reducing strategies identified by Rothgerber [43] as a way to justify their current diet. This could lead them to rate veganism as worse than vegetarianism in terms of practical aspects and rate veganism as no better than vegetarianism in terms of the ethical and environmental aspects.

Animal advocates might therefore consider promoting vegetarianism rather than veganism, because the former likely seems like a more achievable goal to meat-eaters. Whilst a tacit endorsement of consuming eggs and dairy will seem unsavoury to many advocates, a vegetarian diet may be a necessary stepping stone for many meat-eaters [61]. Indeed, Humane League Labs [36] find some evidence that omnivores are more likely to transition to vegetarianism, pescatarianism and meat reduction than outright veganism. This analysis seems to suggest that many who eventually become vegan have followed a meat reduction path through flexitarianism and vegetarianism first. Endorsing and encouraging any type of meat reduction is likely to be helpful in this context, whereas purist 'vegan or nothing' messages are unlikely to be effective [62].

4.4.2. Agreement in Principle, Disagreement in Practice

Overall, the data here support Schenk, Rössel and Scholz's [30] typology of motivations and constraints regarding vegetarian and vegan diets. Health, environmental and ethical aspects are generally rated positively, whilst price, taste and convenience are generally rated negatively. Furthermore, vegetarian and vegan diets are considered socially acceptable, but most stop short of calling them aspirational.

Strikingly, there appears to be strong awareness of, and agreement with the ethical and environmental arguments for vegetarianism and veganism. A large majority of UK meat-eaters said that vegetarian and vegan diets are good for the environment and are ethical.

In terms of the environmental aspect, this finding appears to be in contrast with previous research, which has found that the majority of consumers are not aware of the negative environmental impact of animal products [37]. This may mean that the public has become more aware of this during that time, which seems plausible after a number of high-profile media stories on the link between meat and climate change [63,64]. However, it may also be a result of framing the question as vegetarianism/veganism being good for the environment, as opposed to meat and animal products being bad for the environment. The latter would appear to invite more disagreement, as meat-eaters' own behaviour is directly implicated.

Additionally, most respondents rated vegetarianism as healthy (72.1%) and nutritious (63.6%), indicating that the majority of UK meat-eaters do not have serious health concerns about giving up meat. Whilst previous research has highlighted concerns around specific nutritional deficiencies [35], the current data indicate that most meat-eaters do not consider a vegetarian diet to be lacking in nutrition in any significant way. A slight majority also agreed that veganism is healthy (50.3%), with just 29.5% saying it is unhealthy. There was lower agreement that veganism is nutritious, however: Just 41.5% agreed with this, whilst 37.7% said it is not nutritious. It appears that respondents were more sceptical about the healthiness of a vegan diet overall.

Moreover, 80.6% said vegetarianism is socially acceptable, while just 6.0% said it is not socially acceptable. It appears that few people actively disagree with vegetarianism or find vegetarians to be a social annoyance. Indeed, 41.5% said that vegetarianism is aspirational. Most respondents said veganism is acceptable (59.6%), though a minority said it is aspirational (33.1%). Indeed, more respondents said veganism is not aspirational (39.3%) suggesting that ther
e is more of a stigma towards veganism in general.
With regard to the finding that most people think vegetarianism and veganism are ethical, this is less surprising. Indeed, this appears to be in line with findings that a substantial portion of the public agrees that animal farming and slaughterhouses should be banned [65]. However, there is likely some framing effect here, also: Whilst 72.7% of respondents in this study rated veganism as ethical and 32.3% rated it at the top end of the 'ethical' scale, Sentience Institute [65] found that 96% of Americans agreed that eating animals is a personal choice, and nobody has the right to tell them not to [65].

These data provide another example of the meat paradox [42], which is now a well-documented phenomenon amongst meat-eaters. Many meat-eaters recognise, on some level, that their behaviour causes animal suffering, and this is a moral problem. The maintenance of this behaviour is more likely justified on practical grounds than ideological grounds, which again is demonstrated here: Though people rated vegetarian and vegan diets positively in terms of health, ethics, and the environment, they rated them negatively in terms of taste, price and convenience.

Unfortunately, price, taste and convenience are repeatedly highlighted as major predictors of food choice in practice [66–72]. This suggests that vegetarian and vegan diets, which are rated poorly on these aspects here and in previous research [29,30], are inevitably unappealing to most people. However, these barriers are not intractable and may be able to be addressed by technological advances which improve the quality, affordability and availability of animal product alternatives [73].

4.4.3. Addressing Objections through Animal Product Alternatives

Animal advocates often highlight the ethical and environmental arguments for vegetarianism and veganism, and indeed, much research has been conducted comparing the relative persuasiveness of these and other rational arguments [55,62,74]. However, these findings indicate that the majority of meat-eaters do not need persuading of these arguments. The data suggest that many meat-eaters recognise the benefits of avoiding animal products but find vegetarianism/veganism to be too inconvenient, expensive or simply not enjoyable. These objections are practical rather than ideological and may be able to be addressed through practical solutions rather than ideological persuasion.

Hoek et al. [73] have argued that replacement of meat consumption is likely to be best achieved not by reiterating reasoned arguments for reducing meat consumption, but by significantly improving the sensory quality of meat substitutes. Based on these data, and Schenk, Rössel and Scholz's [30] typology of motivations and constraints, such alternatives need not just high sensory quality, but low cost and wide availability to address all of the main barriers to vegetarian and vegan eating. Developing good quality, low cost and familiar replacements for animal products is likely to be the best route to replacing animal product alternatives.

First, taste and enjoyability must be addressed. Plant-based meat analogues are becoming increasingly realistic, and some consumers now find it difficult to distinguish them from conventional meat [75]. Plant-based dairy alternatives have been popular for some time and have been implicated in a 7.5% year-on-year fall in dairy sales in the USA [76]. Emulating the sensory properties of animal products using plant-based ingredients is one possible way to overcome the taste barriers to vegetarianism and veganism, though many existing alternatives fail to satisfy meat-eaters [73].

Another approach to overcoming the taste and enjoyability barrier is by creating identical animal products using cellular agriculture [77]. In particular, scientists in academia and industry are working to further the development of cultured meat, which can be grown from animal cells rather than by rearing animals [78]. Cultured meat production does not need to harm animals and potentially has a lower environmental footprint than conventional meat [79]. Therefore, producing meat in this way could allow consumers to continue enjoying the taste and texture of animal meat whilst circumventing many of the ethical and environmental concerns around meat production. However, widespread consumer acceptance of these products is far from certain [80].

Second, vegetarian and vegan diets must be easier and more convenient to follow. Again, there is reason to be optimistic here. Several high-profile mainstream food outlets have added vegan options to their menus recently, seemingly driven by a rise in demand [81,82]. One analysis by Foodable Labs [83] found that 51% of chefs in the USA added vegan options to their menu in 2018, an increase of 31% from the previous year. Vegan options at chain restaurants and supermarkets are increasingly common, improving easy and convenient access to vegan options. Moreover, meat analogues sold in supermarkets provide a direct replacement for meat in dishes, meaning that consumers can cut out meat whilst keeping the same recipes they are used to. As research has demonstrated, familiarity and ease of cooking are important factors in willingness to substitute meat [84].

Third, affordability of alternatives must improve. Indeed, one analysis found that a vegetarian diet tended to be cheaper than one including meat, but a vegan diet was most expensive of all [22]. This is likely because some animal product alternatives (including plant-based milks and plant-based meat analogues) tend to be more expensive than conventional animal products. This may be a result of their status as relatively niche, and therefore low supply. As consumer interest in these products grows, we may see their price fall in the coming years. Indeed, one analysis has argued that the price of plant-based meat analogues is likely to fall due to supply catching up with demand, higher quality ingredients being produced at larger scale, the development of infrastructure, economies of scale brought in by established food businesses investing in the space and a shift in focus from research and product development to scaling up production [85].

4.4.4. Limitations

There are some limitations to this study which must be considered. Firstly, research using self-reported attitude and intention measures is perennially prone to social desirability bias, particularly around moralised issues [86]. In order to counter this, a very specific intention measure was used: Participants said how they thought their consumption would change 'one month from today', a specific quantifiable target. Participants also saw the message 'Thank you for being honest!' in an attempt to prevent people overestimating their intended changes. Nevertheless, Humane League Labs [87] have recommended against relying on self-reported intentions measures like these in future.

Secondly, the sample was younger than the general UK population, and therefore, these results may not be generalizable to older portions of the population. The median age in the sample was 30, compared to the median age in the UK of 40.2 [88]. This may be linked with more positive evaluations of vegetarian and vegan diets than one would expect amongst the general population, since evidence suggests that younger people are more likely to embrace these diets [36,89].

4.4.5. Future Research

The present research focused on evaluations of specific aspects of vegetarianism and veganism and found that the major negative views of these diets related to their price, taste and convenience. Indeed, many meat-eaters recognise the arguments for vegetarianism and veganism but do not change their diet because of practical, rather than ideological, reasons. The most promising avenue of future research for reducing the consumption of animal products, therefore, is the development and marketing of products designed to address these deficiencies. Bringing products to market which can replace animal products and are familiar, enjoyable, affordable and widely available is likely to be an excellent strategy for reducing consumption of animal products in the long term.

4.5 References

1. Poore, J.; Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* **2018**, *360*, 987−992.
2. Willett, W.; Rockström, J.; Loken, B.; Springmann, M.; Lang, T.; Vermeulen, S.; Garnett, T.; Tilman, D.; DeClerck, F.; Wood, A.; et al. Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *Lancet* **2019**, *393*, 447−492.
3. Steinfeld, H.; Pierre Gerber, T.D. Wassenaar, Vincent Castel, Mauricio Rosales, Mauricio Rosales, and Cees de Haan. In Livestock's Long Shadow: Environmental Issues and Options; Food Agriculture Organisation: Roma, Italy, 2006.
4. Margulis, S. Causes of Deforestation of the Brazilian Amazon; World Bank Working Paper No. 22; The World Bank: Washington, DC, USA, 2003.
5. Mottet, A.; de Haan, C.; Falcucci, A.; Tempio, G.; Opio, C.; Gerber, P. Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Glob. Food Secur.* **2017**, *14*, 1−8.
6. Springmann, M.; Clark, M.; Mason-D'Croz, D.; Wiebe, K.; Bodirsky, B.L.; Lassaletta, L.; de Vries, W.; Vermeulen, S.J.; Herrero, M.; Carlson, K.M.; et al. Options for keeping the food system within environmental limits. *Nature* **2018**, *562*, 519–525.
7. Godfray, H.C.J.; Aveyard, P.; Garnett, T.; Hall, J.W.; Key, T.J.; Lorimer, J.; Pierrehumbert, R.T.; Scarborough, P.; Springmann, M.; Jebb, S.A. Meat consumption, health, and the environment. *Science* **2018**, *361*, 5324.
8. Singer, P. *Animal Liberation*; Harper Collins: New York, NY, USA, 1975.
9. Reese, J. *The End of Animal Farming: How Scientists, Entrepreneurs, and Activists Are Building an Animal-Free Food System*; Beacon Press: Boston, MA, USA, 2018.
10. Sentience Institute. Global Farmed Factory Farmed Animals Estimates. Available online: https://www.sentienceinstitute.org/global-animal-farming-estimates (accessed on 19 November 2019).
11. Lymbery, P.; Oakeshott, I. *Farmageddon: The True Cost of Cheap Meat*; Bloomsbury Publishing: London, UK, 2014.
12. Abete, I.; Romaguera, D.; Vieira, A.R.; de Munain, A.L.; Norat, T. Association between total, processed, red and white meat consumption and all-cause, CVD and IHD mortality: A meta-analysis of cohort studies. *Br. J. Nutr.* **2014**, *112*, 762−775.
13. Etemadi, A.; Sinha, R.; Ward, M.H.; Graubard, B.I.; Inoue-Choi, M.; Dawsey, S.M.; Abnet, C.C. Mortality from different causes associated with meat, heme iron, nitrates, and nitrites in the NIH-AARP Diet and Health Study: Population based cohort study. *Br. Med. J.* **2017**, *357*, 1957.
14. Feskens, E.J.; Sluik, D.; van Woudenbergh, G.J. Meat consumption, diabetes, and its complications. *Curr. Diabetes Rep.* **2013**, *13*, 298−306.
15. Sinha, R.; Cross, A.J.; Graubard, B.I.; Leitzmann, M.F.; Schatzkin, A. Meat intake and mortality: A prospective study of over half a million people. *Arch. Intern. Med.* **2009**, *169*, 562−571.
16. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Red Meat and Processed Meat, 114; World Health Organisation: Geneva, Switzerland, 2018.
17. Compare The Market. Cars Against Humanity. What Would You Give up to Improve the Environment? Available online: https://www.comparethemarket.com/car-insurance/content/cars-against-humanity/?awc=7896_1559820885_bbae931e0be18c2e2ed8887e64a76888&AFFCLIE=EE11&APUID=201309 (accessed on 30 May 2019).
18. The Grocer. 12% of Brits Now Follow a Meat-Free Diet, The Grocer Research Shows. Available online: https://www.thegrocer.co.uk/future-of-meat/12-of-brits-follow-meat-free-diet-the-grocer-research-shows/565771.article (accessed on 30 May 2019).

19. Ipsos Mori. Vegan Society Poll. Available online: https://www.ipsos.com/ipsos-mori/en-uk/vegan-society-poll (accessed on 30 May 2019).
20. YouGov. YouGov/Eating Better Survey Results. Available online: https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/yjset7flxy/EatingBetterResults_170424_EatingLessMeat_W.pdf (accessed on 30 May 2019).
21. YouGov. YouGov/NFU Survey Results. Available online: https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/4b80qjmsu5/NFUResults_Veganism_UK_170410_Extra_W.pdf (accessed on 30 May 2019).
22. Finder. UK Diet Trends. Available online: https://www.finder.com/uk/uk-diet-trends (accessed on 30 May 2019).
23. YouGov. Is the Future of Food Flexitarian? Available online: https://campaign.yougov.com/rs/060-QFD-941/images/Is%20the%20future%20of%20food%20flexitarian.pdf (accessed on 30 May 2019).
24. Food Standards Agency. The Food & You Survey: Wave 5. Available online: https://www.food.gov.uk/sites/default/files/media/document/food-and-you-wave5-combined-report-web-revised.pdf (accessed on 30 May 2019).
25. Food Standards Agency. The Food & You Survey: Wave 4. Available online: https://www.food.gov.uk/sites/default/files/media/document/food-and-you-w4-combined-report_0.pdf (accessed on 30 May 2019).
26. Food Standards Agency. The 2014 Food and You Survey. Available online: https://www.food.gov.uk/sites/default/files/media/document/food-and-you-2014-uk-bulletin-1.pdf (accessed on 30 May 2019).
27. Food Standards Agency. Exploring Food Attitudes and Behaviours in the UK: Findings from the Food and You Survey 2012. Available online: https://www.food.gov.uk/sites/default/files/media/document/food-and-you-2012-main-report_1.pdf (accessed on 30 May 2019).
28. Food Standards Agency. Exploring Food Attitudes and Behaviours in the UK: Findings from the Food and You Survey 2010. Available online: https://www.food.gov.uk/sites/default/files/media/document/food-and-you-2010-main-report_0.pdf (accessed on 30 May 2019).
29. Corrin, T.; Papadopoulos, A. Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs. *Appetite* **2017**, *109*, 40–47.
30. Schenk, P.; Rössel, J.; Scholz, M. Motivations and Constraints of Meat Avoidance. *Sustainability* **2018**, *10*, 3858.
31. Mullee, A.; Vermeire, L.; Vanaelst, B.; Mullie, P.; Deriemaeker, P.; Leenaert, T.; De Henauw, S.; Dunne, A.; Gunter, M.J.; Clarys, P.; et al. Vegetarianism and meat consumption: A comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite* **2017**, *114*, 299–305.
32. Lea, E.; Worsley, A. The cognitive contexts of beliefs about the healthiness of meat. *Public Health Nutr.* **2002**, *5*, 37–45.
33. Vanhonacker, F.; Van Loo, E.J.; Gellynck, X.; Verbeke, W. Flemish consumer attitudes towards more sustainable food choices. *Appetite* **2013**, *62*, 7–16.
34. Graça, J.; Oliveira, A.; Calheiros, M.M. Meat, beyond the plate. Data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet. *Appetite* **2015**, *90*, 80–90.
35. Lea, E.; Crawford, D.; Worsley, A. Consumers' readiness to eat a plant-based diet. *Eur. J. Clin. Nutr.* **2006**, *60*, 342–351.
36. Humane League Labs. Diet Change and Demographic Characteristics of Vegans, Vegetarians, Semi-Vegetarians, and Omnivores. Available online: http://www.humaneleaguelabs.org/static/reports/2014/04/diet-change-and-demographic-characteristics1.pdf (accessed on 6 November 2018).

37. Hartmann, C.; Siegrist, M. Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends Food Sci. Technol.* **2017**, *61*, 11–25.
38. Lea, E.J.; Crawford, D.; Worsley, A. Public views of the benefits and barriers to the consumption of a plant-based diet. *Eur. J. Clin. Nutr.* **2006**, *60*, 828.
39. Campbell-Arvai, V. Food-related environmental beliefs and behaviours among university undergraduates: A mixed-methods study. *Int. J. Sustain. High. Educ.* **2015**, *16*, 279–295.
40. Tobler, C.; Visschers, V.H.; Siegrist, M. Eating green. Consumers' willingness to adopt ecological food consumption behaviors. *Appetite* **2011**, *57*, 674–682.
41. Kunda, Z. The case for motivated reasoning. *Psychol. Bull.* **1990**, *108*, 480.
42. Loughnan, S.; Haslam, N.; Bastian, B. The role of meat consumption in the denial of moral status and mind to meat animals. *Appetite* **2010**, *55*, 156–159.
43. Rothgerber, H. Efforts to overcome vegetarian-induced dissonance among meat eaters. *Appetite* **2014**, *79*, 32–41.
44. Bastian, B.; Loughnan, S.; Haslam, N.; Radke, H.R. Don't mind meat? The denial of mind to animals used for human consumption. *Personal. Soc. Psychol. Bull.* **2012**, *38*, 247–256.
45. Pohjolainen, P.; Vinnari, M.; Jokinen, P. Consumers' perceived barriers to following a plant-based diet. *Br. Food J.* **2015**, *117*, 1150–1167.
46. Lea, E.; Worsley, A. Benefits and barriers to the consumption of a vegetarian diet in Australia. *Public Health Nutr.* **2003**, *6*, 505–511.
47. The Independent. Aggressive Vegans Are Putting a Quarter of Britons off Vegetarianism, Finds Study. Available online: https://www.independent.co.uk/life-style/food-and-drink/vegans-aggressive-british-people-turn-off-vegetarianism-meat-dairy-study-a7880251.html (accessed on 6 November 2018).
48. Janda, S.; Trocchia, P.J. Vegetarianism: Toward a greater understanding. *Psychol. Mark.* **2001**, *18*, 1205–1240.
49. Povey, R.; Wellens, B.; Conner, M. Attitudes towards following meat, vegetarian, and vegan diets: An examination of the role of ambivalence. *Appetite* **2001**, *37*, 15–26.
50. Heiervang, E.; Goodman, R. Advantages and limitations of web-based surveys: Evidence from a child mental health survey. Soc. Psychiatry Psychiatr. Epidemiol. 2011, 46, 69–76.
51. Horne, C.; Kennedy, E.H. The power of social norms for reducing and shifting electricity use. *Energy Policy* **2017**, *107*, 43–52.
52. Macchia, L.; Plagnol, A.C.; Reimers, S. Does experience with high inflation affect intertemporal decision making? Sensitivity to inflation rates in Argentine and British delay discounting choices. J. Behav. Exp. Econ. 2018, 75, 76–83.
53. Casteel, M.A. An empirical assessment of impact based tornado warnings on shelter in place decisions. *Int. J. Disaster Risk Reduct.* **2018**, *30*, 25–33.
54. Mercy for Animals. Which Call to Action Should We Use in Pro-Vegetarian Videos? Available online: https://mercyforanimals.org/which-call-to-action-should-we-use-in-pro (accessed on 6 November 2018).
55. Humane League Labs. Which Leaflet Is More Effective: A Reanalysis. Available online: http://humaneleaguelabs.org/static/reports/E001R02-which-leaflet-is-more-effective.pdf (accessed on 6 November 2018).
56. Ruby, M.B. Vegetarianism. A blossoming field of study. *Appetite* **2012**, *58*, 141–150.
57. de Boer, J.; Schösler, H.; Aiking, H. Towards a reduced meat diet: Mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite* **2017**, *113*, 387–397.
58. Chin, M.G.; Fisak, B., Jr.; Sims, V.K. Development of the attitudes toward vegetarians scale. *Anthrozoös* **2015**, *15*, 332–342.
59. Cole, M.; Morgan, K. Vegaphobia: Derogatory discourses of veganism and the reproduction of speciesism in UK. *Br. J. Sociol.* **2011**, *62*, 134–153.

60. Črnič, A. Studying social aspects of vegetarianism: A research proposal on the basis of a survey among adult population of two Slovenian biggest cities. *Coll. Antropol.* **2013**, *37*, 1111–1120.
61. MacNair, R. McDonald's "Empirical Look at Becoming Vegan". *Soc. Anim.* **2001**, *9*, 63–69.
62. Humane League Labs. Report: Is Animal Cruelty, Environmental or Purity (Abolitionist) Messaging More Effective at Inspiring People to Change Their Diet? Available online: http://www.humaneleaguelabs.org/static/reports/2015/09/animal-cruelty-vs-22abolitionist22-messaging.pdf (accessed on 11 June 2019).
63. The Guardian. Huge Reduction in Meat-Eating 'Essential' to Avoid Climate Breakdown. Available online: https://www.theguardian.com/environment/2018/oct/10/huge-reduction-in-meat-eating-essential-to-avoid-climate-breakdown (accessed on 11 June 2019).
64. BBC. A Bit of Meat, a Lot of Veg-The Flexitarian Diet to Feed 10bn. Available online: https://www.bbc.co.uk/news/health-46865204 (accessed on 11 June 2019).
65. Sentience Institute. Survey of US Attitudes Towards Animal Farming and Animal-Free Food October 2017. Available online: https://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017 (accessed on 11 June 2019).
66. Fotopoulos, C.; Krystallis, A.; Vassallo, M.; Pagiaslis, A. Food Choice Questionnaire (FCQ) revisited. Suggestions for the development of an enhanced general food motivation model. *Appetite* **2009**, *52*, 199–208.
67. Furst, T.; Connors, M.; Bisogni, C.A.; Sobal, J.; Falk, L.W. Food choice: A conceptual model of the process. *Appetite* **1996**, *26*, 247–266.
68. Glanz, K.; Basil, M.; Maibach, E.; Goldberg, J.; Snyder, D.A.N. Why Americans eat what they do: Taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *J. Am. Diet. Assoc.* **1996**, *98*, 1118–1126.
69. Januszewska, R.; Pieniak, Z.; Verbeke, W. Food choice questionnaire revisited in four countries. Does it still measure the same? *Appetite* **2011**, *57*, 94–98.
70. Lennernäs, M.; Fjellström, C.; Becker, W.; Giachetti, I.; Schmitt, A.; De Winter, A.M.; Kearney, M. Influences on food choice perceived to be important by nationally-representative samples of adults in the European Union. *Eur. J. Clin. Nutr.* **1997**, *51*, 8.
71. Prescott, J.; Young, O.; O'neill, L.; Yau, N.J. N.; Stevens, R. Motives for food choice: A comparison of consumers from Japan, Taiwan, Malaysia and New Zealand. *Food Qual. Prefer.* **2002**, *13*, 489–495.
72. Steptoe, A.; Pollard, T.M.; Wardle, J. Development of a measure of the motives underlying the selection of food: The food choice questionnaire. *Appetite* **1995**, *25*, 267–284.
73. Hoek, A.C.; Luning, P.A.; Weijzen, P.; Engels, W.; Kok, F.J.; De Graaf, C. Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance. *Appetite* **2011**, *56*, 662–673.
74. Faunalytics. 2013 Comparing Effectiveness of Videos and Ads. Available online: https://animalcharityevaluators.org/advocacy-interventions/interventions/online-ads/comparing-effectiveness-of-videos-and-ads/ (accessed on 11 June 2019).
75. The Guardian. Burger King's Plant-Based Whopper Gets Glowing Review—From a Meat Lobbyist. Available online: https://www.theguardian.com/business/2019/apr/08/burger-king-impossible-whopper-plant-based-review-meat-lobbyist (accessed on 10 June 2019).
76. Fox News. Milk Sales Fell $1.1 Billion in 2018, Says Report from Dairy Farmers of America. Available online: https://www.foxnews.com/food-drink/milk-sales-fell-1-1-billion-in-2018-says-report-from-dairy-farmers-of-america (accessed on 10 June 2019).
77. Datar, I.; Betti, M. Possibilities for an in vitro meat production system. *Innov. Food Sci. Emerg. Technol.* **2010**, *11*, 13–22.
78. Post, M.J. Cultured meat from stem cells: Challenges and prospects. *Meat Sci.* **2012**, *92*, 297–301.

79. Lynch, J.; Pierrehumbert, R. Climate impacts of cultured meat and beef cattle. *Front. Sustain. Food Syst.* **2019**, *3*, 5.
80. Bryant, C.; Barnett, J. Consumer acceptance of cultured meat: A systematic review. *Meat Sci.* **2018**, *143*, 8–17.
81. Forbes. The Growing Acceptance of Veganism. Available online: https://www.forbes.com/sites/janetforgrieve/2018/11/02/picturing-a-kindler-gentler-world-vegan-month (accessed on 10 June 2019).
82. The Economist. The Year of the Vegan. Available online: https://worldin2019.economist.com/theyearofthevegan (accessed on 10 June 2019).
83. The Independent. 51% of Chefs Have Added Vegan Dishes to Their Menus in 2018, Study Finds. Available online: https://www.independent.co.uk/life-style/food-and-drink/vegan-dishes-chefs-restaurant-menus-added-2018-veganism-trend-us-a8511526.html (accessed on 10 June 2019).
84. Schösler, H.; De Boer, J.; Boersema, J.J. Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution. *Appetite* **2012**, *58*, 39–47.
85. The Good Food Institute. Why Plant-Based Meat Will Ultimately Be Less Expensive Than Conventional Meat. Available online: https://www.gfi.org/plant-based-meat-will-be-less-expensive (accessed on 8 August 2019).
86. King, M.F.; Bruner, G.C. Social desirability bias: A neglected aspect of validity testing. *Psychol. Mark.* **2000**, *17*, 79–103.
87. Humane League Labs. Measuring Change in Diet for Animal Advocacy. Available online: http://www.humaneleaguelabs.org/static/reports/E009R01-measuring-diet-animal-advocacy.pdf (accessed on 9 April 2019).
88. Statista. United Kingdom: Median Age of the Population from 1950 to 2050 (in years). Available online: https://www.statista.com/statistics/275394/median-age-of-the-population-in-the-united-kingdom/ (accessed on 12 June 2019).
89. Cooney, N. Veganomics: The Surprising Science on What Motivates Vegetarians, from the Breakfast Table to the Bedroom; Lantern Books: Brooklyn, NY, USA, 2014.

Thus far, I have argued that a reduction in animal farming represents important moral progress, and that a variety of social and psychological factors make it difficult to appreciate the urgency of such progress. However, we have also seen that, although many meat-eaters view vegetarian and vegan diets as ethical, healthy, and good for the environment, they also see them as expensive, inconvenient, and most importantly - a sacrifice in terms of taste. As a result of this, the majority are unwilling to reduce their meat consumption.

This data implies that highlighting the arguments in favour of vegetarianism is unlikely to be effective in reducing animal product consumption, because many people are already aware of and agree with these reasons. In terms of the AIDA model, we might say that these people have passed through the stages of attention and interest, but meat attachment is preventing them from developing the desire to reduce their meat consumption.

For this group of consumers who know there are good reasons to eat less meat, but just do not want to, the barriers to meat reduction are not ideological but merely practical. It is possible that such people would want to contribute to reducing environmental and animal harm if they did not have to stop eating meat. With cultured meat, grown from animal cells in vitro (Post et al., 2020), this will soon be possible. However, as recent decades have shown, public acceptance of novel food technologies is not a given (Mohorcich & Reese, 2019). Therefore, if we are to realise the potential benefits of cultured meat, it is useful to assess what is already known about public perceptions of the technology. My third study was a systematic review of the literature on consumer acceptance of cultured meat.

<table>
<tr><td colspan="4">This declaration concerns the article entitled:</td></tr>
<tr><td colspan="4">Consumer acceptance of cultured meat: A systematic review.</td></tr>
<tr><td colspan="4">Publication status (tick one)
Draft manuscript [ ] Submitted [ ] In review [ ] Accepted [ ] Published [X]</td></tr>
<tr><td>Publication details (reference)</td><td colspan="3">Bryant, C., & Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. Meat Science, 143, 8-17.</td></tr>
<tr><td colspan="4">Copyright status (tick the appropriate statement)
I hold the copyright for this material [X] Copyright is retained by the publisher, but I have been given permission to replicate the material here [ ]</td></tr>
<tr><td>Candidate's contribution to the paper (provide details, and also indicate as a percentage)</td><td colspan="3">The candidate contributed to / considerably contributed to / predominantly executed the…

Formulation of ideas:

Contributed considerably (75%). Began the PhD with an interest in this area and some knowledge of the literature. Had conducted a scoping review in my MSc thesis.

Design of methodology:

Contributed considerably (75%). Created the literature search plan in collaboration with Julie Barnett and refined this iteratively after initial searches.

Experimental work:

Predominantly executed (90%). I read the literature and synthesized the themes.

Presentation of data in journal format:

Predominantly executed (90%). I wrote the first and final manuscript with help from Julie.</td></tr>
<tr><td>Statement from Candidate</td><td colspan="3">This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.</td></tr>
<tr><td>Signed</td><td>C Bryant</td><td>Date</td><td>29 June 2020</td></tr>
</table>

5. Consumer Acceptance of Cultured Meat: A Systematic Review

Abstract

Cultured meat grown in-vitro from animal cells is being developed as a way of addressing many of the ethical and environmental concerns associated with conventional meat production. As commercialisation of this technology appears increasingly feasible, there is growing interest in the research on consumer acceptance of cultured meat. We present a systematic review of the peer-reviewed literature, and synthesize and analyse the findings of 14 empirical studies. We highlight demographic variations in consumer acceptance, factors influencing acceptance, common consumer objections, perceived benefits, and areas of uncertainty. We conclude by evaluating the most important objections and benefits to consumers, as well as highlighting areas for future research.

5.1 Introduction

The ethical and environmental concerns associated with meat production will be exacerbated as millions rising out of poverty in developing countries drive a 73% increase in demand for meat by 2050 (Food and Agriculture Organization, 2003, 2011). Meanwhile, consumers in the West are unwilling to reduce their meat consumption (Tobler, Visschers, & Siegrist, 2011), yet are increasingly concerned about the implications of meat for sustainability and animal welfare (Vinnari & Tapio, 2009). Alongside changes to conventional farming systems, various types of artificial meat may play a role in addressing these issues (Bonny, Gardner, Pethick, & Hocquette, 2017).

One proposed solution is cultured meat, which can be grown from animal cells in a culture medium rather than being taken from slaughtered animals (Post, 2012). Cultured meat largely circumvents the need for animals in the meat production system, alleviating a milieu of animal welfare, public health, and environmental concerns associated with conventional meat (Hopkins & Dacey, 2008; Mattick, Landis, & Allenby, 2015; Tuomisto & de Mattos, 2011; Zhi-Chang, Qun-Li, & Lin, 2015).

Several prototypical cultured meat products have been made (BBC, 2013; The Telegraph, 2017), and whilst it is not yet available commercially, several producers are aiming to sell cultured meat within five years (BBC, 2015; Business Insider UK, 2017). Given the expected commercialisation of the technology, and widespread consumer rejection of other conceptually similar food technologies such as GMOs (Bánáti, 2011), there is now significant interest in consumer acceptance of cultured meat. Some have claimed that consumer acceptance could be the biggest barrier cultured meat faces (Sharma, Thind, & Kaur, 2015).

Consumer acceptance of cultured meat has been the subject of several studies in recent years. Hartmann and Siegrist (2017) recently explored this as part of a systematic review. However, this review was restricted to quantitative studies, which meant valuable insights from several qualitative studies were omitted (O'Keefe, McLachlan, Gough, Mander, & Bows-Larkin, 2016; Verbeke, Marcu, et al., 2015). Moreover, several relevant studies have been published since that review, such is the present interest in cultured meat (including Siegrist & Sütterlin, 2017; Wilks & Phillips, 2017).

Given the increasing urgency of addressing sustainability in meat production and the impending commercial feasibility of cultured meat, it is imperative to synthesize the current evidence base about public perceptions of cultured meat. The present systematic review, therefore, aims to provide an updated and comprehensive answer to the question, 'What is known about consumer acceptance of cultured meat?' It is hoped that the findings will be of use to researchers looking at public understanding of novel food technologies, and those in the industry developing cultured meat.

5.2 Methodology

This systematic review sought to identify, collate, and synthesize the findings of empirical studies looking at consumer acceptance of cultured meat. The review followed the five steps outlined by Khan, Kunz, Kleijnen, and Antes (2003): framing the question, identifying relevant publications, assessing study quality, summarising the evidence, and interpreting the findings.

5.2.1. Framing the question

This review addressed the question: what is known about consumer acceptance of cultured meat? We applied the inclusion/exclusion criteria listed in Table 5.1.

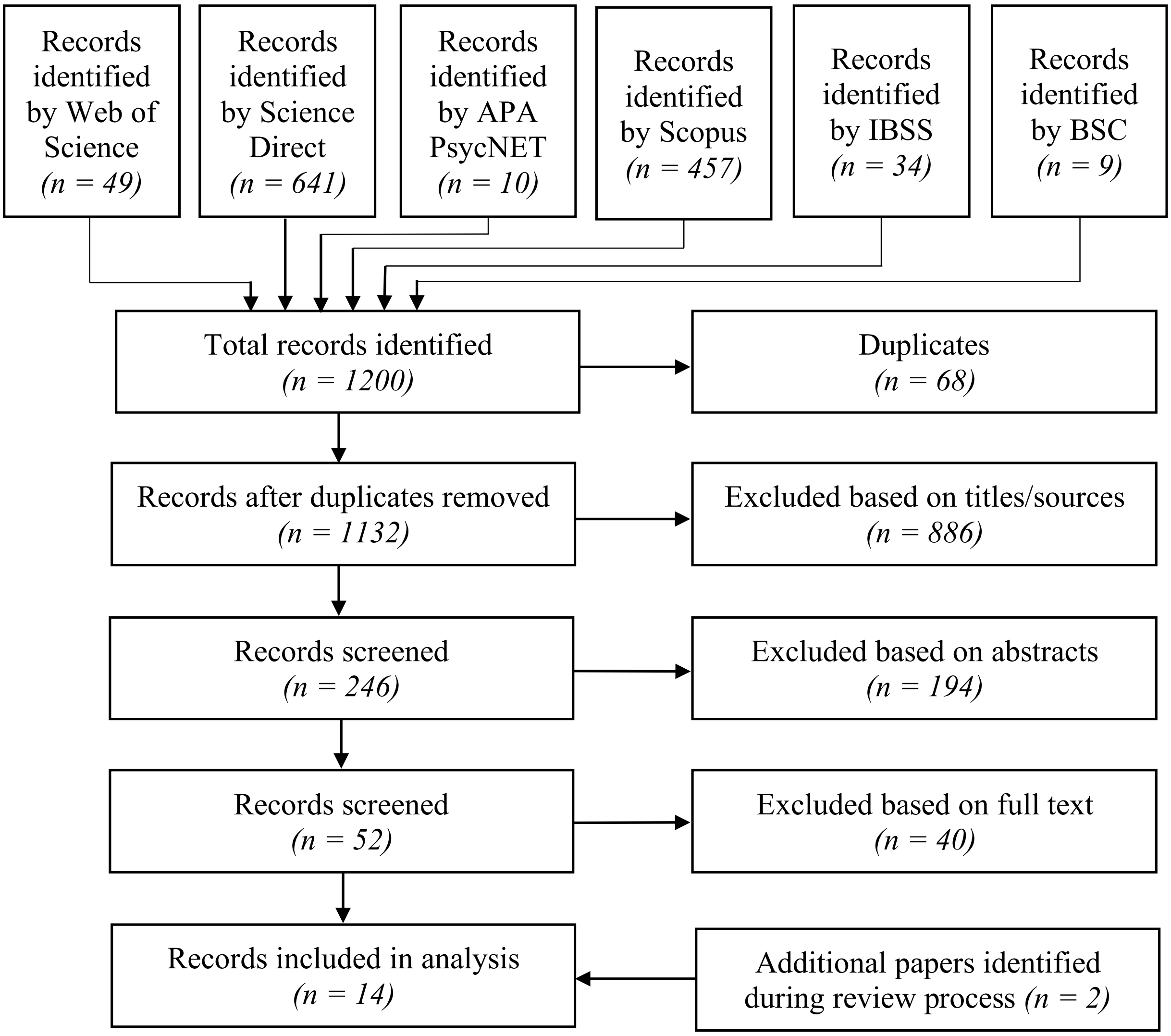
Table 5.1: Inclusion and exclusion criteria used for article selection.

Inclusion criteria	Exclusion criteria
Full text paper published in peer-reviewed journal	Non-peer-reviewed sources
Papers presenting the results of primary empirical studies	Papers which do not present primary research (review papers, discussion papers, etc.)
Quantitative or qualitative studies	Focus on other aspects of cultured meat (production processes, media coverage, etc.) with no consumer behaviour focus
Focus on consumer attitudes towards cultured meat	Papers focusing on vegetarianism, veganism, plant-based meat alternatives, organic meat, high animal welfare meat
English language	

5.2.2 Identifying relevant publications

We searched a broad variety of literature databases using a search term[1] including a wide range of alternative terms for 'consumer acceptance' and 'cultured meat'. Figure 5.1 depicts how these records were subsequently filtered:

Figure 5.1: Process for identifying and excluding records based on Moher, Liberati, Tetzlaff, Altman, and PRISMA Group (2009).



[1] Available from author.

5.2.3 Assessing study quality

The 14 studies identified as relevant were then subject to a quality assessment using the Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields (Kmet, Lee, & Cook, 2004). For more detail on these criteria, see Appendix B. Since all the eligible studies identified achieved reasonable quality ratings, none were excluded from the review. The quality assessment did, however, highlight methodological concerns in some studies, which led to caveats being issued in relation to their findings.

5.3 Results

A summary of each included study's design, sample, description given of cultured meat, and main findings is shown in Table 5.2.

Table 5.2: Summary of studies included in the review.

Study	Design	Country & sample	Description given to participants	Main findings
Bekker, Fischer, Tobi, and van Trijp (2017)	Experimental	Netherlands: 190, 194, 192 university students (three experiments)	Text description. Used the term 'cultured meat'. Discussed the production method, environmental impact, taste, and artificiality. Descriptions were experimentally manipulated to be positive/negative.	Positive and negative information about cultured meat (or a related product) influenced explicit, but not implicit, attitudes towards it in the direction of the information. There was less effect for more familiar participants.
Hocquette et al. (2015)	Survey	France and international: 1,890 educated people; many scientists and meat industry workers, including people personally known to authors	Presentation/text description. Used the terms 'in vitro meat', and 'lab or factory grown meat'. Some participants were told in a presentation about the production method, environmental, animal welfare, and food security benefits. Most participants read text about the production method, potential health benefits, and extensive production challenges.	Most respondents believed that the meat industry had substantial environmental and animal welfare problems, and believed that cultured meat was feasible and realistic. However, only a minority chose eating cultured meat as their first choice to mitigate problems related to meat production. Most thought it would not be healthy or tasty, and thought consumers would not accept it. Nonetheless, many were in favour of supporting further research into cultured meat.
Siegrist and Sütterlin (2017)	Experimental	Switzerland: 244, 253 online participants from research panel (two experiments)	Text description. Used the term 'in vitro meat'. Discussed the production method, environmental and animal welfare benefits, and potential health risks.	Health risks from cultured meat were judged to be less acceptable than health risks from conventional meat. This effect was fully mediated by perceived naturalness.
Siegrist, Sütterlin, and Hartmann (2018)	Experimental	Switzerland: 204, 298 online participants from research panel (two experiments)	Text description. Used the terms 'in vitro meat' and 'red meat' (description was experimentally varied). Discussed the production method, environmental and animal welfare benefits, artificiality, and stated that the taste was comparable to conventional meat.	Cultured meat has lower acceptance than conventional meat because of its perception as unnatural. Discussing cultured meat increased acceptance of conventional meat. Non-technical descriptions of cultured meat lead to higher acceptance than technical descriptions, largely explained by perceived unnaturalness and disgust.
Slade (2018)	Experimental	Country not specified: 533 online participants recruited through a research organisation	Text description. Used the term 'cultured meat'. Very brief description discussing the production method only.	A minority of participants (11%) chose cultured meat over conventional meat or plant-based meat. Preference for cultured meat was higher amongst men, younger people, more educated people, those who consume meat substitutes, and those with high concern for the environment.
Verbeke, Sans, and Van Loo (2015)	Exploratory experimental (before/after testing)	Netherlands: 180 online participants, mainly students	Text description. Used the terms 'in vitro meat' and 'cultured meat'. Basic information discussed the production method only. Additional information	The provision of additional information about the benefits of cultured meat increased acceptance compared to providing basic information only.

			discussed environmental benefits, health benefits, and food safety benefits.	Price and sensory expectations are major obstacles to acceptance.
Wilks and Phillips (2017)	Survey	USA: 673 adults recruited through MTurk; broadly representative of country population	Text description. Used the terms ‘in vitro meat’, ‘cultured meat’, ‘synthetic meat’, and ‘schmeat’. Discussed the production method and challenges, and animal welfare.	Most respondents were willing to try cultured meat, though only one third were willing to eat it regularly or as a replacement for conventional meat. Men were more receptive than women, as were liberals compared to conservatives. The primary concerns were price, taste, and unnaturalness.
Bekker, Tobi, and Fischer (2017)	‘Freelist’ word association task	Netherlands: 30 graduate students (10 each from Netherlands, China, Ethiopia)	Text description. Used the term ‘cultured meat’. Discussed the production method and challenges, as well as environmental, animal welfare, and food safety benefits.	Most associations related to the future and societal impact. Cultured meat was generally conceived of as comparable to conventional meat in terms of physical properties and contents, though some participants conceived of it as not ‘real’ meat. This varied between participants of different countries, depending on how liberal their definition of meat was.
Laestadius and Caldwell (2015)	Online comment analysis	USA: 462 commenters making 814 comments on US news stories	No description given – participants were reacting to news stories which described cultured meat.	Overall, comments were more negative than positive. Positive comments mainly related to animal welfare, the environment, and public health benefits, whereas negative comments related to cultured meat being unnatural and unappealing.
Laestadius (2015)				Both positive and negative comments were grounded in similar values (including animal welfare, sustainability, justice, naturalness, and maximising scarce resources) but interpreted cultured meat differently. Themes similar to above.
O'Keefe, McLachlan, Gough, Mander, and Bows-Larkin (2016)	Focus groups	UK: 40 participants in 6 focus groups in Manchester	No information about description given in the paper.	Overall, a sense of scientific progress underpinned a positive discussion of cultured meat. Much of the discussion related to sustainability, though the main perceived benefit was to animal welfare. Many had questions about the safety and nutrition of the product, and overall agreed it would have to be cheaper than conventional meat to gain acceptance.
Tucker (2014)	Focus groups	New Zealand: 69 participants in 19 focus groups across NZ	Exact description not given in the paper. Participants were shown an image and given a ‘brief description… including the positive and negative aspects and implications’ (p. 171)	There was an overall negative view of cultured meat, although some (particularly males, younger people, middle income people, and city dwellers) were positive. The main perceived benefits were animal ethics and increased protein productivity, whereas the main perceived

				drawbacks were sensory characteristics, unnaturalness, and perceived unhealthiness.
Verbeke, Marcu, et al. (2015)	Focus groups	UK, Belgium, Portugal: 174 online participants, 109 focus group participants	Video. Used the term 'synthetic meat'. Discussed the production method and challenges, and animal welfare benefits.	Initial reactions related to disgust and unnaturalness. Participants perceived few personal benefits, but acknowledged societal to the environment and food security. Personal and societal risks related to health, safety, and adverse social and economic effects. Further considerations concerned inevitable scientific progress, governance and risk control, and the need for regulation and clear labelling.
Marcu et al. (2015)				Participants' sense-making strategies included anchoring to more familiar technologies, using metaphors and commonplace arguments to close off debate, and establishing polarities. Conversely, some asked questions and engaged in pragmatic consideration of the possible costs and benefits.

These findings will be further discussed in four sections. First, we will review the overall picture of consumer acceptance, including survey data, demographic variations, and factors which may influence acceptance. Secondly, we will discuss common personal and societal objections to cultured meat. Thirdly, we will highlight some areas in which there is significant consumer uncertainty. Finally, we will discuss some of the perceived benefits of cultured meat.

5.3.1 Consumer acceptance

First, we will discuss findings which relate to overall willingness to eat cultured meat.

5.3.1.1 Personal willingness to eat cultured meat

Three surveys have investigated the rate of personal willingness to consume cultured meat, each with different findings (Hocquette et al., 2015; Slade, 2018; Wilks & Phillips, 2017). These differences are likely underpinned by differences in the samples, descriptions of cultured meat, and question design.

Wilks and Phillips (2017) give an overall positive view of consumer acceptance, reporting that 65.3% would be willing to try cultured meat, of whom 32.6% would be willing to eat it regularly, 47.7% would be more willing to eat it compared to soy-based meat substitutes, and 31.5% would be willing to eat it as a replacement for farmed meat. Hocquette et al. (2015), meanwhile, found that between 5 and 11% of their respondents said they would eat cultured meat, and Slade (2018) report that 11% chose cultured meat over conventional and plant-based alternatives.

Whilst Wilks and Phillips (2017) and Slade (2018) surveyed reasonably representative samples with minor deviations from census populations, Hocquette et al. (2015) did not intend their sample to be representative, thus limiting generalizability: 40.4% of their total sample were scientists, 9.3% were working in the meat sector, and a further 11.3% were scientists working on meat, whilst some respondents were from 'mailing lists or groups of people known by researchers' (p. 275).

Furthermore, as shown in Table 2, the descriptions of cultured meat given to participants differed greatly. More importantly, respondents in each survey answered very different questions: Wilks and Phillips (2017) asked participants whether they would try, buy regularly, prefer to other products, and pay more for cultured meat, and participants used Likert scales to indicate their propensity to do each of these. Conversely, Slade (2018) used a hypothetical choice experiment, asking participants to choose between cultured meat burgers, plant-based burgers, and conventional burgers. Similarly, Hocquette et al. (2015) asked respondents to choose between eating cultured meat, reducing their meat consumption, becoming vegetarian, or changing nothing in their meat consumption. In practice these options are not mutually exclusive, and therefore the conclusion that 'only a minority of respondents (from 5 to 11%) would recommend or accept to eat *in vitro* meat instead of meat produced from farm animals' (p. 273) should be taken with some scepticism.

Overall, these studies indicate that most consumers are willing to try cultured meat, but a relatively small proportion would choose it over conventional meat or other meat alternatives. In practice, this preference is likely predicated on a number of factors such as taste, price, and popularity. Since cultured meat is not currently available commercially, these things cannot be accounted for.

Nonetheless, studies suggest some demographic variation in willingness to engage with cultured meat. Wilks and Phillips (2017) report that males (vs. females), liberals (vs. conservatives), and low income respondents (vs. high income respondents) were significantly more willing to try cultured meat. They also find that, whilst vegetarians and vegans had more positive perceptions of some aspects of cultured meat, they were significantly less willing to consume it than were omnivores. Slade (2018) provide further support for males having higher preference for cultured meat, and note the same preference amongst younger and more educated respondents. Some of these trends are also observed in the qualitative work of Tucker (2014) who reported that men, younger people, and city-dwellers showed more willingness to eat cultured meat compared to women, older people, and rural participants respectively. There is also some evidence of cultural variation in the way consumers relate to cultured meat (Bekker, Tobi, & Fischer, 2017), though this is based on non-generalizable qualitative work.

5.3.1.2 Factors influencing acceptance

Some evidence suggests that increased familiarity with cultured meat is associated with increased acceptance (Bekker, Fischer, Tobi, & van Trijp, 2017; Wilks & Phillips, 2017), though this has not been tested statistically. Verbeke, Marcu, et al. (2015) reported that participants were less resistant to the concept at the end of focus group discussions compared to the start. Indeed, such a relationship would be in line with what one would expect based on the mere exposure effect (Zajonc, 2001). Lack of familiarity may underpin many of the ‘sense-making strategies’ identified by Marcu et al. (2015, p. 11): these included using metaphors such as ‘Frankenfoods’ and ‘zombies’, as well as using commonplaces such as ‘playing God’ and ‘interfering with nature’ as bottom line arguments which closed off further debate. Anchoring cultured meat to more familiar technologies (such as GMOs and cloning) and attempting to define cultured meat in terms of its similarities and differences compared to conventional meat also indicated an attempt to locate the concept in a network of the familiar. Conversely, some participants engaged in pragmatic reasoning, weighing up the costs and benefits of cultured meat, reflecting on the process of public acculturation to new technologies, revealing dilemmas and ultimately expressing ambivalence.

Meanwhile, experimental data indicates that measures of acceptance are sensitive to information provision. Verbeke, Sans, and Van Loo (2015) found that self-reported willingness to try, purchase, and pay more for cultured meat increased when participants were given additional information about the benefits for the environment and public health, compared to when they just had basic information. Whilst this study is somewhat limited by the sample and before/after design, its findings are corroborated by Bekker, Fischer, et al. (2017), who report that positive or negative information about cultured meat changed explicit (but not implicit) attitudes towards cultured meat in the direction of the information. Subsequent experiments in this study found that providing positive/negative information about solar panels (a related product in the ‘sustainability’ category) also affected attitude measures towards cultured meat, leading the authors to speculate that ‘The pre-activated associations with sustainability in turn may have facilitated making sense of the unfamiliar attitude object.’ (p. 252). This interpretation of their results seems to be in line with Marcu et al.’s (2015) identification of anchoring to familiar technologies as a key part of the sense-making process surrounding cultured meat.

Additionally, Siegrist, Sütterlin, and Hartmann (2018) found a significantly higher rate of acceptance when participants were given a non-technical description of cultured meat compared to a technical description due to a difference in perceived naturalness and evoked disgust. The authors recommend that advocates give non-technical descriptions of cultured meat which focus on the similarity of the product to conventional meat, rather than the difference of the production process.

Finally, Slade (2018) found that preference for cultured meat was significantly higher when its price was lower, and when its perceived market share was higher. Whilst the former is in line with other research (see Section 3.2.1 on anticipated price), the latter indicates that perceived popularity is a predictor of acceptance; the author speculates that this could be due to a desire to conform to social norms, or because consumers use popularity to infer product quality. In any case, it must be considered that existing research has framed cultured meat as a future technology, unverified by other consumers, and therefore consumer acceptance in practice may differ significantly from the observations of these studies.

5.3.2 Common objections to cultured meat

Common objections to cultured meat broadly relate to either personal or societal concerns.

5.3.2.1 Personal concerns

Unnaturalness

Amongst the most common objections to cultured meat is that it is unnatural. Marcu et al. (2015) report that 'natural vs. artificial' is one of the polarities participants established in order to locate cultured meat relative to conventional meat. Indeed, participants in other studies have referred, unprompted, to 'real meat' (as opposed to cultured meat) in the context of these discussions (Tucker, 2014; Verbeke, Marcu, et al., 2015), or have described cultured meat as 'fake' (Bekker, Tobi, et al., 2017). Laestadius (2015) observed that, unlike other concerns, the unnaturalness objection has been recorded universally across a range of cultures.

As well as forming the basis for some claims that it may be dangerous to consume or cause environmental harm (Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015), perceived unnaturalness causes some to believe that cultured meat is inherently unethical (Laestadius, 2015). As Marcu et al. (2015, p. 9) argue, some deploy nature as an ideology within which anything natural is construed as being good/healthy, and anything unnatural is bad or carries risks. This ideology may have formed the ground for some to dismiss cultured meat using the commonplace 'interfering with nature' argument.

Laestadius (2015) provides an insightful analysis of the unnaturalness perception, arguing that ethical concerns stemming from the alleged unnaturalness of cultured meat fall into two categories: practical concerns about unknown consequences of the technology causing tangible harm to human health or the environment, and a more fundamental conceptualisation of unnaturalness as inherently unethical. She argues that the former could be addressed by further research or exposure over time, whilst the latter may be insensitive to evidence, and further cautions against dismissing such concerns as naturalistic fallacy, arguing that prevailing ethics have real world consequences regardless of whether they are, in themselves, sound.

Nonetheless, there is some evidence of people overcoming the unnaturalness objection. O'Keefe et al. (2016) found that participants considered that many other phenomena in modern society are unnatural, yet widely accepted, a finding mirrored by Verbeke, Marcu, et al. (2015). Laestadius (2015, p. 997) identified some comments arguing that conventional meat is also unnatural ('riddled with… hormones and bacteria', as one commenter said), though she notes that this argument did not necessarily extend to the conclusion that naturalness should not matter.

Quantitative studies highlight the role perceived unnaturalness plays in acceptance. Whilst Wilks and Phillips (2017) report overall agreement that cultured meat is unnatural compared to conventional meat, Siegrist and Sütterlin (2017) demonstrate experimentally that perceived naturalness mediated respondents' acceptance of health risks associated with conventional vs. cultured meat. Siegrist et al. (2018) also found perceived naturalness to mediate willingness to consume cultured meat, directly and indirectly via evoked disgust.

Other evidence supports the link between perceived naturalness and disgust: Verbeke, Marcu, et al. (2015) report that this was one of the first reactions observed, and was experienced as a shared emotion in focus groups. Some of their participants described cultured meat as 'vile', 'freakish' and 'weird' (p. 52). In their content analysis of online comments, Laestadius and Caldwell (2015) report that 10% of the commenters observed expressed disgust, and many used terms like 'lab-meat' and 'test-tube' in a pejorative way. Although disgust is likely to be partly explicable through traditional notions that it guards against ingesting potentially harmful substances (Rozin & Fallon, 1987), Laestadius (2015) notes that some disgust was morally grounded.

Safety

A common related concern regarding cultured meat was food safety. Safety concerns were reported in many of these studies; Verbeke, Marcu, et al. (2015) report that this concern was linked to the perception of unnaturalness (mirroring the findings of Siegrist and Sütterlin (2017) and Siegrist et al. (2018)) and to a sense of scientific uncertainty. Laestadius and Caldwell (2015) report some concerns that cultured meat could be linked to cancer, for example. Hocquette (2016) explains that cancerous cells could develop through cell proliferation, but are unlikely to harm consumers as they are dead when digested. However, many studies also report some participants perceiving potential safety benefits; O'Keefe et al. (2016), in particular, highlight this in relation to BSE affecting conventional meat, and report that participants expressed confidence that cultured meat would not be allowed to be sold unless it was proven safe. Verbeke, Marcu, et al. (2015) also reported that participants perceived possible safety benefits, though they expressed concerns about regulation in this context.

On balance, there are more concerns than optimism expressed around the issue of safety in the qualitative literature. However, the quantitative data seems to tell a different story: Verbeke, Sans, et al. (2015) report that participants gave a mean rating slightly favouring 'safe' rather than 'not safe' on a 7-point scale, whilst Wilks and Phillips (2017) reported similarly favourable figures on a question about the risk of zoonoses from cultured compared to conventional meat. It seems that, whilst people discuss safety concerns in focus groups and online comments, when asked directly about this issue in surveys, overall results err towards a perception of safety. This may reflect the difference between perception of risk and acceptability of risk highlighted by the results of Siegrist and Sütterlin (2017): because the risk is perceived as coming from an unnatural source, it is worthy of more attention, though the level of risk itself may be low.

Healthiness

A further common concern observed in the literature relates to the nutritional content of cultured meat. Verbeke, Marcu, et al. (2015) report that participants generally thought that cultured meat would be less healthy than conventional meat, a concern also observed by Laestadius and Caldwell (2015). Both of these studies noted that some participants were open to perceiving health benefits relative to conventional meat, especially in relation to its lower fat content, although such perceptions were outnumbered by concerns about unhealthiness. Bekker, Tobi, et al. (2017) also observe mixed perceptions here, whilst

Tucker (2014) notes that although some participants said cultured meat was likely to be unhealthy, this was not a key reason for rejection. Hocquette et al. (2015) found that 28.6% of their respondents thought that cultured meat would be healthy, whilst 37.9% thought it would not be (33.5% did not know). Both Verbeke, Sans, et al. (2015) and Wilks and Phillips (2017) reported mean figures almost exactly in the middle of the 'healthiness' scales included in their studies, indicating that there is overall uncertainty as to the healthiness of cultured meat.

Anticipated taste/texture/appearance

Many consumers anticipate cultured meat having an inferior taste, texture, or appearance compared to conventional meat. This is a major theme highlighted by Tucker (2014), who argues that lack of sensory appeal was the main reason underpinning rejection of cultured meat. Similarly, Verbeke, Marcu, et al. (2015) reported that many participants anticipated inferior taste, and those who said they might eat it said that tasting as good as conventional meat would be a condition of regular consumption. O'Keefe et al. (2016) highlighted some participants wanting to be able to compare cultured meat side-by-side with conventional meat for aesthetic appeal, whilst Bekker, Tobi, et al. (2017) find evidence of concerns about taste and texture (some anticipated a 'soft' or 'boring' texture) were held by participants from all three countries in their study. Laestadius and Caldwell (2015) found comments on online news articles anticipating a good and bad taste in equal measure; those who were pessimistic about the taste and texture often mentioned the lack of fat, which was mentioned in several of the news articles from which comments were gathered. Hocquette et al. (2015) found that just 23.6% of their respondents thought that cultured meat would be tasty; 39% thought it would not be, and 37.5% did not know. Wilks and Phillips (2017) and Verbeke, Sans, et al. (2015) both report that their samples, on average, thought that cultured meat would be less tasty than conventional meat, whilst Slade (2018) found that almost 90% of their sample believed cultured meat would taste worse than conventional meat, though most thought it would taste better than plant-based meat alternatives.

Anticipated price

Bekker, Tobi, et al. (2017) report that price was a theme discussed by participants from all cultures; some participants anticipated cultured meat being cheaper whilst others thought it would be more expensive. Verbeke, Marcu, et al. (2015) also report such uncertainty, further noting that some participants said they would buy cultured meat if it was cheaper, whilst others thought the perceived ethical benefits would justify paying the same price. O'Keefe et al. (2016) report that their participants said it would have to be cheaper to achieve mainstream acceptance, but also discussed the possibility of producing superior cuts of meat at a cheaper price. Slade (2018) found that a lower price was a significant predictor of preference for cultured meat, indicating that price competitiveness will likely be important for consumers in practice. Laestadius and Caldwell (2015) note that many commenters reacted to the very high 'price' of around $350,000 reported in the media, which was in fact the cost of the entire research project. This sensationalist reporting may contribute to the perception that cultured meat is expensive.
Whilst Verbeke, Sans, et al. (2015) report that their participants anticipated a slightly higher price, Wilks and Phillips (2017) found that their participants, on average, expected it would be cheaper 'on a global level' to meet demand for meat using cultured rather than conventional meat. This discrepancy is likely due to framing; the phrasing of the latter question may have triggered the idea that cultured meat could be produced cheaply to feed the global poor. Indeed, the idea that cultured meat could be used to feed the global poor who cannot afford conventional meat is a common theme in the literature (Bekker, Tobi, et al., 2017; Tucker, 2014). Verbeke, Marcu, et al. (2015) note that this idea allowed some participants to accept cultured meat in principal, whilst rejecting it in practice. Laestadius

(2015) reports that some commenters thought this was a good thing, whilst others perceived an injustice whereby only the rich would get 'real' meat.

5.3.2.2 Societal concerns

There is also evidence of societal concerns relating to the end of traditional animal agriculture, distrust of companies producing cultured meat, and the energy required for production.

Wilks and Phillips (2017) found that, overall, survey respondents agreed that cultured meat would have negative impacts on traditional farmers. Such concerns were mirrored by the participants of Bekker, Tobi, et al. (2017), whilst Verbeke, Marcu, et al. (2015) stress that the anticipated losses to farming were social and cultural as well as economic: participants also worried that cultured meat might take away from cultural rituals in which meat plays a central role, such as barbecues and Sunday roasts. Furthermore, they expressed regret about the possible erosion of the countryside, as well as the tradition and heritage of farming (see Fiddes, 1994). In general, the end of traditional farming was thought of as unwelcome.

Interestingly, Laestadius and Caldwell (2015) comment that these concerns seem less prominent amongst American consumers, perhaps because much of US agriculture is already industrialised (Laestadius, 2015). However, some did worry about the consolidation of power in the food system which could accompany a shift towards cultured meat production. Indeed, Laestadius and Caldwell (2015) report that 4% of commenters expressed such concerns, with one commenter claiming that the innovation was motivated by 'vast profits, or fame' (p. 2463). Similarly, Verbeke, Sans, et al. (2015) note that in the aftermath of debates about GMOs, consumers are likely to see such products as being 'driven by corporate interests' (p. 56).

Many consumers expressed concerns that in the future, they may be consuming cultured meat without their knowledge (Laestadius & Caldwell, 2015). O'Keefe et al. (2016) reported participants discussing maintaining food choice in this context, whilst Verbeke, Marcu, et al. (2015, p. 54) quote one participant as saying 'If they can get your money, I don't think you will never [sic] know what you will eat.' This perception led some consumers to demand that regulation should ensure transparency in cultured meat labelling, marketing, and information provision. Laestadius (2015) quotes one commenter who alluded to the idea that cultured meat would be 'slipped' into the diets of the poor, whilst the rich would continue to have access to conventional meat. Marcu et al. (2015) and Laestadius and Caldwell (2015) report some going further, alluding to dystopian sci-fi-like future visions involving Jurassic Park and Soylent Green. The latter observed some concerns that cultured meat could enable a future where cannibalism is acceptable (see Leroy & Praet, 2017).

Rather more practical societal concerns pertain to the amount of energy needed for cultured meat production. Verbeke, Marcu, et al. (2015) and Laestadius and Caldwell (2015) both report this concern amongst consumers, although in general these concerns seem to be outweighed by perceptions that cultured meat will be relatively sustainable.

5.3.3 Doubts and uncertainty

Consumers express doubt and uncertainty regarding some aspects of cultured meat, in particular its feasibility, ethical status, and how it will be regulated.

5.3.3.1 Feasibility

Verbeke, Marcu, et al. (2015) and O'Keefe et al. (2016) both report some scepticism about the feasibility of cultured meat, although participants recognised that other food technologies were once thought to be unfeasible (including microwave meals and astronauts eating ‘food in a tube’). Laestadius and Caldwell (2015) report some specific aspects perceived as unfeasible, including the idea that cultured meat could never be made affordable, and that it could never be made without foetal bovine serum as a culture medium, so could never be truly animal-free. Quantitative data indicates that, whilst people tend to favour the view that cultured meat is feasible, overall results are far from decisive, and significant scepticism remains (Hocquette et al., 2015; Wilks & Phillips, 2017).

5.3.3.2 Ethical status

There is some disagreement among consumers regarding the ethical status of cultured meat. Laestadius (2015) has argued that both those in favour of and those against the technology often express the same values, but interpret the role of cultured meat relative to those values differently. For example, whilst both claim to care about animal welfare, those in favour of cultured meat claim that the technology will reduce animal suffering, whereas those opposed to it object that it will reduce the number of living animals. However, this apparent ethical indecision is not replicated in the quantitative data: both Verbeke, Sans, et al. (2015) and Wilks and Phillips (2017) report fairly strong agreement that cultured meat is ethical, especially compared to conventional meat. Other issues including the economic impacts (Laestadius & Caldwell, 2015) and the perception of unnaturalness (Verbeke, Marcu, et al., 2015) appear to underpin ethical uncertainty about other aspects of cultured meat.

5.3.3.3 Regulation and control

Verbeke, Marcu, et al. (2015) and O'Keefe et al. (2016) both report that consumers were anxious to ensure proper regulation around cultured meat. Whilst participants in the latter study wanted to ensure that food producers maintained quality and choice, and that consumers would know what they are eating, Verbeke, Marcu, et al. (2015) report more detailed demands, including transparency in labelling, marketing, and information provision. Laestadius and Caldwell (2015) highlight regulation as a potential tool for building public trust and acceptance.

5.3.4 Positive perceptions

Whilst the most common benefits of cultured meat consumers perceive are to animals and the environment, some also acknowledge potential benefits to food security and public health. O'Keefe et al. (2016) note that positivity towards science and progress generally underlie many positive perceptions of cultured meat. This stands in opposition to the naturalistic ideology discussed above, instead holding science and technology as a source of valuable progress.

Avoiding animal slaughter was the most commonly perceived benefit of cultured meat for meat-eaters and vegetarians alike (O'Keefe et al., 2016; Tucker, 2014). Whilst some consumers have expressed concern that cultured meat will lead to a reduction in the number of living animals, reinforce demand for meat, or change our relationship to animals and nature (Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015), Wilks and Phillips (2017) report that on average, people agreed that cultured meat would improve animal welfare conditions, and disagreed that it would reduce the number of happy animals on earth.

Consumers also perceive benefits to the environment of cultured meat, mainly in relation to reduced greenhouse gas emissions (Bekker, Tobi, et al., 2017; Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015). Some express a belief that cultured meat will have environmental costs or be less efficient (Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015), but again the quantitative data indicates that consumers believe cultured meat will be more environmentally friendly than conventional meat, especially in terms of greenhouse gas emissions (Verbeke, Sans, et al., 2015; Wilks & Phillips, 2017).

Some studies report perceived benefits of cultured meat for public health, particularly with regards to the potential for reduced fat content (Bekker, Tobi, et al., 2017; Laestadius & Caldwell, 2015), and avoiding zoonotic diseases (Bekker, Tobi, et al., 2017; O'Keefe et al., 2016). Wilks and Phillips (2017) report that their participants perceived less risk of zoonoses from cultured meat, whilst Verbeke, Sans, et al. (2015) report that their sample considered it safe overall, although they were undecided about its healthiness. Hocquette et al. (2015) also report split opinions on the healthiness of cultured meat.

Several studies report a perception that cultured meat will enable the global poor to afford meat (Laestadius, 2015; Tucker, 2014; Verbeke, Marcu, et al., 2015). Indeed, Tucker (2014) reports that 'higher capacity protein production' was the second most common reason given in support of cultured meat. This is seemingly underpinned by the assumption that cultured meat could be produced more cheaply and on a larger scale than conventional meat, which is unlikely to be the case initially. Cultured meat may have benefits for global food security, but these are more likely to be a result of reducing the food input of meat (which could otherwise be fed to humans) and mitigating some harmful effects of climate change.

5.4 Discussion

Research on consumer acceptance of cultured meat has found significant demographic variation in rates of acceptance and identified several common objections, perceived benefits, and areas of uncertainty. Further, identifiable sense-making strategies underlie discourses of acceptance or rejection, and attitudes and intentions are sensitive to the information available to consumers. In the following discussion, we place these findings in the context of wider literature, and consider some implications for the future of meat consumption.

5.4.1 Overall acceptance and demographic variation

The demographic trends we observe in acceptance of cultured meat are in line with those observed for other novel food technologies and related theory. In particular, studies on acceptance of genetically modified food (which many consumers consider conceptually similar to cultured meat (Marcu et al., 2015)) have observed higher acceptance amongst males vs. females (Moerbeek & Casimir, 2005), amongst younger vs. older people (Magnusson & Hursti, 2002), and amongst those with more education and familiarity with the technology (Huang, Qiu, Bai, & Pray, 2006).

Tucker (2014) points to theory which may underpin some of these trends; Bäckström, Pirttilä-Backman, and Tuorila (2003) have argued that women may be more reluctant with regards to novel foods based on heightened concerns about safety, whilst Nath (2011) highlights toughness and daring as components of western masculinity being reasons for increased willingness of males to embrace novel foods. Youth and education, meanwhile, are characteristics of early adopters of new technology according to Rogers' (2003) diffusion of innovation framework. Age has been shown to be negatively correlated with openness to experience (McCrae et al., 1999), suggesting that older people are more likely to stick to established habits. Meanwhile, those with more education are more likely to engage in analytic, deliberative thinking (Sinclair, 2014) and less likely to make decisions based on heuristics such as naturalness. In the context of cultured meat, this may be more likely to lead to acceptance. Finally, increased liking for more familiar objects is well documented, particularly with regards to food (Crandall, 1985; Pliner, 1982), though this has yet to be statistically demonstrated with regards to cultured meat.

Whilst there is limited peer-reviewed evidence around cultural variation in acceptance of cultured meat (Bekker, Tobi, et al., 2017), this is supported by evidence from outside of the peer-reviewed literature. Eurobarometer (2005) reported considerable differences in acceptance of cultured meat between different European countries, whilst Surveygoo (2018) found substantially higher acceptance in the USA compared to the UK. Given limited evidence on this issue and the increasing importance of addressing these issues in developing countries, further research is warranted. Additionally, though several analyses of media coverage of cultured meat have been published (Dilworth & McGregor, 2015; Goodwin & Shoulders, 2013; Hopkins, 2015), research thus far has not explored how media representations of cultured meat will impact consumer acceptance.

One issue in this literature is the inconsistency in descriptions given to participants and measures of acceptance used, which renders most separate studies effectively incomparable. This is an issue which accounts for the drastically different conclusions of Wilks and Phillips (2017) and Hocquette et al. (2015), but which also affects data on acceptance of cultured meat from outside the peer-reviewed literature (Flycatcher, 2013; Pew Research, 2014; Surveygoo, 2018). These surveys often report drastically different rates of acceptance, even for similar populations. Using standardised descriptions and questions would allow future research to be more comparable across time and cultures.

5.4.2 Objections

Although consumers in these studies raised a wide variety of objections to cultured meat, it seems that only a few are important drivers of behaviour. Wilks and Phillips (2017) asked why participants might be unwilling to try cultured meat, and found that these concerns were cited at dramatically different rates: 79% of their sample had concerns about the taste/appeal, whilst 24% had ethical concerns, and 20% were worried about the price. Interestingly, other concerns (including safety) accounted for no more than 4% of responses to this question, but this can likely be explained by the response formats; whilst the three most commonly cited concerns could be expressed by checking a box, ‘other’ concerns required participants to enter text, meaning that it is likely that safety concerns in particular were under-reported in this study. Indeed, The Grocer (2017) report that, amongst a UK sample, the most prominent concerns about cultured meat were about what chemicals or ingredients it contains (56%), possible long-term side effects (49%), and its unnaturalness (48%). Less important were concerns about its taste (29%) and price (23%). Taken together, these results indicate that healthiness, safety, taste, and price are likely to be the most important consumer concerns. This view is corroborated by Lusk and Briggeman (2009, p. 184), who found that, regarding food choice, ‘the values of safety, nutrition, taste, and price were among the most important to consumers…’

Grunert (2005) has characterised food safety as a ‘sleeping giant’: whilst it is not a concern for consumers under normal circumstances, when a risk is perceived, safety becomes the single most important consideration. Siegrist and Sütterlin (2017) demonstrate that safety concerns about cultured meat are inextricably linked to concerns relating to naturalness. This is in line with Yeung and Morris (2001), who argue that the perceived high level of scientific uncertainty underpin perceived risks from food technology. A recent systematic review identified perceived naturalness as crucial for the acceptance of food technologies across cultures (Roman, Sanchez-Siles, & Siegrist, 2017), reflecting Laestadius' (2015) observation that such concerns regarding cultured meat transcend cultures. Acknowledging Marcu et al.'s (2015) conceptualisation of naturalness as an ideology, future research might investigate how cultured meat advocates might address this concern; would reframing cultured meat as natural relative to conventional meat be effective, or should producers attempt to deconstruct the appeal to nature?

It is possible that many concerns about the safety of cultured meat will dissipate once it is available to consumers: whilst safety concerns have been recorded in the context of cultured meat as a future food, Van Wezemael, Verbeke, Kügler, de Barcellos, and Grunert (2010) found that safety was considered a precondition of beef being allowed to be sold, and consumers might therefore infer that cultured meat is safe merely by its availability. Hocquette (2016) has argued that cultured meat could entail some safety risks, whilst Bonny, Gardner, Pethick, and Hocquette (2015) have highlighted that it also brings about safety benefits including reduced pathogens and contaminants.

Objections based on anticipated taste or price are more straightforward. Unlike safety, which is considered a credence attribute that cannot be verified by experience (Font-i-Furnols & Guerrero, 2014), taste is an experiential characteristic, meaning that consumers can make their own judgements based on trying the product. Indeed, Wilks and Phillips (2017) found that, whilst relatively few people were willing to eat cultured meat regularly, most were willing to try it. This was amongst a sample for whom the primary concern was taste, indicating that consumers may be willing to verify this aspect for themselves.

Whilst some consumers anticipated a high price, others thought it would be cheaper; this may be dependent on the extent to which it is framed as a solution for those in poor parts of the world. Most said they would not be willing to pay more for cultured meat (Wilks & Phillips, 2017), which is in line with Slade's (2018) findings that lower price predicted higher preference for cultured meat.

In summary, the data suggests that the objections most likely to drive rejection of cultured meat in practice are safety concerns, taste, and price. Whilst taste and price can be verified through experience, safety concerns are not only more difficult to address, but may be a barrier willingness to try cultured meat (Verbeke, Marcu, et al., 2015). Cultured meat advocates, therefore, should prioritise addressing safety concerns (and to the extent that they are related, perceptions of unnaturalness (Siegrist & Sütterlin, 2017)), and secondarily, concerns about taste and price.

5.4.3 Perceived benefits

The most commonly perceived benefit of cultured meat was in terms of animal welfare. Whilst many also perceived benefits for the environment and food security, relatively few discussed the potential for cultured meat to have health/safety benefits to individual consumers. The personal benefits, which appear to be the least obvious to consumers, are also those which are likely to be those most important for motivating consumption of cultured meat (Bruhn, 2007). However, whilst The Grocer (2017) addresses this question, there is currently no data in the peer-reviewed literature assessing the relative value of health, environmental, and animal welfare benefits, or the efficacy of persuasive messages based on these.

5.5 Conclusion

The variation in survey findings points to the importance of framing. We hope that the issues identified in this review might form the basis of attempts to formulate a standard description and set of measures which can be used in future studies to enable more comparable and comprehensive data.

Furthermore, framing itself could be an important variable to consider in future research on this topic. Research could build on existing studies to investigate how different descriptions of cultured meat affect consumer acceptance, as well as the different names used. In particular, studies should investigate the most effective ways of addressing concerns around naturalness, given the centrality of naturalness to perceived safety and the acceptance of food technologies in general.

Moreover, the paucity of studies investigating the most important benefits to highlight to consumers is somewhat surprising, given the importance of such evidence in formulating information and marketing campaigns in the future. Current evidence suggests that, whilst consumers most readily perceive benefits to animal welfare and the environment, these issues are unlikely to be central to their buying decisions. Future research should therefore test the effect of highlighting these different benefits on consumer acceptance experimentally.

Overall, the research reviewed in this paper is geographically focused in Europe and the USA. Research investigating consumer acceptance of cultured meat elsewhere in the world, particularly China and India, is warranted, given that most of the forecast increase in demand for meat will be driven by those in developing countries. Moreover, some evidence suggests that the character of consumer acceptance in different cultures is likely to be significantly different from that observed in the west. Cross-cultural studies of consumer acceptance could be vital in informing future marketing or regulatory strategies.

It is likely that the picture of consumer acceptance of cultured meat will continue to change over the coming years as the concept nears commercialisation. Increased familiarity, increased perceived feasibility, regulation, commercial availability, media coverage, and the ability to try cultured meat are all factors which are likely to drive consumer acceptance in the future. Longitudinal studies which allow us to observe how, if at all, attitudes shift over time are likely to be vital going forward.

5.6 References

Bäckström, A., Pirttilä-Backman, A.-M., & Tuorila, H. (2003). Dimensions of novelty: a social representation approach to new foods. *Appetite, 40*(3), 299-307.

Bánáti, D. (2011). Consumer response to food scandals and scares. *Trends in food science & technology, 22*(2), 56-60.

BBC. (2013). World's first lab-grown burger is eaten in London. Retrieved 09 January, 2017, from http://www.bbc.co.uk/news/science-environment-23576143

BBC. (2015). Team wants to sell lab grown meat in five years. Retrieved January 20, 2017, from http://www.bbc.co.uk/news/science-environment-34540193

Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245-254.

Bekker, G. A., Tobi, H., & Fischer, A. R. (2017). Meet meat: An explorative study on meat and cultured meat as seen by Chinese, Ethiopians and Dutch. *Appetite, 114*, 82-92.

Bonny, S. P. F., Gardner, G. E., Pethick, D. W., & Hocquette, J.-F. (2017). Artificial meat and the future of the meat industry. *Animal Production Science, 57*(11), 2216-2223. doi: https://doi.org/10.1071/AN17307

Bonny, S. P. F., Gardner, G. E., Pethick, D. W., & Hocquette, J. F. (2015). What is artificial meat and what does it mean for the future of the meat industry? *Journal of Integrative Agriculture, 14*(2), 255-263. doi: 10.1016/S2095-3119(14)60888-1

Bruhn, C. M. (2007). Enhancing consumer acceptance of new processing technologies. *Innovative Food Science & Emerging Technologies, 8*(4), 555-558. doi: http://dx.doi.org/10.1016/j.ifset.2007.04.006

Business Insider UK. (2017). Hampton Creek says it's making lab-grown meat that will be in supermarkets by 2018. Retrieved 15 August, 2017, from http://uk.businessinsider.com/hampton-creek-lab-grown-meat-2017-6

Crandall, C. S. (1985). The Liking of Foods as a Result of Exposure: Eating Doughnuts in Alaska. *The Journal of Social Psychology, 125*(2), 187-194. doi: 10.1080/00224545.1985.9922871

Dilworth, T., & McGregor, A. (2015). Moral Steaks? Ethical Discourses of In Vitro Meat in Academia and Australia. *Journal of Agricultural & Environmental Ethics, 28*(1), 85-107. doi: 10.1007/s10806-014-9522-y

Eurobarometer. (2005). Social values, Science and Technology: European Commission.

Fiddes, N. (1994). Social aspects of meat eating. *Proceedings of the Nutrition Society, 53*(2), 271-279.

Flycatcher. (2013). Kweekvlees [cultured meat]. Netherlands.

Font-i-Furnols, M., & Guerrero, L. (2014). Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Science, 98*(3), 361-371.

Food and Agriculture Organization. (2003). World Agriculture: Towards 2015/2030: An FAO Perspective. London: Earthscan Publications Ltd.

Food and Agriculture Organization. (2011). World Livestock 2011: Livestock in food security. Rome: Food and Agriculture Organization.

Goodwin, J. N., & Shoulders, C. W. (2013). The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science, 95*(3), 445-450. doi: 10.1016/j.meatsci.2013.05.027

Grunert, K. G. (2005). Food quality and safety: consumer perception and demand. *European review of agricultural economics, 32*(3), 369-391.

Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in food science & technology, 61*, 11-25. doi: http://dx.doi.org/10.1016/j.tifs.2016.12.006

Hocquette, A., Lambert, C., Sinquin, C., Peterolff, L., Wagner, Z., Bonny, S. P. F., . . . Hocquette, J. F. (2015). Educated consumers don't believe artificial meat is the solution to the problems with the meat industry. *Journal of Integrative Agriculture, 14*(2), 273-284. doi: 10.1016/S2095-3119(14)60886-8

Hocquette, J. F. (2016). Is in vitro meat the solution for the future? *Meat Science, 120*, 167-176. doi: 10.1016/j.meatsci.2016.04.036

Hopkins, P. D. (2015). Cultured meat in western media: The disproportionate coverage of vegetarian reactions, demographic realities, and implications for cultured meat marketing. *Journal of Integrative Agriculture, 14*(2), 264-272. doi: 10.1016/S2095-3119(14)60883-2

Hopkins, P. D., & Dacey, A. (2008). Vegetarian Meat: Could Technology Save Animals and Satisfy Meat Eaters? *Journal of Agricultural & Environmental Ethics, 21*(6), 579-596. doi: 10.1007/s10806-008-9110-0

Huang, J., Qiu, H., Bai, J., & Pray, C. (2006). Awareness, acceptance of and willingness to buy genetically modified foods in Urban China. *Appetite, 46*(2), 144-151.

Khan, K. S., Kunz, R., Kleijnen, J., & Antes, G. (2003). Five steps to conducting a systematic review. *Journal of the Royal Society of Medicine, 96*(3), 118-121.

Kmet, L. M., Lee, R. C., & Cook, L. S. (2004). *Standard quality assessment criteria for evaluating primary research papers from a variety of fields* (Vol. 22): Alberta Heritage Foundation for Medical Research Edmonton.

Laestadius, L. (2015). Public Perceptions of the Ethics of In-vitro Meat: Determining an Appropriate Course of Action. *Journal of Agricultural & Environmental Ethics, 28*(5), 991-1009. doi: 10.1007/s10806-015-9573-8

Laestadius, L. I., & Caldwell, M. A. (2015). Is the future of meat palatable? Perceptions of in vitro meat as evidenced by online news comments. *Public Health Nutrition, 18*(13), 2457-2467. doi: 10.1017/S1368980015000622

Leroy, F., & Praet, I. (2017). Animal killing and postdomestic meat production. *Journal of Agricultural and Environmental Ethics, 30*(1), 67-86.

Lusk, J. L., & Briggeman, B. C. (2009). Food values. *American Journal of Agricultural Economics, 91*(1), 184-196.

Magnusson, M. K., & Hursti, U.-K. K. (2002). Consumer attitudes towards genetically modified foods. *Appetite, 39*(1), 9-24.

Marcu, A., Gaspar, R., Rutsaert, P., Seibt, B., Fletcher, D., Verbeke, W., & Barnett, J. (2015). Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic meat. *Public Understanding of Science, 24*(5), 547-562. doi: 10.1177/0963662514521106

Mattick, C. S., Landis, A. E., & Allenby, B. R. (2015). A case for systemic environmental analysis of cultured meat. *Journal of Integrative Agriculture, 14*(2), 249-254. doi: 10.1016/S2095-3119(14)60885-6

McCrae, R. R., Costa, P. T., de Lima, M. P., Simões, A., Ostendorf, F., Angleitner, A., . . . Barbaranelli, C. (1999). Age differences in personality across the adult life span: parallels in five cultures. *Developmental psychology, 35*(2), 466.

Moerbeek, H., & Casimir, G. (2005). Gender differences in consumers' acceptance of genetically modified foods. *International Journal of Consumer Studies, 29*(4), 308-318.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine, 6*(7), e1000097.

Nath, J. (2011). Gendered fare? A qualitative investigation of alternative food and masculinities. *Journal of Sociology, 47*(3), 261-278.

O'Keefe, L., McLachlan, C., Gough, C., Mander, S., & Bows-Larkin, A. (2016). Consumer responses to a future UK food system. *British Food Journal, 118*(2), 412-428. doi: 10.1108/Bfj-01-2015-0047

Pew Research. (2014). U.S. Views of Technology and the Future: Science in the next 50 years.

Pliner, P. (1982). The Effects of Mere Exposure on Liking for Edible Substances. *Appetite, 3*(3), 283-290. doi: http://dx.doi.org/10.1016/S0195-6663(82)80026-3

Post, M. J. (2012). Cultured meat from stem cells: Challenges and prospects. *Meat Science, 92*(3), 297-301. doi: 10.1016/j.meatsci.2012.04.008

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York ; London: Free Press.

Roman, S., Sanchez-Siles, L. M., & Siegrist, M. (2017). The importance of food naturalness for consumers: Results of a systematic review. *Trends in food science & technology, 67*, 44-57.

Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological review, 94*(1), 23.

Sharma, S., Thind, S. S., & Kaur, A. (2015). In vitro meat production system: why and how? *Journal of Food Science and Technology-Mysore, 52*(12), 7599-7607. doi: 10.1007/s13197-015-1972-3

Siegrist, M., & Sütterlin, B. (2017). Importance of perceived naturalness for acceptance of food additives and cultured meat. *Appetite, 113*, 320-326. doi: 10.1016/j.appet.2017.03.019

Siegrist, M., Sütterlin, B., & Hartmann, C. (2018). Perceived naturalness and evoked disgust influence acceptance of cultured meat. *Meat Science*.

Sinclair, M. (2014). *Handbook of research methods on intuition*: Edward Elgar Publishing.

Slade, P. (2018). If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite, 125*, 428-437.

Surveygoo. (2018). Nearly one in three consumers willing to eat lab-grown meat, according to new research. Retrieved March 1, 2018, from https://www.datasmoothie.com/@surveygoo/nearly-one-in-three-consumers-willing-to-eat-lab-g/

The Grocer. (2017). Meat the future... and how to market it. Retrieved February 21, 2017, from http://www.thegrocer.co.uk/buying-and-supplying/categories/meat/meat-the-future-and-how-to-market-it/546754.article

The Telegraph. (2017). Test-tube chicken meat unveiled to allow vegetarians to eat poultry. Retrieved 15 August, 2017, from http://www.telegraph.co.uk/science/2017/03/15/test-tube-chicken-meat-unveiled-allow-vegetarians-eat-poultry/

Tobler, C., Visschers, V. H. M., & Siegrist, M. (2011). Eating green. Consumers' willingness to adopt ecological food consumption behaviors. *Appetite, 57*(3), 674-682. doi: http://dx.doi.org/10.1016/j.appet.2011.08.010

Tucker, C. A. (2014). The significance of sensory appeal for reduced meat consumption. *Appetite, 81*, 168-179. doi: 10.1016/j.appet.2014.06.022

Tuomisto, H. L., & de Mattos, M. J. T. (2011). Environmental Impacts of Cultured Meat Production. *Environmental Science & Technology, 45*(14), 6117-6123. doi: 10.1021/es200130u

Van Wezemael, L., Verbeke, W., Kügler, J. O., de Barcellos, M. D., & Grunert, K. G. (2010). European consumers and beef safety: Perceptions, expectations and uncertainty reduction strategies. *Food Control, 21*(6), 835-844.

Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Science, 102*, 49-58. doi: 10.1016/j.meatsci.2014.11.013

Verbeke, W., Sans, P., & Van Loo, E. J. (2015). Challenges and prospects for consumer acceptance of cultured meat. *Journal of Integrative Agriculture, 14*(2), 285-294. doi: 10.1016/S2095-3119(14)60884-4

Vinnari, M., & Tapio, P. (2009). Future images of meat consumption in 2030. *Futures, 41*(5), 269-278.

Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PloS one, 12*(2), e0171904.

Yeung, R., & Morris, J. (2001). Food safety risk: consumer perception and purchase behaviour. *British Food Journal, 103*(3), 170-186.

Zajonc, R. B. (2001). Mere Exposure: A Gateway to the Subliminal. *Current Directions in Psychological Science, 10*(6), 224-228.

Zhi-Chang, S., Qun-Li, Y., & Lin, H. (2015). The environmental prospects of cultured meat in China. *Journal of Integrative Agriculture, 14*(2), 234-240.

This review identified several areas for further exploration with respect to consumer acceptance of cultured meat. Of interest to this thesis are two prevalent themes in the literature. First, cultured meat is often perceived as unnatural and potentially unsafe. Given that most people are still not aware of the technology, and that those who are aware of it tend to have less malleable opinions, the battle for public sentiment around cultured meat is largely yet to be fought. Although cultured meat may be several years from market, it is worth thinking now about how marketers can position the product, and what product features will appeal to consumers so that producers and advocates can make decisions with this information in mind.

The second theme of interest to this thesis, which I shall address first, is a lack of research on consumer acceptance of cultured meat outside of the West. Whilst many had studied perceptions of cultured meat in America and Europe, research largely neglected important emerging markets in Asia. In particular, China and India represent massive populations whose rising incomes are going to precede an explosion in demand for animal protein. Therefore, my fourth study sought to address this gap by surveying consumers on their perceptions of plant-based and cultured meat in China, India, and the USA.

<table>
<tr><td colspan="10">This declaration concerns the article entitled:</td></tr>
<tr><td colspan="10">A Survey of Consumer Perceptions of Plant-Based and Clean Meat in the USA, India, and China</td></tr>
<tr><td colspan="10">Publication status (tick one)</td></tr>
<tr><td>Draft manuscript</td><td></td><td>Submitted</td><td></td><td>In review</td><td></td><td>Accepted</td><td></td><td>Published</td><td>X</td></tr>
<tr><td>Publication details (reference)</td><td colspan="9">Bryant, C., Szejda, K., Parekh, N., Desphande, V., & Tse, B. (2019). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China. Frontiers in Sustainable Food Systems, 3, 11.</td></tr>
<tr><td colspan="10">Copyright status (tick the appropriate statement)</td></tr>
<tr><td colspan="4">I hold the copyright for this material</td><td>X</td><td colspan="4">Copyright is retained by the publisher, but I have been given permission to replicate the material here</td><td></td></tr>
<tr><td>Candidate's contribution to the paper (provide details, and also indicate as a percentage)</td><td colspan="9">The candidate contributed to / considerably contributed to / predominantly executed the…

Formulation of ideas:

Considerably contributed (50%). Formulated the concept with Keri Szejda based on research from my systematic review before bringing others on to advise.

Design of methodology:

Considerably contributed (50%). Drafted the survey instruments, edited them in line with feedback, had them approved for ethics, etc.

Experimental work:

Predominantly executed (75%). Administered data collection, data cleaning, and analysis with checking from others.

Presentation of data in journal format:

Predominantly executed (90%). Wrote first and final drafts, feedback form co-authors.</td></tr>
<tr><td>Statement from Candidate</td><td colspan="9">This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.</td></tr>
<tr><td>Signed</td><td colspan="6"></td><td>Date</td><td colspan="2">29 June 2020</td></tr>
</table>

Data Access Statement: The full datasets can be accessed at https://osf.io/gav7z/

Ethics: This study received ethical approval from the University of Bath Psychology Research Ethics Committee.

6. A Survey of Consumer Perceptions of Plant-Based and Clean Meat in the USA, India, and China

Abstract

Recent years have seen increasing interest in research on consumer acceptance of clean meat. Whilst some consumers are enthusiastic about the prospect of reducing the health risks, environmental harms, and animal welfare implications associated with conventional meat production, others have concerns about the product's taste, price, safety, and naturalness.

Some evidence suggests that acceptance of clean meat will vary substantially across cultures, though there is currently a lack of quantitative research in Asia and country comparisons on this topic. Both are likely to be important areas given the forecasted increase in meat consumption in developing countries.

Participants (n = 3,030) were recruited through the research panel CINT to take an online questionnaire about clean meat and plant-based meat. The participants were representative of China, India, and the U.S. in terms of age and gender, though participants in India and China were disproportionately urban, high income, and well educated. As well as clean meat, participants were asked about plant-based meat, a conceptually similar product with similar potential to displace demand for conventional meat. They also answered the Meat Attachment Questionnaire and the Food Neophobia Scale. We compared these variables between countries, and used regression models to identify which demographic and attitudinal factors predicted purchase intent towards both products.

We found significantly higher acceptance of clean and plant-based meat in India and China compared to the USA. We also found significantly higher food neophobia and significantly lower meat attachment in India compared to China and the USA. We identified several demographic patterns of clean and plant-based meat acceptance, as well as which beliefs were important predictors of acceptance within each country. In particular, higher familiarity predicted higher acceptance of plant-based and clean meat across all countries.

We found high levels of acceptance of clean meat in the three most populous countries worldwide, and with even higher levels of acceptance in China and India compared to the USA. These results underline the importance of clean meat producers exploring new markets for their products, especially as meat consumption in developing countries continues to rise.

6.1 Introduction

Conventional meat produced by rearing animals is associated with a range of important global problems, including greenhouse gas emissions, deforestation, and freshwater consumption (McMichael et al. 2007, 63). In recent years, there has been increasing interest in alternative ways of producing meat. Clean meat is produced by culturing animal cells in a suitable medium (Post 2012), whilst plant-based meat is made directly from plant materials (Good Food Institute, 2018).

In the future, the wide scale production of clean meat without animals will help alleviate many of the ethical, environmental, and public health issues associated with meat production today (Bryant and Barnett 2018, 8). Similarly, plant-based meat is becoming an increasingly viable alternative to conventional meat as quality improves and these products become more mainstream (Wild et al. 2014, 48). However, the benefits of these products will only be realized to the extent that they displace demand for conventional meat. With much of the forecast 73% rise in demand for meat by 2050 coming from developing countries (Food and Agriculture Organization 2011, 79), there is a concerning lack of research on consumer acceptance of clean and plant-based meat outside of the West.

In particular, China and India have been identified as prime countries in which to conduct consumer surveys on clean meat (Bryant and Barnett 2018, 16). Indeed, not only do these countries have the highest populations in the world, but rising economies mean that their meat consumption is likely to increase over the coming decades as more consumers can afford meat. Furthermore, substantial cultural differences from the West, where most consumer acceptance research has been conducted, mean that consumer acceptance in China and India may differ in character.

Limited research has explored consumer acceptance of clean meat in China. YouGov (2018) reported that 26% of Chinese consumers said they would eat clean meat, which was amongst the lowest rate of acceptance compared to other countries in Asia. This series of surveys yielded evidence of substantial differences between countries. For example, 34% of Thai consumers said they would eat clean meat and 52% of Vietnamese consumers said they would eat clean meat. India was not part of this survey, and very little is known about consumer perceptions of clean meat in India.

Other research has similarly explored cross-cultural variations in acceptance of clean meat. Surveygoo (2018) reported that, whilst 40% of US consumers said they would buy clean meat, the figure was just 18% for UK consumers. Likewise, Hoek et al. (2011, 667) found significantly higher use of plant-based meats in the UK compared to the Netherlands. In a small study of graduate students, Bekker, Tobi and Fischer (2017) explored responses to clean meat amongst Chinese, Ethiopian, and Dutch consumers. The authors found that Dutch consumers were more focused on research, development, and future expectations, whereas Chinese consumers were the only ones to discuss their own intentions towards clean meat. However, this study was qualitative in design, and the sample was limited to just 30 graduate students. Therefore, the findings are not generalizable to the total populations of these countries.

Whilst there have been many surveys on this question in the USA and various countries in Europe (Eurobarometer 2005; Wilks & Phillips 2017; YouGov 2013), the results of these are not necessarily comparable. Even within countries, different surveys can show wildly different rates of acceptance, based on variations in question design and terminology (Bryant and Barnett 2018, 15). Surveys that ask the same questions at the same time in different countries are far less common. Therefore, the present study can add significantly to the research by using the same surveys at the same time to directly compare consumer perceptions in potentially important countries.

The present study seeks to investigate the nature of consumer acceptance of clean meat in the U.S., India, and China. We also investigate consumer acceptance of a related technology, plant-based meat, as well as two potentially relevant theoretical constructs: food neophobia (Pliner & Hobden 1992) and meat attachment (Graça et al. 2015).

6.2 Materials & Methods

6.2.1 Participants

Participants were recruited online through the research panel, CINT, via the research agency Positly. Participants were members of a range of online CINT partner panels who have signed up to take surveys online. They were compensated with a range of incentives for their time (incentives vary across CINT partner panels). We aimed to recruit representative samples of 1,000 people in each country to achieve an acceptable margin of error within each country and be well powered to detect differences between countries (Cohen 1992, 158; Kotrlik & Higgins 2001, 46-49).

We set quotas for age and gender for all three countries to ensure that the samples were representative of the general population with respect to these variables. Since internet access is limited among some groups in India and China, these samples were skewed towards higher income and more urban groups. However, this is likely to be representative of the population who will feasibly have access to clean meat in the near future.

We removed participants who were under 18, who did not consent to take part, who failed either of two attention check questions, or who were duplicates of other respondents. The total sample size was 3,030: 987 in the USA, 1,024 in India, and 1,019 in China.

6.2.2 Procedure

This study received ethical approval from the Psychology Research Ethics Committee at the University of Bath (REF 18-137). All participants used a checkbox on the questionnaire to indicate their informed consent in accordance with the Declaration of Helsinki.

Before beginning the survey, participants were given information about the study and were asked whether they consented to take part. Participants who did not give their consent were subsequently removed from the study.

First, participants answered questions about which animal products they ate at least occasionally. This data was used to classify participants as vegan, vegetarian, pescatarian, or omnivore. They also indicated how many times they ate meat for each of three meals in an average week, which was used to classify participants as vegetarian, light meat eater (1-6 times a week in total), medium meat eater (7-13 times a week in total), or heavy meat eater (14 or more times a week in total).

Next, participants completed the Food Neophobia Scale (Pliner & Hobden 1992, 109) and the Meat Attachment Questionnaire (Graça et al. 2015, 117). These were presented in a random order, and before any mention of clean or plant-based meat to avoid priming. After completing each of these measures, participants answered one of two simple multiple choice quality checks. These two questions were designed to be easy for humans to answer, while providing a mechanism for filtering out thoughtless or computer-assisted responses.

Participants who answered these questions incorrectly were subsequently removed from the survey.

Next, participants rated their attitudes towards conventional meat on 16 different attributes using 5-point semantic differential scales (see section 2.3). They then answered questions about clean meat and plant-based meat, with the order of these blocks of questions randomized to control for order effects. Participants were asked about their familiarity with, attitudes towards, and intentions towards, each type of meat.

They were then asked to consider a hypothetical future where clean, plant-based, and conventional meats are all widely available. They indicated which type of meat they preferred and what proportion of their diet they thought would come from each type of meat.

Participants were then asked for demographic information, including age, gender, education, political orientation, dwelling size, and household income. Finally, participants were invited to provide any final comments on clean and plant-based meat before being debriefed and thanked for their time.

6.2.3 Materials

The survey instrument was distributed in English in the USA and India, and was translated into Mandarin for distribution in China. In India, English is widely spoken, particularly amongst the urban population who are the most likely consumers of clean meat. Translation into Mandarin was done using back-translation, which is considered best practice for cross-country research to ensure that meaning is equivalent in the target language (Johnson 1998, 17).

Given the expanding research on clean meat nomenclature in English, we ran two pre-tests to determine which names would be appealing in Chinese. We worked with stakeholder groups to compile a list of potential names in Chinese, and then had a small sample ofChinese consumers (N = 164) rank them for appeal and descriptiveness. Based on this data, we decided to use the term '纯净肉' (approximately translates to 'purity meat') for clean meat and the term '蔬食肉' (approximately translates to 'vegetable meat' or 'plant-based meat') for plant-based meat in the Chinese survey instrument.

The questions in each survey were identical, apart from some demographic questions. We did not ask about political orientation in China due to a lack of cultural fit. Furthermore, the household income measures were adjusted to reflect local currencies and income strata. Questions about education, region, and ethnicity were also modified to reflect relevant variations between countries.

The Food Neophobia Scale contained minor modifications from the original measure (Pliner & Hobden 1992), asking about 'foods from other countries' rather than 'ethnic foods' to make it more relevant to participants in India and China. Measures of behavioral intentions towards clean and plant-based meat were adapted from Wilks and Phillips (2017, 6), and modified to address common concerns about product availability and taste. Participants answered these questions about how likely they were to try, purchase regularly, eat in place of conventional meat, and pay more for clean and plant-based meat on a 5-point Likert scale, ranging from 1 (not at all likely) to 5 (extremely likely).

We used the same set of attitudinal questions when asking about clean meat, plant-based meat, and conventional meat. Participants gave their opinions on each type of meat using the following five-point semantic differential items: 'Unhealthy—healthy, unnatural—natural, bad for the environment—good for the environment, unethical—ethical, unappealing—

appealing, not tasty—tasty, unsafe—safe, expensive—affordable, bad for animals—good for animals, unsustainable as a long term food source—sustainable as a long term food source, inconvenient—convenient, boring—exciting, not nutritious—nutritious, unnecessary—necessary, bad—good, disgusting—not disgusting'.

The full survey instruments can be viewed in our OSF registration (https://osf.io/gav7z/).

6.3 Results

Data cleaning and analysis was conducted in accordance with our pre-registered analysis plan (https://osf.io/gav7z/). Where we deviated from the pre-registered plan for any reason, we have noted that in the following text. Data cleaning and analysis was conducted independently by two researchers and then compared to ensure accuracy.

Since we had age quotas, we did not specify a plan for removing participants who were under 18, but we found 7 of these in the Chinese sample. They were removed, as well as one participant who entered their age as 200023.

6.3.1 Descriptive Statistics

Tables showing the full demographic and acceptance data of each sample can be seen in the supplementary materials.

6.3.1.1 Demographics

We used quotas to ensure samples were representative of each country in terms of age and gender. The US sample was 47.7% male, 51.4% female, and 0.9% other genders; the mean age was 40.01 (SD = 11.86). The China sample was 49.5% male, 50.3% female, and 0.2% other genders; the mean age was 37.29 (SD = 9.26). The India sample was 50.5% male, 49.1% female, and 0.1% other genders; the mean age was 34.76 (SD = 8.86).

Whilst the US sample was relatively representative across other factors, the China and India samples skewed towards more urban-dwelling, well-educated, and high income participants compared to the general population. This was a skew we anticipated, since rural populations are less likely to have internet access in these countries. Whilst this means that these samples were not fully representative of the countries overall, they likely were representative of the populations who are most likely to have access to plant-based and clean meat in the near future. Full details of this can be seen in the supplementary materials.

6.3.1.2 Familiarity

Both familiarity with and acceptance of clean meat were substantially higher in India and China compared to in the USA. In the USA, 57.3% were not at all familiar with clean meat; 31.9% were slightly or moderately familiar, and just 10.8% were very or extremely familiar. In China, 35.5% were not at all familiar; 34.6% were slightly or moderately familiar, and 29.9% were very or extremely familiar. In India, 25.5% were not at all familiar; 35.8% were slightly or moderately familiar, and 38.7% were very or extremely familiar.

We found a somewhat similar pattern with regards to plant-based meat. In the US, 36.4% were not at all familiar with plant-based meat; 44.5% were slightly or moderately familiar, and 19.1% were very or extremely familiar. In China, 34.1% were not at all familiar with plant-based meat; 36.1% were moderately or slightly familiar, and 29.9% were very or extremely familiar. In India, 28.6% were not at all familiar with plant-based meat; 31.6% were slightly or moderately familiar, and 39.9% were very or extremely familiar.

These figures are likely a reflection of the skewed sample: plant-based and clean meat are not widely available or reported on in China and India, and there are few companies working on these technologies there. It is possible that some respondents over-reported their familiarity with these products, though it may simply be a reflection of the urban well-educated samples. Although we were careful to develop and translate clear descriptions of the products, we also cannot rule out the possibility that some participants did not fully understand them.

6.3.1.3 Acceptance

We see a similar pattern with regards to purchase likelihood, which was also substantially higher in China and India compared to in the USA. In the USA, 23.6% were not at all likely to purchase clean meat; 46.6% were somewhat or moderately likely, and 29.8% were very or extremely likely. In China, 6.7% were not at all likely to purchase clean meat; 33.9% were somewhat or moderately likely, and 59.3% were very or extremely likely. In India, 10.7% were not at all likely to purchase clean meat; 37.7% were somewhat or moderately likely, and 48.7% were very or extremely likely.

A similar pattern emerged with regards to purchase likelihood of plant-based meat. In the USA, 25.3% were not at all likely to purchase plant-based meat; 41.8% were slightly or moderately likely, and 32.9% were very or extremely likely. In China, 4.4% were not at all likely to purchase plant-based meat; 33.2% were somewhat or moderately likely, and 62.4% were very or extremely likely. In India, 5.5% were not at all likely to purchase plant-based meat; 31.7% were somewhat or moderately likely, and 62.8% were very or extremely likely.

6.3.2 Cross Country Comparisons

We ran one-way ANOVAs (analyses of variance) to compare the different countries surveyed on measures of (a) likelihood of purchasing clean meat, (b) likelihood of purchasing plant-based meat, (c) food neophobia, and (d) meat attachment. All of these variables were measured on a 1-5 scale, where 5 represents higher purchase likelihood, higher food neophobia, and higher meat attachment.

Some of the assumptions of ANOVA were violated in this case, although we believe that this analysis is still valid. Firstly, each of the variables returned significant ($p < .001$) values for the Shapiro-Wilk test of normality, indicating that they are not normally distributed (see Figures 6.1 – 6.4). However, the distributions are not extreme, and ANOVA is generally regarded as being robust to this assumption being violated (Schmider et al. 2010). Secondly, Levene's test indicated that the assumption of homogeneity of variance was also violated ($p < .001$). Therefore, we ran a Welch ANOVA, which does not require the homogeneity of variance assumption, and obtained extremely similar results. On this basis, we proceeded with ANOVAs.

Figure 6.1. Histogram showing distribution of likelihood of purchasing clean meat.

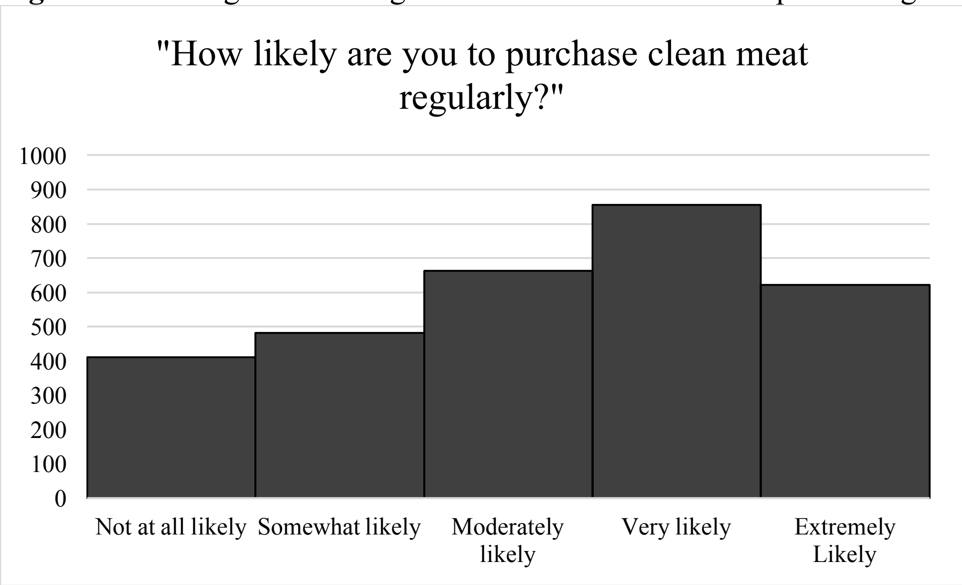


Figure 6.2. Histogram showing distribution of likelihood of purchasing plant-based meat.

Figure 6.3. Histogram showing distribution of food neophobia scale.

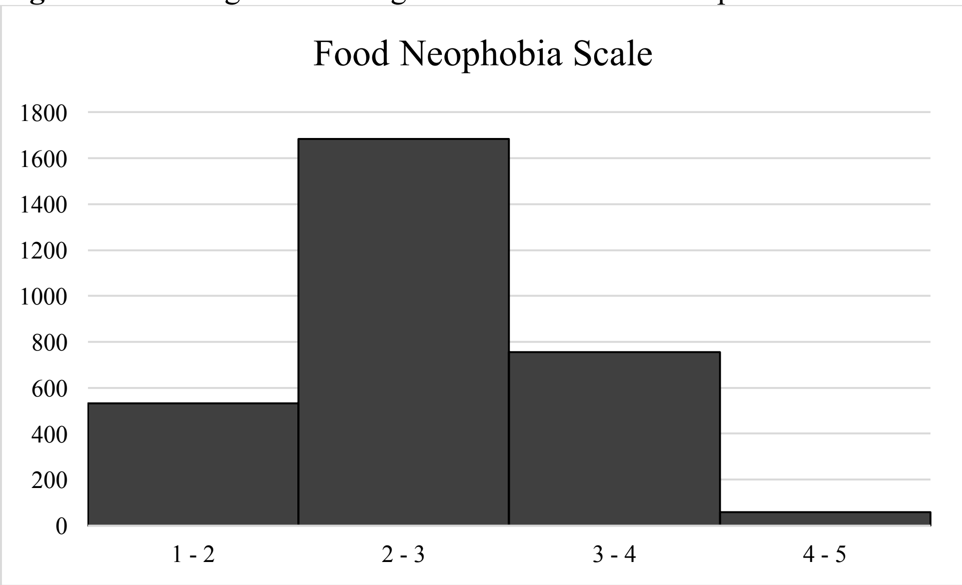
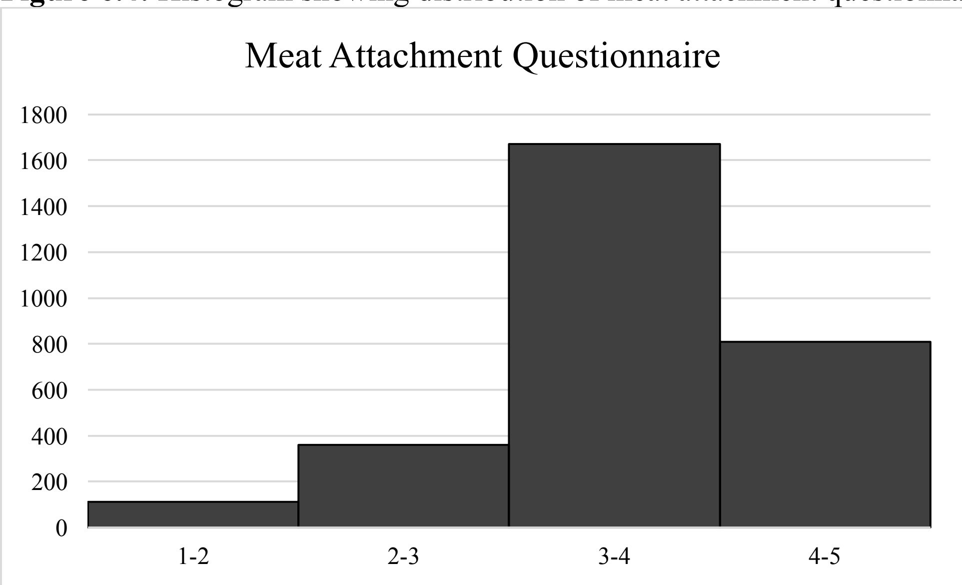


Figure 6.4: Histogram showing distribution of meat attachment questionnaire.



All of the ANOVAs returned significant results ($p < .05$). This was the case for likelihood of purchasing clean meat, ($F(2,3027) = 132.51$, $p < .001$), likelihood of purchasing plant-based meat ($F(2,3027)=180.96$, $p < .001$), food neophobia ($F(2,3027) = 6.15$, $p < .01$), and meat attachment ($F(2,3027) = 132.10$, $p < .001$).

Table 6.1 shows the mean score and standard deviation in each country. Pairwise comparisons were assessed using LSD post hoc tests in accordance with the data analysis plan. Within rows, mean values which are significantly different are denoted using different superscript letters. Values which share a superscript letter are not significantly different. For example, in the first row, the result in the US is significantly different from China and India, as shown by the differing superscript letters 'a' in the US, and 'b' in China and India. China and India, which are not significantly different, both share the superscript letter 'b'.

Table 6.1: ANOVA results showing omnibus results and pairwise comparisons.

	USA	China	India
Likelihood of purchasing clean meat	2.72[a] (1.35)	3.52[b] (1.14)	3.52[b] (1.30)
Likelihood of purchasing plant-based meat	2.78[a] (1.40)	3.63[b] (1.10)	3.73[b] (1.19)
Food neophobia	2.52[a] (0.84)	2.51[a] (0.51)	2.60[b] (0.56)
Meat attachment	3.76[a] (0.81)	3.70[a] (0.54)	3.28[b] (0.78)

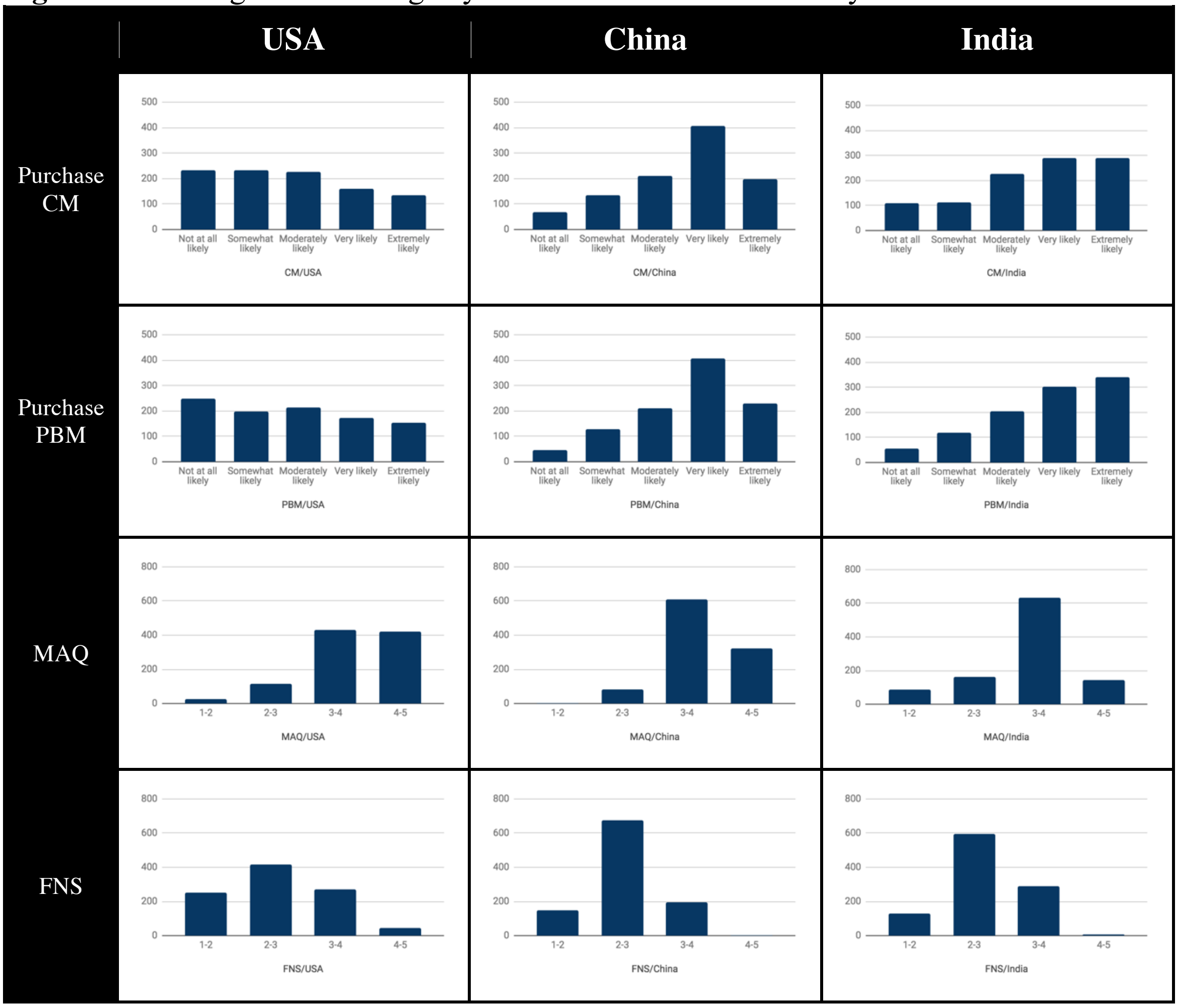
As shown here, we find significantly higher likelihood of purchasing clean meat and plant-based meat in China and India compared to the USA ($p < .01$). We also find significantly lower meat attachment ($p < .01$) and significantly higher food neophobia ($p < .01$) in India compared to China and the USA.

The composite measure for meat attachment achieved good levels of reliability in the USA ($\alpha = .92$), China ($\alpha = .80$) and India ($\alpha = .88$), but the results regarding food neophobia should be interpreted with greater caution. Although this composite measure was reliable in the US ($\alpha = .88$), it was less reliable in China ($\alpha = .62$) and India ($\alpha = .64$). Whilst Nunnally (1978) has argued that $\alpha > .6$ is an acceptable level of internal consistency, $\alpha > .7$ is more commonly used (Churchill 1979), and therefore this measure may be questionable in India and China. This may be due, in part, to the presence of items asking about both new food and food from different cultures. Whilst these form part of a coherent measure of food neophobia in the West, the concepts may be more distinct in China and India. Indeed, mean responses to items mentioning food from different cultures were amongst the most different from the overall scale mean in China and India.

To rule out the possibility that the higher rate of vegetarianism in India accounted for these latter two differences, we conducted further unplanned analyses in which we excluded vegetarians. We found that, when focusing on omnivores only, India still has a significantly lower meat attachment compared to China and the USA ($F(2,2757) = 48.68$, $p < .01$). When focusing on meat-eaters only, USA also has a significantly higher meat attachment than China ($p < .01$). The differences in food neophobia are still significant, also ($F(2,2757) = 3.25$, $p = .04$). India is significantly higher than the USA ($p = .02$) and China ($p = .04$).

To further illustrate the distribution of important variables measured within each country, we report histograms for each country showing purchase intent for plant-based and cultured meat, as well as food neophobia and meat attachment (see Figure 6.5).

Figure 6.5: Histograms showing key variables within each country.



The results shown here reflect the ANOVAs in Table 6.1.

6.3.3 Within Country Regressions

Next, we built linear regression models to identify demographic and attitudinal predictors of clean and plant-based meat acceptance within each country. Within each country, we ran two sets of regressions: one for clean meat, and one for plant-based meat. For clean meat models, likelihood of purchasing clean meat was the dependent variable; for plant-based meat models, likelihood of purchasing plant-based meat was the dependent variable.

Linear regression models were built in three iterations. In the first iteration, the models included nine demographic variables: gender, age, diet, meat consumption frequency, education, politics (except in China), population density, income, and familiarity with the product. We then identified which of these were significant predictors of purchase likelihood, and dropped variables which were not significant predictors iteratively until all predictors were significant.

In the second iteration, we added Food Neophobia and Meat Attachment. We observed the change in R^2, and proceeded if the change was significant at $p < .05$. Again, we dropped insignificant variables iteratively until all remaining variables were significant. However, in each iteration, we kept all variables from the previous iteration regardless of significance (i.e., we kept diet in the model, even though it lost significance when accounting for Food Neophobia in the second iteration). The only exception to this was gender in the clean meat model in the USA - in the first iteration, those identifying as other genders were significantly less likely to purchase compared to males. However, this was a small group of just 9 people, and this difference lost its significance in subsequent iterations. We therefore removed gender from the model to prevent overfitting.

In the third iteration, we added the 16 attitude variables (see Section 2.3) relating to clean or plant-based meat, as relevant. Again, we proceeded where the R^2 change was significant at $p < .05$, and dropped insignificant variables iteratively. Our final models therefore included significant demographic as well as attitudinal predictors. This enabled us to identify which demographic groups are most likely to purchase clean meat, and what attitudes are key drivers of purchase intent within each country.

6.3.3.1 Clean meat

With respect to clean meat, the final regression models were as follows:

Table 6.2: Regression models showing significant predictors (standardized *β*) of intention to purchase clean meat in the USA, China, and India.

Variable	USA		China		India	
	R^2 = .504, Adjusted R^2 = .500 (F(7,979)=128.624, p<.001)		R^2 = .501, Adjusted R^2 = .494 (F(13,1005)=77.560, p<.001)		R^2 = .552, Adjusted R^2 = .548 (F(10,1011)=124.660, p<.001)	
	β	***p***	***β***	***p***	***β***	***p***
(Constant)		.016		.827		.125
Gender: Female			.103	<.001		
Gender: Other			.052	.022		
Diet	-.066	.004	-.066	.004	-.141	<.001
Frequency of meat consumption			.087	<.001	.058	.032
Political views	.079	.001			.021	.314
Income					.093	<.001
Familiarity with CM	.160	<.001	.283	<.001	.256	<.001
Food neophobia	-.082	<.001	-.093	<.001	-.031	.167
Meat attachment			.046	.077	.134	<.001
Attitude: Healthiness			.106	.001		
Attitude: Ethics					.167	<.001
Attitude: Appeal	.254	<.001	.121	<.001	.160	<.001
Attitude: Excitement			.092	.002		
Attitude: Nutrition			.099	.001		
Attitude: Necessity			.116	<.001	.163	<.001
Attitude: Goodness	.209	<.001	.094	.002		
Attitude: Disgust	.188	<.001				

In the USA, we find that those who follow pescatarian, vegetarian, or vegan diets are significantly less likely to purchase clean meat compared to omnivores. Purchase intention is also higher for those who are left-leaning politically, and for those who are more familiar with clean meat. Predictably, low food neophobia was a predictor of purchase intent; indeed, this was a predictor of purchase intent for clean meat and plant-based meat in every country.

Whilst higher disgust predicted lower purchase likelihood, perceived appeal and goodness were predictors of higher purchase likelihood.

In China, we found that women were significantly more likely than men to buy clean meat. Purchase likelihood was also higher for meat-eaters (compared to vegetarians), and for those who ate more meat. Again, those more familiar with the concept were more likely to purchase it. We also found higher food neophobia predicted lower purchase likelihood, whilst higher meat attachment predicted higher purchase likelihood. Attitudinal predictors of purchase intent included perceived healthiness, appeal, excitement, nutrition, necessity, and goodness.

We find in India that omnivores and those who eat more meat are significantly more likely to purchase clean meat. We also find that those in higher income brackets, those who are more politically liberal, and those who are more familiar with the concept are more likely to purchase clean meat. Again, higher meat attachment and lower food neophobia are predictive of purchase intent. People were also more likely to purchase clean meat when they perceived it as ethical, appealing, and necessary.

6.3.3.2 Plant-based meat

With respect to plant-based meat, the final regression models were as follows:

Table 6.3. Regression models showing significant predictors (standardized β) of intention to purchase plant-based meat in the USA, China, and India.

Variable	USA		China		India	
	R^2 = .503, Adjusted R^2 = .500 (F(7,979)=141.672, p<.001)		R^2 = .396, Adjusted R^2 = .390 (F(10,1008)=66.065, p<.001)		R^2 = .441, Adjusted R^2 = .435 (F(11,1010)=72.527, p<.001)	
	β	p	β	p	β	p
(Constant)		.139		.087		.116
Gender: Female			.107	<.001		
Gender: Other			.058	.019		
Diet			-.065	.009	-.156	<.001
Frequency of meat consumption					.089	.002
Education					.057	.019
Political views	.071	.003			.039	.101
Income					.076	.002
Familiarity with PBM	.141	<.001	.279	<.001	.234	<.001
Food neophobia	-.073	.002	-.109	<.001	-.063	.012
Meat attachment	-.033	.185	.071	.013		
Attitude: Healthiness			.139	<.001		
Attitude: Appeal	.206	<.001	.128	<.001		
Attitude: Excitement	.234	<.001			.125	<.001
Attitude: Taste			.153	<.001		
Attitude: Sustainability			.138	<.001	.113	<.001
Attitude: Necessity					.142	<.001
Attitude: Goodness					.173	<.001
Attitude: Disgust	.221	<.001				

In the USA, we found that more politically liberal people and those more familiar with the product were more likely to buy it. Meat attachment was found to be negatively predictive of acceptance, indicating that those who are especially attached to meat are relatively unlikely to buy plant-based meat. Attitudinal predictors of purchase intent included appeal, excitement, and low disgust.

In China, we again find that women are more likely than men to buy plant-based meat. Meat eaters are significantly more likely than vegetarians and vegans to buy plant-based meat, and higher meat attachment predicts higher purchase likelihood. Again, higher familiarity and lower food neophobia are predictive of purchase intent. The key attitudinal predictors of purchase intent were perceived healthiness, appeal, tastiness, and sustainability as a long term food source.

In India, we find omnivores and those who eat more meat are again more likely to eat plant-based meat. Higher income groups in India expressed more interest in plant-based meat, as did more educated and more politically liberal consumers. Familiarity with the products was strongly predictive of purchase intent, and food neophobia predicted lower purchase intent. In terms of attitudes, perceived sustainability, excitement, necessity, and goodness were predictors of plant-based meat purchase intent in India.

6.4 Discussion

The most consequential finding of this study is the significantly higher likelihood of urban, well-educated and high income consumers in India and China purchasing clean meat and plant-based meat compared to consumers in the USA. Most consumer research thus far has focused disproportionately on the West, leaving emerging markets relatively unexplored (Bryant and Barnett 2018, 16). Our findings indicate that these markets represent high-value opportunities for plant-based and clean meat producers, most of which are US-based. In the case of China, there is reason to believe that the government is supportive of advanced agricultural technology for its environmental, food safety, and food security benefits, though the reporting doesn't offer insight on whether this specifically extends to clean meat. (Reuters 2017).

Furthermore, these markets may represent especially good opportunities to displace demand for conventional meat. The findings in India and China indicate that those who eat more meat, and are more attached to meat, are more likely to purchase plant-based and clean meat. In terms of reducing the impact of conventional meat on the environment and animal suffering, aiming at markets in China and India may have particularly high potential.

We cannot ignore, however, the large skew towards more urban, more educated, and higher income populations in our China and India samples compared to the general population. This was partly by design. As we discuss in our pre-registration documentation, affluent educated city-dwellers are the population most likely to have access to clean and plant-based meat. Moreover, whilst these are characteristics that have been associated with higher acceptance of clean meat in the West (Flycatcher 2013, 18; Tucker 2014, 174), this may not be the case in China and India. Indeed, these characteristics rarely emerged as predictors in our regression models. Furthermore, we see some commonly observed demographic trends such as higher acceptance amongst men compared to women (Bryant and Barnett 2018, 12) reversed in China. Therefore, the effect of this skewed data is unclear, and is unlikely to account for all of the large differences observed.

Other limitations include a variety of issues commonly associated with self-reported data. As well as poor recollection (e.g. of foods consumed) and poor ability to predict one's own future behavior (e.g. with regard to clean meat), it is likely that respondents will have exhibited a degree of social desirability bias (i.e. an inclination to give answers that make them look good). These are perennial issues with respect to self-reported survey responses, though we have tried to mitigate them by informing participants in the briefing that they should answer as honestly as they can.

Moreover, we do not know the extent to which participants' answers will have been affected by earlier questions. For example, participants' answers about clean and plant-based meat may have been affected by answering earlier questions about their attitudes to conventional meat and new food in general. We have tried to control for such priming effects by partially randomizing the order of question blocks and questions within blocks. However, some questions always come before others, and in this case, we cannot rule out the possibility that participants were primed by earlier questions when answering the key variables.

Finally, it is possible that people in different countries answer survey questions differently in general. For example, Faunalytics (2018) observed that survey respondents in China were more likely to acquiesce to statements and were more likely to give responses in the middle of scales than respondents in the U.S. Whilst it is difficult to assess whether such patterns represent differences in survey answering styles or real differences in attitudes, we tried to minimize such differences in this study by ensuring that the China survey instrument was back-translated and had equivalent meaning in China as in the U.S.

6.4.1 Different Strategies for Different Markets

Differences between regression models imply that different market strategies may be appropriate in US, Chinese, and Indian markets.

In the USA, we find that meat-eaters are most likely to express interest in purchasing clean meat, replicating the finding of Wilks and Phillips (2017, 10-11). We also found that meat attachment predicted lower purchase likelihood of plant-based meat, but not of clean meat. This implies that plant-based and clean meat could cater to different markets in the US: whilst plant-based meats may be appealing to those low in meat attachment, clean meat may play a crucial role in displacing demand for conventional meat amongst those who do not find plant-based meat appealing.

We also found that disgust was a significant predictor of plant-based and clean meat acceptance, a finding which was unique to the USA. Disgust is commonly discussed as a mechanism for rejection in clean meat research amongst Western consumers (Siegrist, Sutterlin, & Hartmann 2018, 217; Verbeke et al. 2015, 52), though it is interesting that this was not the case in India and China. This has implications for marketers in the USA, where disgust is an important reaction to overcome.

In China, we see an interesting reversal of a commonly observed demographic variation in the West with respect to clean meat acceptance: gender. Whilst it is common to observe higher acceptance amongst men compared to women in the West (Bryant and Barnett 2018, 12), this data shows higher purchase intent amongst women compared to men in China. It is not entirely clear why this is the case, though Nath (2011) has posited that Western construals of masculinity might account for higher willingness to eat unfamiliar foods in the West.

We also find an interesting set of attitudinal predictors for both plant-based and clean meat acceptance in China: perceived healthiness predicted higher purchase intent for plant-based and clean meat, and perceived nutritional value also predicted higher acceptance of clean meat. This implies that modifications to increase health and nutrition profiles compared to conventional meat (such as decreasing saturated fat content or increasing omega fatty acids) may be particularly welcome in China. Excitement, as well as perceived goodness and necessity also predicted purchase likelihood of clean meat, indicating that some consumers will find clean meat appealing as a novel solution to problems of conventional meat.

In India, perceived necessity was again a predictor of both plant-based and clean meat acceptance, whilst perceived sustainability predicted plant-based meat acceptance and perceived ethicality predicted clean meat acceptance. This seems to suggest that consumers in India, who had the lowest levels of meat attachment, are most cognizant of the environmental and ethical issues with conventional meat. Messages about the environment and animal welfare may be more effective marketing strategies in India compared to China and the USA.

Whilst there were substantial differences between countries in terms of demographic and attitudinal predictors of plant-based and clean meat acceptance, several factors recurred consistently across countries. Firstly, lower food neophobia and higher familiarity predicted acceptance of both plant-based and clean meat in every country. This is good evidence confirming the idea that increased familiarity with these new food technologies will likely cause increased willingness to eat them (Bryant and Barnett 2018, 12). This seems to be the case across cultures, and likely means that acceptance will increase over time, as consumers become more familiar with the products.

Political orientation was also a consistent predictor of purchase likelihood across countries. We did not ask about political orientation in China, but in the USA and India, we consistently found that more liberal people reported a higher likelihood of purchasing plant-based and clean meat. This may be a result of left-leaning people placing higher value on universalism and benevolence, and a lower value on conformity and tradition (Caprara et al. 2006, 16). It may also reflect the correlation between political conservatism and disgust sensitivity (Inbar et al. 2012, 539-540).

6.4.2 Conclusion

This study was the first to quantitatively compare consumer acceptance of plant-based and clean meat between the USA and Asia. Some research has compared acceptance across countries (Surveygoo 2018) and amongst Chinese consumers (Bekker, Tobi, and Fischer 2017), though the studies were very limited in scope. As an exploration of consumer demand in China and India overall, the present study is limited by a highly skewed sample. However, as an exploration of consumer demand in the markets which will have access to plant-based and clean meat, this is the most comprehensive study to date exploring market demand in India and China.

There is room for more research exploring consumer acceptance of plant-based and clean meat in different countries. As we note, most surveys have differed in their question wording, response options, and terminology, so their outcomes are often not comparable between countries. For this reason, future studies aiming to compare acceptance in unexplored countries might consider using the same survey instruments as previous studies, or distributing the same survey instrument in the USA for comparison. Given the high acceptance in China and India, further investigation into consumer acceptance there may be warranted.

Future research could also address the ways social and policy context might affect consumer attitudes towards clean and plant-based meat. One example is exploring how consumer perceptions change as clean meat products come to market, and come out of the shadows of being perceived as a mysterious future technology. This could also be a fertile area for research exploring what role regulation plays in individuals' judgements of food safety.

Research might also explore the extent to which clean meat enthusiasts are 'reluctant omnivores' – i.e. consumers who recognize the moral arguments for vegetarianism, but still want to eat meat regardless. Given that clean meat is most appealing to meat-eaters, this may likely be the case.

Whilst there are a multitude of unexplored factors which could affect consumer acceptance of clean and plant-based meat, this study has demonstrated the importance of China and India as potential future markets. All three markets are substantial, with consumers in China and India showing even more initial interest than the US. These findings indicate that consumer demand in the three most populous countries will be ready when producers begin supplying these markets.

6.5 References

Bekker, Gerben A., Hilde Tobi, and Arnout RH Fischer. 2017. "Meet meat: An explorative study on meat and cultured meat as seen by Chinese, Ethiopians and Dutch." *Appetite* 114: 82-92. https://doi.org/10.1016/j.appet.2017.03.009

Bryant, Christopher, and Julie Barnett. 2018. "Consumer acceptance of cultured meat: A systematic review." *Meat science* 143: 8-17. https://doi.org/10.1016/j.meatsci.2018.04.008

Caprara, Gian Vittorio, Shalom Schwartz, Cristina Capanna, Michele Vecchione, and Claudio Barbaranelli. 2006. "Personality and politics: Values, traits, and political choice." *Political psychology* 27, no. 1: 1-28. https://doi.org/10.1111/j.1467-9221.2006.00447.x

Churchill Jr, Gilbert A. 1979. "A paradigm for developing better measures of marketing constructs." *Journal of marketing research*: 64-73. https://doi.org/10.2307/3150876

Cohen, Jacob. 1992. "A power primer." *Psychological bulletin* 112, no. 1: 155.

Eurobarometer. 2005. "Social values, Science and Technology". Accessed October 25, 2018. http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_225_report_en.pdf

Faunalytics. 2018. "Attitudes Toward Farmed Animals in the BRIC Countries". Accessed 14 January, 2019. https://faunalytics.org/wp-content/uploads/2018/09/BRIC-Full-Report.pdf

Flycatcher. 2013. "Kweekvlees [cultured meat]". Netherlands. Accessed October 25, 2018. http://www.flycatcherpanel.nl/news/item/nwsA1697/media/images/Resultaten_onderzoek_kweekvlees.pdf

Food and Agriculture Organization. 2011. *World livestock 2011: Livestock in food security.* Rome: Food and Agriculture Organization. Accessed 25 October 2018. http://www.fao.org/docrep/014/i2373e/i2373e.pdf

Good Food Institute. 2018. "Plant-Based Meat Production 101". Accessed 14 January, 2019. https://www.gfi.org/plant-based-meat-production-101

Graça, João, Maria Manuela Calheiros, and Abílio Oliveira. 2015. "Attached to meat?(Un) Willingness and intentions to adopt a more plant-based diet." *Appetite* 95: 113-125. https://doi.org/10.1016/j.appet.2015.06.024

Hoek, Annet C., Pieternel A. Luning, Pascalle Weijzen, Wim Engels, Frans J. Kok, and Cees de Graaf. 2011. "Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance." *Appetite* 56, no. 3: 662-673. https://doi.org/10.1016/j.appet.2011.02.001

Inbar, Yoel, David Pizarro, Ravi Iyer, and Jonathan Haidt. 2012. "Disgust sensitivity, political conservatism, and voting." *Social Psychological and Personality Science* 3, no. 5: 537-544. https://doi.org/10.1177/1948550611429024

Johnson, Timothy P. 1998. "Approaches to equivalence in cross-cultural and cross-national survey research." *ZUMA-Nachrichten Spezial* 3, 1-40.

Kotrlik, J. W. K. J. W., and C. C. H. C. C. Higgins. 2001. "Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research." *Information technology, learning, and performance journal* 19, no. 1: 43.

McMichael, Anthony J., John W. Powles, Colin D. Butler, and Ricardo Uauy. 2007. "Food, livestock production, energy, climate change, and health." *The Lancet* 370, no. 9594: 1253-1263.

Nath, Jemál. 2011. "Gendered fare? A qualitative investigation of alternative food and masculinities." *Journal of Sociology* 47, no. 3: 261-278. https://doi.org/10.1177/1440783310386828

Nunnally, Jum. 1978. "Psychometric methods." 464-465.

Pliner, Patricia, and Karen Hobden. 1992. "Development of a scale to measure the trait of food neophobia in humans." *Appetite* 19, no. 2: 105-120. https://doi.org/10.1016/0195-6663(92)90014-W

Post, Mark J. 2012. "Cultured meat from stem cells: Challenges and prospects." *Meat Science* 92, no. 3: 297-301.

Reuters. 2017. “Israel and China sign $300 million ‘clean-tech’ trade agreement.” Accessed 14 January 2019. https://www.reuters.com/article/us-israel-china-cleantech/israel-and-china-sign-300-million-clean-tech-trade-agreement-idUSKCN1BM13E

Schmider, Emanuel, Matthias Ziegler, Erik Danay, Luzi Beyer, and Markus Buhner. 2010. “Is It Really Robust? Reinvestigating the Robustness of ANOVA Against Violations of the Normal Distribution Assumption.” *Methodology* Vol 6(4): 147-151. https://doi.org/10.1027/1614-2241/a000016

Siegrist, Michael, and Bernadette Sütterlin. 2017. "Importance of perceived naturalness for acceptance of food additives and cultured meat." *Appetite* 113: 320-326. https://doi.org/10.1016/j.appet.2017.03.019

Surveygoo. 2018. “Nearly one in three consumers willing to eat lab-grown meat, according to new research.” Accessed 25 October 2018 https://www.datasmoothie.com/@surveygoo/nearly-one-in-three-consumers-willing-to-eat-lab-g/

Tucker, Corrina A. 2014. "The significance of sensory appeal for reduced meat consumption." *Appetite* 81: 168-179. https://doi.org/10.1016/j.appet.2014.06.022

Verbeke, Wim, Afrodita Marcu, Pieter Rutsaert, Rui Gaspar, Beate Seibt, Dave Fletcher, and Julie Barnett. 2015. "‘Would you eat cultured meat?’: Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom." *Meat science* 102: 49-58. https://doi.org/10.1016/j.meatsci.2014.11.013

Wild, Florian, Michael Czerny, Anke M. Janssen, Adriaan PW Kole, Marija Zunabovic, and Konrad J. Domig. 2014. "The evolution of a plant-based alternative to meat. From niche markets to widely accepted meat alternatives." *Agro Food Industry Hi-Tech*: 45-49.

Wilks, Matti, and Clive JC Phillips. 2017. "Attitudes to in vitro meat: A survey of potential consumers in the United States." *PloS one*12, no. 2: e0171904. https://doi.org/10.1371/journal.pone.0171904

YouGov. 2013. “No British demand for fake meat.” Accessed 25 October 2018. https://yougov.co.uk/news/2013/08/05/no-demand-fake-meat/

YouGov. 2018. “No demand for fake meat.” Accessed 25 October 2018. https://china.yougov.com/en-cn/news/2018/02/22/no-demand-for-fake-meat/

This research identified important potential markets in China and India, and has prompted further investigation into public perceptions in these markets (Arora et al., 2020; Dempsey & Bryant, 2020). Many of the problems cultured meat purports to solve relate to global problems, and therefore deploying what limited quantity of cultured meat we have effectively to displace the maximum demand for animals requires that we identify the most receptive markets.

However, another area of concern identified in our systematic review was active resistance to cultured meat on the grounds that it is unnatural, and could be unsafe. Although it may not be an issue from a marketing perspective for some portion of consumers to have this view (see Section 12.2.1) it may become a problem if such people organise against the technology and are able to restrict its access to market, as was the case with GMOs (Mohorcich & Reese, 2019). Therefore, addressing concerns about cultured meat being unnatural was the focus of my fifth study.

This declaration concerns the article entitled:									
Strategies for overcoming aversion to unnaturalness: the case of clean meat									
Publication status (tick one)									
Draft manuscript		**Submitted**		**In review**		**Accepted**		**Published**	**X**

Publication details (reference)	Bryant, C. J., Anderson, J. E., Asher, K. E., Green, C., & Gasteratos, K. (2019). Strategies for overcoming aversion to unnaturalness: the case of clean meat. *Meat science*, *154*, 37-45.

Copyright status (tick the appropriate statement)			
I hold the copyright for this material	X	Copyright is retained by the publisher, but I have been given permission to replicate the material here	

Candidate's contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** Considerably contributed (50%). Central team member from the early stages and through a change in leadership (Kathryn Asher left the organisation and was replaced by Jo Anderson). Drafted several versions of the study. **Design of methodology:** Considerably contributed (50%). Drafted several versions of survey instrument and intervention texts, collaborated with others to refine them. **Experimental work:** Considerably contributed (50%). Administered data collection, carried out data cleaning and analysis. **Presentation of data in journal format:** Considerably contributed (50%). Lead the writing for the journal edition, whilst Jo Anderson, the other main author, lead the writing for a white paper edition.
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.

Signed		**Date**	29 June 2020

Data Access Statement: The full dataset can be accessed at https://doi.org/10.17632/9nrd8p57bs.1

Ethics: This study received ethical approval from the University of Bath Psychology Research Ethics Committee.

7. Strategies for overcoming aversion to unnaturalness: the case of clean meat

Abstract

Clean meat (grown from animal cells rather than rearing animals) has the potential to address many concerns associated with meat production. However, research suggests that the perceived unnaturalness of clean meat could be a barrier to consumer acceptance. This study investigated the efficacy of different messages designed to address consumers' concerns about clean meat naturalness. In an experimental design, participants read one of four messages: clean meat is natural, conventional meat is unnatural, naturalness is not important, or highlighting benefits of clean meat without addressing naturalness. The results indicated that arguing that conventional meat is unnatural resulted in a significant increase in some measures of acceptance compared to other messages. Arguing that clean meat is natural and challenging the appeal to nature were less persuasive, and challenging the appeal to nature resulted in some measures of acceptance being lower than not addressing naturalness. We discuss these results in the context of existing naturalness research and give recommendations for further research.

7.1 Introduction

Modern animal agriculture contributes substantially to a plethora of global problems including climate change, antibiotic resistance, and animal suffering (Garnett, 2009; Norwood & Lusk, 2011; Oliver, Murinda, & Jayarao, 2011). Despite this, consumers are generally unwilling to reduce their meat consumption (Tobler, Visschers, & Siegrist, 2011) and economic growth in developing countries means that global meat consumption is likely to continue to rise (Delgado, 2003), exacerbating many of the problems associated with animal agriculture in its current form. Though diverse forms of conventional meat production vary in their impacts, all types contribute to significant global problems.

As Hartmann and Siegrist (2017) have argued, these trends necessitate exploring various meat alternatives, including clean meat (also called 'cultured meat' or 'in vitro meat'). Clean meat can be produced using cell cultures without the need to slaughter animals, thus circumventing many of the environmental and ethical problems associated with conventional meat production (Post, 2012; Tuomisto & de Mattos, 2011). Although clean meat is not yet commercially available, several companies are poised to bring a product to market within five years (Shapiro, 2018).

However, it is unclear whether consumers will accept this novel food (Bryant & Barnett, 2018). While some studies show a high level of willingness to try clean meat (Wilks & Phillips, 2017), others have found that less than half of consumers would eat clean meat, and most would prefer conventional meat in practice (Slade, 2018; Surveygoo, 2018). Common concerns about clean meat include its taste, price, and safety (Laestadius & Caldwell, 2015; Tucker, 2014; Verbeke, Marcu, et al., 2015). One of consumers' primary concerns about clean meat is its alleged unnaturalness. This is a theme which has been observed in many qualitative studies (Laestadius, 2015; Verbeke, Marcu, et al., 2015) and cited as one of the most common reasons for rejecting clean meat in surveys (The Grocer, 2017). Indeed, Siegrist and Sütterlin (2017) have demonstrated that the perceived unnaturalness of clean meat explains a great deal of consumers' safety concerns, whilst Siegrist, Sütterlin, and Hartmann (2018) show that this perception evokes disgust and likely causes rejection of clean meat in practice.

This response is an example of the appeal to nature, a well-documented fallacy whereby people assume that naturalness is analogous to goodness (Moore, 1903). Demonstrably, this is not the case: there are many unnatural things which are good (e.g. modern medicine) as well as natural things which are bad (e.g. earthquakes). In other contexts, it is clear that naturalness in and of itself has no bearing on goodness; as Shapiro (2018) points out, 'unnatural' ice from freezers is no worse than 'natural' ice from glaciers. However, Laestadius (2015) points out that prevailing ethics are not always good ones, but that failing to engage with such perceptions is likely to have practical consequences in terms of consumer behaviour. As Welin (2013, p. 29) argues, 'Whether or not a good argument can be made for the unnaturalness of [clean] meat… one has to take such perceptions seriously.' Indeed, similar consumer concerns likely contributed to policies restricting the cultivation of genetically modified (GM) foods in Western Europe (Schurman, 2004), and thus identifying effective strategies for addressing the appeal to nature may prove useful in other food technology contexts.

Mielby, Sandøe, and Lassen (2013) found that consumers used the term 'unnatural' to object to several aspects of GM crops. Whilst some objected to human interference, others were more concerned about crops' abnormal features or their own personal unfamiliarity with the concept. Meanwhile, Deckers (2005, p. 451) has argued that consumers who object to unnatural agricultural products may have distinct worldviews in which 'the instrumentalization of the nonhuman world is questioned to a larger extent'—that is, they may be more concerned than others about people manipulating the environment for their own use. It seems, therefore, that whilst some consumers use the term ‘unnatural’ imprecisely to object to unrelated features of products (such as unfamiliarity), others are committed to worldviews in which naturalness itself is valued.

This is in line with Laestadius (2015), who has argued that, in the context of clean meat, objections about naturalness generally fall into two categories. On one hand, some people infer that, because clean meat is unnatural, it probably has negative consequences for human health and/or the environment in practice. Others assume that clean meat is inherently bad because of its unnaturalness. The author argues that, whilst the former type of objection may be able to be overcome by evidence to the contrary, the latter appears to be more deeply rooted in fundamental ideas about naturalness as an ideology (see Marcu et al., 2015) and may therefore be more resistant to reasoning.

The present study, therefore, sought to investigate the efficacy of several messaging strategies designed to address the appeal to nature in the context of consumer acceptance of clean meat. The study aims to answer the questions:

1. Can consumer acceptance of clean meat be increased by directly addressing concerns about naturalness?
2. What is the relative efficacy of arguments that clean meat is natural, that conventional meat is unnatural, and that naturalness is unimportant?

7.2 Methods & materials

7.2.1 Participants

7.2.1.1 Power and sample

The purpose of this study was to put the above questions to a fair test, allowing for the possibility that the answer to the first question is no. Therefore, it was crucial to be able to draw meaningful conclusions from null effects. To that end, a power analysis was conducted in order to determine the required sample size. This was initially based on estimated effect sizes from a review of the literature and subsequently updated based on the results of a pilot study of 110 participants.

We aimed to detect differences between conditions as well as an overall difference; therefore, the power analysis examined our ability to find significant pairwise differences in willingness to try clean meat (our primary outcome measure) using a two-tailed independent samples t test. Based on consultations with researchers and industry stakeholders, we chose a minimal meaningful effect size of $d = .24$ and an 80% power level. With the standard significance level of $\alpha = .05$, the power analysis indicated the study would require a sample size of 275 subjects in each of four experimental conditions (1,100 in total).
The final sample of 1,185 U.S. adults surpassed the number suggested by the power analysis.[2] This sample was census-balanced and recruited through the research firm Ipsos: 550 (46.4%) were male, 627 (52.9%) were female, and 8 (0.7%) had other gender identities. The mean age was 47.3 (SD = 16.8). Diet was extrapolated from a basic consumption item

[2] Overall, 463 (28%) of the original 1,648 survey respondents were automatically ejected from the study for failing one of two basic attention checks. Although this ensures that those who completed the study were paying attention, it may introduce a degree of selection bias.

("Which of the following do you eat at least occasionally?"),[3] according to which, 2.2% of participants were vegetarian or vegan, 2.5% were pescatarian, and 95.3% were omnivorous.

7.2.2 Experimental procedure

An experimental survey design was used to compare the efficacy of four different promotional messages addressing the naturalness concern: messages that were as close as possible to the type of message that would be used by clean meat manufacturers and advocates.

The experimental procedure for this study was pre-registered at the Open Science Framework (Faunalytics, 2018). The study also received full ethical approval from the Social Science Research Ethics Committee at the University of Bath.

First, participants read a description of the study and gave their informed consent to take part. Block randomization was used to evenly allocate participants to one of the four conditions based on gender and diet (two characteristics found to predict acceptance of clean meat in previous studies).[4] All participants answered questions about their familiarity with clean meat and read an introductory passage describing it, to ensure that everyone had the same basic information before they received the promotional message.

At this stage, participants then read the message. The development and content of these messages are described in more detail in the next section.

Participants then answered questions about their behavioural intentions, attitudes, beliefs, affective reactions, and willingness to pay (WTP) for clean meat. These questions are summarized in Section 2.4. Finally, participants were debriefed, thanked for taking part, and compensated for their time in Ipsos credit (worth approximately $2).

7.2.3 Promotional messages

The manipulated variable in this study was the central argument of a promotional message. The introductory paragraph of the message was held constant to set the positive tone. It was followed by one of the four arguments about naturalness shown in Table 7.1: (1) clean meat is natural, (2) conventional meat is unnatural, (3) challenging the appeal to nature, and (4) a control message which outlined some benefits of clean meat but did not mention naturalness. The control message was designed to match as closely as possible the messaging used by manufacturers on their websites at that time (e.g., Memphis Meats, Just).

Table 7.1: Promotional messages given to participants in each experimental condition.

Condition	Message
Introductory passage (shown to all participants)	Clean meat is real meat, grown from animal cells without the need to raise and slaughter farm animals. It has significant benefits for the

[3] Participants were asked to select all that applied of the following options: beef or other red meat (e.g., lamb, goat, bison), pork (e.g., bacon, ham, ribs), poultry (e.g., chicken, turkey, duck), fish or shellfish (e.g., tuna, lobster, shrimp, oysters), dairy products (e.g., milk, yogurt, cheese, ice cream), and eggs. They could alternatively choose 'I never eat any of the above.' Participants were considered pescatarian if they reported consumption of fish but no other meats. They were considered vegetarian if they reported consumption of eggs and/or dairy, but no meats. They were considered vegan only if they indicated that they never eat any of the above.

[4] Prior to the main analyses, ANOVA and chi square analyses indicated no significant differences between experimental groups on relevant demographic factors including age, gender, diet, race, state, education, income, and familiarity with clean meat. This demonstrates that random assignment was successful.

	environment, animals, and human health. Products include chicken (as shown), beef, and more!
Clean meat is natural	Clean meat products are made using a natural process very similar to the way yogurt and beer are fermented. This is a method which has been used in food manufacturing for thousands of years. The development of clean meat resembles how muscles naturally grow within an animal very closely. In fact, this process of cell growth is present in all natural life. Clean meat has many benefits for human health, animals, and the environment. But best of all, it's all-natural!
Conventional meat is unnatural	Production of conventional meat today is far from natural. Animals are fed antibiotics and hormones so that they grow much faster and larger than they would in nature. Unsanitary farming conditions increase the risk of contamination from feces, as well as viruses and bacteria. The meat also contains additives, artificial coloring, and preservatives, and is often treated with radiation. Clean meat avoids all of those issues. It has many benefits for human health, animals, and the environment. But best of all, it's just meat!
Challenging the appeal to nature	You might think that clean meat is unnatural, but naturalness does not necessarily mean goodness. Indeed, most modern food (including rice, tomatoes, milk, and – yes – meat) has been manipulated by people to make it suit our needs, and it is tastier and more nutritious as a result. On the other hand, some plants (like many types of poisonous mushroom) are completely natural but can easily kill you. Clean meat has many benefits for human health, animals, and the environment. It's a perfect example of humans improving on nature!
Control	There are many reasons to eat clean meat: It requires much less water to produce and will cause far less climate change than conventionally-produced meat; it doesn't require animals to suffer or die; it can feed far more people from the same amount of land; and it has the same or better nutritional content as conventionally-produced meat. In sum, clean meat has many benefits for human health, animals, and the environment. But best of all, it's delicious real meat!

These messages were developed in close consultation with industry professionals and clean meat advocates, to reflect the best arguments those key stakeholders could raise in response to unnaturalness concerns. They began as many pages of ideas, points, and references from many individuals and were pared down over multiple rounds of feedback to the arguments presented above. In short, this study's messages, whilst open to criticism, represent a strong test of marketers' ability to overcome unnaturalness concerns with rationale argument.

Specifically, the first argument in Table 7.1 takes a defensive tack, defending clean meat against the allegation of unnaturalness; the second argument can be considered offensive, highlighting concerns about the naturalness of conventional meat); and the third argument was developed to reject the premise that naturalness is an important factor in food altogether. In order to hold constant other features of the messages, they were checked for length and readability using an online tool (Readable, 2018). They were also informally pretested on a small convenience sample to confirm that they were perceived as presenting the intended message (a manipulation check).

7.2.4 Terminology

Throughout the present study — both in the study materials and this article — we used the term 'clean meat,' though it is also sometimes called 'cultured meat' or 'in vitro meat.' We made this decision because, at the time of data collection, most clean meat companies and advocates were using the term after several studies showed this name was associated with the highest level of consumer acceptance (Animal Charity Evaluators, 2017; The Good Food Institute, 2017). Whilst many continue to use the term 'clean meat', others in the industry now use the term 'cell-based meat', and the preferred nomenclature may continue to change in the future. However, given the positive associations with 'clean meat' shown in previous research, this choice of terminology made for a conservative test of our hypotheses: insofar as the name 'clean meat' reduces concerns about the product, its effectiveness may overlap with the promotional messages, which had the same purpose.

7.2.5 Measures

The measures used to assess participants' acceptance of clean meat are shown in Tables 7.2 through 7.5.

Table 7.2: Behavioural intention measures.

Question	Response options
1. Would you be willing to try clean meat?	Definitely no (1) to Definitely yes (5)
2. Would you be willing to buy clean meat regularly?	
3. Would you be willing to eat clean meat as a replacement for conventionally-produced meat?	
4. How willing would you be to eat clean meat compared to plant-based substitutes (e.g. soy)?	

The behavioural intentions measures shown in Table 7.2 were adapted from Wilks and Phillips (2017). Question 3 also included a response option for 'Not applicable (I do not eat conventionally produced meat).'

Table 7.3: Cognitive belief measures.

Question	Response options
To what extent do you agree or disagree that…	Strongly disagree (1) to Strongly agree (5)
1. Eating clean meat is likely to be healthy?	
2. Clean meat is likely to be safe for human consumption?	
3. Clean meat is more environmentally friendly than conventionally-produced meat?	
4. Clean meat is likely to look, taste, smell, and feel the same as conventionally-produced meat?	
5. Clean meat will have benefits for society?	

The cognitive beliefs items shown in Table 7.3 were adapted from Bryant and Barnett (in prep), and based on measures used in various previous studies of food technology acceptance (Cardello, 2003; Frewer, Howard, Hedderley, & Shepherd, 1997; Magnusson & Hursti, 2002; Scholderer & Frewer, 2003; Tan, Verbaan, & Stieger, 2016; Tanaka, 2004; Tenbült, de Vries, Dreezens, & Martijn, 2005; Titchener & Sapp, 2002). The sequence of these questions was randomised to control for order effects.

Table 7.4: Items, response options, and reliability measures for composite variables.

Measure	Items	Response options	Reliability
Attitude	1. For me to eat clean meat would be…* 2. For me to eat clean meat would be…	1. Extremely good (1) to Extremely bad (7) 2. Extremely unpleasant (1) to Extremely pleasant (7)	α = .88
Affect	Indicate the extent to which each of the following describes your feelings about eating clean meat: 1. Disgusted* 2. Excited 3. Anxious* 4. Comfortable 5. Ethical 6. Immoral*	Not at all (1) to Extremely (7)	α = .75

* Denotes item was reverse scored. Within these measures, the sequence of items was randomised to control for order effects.

The attitude composite shown in Table 7.4 used Fishbein and Ajzen's (2010) recommended construction. The items of the affect composite were chosen based on reactions to clean meat commonly observed in previous research (Laestadius & Caldwell, 2015; Verbeke, Marcu et al., 2015). Three positively-framed and three negatively-framed items were chosen to prevent response sets.

As well as the measures listed above, participants also indicated their WTP for clean meat. This was done by showing participants pairs of conventional and clean meat products in each of three categories (chicken nuggets, beef burgers, and fish sticks). They were shown a price for the conventional meat version and asked to indicate the maximum they would be willing to pay for the clean meat version. For the purpose of analyses, a difference score was calculated between the participant's maximum price for clean meat and the given price for conventional meat, to indicate relative willingness. Participants could also indicate that they would not buy the clean meat version at any price. If they chose that option, they were subsequently asked whether they would buy the conventional meat version instead, to differentiate between people unwilling to buy clean meat and people unwilling to buy that product (chicken nuggets, beef burgers, or fish sticks) at all. People who would not buy either product were excluded from analyses, as their unwillingness to buy clean meat cannot be said to stem from the fact that it is cultured.

The distribution of values was extremely non-normal and unsuitable for standard parametric tests. Therefore, in order to analyze the data, responses were categorised as one of the following: would not buy the clean product at all, would pay less for it than the conventional product, would pay equal, or would pay more.

Table 7.5: Persuasion checks

Question	Response options
1. Clean meat is unnatural.	Strongly disagree (1) to Strongly agree (5)
2. Conventionally-produced meat is unnatural.	
3. It is important for meat to be natural.	

The measures of perceptions of naturalness shown in Table 7.5 were included to check the persuasive efficacy of the intervention messages on relevant beliefs.

7.2.6 Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics, Version 22. ANOVA and chi square analyses were used to check for differences between groups on relevant demographic factors. ANOVAs were then used to check for differences in measures of agreement with the persuasion checks.

Per the pre-registered analysis plan, multivariate outliers were detected and reeled in to avoid extreme values exerting undue influence on subsequent analyses using methods discussed by Judd, McClelland, and Ryan (2017).[5] This was deemed necessary because clean meat can be divisive, creating a potential for a few very negative responses to exert undue influence on the analyses.

For the main analyses, ANOVAs were used to compare measures of behavioural intentions, cognitive beliefs, attitudes, affective responses, and perceptions of naturalness between experimental conditions.

For willingness to try clean meat, which was considered a primary analysis in the pre-registration, planned pairwise comparisons were conducted between the control condition and each experimental condition. The other three pairwise analyses for willingness to try clean meat were Bonferroni-corrected.

All pairwise comparisons for the other Likert-type measures, which were considered secondary analyses, were corrected for post hoc analysis using Tukey's HSD, which is designed for making all possible comparisons.
Finally, ordinal regression was used to compare WTP for clean meat between experimental conditions. This was also considered a primary analysis, so as with willingness to try clean meat, planned pairwise comparisons were conducted between the control condition and each experimental condition. The other three pairwise analyses for WTP were Bonferroni-corrected.

7.3 Results

The results of ANOVAs and pairwise comparisons for all Likert-type outcome variables are provided in Table 7.6. For all of these, outlier adjustments were performed using the method described above. This resulted in outlier values in outcome variables being adjusted to the nearest acceptable value for between 41 and 106 records per variable. The pattern of results did not differ substantially if outliers were left unadjusted.

[5] All output variables were examined for multivariate outliers as a function of experimental condition using Cook's D and leverage values. Values were considered outliers if they had a Cook's D > 4/n (Bollen & Jackman, 1990) or a leverage > 2(p + 1)/n (Hoaglin & Welsch, 1978), and were reeled in to the nearest acceptable value.

In the table, statistically significant differences between pairs of means—as determined using the criteria laid out in the previous section—are denoted in the table using subscript letters. Means that significantly differ have different subscripts, whereas means that do not differ share a subscript. For example, in the 'perceived importance of naturalness' row, those in the 'clean meat is natural' condition showed significantly higher agreement than those in the 'challenging appeal to nature' condition (as indicated by subscripts *a* and *b*, which these two conditions do not share). However, those in the 'conventional meat is unnatural' condition and the control condition were not significantly different from the other conditions (as indicated by subscripts *a* and *b*, which are shared with all other conditions). As shown, most outcome variables did not differ significantly between conditions, though there were some significant differences in attitude and cognitive beliefs.

7.3.1 Perceptions of naturalness

These analyses revealed that the experimental messages produced mixed results, as described below. The 'conventional meat is unnatural' message was persuasive but the other two were not.

7.3.1.1 Perceived unnaturalness of clean meat

The 'clean meat is natural' message focused on similar processes used in current food production, and argued that clean meat production relies on natural processes. If these arguments were able to overcome concerns about unnaturalness, we would expect participants in this condition to be less likely to say that clean meat is unnatural than participants in the control condition. However, there was no significant difference, as shown in Table 7.6. This finding indicates that this argument for clean meat's naturalness, was not persuasive.

Given that no significant condition differences emerged, we considered the overall, top-line results in order to examine the extent of naturalness concerns in the population. These results indicated that concerns about the naturalness of clean meat were held by only a minority of participants. Across all conditions, 34.1% agreed or strongly agreed with the statement that "clean meat is unnatural," whilst 34.2% disagreed or strongly disagreed, and 31.6% neither agreed nor disagreed.

7.3.1.2 Perceived unnaturalness of conventional meat

The 'conventional meat is unnatural' message highlighted unnatural practices in conventional meat production, and framed clean meat as avoiding such practices. If these arguments overcame concerns about unnaturalness, we would expect participants in this condition to be more likely to say that conventional meat is unnatural than participants in the control condition. As shown in Table 7.6, participants in this condition were significantly more likely to perceive conventional meat as unnatural than participants in the control condition (d = .313). This difference indicates that this argument for the unnaturalness of conventional meat was persuasive.

7.3.1.3 Perceived importance of meat naturalness

The 'challenging the appeal to nature' message focused on explaining and debunking the naturalistic fallacy with some examples. If the messaging was persuasive, participants in the 'challenging the appeal to nature' condition would have been less likely to perceive naturalness as important than participants in the control condition. However, as shown in Table 7.6, the difference between these two means was not significant. The only significant pairwise difference was between the 'clean meat is natural' condition and the 'challenging the appeal to nature' condition, such that participants felt that naturalness was more important in the former (*d* = .274). These findings suggests that our attempt to convince participants that naturalness in meat is unimportant was not persuasive.

Table 7.6: Outcome variables in each experimental condition, and overall.

Measure	Overall mean	Condition means: Clean meat is natural	Conventional meat is unnatural	Challenging appeal to nature	Control	ANOVA: F	*p*
Persuasion checks (5-point scale)							
Perceived unnaturalness of clean meat	2.98	3.01_a	2.91_a	3.03_a	2.99_a	0.57	.64
Perceived unnaturalness of conventional meat	2.58	2.55_a	2.82_b	2.48_a	2.48_a	6.54	< .001
Perceived importance of naturalness	3.80	3.94_a	3.82_{ab}	3.69_b	3.77_{ab}	3.57	.01
Behavioural intentions (5-point scale)							
Willingness to try clean meat	3.88	3.81_a	3.98_a	3.81_a	3.91_a	1.92	.13
Willingness to buy clean meat regularly	3.47	3.45_a	3.57_a	3.38_a	3.49_a	2.02	.11
Willingness to eat clean meat as a replacement for conventional meat	3.54	3.48_a	3.65_a	3.45_a	3.57_a	2.51	.06
Willingness to eat clean meat compared to plant-based substitutes (for 381 participants who ate them)	3.67	3.66_a	3.77_a	3.48_a	3.74_a	1.54	.21
Willingness to eat clean meat compared to plant-based substitutes (for 804 participants who did not eat them)	3.81	3.76_a	3.91_a	3.77_a	3.79_a	1.11	.35
Cognitive beliefs (5-point scale)							
Perceived healthiness of clean meat	3.64	3.61_{ab}	3.78_a	3.53_b	3.65_{ab}	4.14	.01
Perceived safety of clean meat	3.71	3.68_{ab}	3.83_a	3.63_b	3.73_{ab}	2.73	.04
Perceived environmental friendliness of clean meat	4.03	4.04_{ab}	4.09_a	3.87_b	4.10_a	5.10	.002
Perceived similarity in taste of clean meat to conventional meat	3.57	3.58_{ab}	3.65_a	3.46_b	3.60_{ab}	2.46	.06[6]
Perceived benefits to society of clean meat	3.79	3.75_a	3.82_a	3.71_a	3.87_a	1.84	.14
Attitude & Affect							
(Positive) attitude (7-point scale)	4.88	4.78_{ab}	5.07_c	4.70_a	4.98_{bc}	5.31	.001
(Positive) affect (5-point scale)	3.47	3.41_a	3.55_a	3.42_a	3.49_a	1.95	.12

[6] Pairwise comparisons can still be made without a significant omnibus *F* test if appropriate corrections are made for family-wise error (Hsu, 1996)

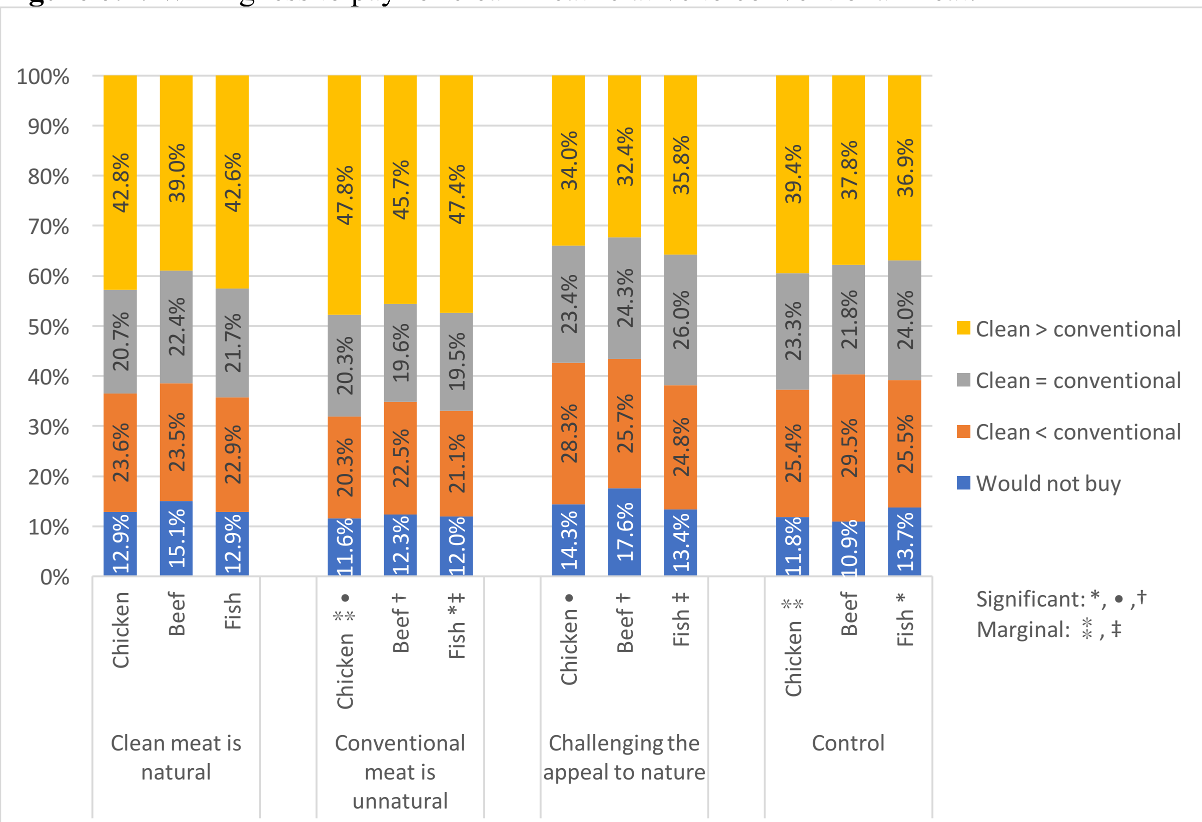
7.3.2 Willingness to pay

Figure 7.1 shows the distribution of WTP for all three products and all conditions. It is apparent from the graph that the three products behaved similarly. Although we analysed them separately, the overall pattern should be considered. Using the significance conventions laid out in Section 2.4 above, several findings emerged.

Of most relevance to hypotheses, relative to the control condition, the 'conventional meat is unnatural' condition produced significantly higher WTP for clean fish (est. = 0.34, Wald $\chi^2 = 4.51$, $p = .03$; indicated with *) and marginally higher WTP for clean chicken (est. = 0.27, Wald $\chi^2 = 3.00$, $p = .08$; indicated with ⁑). The findings for clean beef, while non-significant (est. = 0.23, Wald $\chi^2 = 2.26$, $p = .13$), were in the same direction.

Although less relevant, the 'conventional meat is unnatural' condition also produced significantly higher WTP than the 'challenging the appeal' condition for clean chicken (est. = 0.49, Wald $\chi^2 = 9.72$, $p = .002$; indicated with •) and clean beef (est. = 0.47, Wald $\chi^2 = 9.26$, $p = .002$; indicated with †), and marginally higher WTP for clean fish (est. = 0.35, Wald $\chi^2 = 4.48$, $p = .03$[7]; indicated with ‡).

Figure 7.1: Willingness to pay for clean meat relative to conventional meat.



To ensure that these results are not reliant on the particular analysis we chose, we also conducted non-parametric tests comparing the median WTP for each product in the experimental conditions against the control condition. The analyses comparing conventional meat is unnatural to control were marginally significant for chicken, beef, and fish (*ps* < .06), which supports the results of our main WTP analysis. Neither of the other two experimental conditions differed significantly or marginally from the control.

[7] Note that because this was a post hoc analysis, this contrast is marginally significant when compared against a Bonferroni-corrected alpha of .0167.

7.3.3 Behavioural intentions

As shown in Table 7.6, no significant differences emerged between conditions in willingness to: try clean meat, buy it regularly, eat it as a replacement for conventional meat, or eat it relative to plant-based substitutes.

After reading one of the promotional messages, overall levels of willingness for all of these items were between 3 (I am unsure) and 4 (probably yes). Overall, 66.4% of participants were probably or definitely willing to try clean meat, whilst just 12.1% were probably or definitely not willing to try it. Similarly, 48.9% were probably or definitely willing to buy clean meat regularly and 55.2% were probably or definitely willing to eat clean meat as a replacement for conventional meat. Of people who currently eat plant-based meat substitutes (n = 381), 56.7% were somewhat or much more willing to eat clean meat. Of people who did not currently eat plant-based meat substitutes (n = 804), 62.7% were somewhat or much more willing to eat clean meat.

7.3.4 Cognitive beliefs

As shown in Table 7.6, despite some significant differences in beliefs by experimental condition, none produced significantly more positive beliefs than the control message. Participants in the 'conventional meat is unnatural' condition believed clean meat to be significantly healthier (d = .293), safer (d = .226), tastier (d = .218), and more environmentally friendly (d = .268) than those in the 'challenging the appeal to nature' condition. Indeed, the latter condition reduced beliefs about environmental friendliness relative to the control (d = .271).

After reading one of the promotional messages, beliefs about clean meat were quite positive overall: A majority of participants agreed or strongly agreed that clean meat would have benefits for society (64.7%), be more environmentally friendly than conventional meat (72.5%), be safe for human consumption (60.9%), be healthy (56.5%), and look, taste, smell, and feel the same as conventional meat (56.3%).

7.3.5 Attitude

As shown in Table 7.6, there were significant differences between conditions on the composite attitude measure, although none of the experimental messages produced significantly more positive attitudes than the control message. Those in the 'conventional meat is unnatural' condition had significantly more positive attitudes towards clean meat compared to those in the 'clean meat is natural' (d = .221) and 'challenging the appeal to nature' (d = .299) conditions. Those in the 'challenging the appeal to nature' condition also had significantly less positive attitudes than those in the control (d = .222).

Overall, attitudes towards clean meat after reading one of these promotional messages can be interpreted as fairly positive: the overall mean of 4.88 was on the positive side of the 7-point composite scale, and the mean attitude in each condition was also above the midway point of 4.

7.3.6 Affect

No significant differences in the affect composite emerged between conditions (see Table 7.6). The overall level of affect (M = 3.47) falls between scale points 3 (moderately) and 4 (quite a bit).

One particular affect item—disgusted—is worth considering individually, given its connection to the perceived unnaturalness of clean meat (Siegrist et al., 2018). Disgust was low overall ($M = 1.78$) and did not differ significantly by condition (all post hoc-corrected $ps > .22$). Notably, just 5.2% said they felt extremely disgusted about the idea of eating clean meat, whilst 57.6% said they felt not at all disgusted after reading one of the promotional messages.

7.3.7 Overall clean meat acceptance

All of the above analyses were pre-registered. The following analyses, while not pre-registered, are included to clarify the patterns in the data, which can be hard to draw by eye from the many variables in the study. We could equally have run these analyses using each of the outcome variables, but the results would have been messier and far more susceptible to familywise error.

Therefore, for these analyses, we created a composite variable representing overall clean meat acceptance, which comprises all self-reported outcome variables in the study: the attitude composite, the affect composite, the five cognitive beliefs items, and the four behavioural intentions items. Compositing is supported by moderate-to-strong correlations between predictors (Song, Lin, Ward, & Fine, 2013): The bivariate correlations ranged from $r = .41$ to $r = .83$. Each of the 11 outcome variables was standardized prior to compositing, and the continuous and ordinal predictor variables used in this section were also standardized.

7.3.7.1 Overall clean meat acceptance by condition

ANOVA was used to examine overall clean meat acceptance (the composite variable) as a function of experimental condition—this provides a picture of the overall pattern of results observed in the study, with the exception of WTP and the persuasion checks.

Pairwise difference tests were corrected with Tukey's HSD. Only one pairwise difference emerged as significant: Participants in the 'conventional meat is unnatural' condition were significantly more accepting of clean meat than those in the 'challenging the appeal' condition ($p = .008$, $d = 0.21$). All other pairwise comparisons were non-significant ($ps > .12$).

The lack of significant differences between the control and any of the other message conditions suggests that promotional messages specifically targeting naturalness were no more successful in shifting unnaturalness concerns than the current, untargeted messaging. Although this represents a failure to persuade, it provides valuable information about the difficulty of shifting attitudes in this domain through rational argument.

7.3.7.2 The importance of naturalness

This study stemmed from previous work highlighting concerns about the perceived unnaturalness of clean meat (Siegrist & Sütterlin, 2017; Verbeke, Marcu, et al., 2015). Although attempts to overcome those concerns did not bear much fruit, we looked for evidence to support the initial assumption that concerns about unnaturalness reduce acceptance of clean meat.

To this end, overall clean meat acceptance was regressed on the items measuring perceived unnaturalness of clean meat, perceived unnaturalness of conventional meat, and the importance of meat naturalness. Condition was also included as a dummy-coded predictor.

Controlling for condition, all three naturalness variables significantly predicted overall clean meat acceptance, as shown in Table 7.7. That said, the size of the effects varied substantially: the perceived unnaturalness of clean meat was far and away the strongest predictor of positivity. The perceived unnaturalness of conventional meat also exerted a substantial—albeit much smaller—influence, and the perceived importance of meat naturalness had a small but significant effect. That is, to the extent that participants believed that clean meat is natural and/or that conventional meat is unnatural and/or that meat naturalness is unimportant, they were more accepting of clean meat.

Table 7.7: Regression for overall clean meat acceptance.

	B	*SE*	*t*	*p*
Intercept	0.05	.04	1.43	.15
Contrast: Clean meat is natural vs. Control	-0.07	.05	-1.42	.16
Contrast: Conventional meat is unnatural vs. Control	-0.002	.05	-0.05	.96
Contrast: Challenge vs. Control	-0.13	.05	-2.64	.01
Perceived unnaturalness of clean meat	-0.49	.02	-26.43	< .001
Perceived unnaturalness of conventional meat	0.12	.02	6.55	<.001
Perceived importance of naturalness	-0.04	.02	-2.06	.04

Note. All ordinal/continuous variables are standardized.

Directly supporting Siegrist et al.’s (2018) finding that perceived unnaturalness predicted disgust, a parallel regression analysis with the ‘disgusted’ affect item as the dependent variable showed that perceiving clean meat as unnatural was associated with substantially more disgust (B = 0.48, *SE* = .03, t = 19.25, $p < .001$). Perceiving meat naturalness as important was also associated with more disgust (B = 0.15, *SE* = .03, t = 6.02, $p < .001$). Perceiving conventional meat as unnatural showed a marginal negative association with disgust toward clean meat (B = -0.04, *SE* = .03, t = -1.72, p = .09).

7.4. Discussion

The goal of this study was to investigate the effectiveness of several possible messaging strategies intended to overcome concerns about the perceived unnaturalness of clean meat—concerns observed in several previous studies (Siegrist et al., 2018; Verbeke, Marcu, et al., 2015). Although the experimental messages were developed with several rounds of consultation from researchers and industry insiders and were pretested for how well they conveyed the intended meaning, our checks on the perceptions of naturalness suggested that readers only accepted one of the three messages: that conventional meat is unnatural. Arguments that naturalness is unimportant and that clean meat is natural failed to convince participants..

Given the care that was taken in developing these messages, we believe it is reasonable to interpret these results as an indication that arguing for clean meat's naturalness or the unimportance of naturalness are relatively intractable strategies. In contrast, the argument that conventional meat is unnatural gained some traction, albeit with limited impact. This argument may be worth considering as a strategy—it showed some promise in this study and has the potential for greater indirect impact if the message could be strengthened.

Most notably, in this study, the 'conventional meat is unnatural' message showed a tendency to out-perform the control message across the three pseudo-behavioral WTP measures: it produced significantly higher WTP for clean fish sticks, marginally higher WTP for clean chicken nuggets, and non-significantly higher WTP for clean beef burgers. Specifically, participants who read about the unnaturalness of conventional meat were more likely to pay more for clean meat than in the control condition.

On the self-report measures, the argument that conventional meat is unnatural did not significantly out-perform the control message, although the trend was such that it produced the most positive results of the four conditions on almost all outcomes (see Table 7.6). Because the self-report measures were focused on clean meat alone, this result suggests that most of the effect of the experimental message was to lower the appeal of conventional meat—which was not directly measured—relative to clean meat. This appears to explain why participants in this condition were willing to pay more for clean meat relative to conventional meat than in the control condition.

It is important to consider that only a third of participants said that clean meat is unnatural, and the average disgust reported was very low. Likely due to this study's use of promotional messaging and the positive term 'clean meat' (The Good Food Institute, 2017), participants in this study were less disgusted by and judgmental of clean meat as has been observed in previous studies.. As noted in Section 2.4, this made for a conservative test of differences between the messages: less of a naturalness objection to mitigate means less room for improvement in the experimental conditions relative to control.

Overall, the results favour the view that highlighting the unnatural elements of conventional meat may be the best way for clean meat advocates and producers to address consumer concerns about unnaturalness of clean meat. However, clean meat advocates should interpret this result with some caution, as this data indicates that such concerns may not be as prevalent as previous research has suggested if positive messaging and terminology are used. Moreover, it is important to consider the strategic implications of adopting offensive messaging which directly attacks conventional meat producers, given their potentially crucial role in bringing clean meat to market through investment (Forbes, 2018).

At the same time, it is worth noting that challenging the appeal to nature consistently produced the least favourable responses of any argument. This may reflect Deckers' (2005) observation that, for some consumers, naturalness is a deeply rooted worldview. The current study suggests that challenging this worldview is unlikely to be an effective strategy for persuading consumers. Conversely, pointing out that conventional meat is also unnatural produced slightly but consistently higher measures of acceptance. This appears to be in line with Laestadius (2015), who found that some consumers made this argument in defence of clean meat, though this often did not extend to the conclusion that naturalness was irrelevant.

7.4.1 Limitations

This study was subject to several limitations. First, because only U.S. adults were studied, the findings may not be completely generalizable to other cultures or countries.
In addition, the proportion of would-be participants who were removed for failing attention checks was higher than ideal. Although their removal ensures respondent attention, it may introduce some selection bias. More generally, it may be indicative of low panel quality that could have reduced our ability to find significant associations.

Participants in this study read one of four promotional messages about clean meat. Though the purpose of the study was to test the relative efficacy of these promotional messages, it is likely that in a broader societal context, people will be exposed to a range of pro- and anti-clean meat messages. This study does not, by design, address the interaction of conflicting messages from different sources. It is impossible to know how the tested messages would be perceived in the context of counter-messaging.

Furthermore, the use of the term 'clean meat' throughout this study may limit the applicability of findings if the industry adopts different terminology. At the time of data collection, most producers and advocates of clean meat were using this term, though many now use the term 'cell-based meat', and this may continue to change. That said, 'clean meat' was adopted originally on the basis of its positive associations, and it is reasonable to assume that continued testing and refinement of industry messaging will lead to—if not clean meat—the eventual adoption of a similarly positive term.
It is also worth noting several limitations of the WTP measure in particular. First, it is important to bear in mind that this measure directly followed positive messaging about clean meat, potentially producing higher values than would be observed in reality. In addition, because this measure is hypothetical, it is susceptible to the commonly-observed hypothetical bias, in which consumers tend to overestimate how much they are willing to pay for a product (e.g. Loomis, 2011). It is for this reason that we have provided only broad WTP categories above and focused on the comparison between conditions.

Participants' self-report responses may also be subject to bias. First, forecasting error is probable: predicting one's own future attitudes and behaviours towards a product which is not yet available is difficult (Bryant & Barnett, 2018). Unfortunately, there is little that can be done to avoid it, as clean meat is not yet available. Hypothetical and predictive questions are the only option, though we took care to frame them as realistically as possible.

Finally, participants may have been subject to social desirability bias—answering as they believe others would want them to—for questions about a product with such profound ethical and environmental implications (Grimm, 2010). That said, because even participants who read our control message were exposed to arguments about these implications, we believe that the potential impact of this bias is minimal.

7.4.2 Future Directions

We suggest that future research carefully consider whether trying to directly overcome perceptions of unnaturalness is the most effective option before pursuing it further—a few of this study's effects suggest there may be potential for it to backfire. These results suggest that a focus on the unnaturalness of conventional meat is more likely to be effective, but as noted above, this is not without risk of alienating potential allies.

In addition, the effectiveness of the 'conventional meat is unnatural' message in this study was limited, with mixed results across different outcome measures. We recommend that, if this is to be considered as a strategy for advancing clean meat, further testing of similar and stronger messages should be carried out.

The overall high rates of clean meat acceptance observed in this study suggest another potential strategy: that providing potential consumers with positive educational messaging about the benefits and characteristics of clean meat may be a good way to reduce the emphasis on naturalness before it becomes the focus of the conversation. Further research will be needed to determine which aspects of this messaging are effective, as this study did not directly compare them: for instance, information about the taste, texture, and nutritional profile, or the health, environmental, or animal welfare benefits. This type of research would be similar to studies conducted by Verbeke, Sans, and Van Loo (2015) and Bekker, Fischer, Tobi, and van Trijp (2017) in Belgium and the Netherlands, respectively. In those studies, reading positive information about clean meat made participants more willing to try it and improved their attitudes toward it.

In particular, one can expect that highlighting personal benefits (e.g. health, product safety) over societal benefits (e.g. animal welfare, environmentalism) might produce stronger intentions to engage with clean meat, though this is yet to be demonstrated empirically. Furthermore, the inclusion of societal benefits alongside personal benefits may 'dilute' the effectiveness of the more persuasive arguments (de Vries, Terwel, & Ellemers, 2014), another phenomenon which could be explored in the context of clean meat. Other work might explore cultural variation in the construction of naturalness as an important concern for consumers, including as an indicator of environmentalism and safety.

7.5 References

Animal Charity Evaluators. (2017). "Clean" Meat or "Cultured" Meat: A Randomized Trial Evaluating the Impact on Self-Reported Purchasing Preferences. Retrieved 13 June, 2017, from https://animalcharityevaluators.org/blog/clean-meat-or-cultured-meat-a-randomized-trial-evaluating-the-impact-on-self-reported-purchasing-preferences/

Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245-254.

Bollen, K. A., & Jackman, R. W. (1990). Regression diagnostics: An expository treatment of outliers and influential cases. *Modern methods of data analysis, 13*(4), 257-291.

Bryant, C., & Barnett, J. (in prep). What's In a Name? Social Representations of Cultured Meat Depend on Nomenclature.

Bryant, C. J., & Barnett, J. C. (2018). Consumer Acceptance of Cultured Meat: A Systematic Review. *Meat Science, 143*, 8-17. doi: https://doi.org/10.1016/j.meatsci.2018.04.008

Cardello, A. V. (2003). Consumer concerns and expectations about novel food processing technologies: effects on product liking. *Appetite, 40*(3), 217-233. doi: http://dx.doi.org/10.1016/S0195-6663(03)00008-4

de Vries, G., Terwel, B. W., & Ellemers, N. (2014). Spare the details, share the relevance: The dilution effect in communications about carbon dioxide capture and storage. *Journal of Environmental Psychology, 38*, 116-123.

Deckers, J. (2005). Are scientists right and non-scientists wrong? Reflections on discussions of GM. *Journal of Agricultural and Environmental Ethics, 18*(5), 451-478.

Delgado, C. L. (2003). Rising consumption of meat and milk in developing countries has created a new food revolution. *The Journal of nutrition, 133*(11), 3907S-3910S.

Faunalytics. (2018). Clean Meat Naturalness Study. from osf.io/c764h

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach.* New York: Psychology Press.

Forbes. (2018). Tyson Invests In Lab-Grown Protein Startup Memphis Meats, Joining Bill Gates And Richard Branson. Retrieved June 11, 2018, from https://www.forbes.com/sites/chloesorvino/2018/01/29/exclusive-interview-tyson-invests-in-lab-grown-protein-startup-memphis-meats-joining-bill-gates-and-richard-branson/#7898f3a73351

Frewer, L. J., Howard, C., Hedderley, D., & Shepherd, R. (1997). Consumer attitudes towards different food-processing technologies used in cheese production—The influence of consumer benefit. *Food quality and Preference, 8*(4), 271-280.

Garnett, T. (2009). Livestock-related greenhouse gas emissions: impacts and options for policy makers. *environmental science & policy, 12*(4), 491-503.

Grimm, P. (2010). Social desirability bias. *Wiley international encyclopedia of marketing.*

Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in food science & technology, 61*, 11-25. doi: http://dx.doi.org/10.1016/j.tifs.2016.12.006

Hoaglin, D. C., & Welsch, R. (1978). The Hat Matrix in Regression and ANOVA. *The American Statistician, 33*, 17-22.

Hsu, J. (1996). *Multiple Comparisons: Theory and methods*. London: Chapman & Hall.

Judd, C. M., McClelland, G. H., & Ryan, C. S. (2017). *Data Analysis: A Model Comparison Approach* (3 ed.). London: Routledge.

Laestadius, L. (2015). Public Perceptions of the Ethics of In-vitro Meat: Determining an Appropriate Course of Action. *Journal of Agricultural & Environmental Ethics, 28*(5), 991-1009. doi: 10.1007/s10806-015-9573-8

Laestadius, L. I., & Caldwell, M. A. (2015). Is the future of meat palatable? Perceptions of in vitro meat as evidenced by online news comments. *Public Health Nutrition, 18*(13), 2457-2467. doi: 10.1017/S1368980015000622

Loomis, J. (2011). What's to know about hypothetical bias in stated preference valuation studies? *Journal of Economic Surveys, 25*(2), 363-370.

Magnusson, M. K., & Hursti, U.-K. K. (2002). Consumer attitudes towards genetically modified foods. *Appetite, 39*(1), 9-24.

Marcu, A., Gaspar, R., Rutsaert, P., Seibt, B., Fletcher, D., Verbeke, W., & Barnett, J. (2015). Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic meat. *Public Understanding of Science, 24*(5), 547-562. doi: 10.1177/0963662514521106

Mielby, H., Sandøe, P., & Lassen, J. (2013). Multiple aspects of unnaturalness: are cisgenic crops perceived as being more natural and more acceptable than transgenic crops? *Agriculture and Human Values, 30*(3), 471-480.

Moore, G. E. (1903). *Principia Ethica*. Cambridge: Cambridge University Press.

Norwood, B., & Lusk, J. (2011). *Compassion, by the Pound*. New York: Oxford University Press.

Oliver, S. P., Murinda, S. E., & Jayarao, B. M. (2011). Impact of antibiotic use in adult dairy cows on antimicrobial resistance of veterinary and human pathogens: a comprehensive review. *Foodborne pathogens and disease, 8*(3), 337-355.

Post, M. J. (2012). Cultured meat from stem cells: Challenges and prospects. *Meat Science, 92*(3), 297-301. doi: 10.1016/j.meatsci.2012.04.008

Readable. (2018). Measure the readability of text. Free content analysis tool. Retrieved October, 2017, from https://readable.io/text/

Scholderer, J., & Frewer, L. J. (2003). The biotechnology communication paradox: Experimental evidence and the need for a new strategy. *Journal of Consumer Policy, 26*(2), 125-157.

Schurman, R. (2004). Fighting "Frankenfoods": Industry opportunity structures and the efficacy of the anti-biotech movement in Western Europe. *Social problems, 51*(2), 243-268.

Shapiro, P. (2018). *Clean Meat*. New York: Gallery Books.

Siegrist, M., & Sütterlin, B. (2017). Importance of perceived naturalness for acceptance of food additives and cultured meat. *Appetite, 113*, 320-326. doi: 10.1016/j.appet.2017.03.019

Siegrist, M., Sütterlin, B., & Hartmann, C. (2018). Perceived naturalness and evoked disgust influence acceptance of cultured meat. *Meat Science, 139*, 213-219.

Slade, P. (2018). If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite, 125*, 428-437.

Song, M.-K., Lin, F.-C., Ward, S. E., & Fine, J. P. (2013). Composite variables: when and how. *Nursing research, 62*(1), 45.

Surveygoo. (2018). Nearly one in three consumers willing to eat lab-grown meat, according to new research. Retrieved March 1, 2018, from https://www.datasmoothie.com/@surveygoo/nearly-one-in-three-consumers-willing-to-eat-lab-g/

Tan, H. S. G., Verbaan, Y. T., & Stieger, M. (2016). How will better products improve the sensory-liking and willingness to buy insect-based foods? *Food Research International*.

Tanaka, Y. (2004). Major Psychological Factors Affecting Acceptance of Gene-Recombination Technology. *Risk analysis, 24*(6), 1575-1583.

Tenbült, P., de Vries, N. K., Dreezens, E., & Martijn, C. (2005). Perceived naturalness and acceptance of genetically modified food. *Appetite, 45*(1), 47-50.

The Good Food Institute. (2017). Clean Meat: The Naming of Tissue-Engineered Meat. Retrieved 13 June, 2017, from http://mfait.gfi.org/the-naming-of-clean-meat

The Grocer. (2017). Meat the future... and how to market it. Retrieved February 21, 2017, from http://www.thegrocer.co.uk/buying-and-supplying/categories/meat/meat-the-future-and-how-to-market-it/546754.article

Titchener, G. D., & Sapp, S. G. (2002). A comparison of two approaches to understanding consumer opinions of biotechnology. *Social Behavior and Personality: an international journal, 30*(4), 373-381.

Tobler, C., Visschers, V. H. M., & Siegrist, M. (2011). Eating green. Consumers' willingness to adopt ecological food consumption behaviors. *Appetite, 57*(3), 674-682. doi: http://dx.doi.org/10.1016/j.appet.2011.08.010

Tucker, C. A. (2014). The significance of sensory appeal for reduced meat consumption. *Appetite, 81*, 168-179. doi: 10.1016/j.appet.2014.06.022

Tuomisto, H. L., & de Mattos, M. J. T. (2011). Environmental Impacts of Cultured Meat Production. *Environmental Science & Technology, 45*(14), 6117-6123. doi: 10.1021/es200130u

Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Science, 102*, 49-58. doi: 10.1016/j.meatsci.2014.11.013

Verbeke, W., Sans, P., & Van Loo, E. J. (2015). Challenges and prospects for consumer acceptance of cultured meat. *Journal of Integrative Agriculture, 14*(2), 285-294. doi: 10.1016/S2095-3119(14)60884-4

Welin, S. (2013). Introducing the new meat. Problems and prospects. *Etikk I Praksis, 7*(1), 24-37.

Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PloS one, 12*(2), e0171904.

Although we observed some effects of the different messages on some outcome variables in this study, purchase intent did not differ significantly across experimental conditions relating to different arguments about naturalness.. Importantly, manipulation checks indicated that only one of the three active interventions (arguing that conventional meat is unnatural) had the intended effect, whereas the other two (arguing that cultured meat is natural, and arguing that naturalness should not matter) were not effective in changing their target belief. This indicates that ideas about naturalness are likely closely held, possibly in an emotional way which is resistant to reasoned argumentation. Therefore, my sixth study focused on an alternative, more subtle, way of affecting perceptions of cultured meat: framing.

This declaration concerns the article entitled:
The Impact of Framing on Acceptance of Cultured Meat Acceptance

Publication status (tick one)

Draft manuscript		Submitted		In review		Accepted		Published	X

Publication details (reference)	Bryant, C., & Dillard, C. (2019). The impact of framing on acceptance of cultured meat. *Frontiers in Nutrition*, *6*, 103.

Copyright status (tick the appropriate statement)

I hold the copyright for this material	X	Copyright is retained by the publisher, but I have been given permission to replicate the material here	

Candidate's contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** Contributed (25%). Discussed experimental setup with Courtney as she became interested in quantitative approach. **Design of methodology:** Contributed considerably (50%). Helped design the survey instrument, gave input on measures from previous studies, made analysis plan, etc. **Experimental work:** Predominantly executed (90%). Cleaned and analysed data. **Presentation of data in journal format:** Predominantly executed (75%). Wrote most of first and final draft bar some sections in the Background and Discussion sections.
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.

Signed		**Date**	29 June 2020

Data Access Statement: We do not have permission to share the data from this study.

Ethics: This study received ethical approval from Portland State University's Office of Research Integrity.

8. The Impact of Framing on Acceptance of Cultured Meat

Abstract

Cultured meat can be produced from growing animal cells in-vitro rather than as part of a living animal. This technology has the potential to address several of the major ethical, environmental, and public health concerns associated with conventional meat production. However, research has highlighted some consumer uncertainty regarding the concept. Although several studies have examined the media coverage of this new food technology, research linking different frames to differences in consumer attitudes is lacking. In an experimental study, we expose U.S. adults (n = 480) to one of three different frames on cultured meat: 'societal benefits', 'high tech', and 'same meat'. We demonstrate that those who encounter cultured meat through the 'high tech' frame have significantly more negative attitudes towards the concept, and are significantly less likely to consume it. Worryingly, this has been a very dominant frame in early media coverage of cultured meat. Whilst this is arguably inevitable, since its technologically advanced nature is what makes it newsworthy, we argue that this high tech framing may be causing consumers to develop more negative attitudes towards cultured meat than they otherwise might. Implications for producers and researchers are discussed.

8.1 Introduction

8.1.1 Framing

The ways in which humans strive to make sense of the world they inhabit has long been of interest to scholars in a variety of fields. Goffman (1974) set the course for much of this research when he conceptualized framing as a “schemata of interpretation”, the manner by which humans organize information to make meaning both for themselves and others. Later research, especially in the fields of sociology and psychology, flushed out the way that frames work. Frames were seen as condensing reality, particularly in terms of fore-fronting certain aspects of reality, while back-dropping others (Gamson 1992; Tversky & Kahneman 1986; Snow & Benford 1992). In the last four decades, an impressive body of literature on framing has developed in fields ranging from economics to cognitive linguistics (Barbara et al. 2018; Scheufele & Tewksbury 2007; Semino, Demjén & Demmen 2016; Vicentie Mariño & López Rabadán 2009).

Researchers in the various communication fields have focused their attention on the intentional use of frames, particularly in public life. Entman’s well known definition, “to frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described’’ (1993, p. 52) has undergirded and directed much of the research in this area. Frames have been investigated in terms of their role in media coverage, particularly news media (Iyengar 1996; Tankard 2001), political communication (Cox & Calfano 2018; Druckman 2001) and advertising (Roy & Sharma 2015). One important distinction these scholars have sought to maintain is between the framing activities of those presenting information and those receiving it (Scheufele 1999).

While interesting work has been done on the types of frames created by those presenting information (De Vreese & Boomgaard 2003; Iyengar 1994; Semetko & Valkenburg 2000), some of the most generative areas of research have been in terms of framing effects. This vein of research investigates how particular frames, often intentionally created, influence specific audiences (Gibson 2009; Shah, Domke, & Wackman 1996) and often seeks to establish frame effectiveness (McCarthy 1994; Cress & Snow 2000).

Framing effects in terms of products and product features has more recently become a rich line of investigation. Work has been done on the type of frame employed and its effects in terms of willingness to pay, product preferences, and brand loyalty. For example, scholars have suggested that positive frames are generally more effective than negative ones, while allowing for the fact that there are occasions where a negative frame might be advantageous (Arora, 2008; Biswas & Grau 2008; Donovan and Jalleh 1999). Research has also focused on the effectiveness of marketing products in terms of social causes, particularly the environment. For example, Olsen et al. (2014) found that while making green claims enhanced consumer favorability toward the brand, fewer claims rather than more were preferred. Cho (2014) found that green frames worked best when they highlighted the consumer’s own environmental impact. Ku et al (2012) noted that a consumer’s motivations impacted how favorably they responded to green framing techniques.

Recent research in framing effectiveness has also demonstrated a growing curiosity around the role of images, whether stand alone or combined with text. Early theoretical research in this area (Gitlin 1980; Graber 1990) made the case for the power of visuals, particularly in terms of emotional influence. Researchers have sought to examine this relationship in different contexts. For example, Iyer et al. (2014) found that images of victims of the 2005 bombings in London elicited feelings of sympathy, while images of terrorists elicited feelings of fear and anger. Andrews et al. (2014) found that cigarette packaging which included graphic images positively impacted young smokers determination to quit over an extended period of time.

Other scholars have taken an interest in the effects of multimodal frames, those which include a combination of texts and visuals. Geise and Baden (2014) proposed a theoretical framework for understanding multimodal framing effects which draws attention to the amplifying effect of images. In terms of multimodal frames and products, recent work has suggested that textual framing might be more effective for some types of products, while visual framing or a combination of both works better for others (Chang 2012; Feiereisen, Wong & Broderick 2013).

Of particular relevance here is the research on framing of genetically modified (GM) foods. Media coverage on GM foods has been shown to have a significant impact on public perceptions of, and behaviour towards, the technology (Kalaitzandonakes, Marks and Vickner, 2004; Frewer, Miles & Marsh 2002; Marks et al. 2007; Vilella-Vila & Costa-Font 2008), and there is plenty of research on the nature of this coverage. Researchers have identified coverage on GM foods to be primarily driven by specific events such as food scares and environmental events (Botelho and Kurtz 2008; Marks et al. 2003). Others have shown how mainstream media coverage diverges somewhat from scientific publications (McInerney, Bird & Nucci 2004), and how stakeholders have been characterized to fit simple narratives (Augoustinos, Crabb and Shepherd 2010). This demonstrates how media coverage is dependent on breaking stories, and how complexity is condensed for popular consumption.

Coverage has been different in different countries, however. Listerman (2010) argued that, whilst US coverage of GM foods focused on the scientific-economic elements of the technology, German coverage was focused on the practical ethics and British coverage was focused on the public discourse. Coverage in the US was generally more positive than in the UK (Marks et al. 2003), and in China was universally positive or neutral (Du & Rachul 2012). Whilst Botelho and Kurtz (2008) argued that coverage within countries was fairly similar, Vicsek (2013) noted that Hungarian coverage was particularly polarized. Interestingly, several researchers have commented on how genetic technology was generally framed much more negatively in relation to food than it was in relation to medicine within the same media outlets (Marks et al. 2007; Maeseele & Schuurman 2008; Eyck & Williment 2003).

While there has been some important framing research concerning innovations in food products (Degreef 2018; Phillips & Hallman 2013; Siegrist 2008), there has been surprisingly little work on the intentional use of different frames to introduce audiences to new food products, particularly those closely connected to technological innovation. This article explores the effectiveness of different multimodal frames for a new food innovation, meat produced outside of an animal in a laboratory.

8.1.2 Cultured meat

In the near future, we will be able to produce meat directly from animal cells (Post 2012). Termed 'cultured meat', this technology will enable us to sustainably produce meat for a growing global population, whilst reducing animal suffering on an enormous scale (Hollywood & Pirie 2018; Schaefer & Savulescu 2014). However, research into public perceptions of cultured meat has indicated that some consumers may have reservations around the concept (Bryant & Barnett 2018).

Although many consumers recognize the potential ethical and environmental benefits of cultured meat, some have concerns about its alleged unnaturalness, which can lead to concerns about food safety (Laestadius 2015; Siegrist Sutterlin & Hartmann, 2018; Verbeke et al. 2015). Recent studies have demonstrated how these perceptions can be invoked or avoided by different framings.

The Good Food Institute (2016; 2018) has given substantial attention to the question of what cultured meat should be called, demonstrating that consumers are significantly more likely to find 'clean meat' appealing than other names including 'cultured meat' and 'cell-based meat'. This finding has been replicated by Bryant and Barnett (2019). Siegrist, Sutterlin and Hartmann (2018), meanwhile, have demonstrated that less technical descriptions of cultured meat lead to higher consumer acceptance compared to more technical descriptions.

These findings are relevant for the interpretation of much of the existing research on cultured meat. For instance, Verbeke et al. (2015) noted many consumers in their focus groups reacted with disgust to the concept and perceiving few personal benefits - yet, these responses were undoubtedly influenced by the video participants were shown, which describes 'synthetic meat' being grown in labs. Likewise, Laestadius and Caldwell (2015) conducted an analysis of online comments on news stories about cultured meat, but note '...the framing of the issue in each individual article may have influenced perceptions of [cultured meat].' (p. 2466).

Therefore, the framing of cultured meat is likely to have a substantial impact on consumer perceptions, though this has yet to be studied empirically (Bryant & Barnett 2018). Whilst Goodwin and Shoulders (2013) reported that European and American media coverage of cultured meat commonly discusses its benefits, production process, timescale, history, and skeptics, Dilworth and McGregor (2015) identified naturalness as a key focus in Australian print media. Indeed, stories about cultured meat frequently feature 'science themed' photos such as meat in a petri dish in a lab (e.g. New York Times 2018; Wall Street Journal 2017). Meanwhile, Hopkins (2015) has commented that coverage in western media has focused disproportionately on the reactions of vegetarians.

While a variety of frames pertaining to cultured meat are available, little is known about how they may affect consumer attitudes. A wealth of existing research indicates that frames have an impact on public attitudes, but this has not yet been formally studied in the context of cultured meat. The present study seeks to understand how different frames affect consumer attitudes, beliefs, and behavioral intentions towards cultured meat.

8.2 Methods

We used an experimental survey to test the effect of different framings of cultured meat on consumer attitudes, beliefs, and behavioral intentions. This study received ethical approval from the Portland State University Institutional Review Board.

8.2.1 Participants

Participants were U.S. adults recruited through Amazon MTurk, a microtasking platform frequently used in social research. MTurk enables researchers to get high quality affordable data from a sample which is more representative than college samples which have commonly been used in the past (Buhrmester, Kwang, & Gosling 2011). However, we did find evidence of some illegitimate or duplicate responses. After removing these responses, the sample size dropped from 527 to 480. Participants were each paid $0.50 for their time.

The demographic breakdown of participants is shown in Table 8.1:

Table 8.1: Demographic breakdown of participants

		Number	Percentage
Gender	Male	276	57.5
	Female	202	42.1
	Other	2	0.4
Age	18–25	92	19.2
	26–35	229	47.7
	36–45	84	17.5
	46–55	38	7.9
	Over 55	37	7.7
Region	Northeast	109	22.7
	South	185	38.5
	Midwest	81	16.9
	West	105	21.9
Diet	Omnivore	422	87.9
	Pescatarian	35	7.3
	Vegetarian	14	2.9
	Vegan	9	1.9

As shown here, the sample is slightly skewed towards younger age groups (in particular 26-35) and towards males. The south of the country is also slightly over-represented, though overall the sample is reasonably representative.

8.2.2 Procedure

First, participants read some information about the study and gave their consent to take part. They were then asked for demographic information, including gender, age group, region, and which foods they eat. These foods were later used to determine diet.

Next, participants indicated whether they had heard of cultured meat before. They then read the following description of cultured meat:

"Clean meat (also called cultured meat or in-vitro meat) is real meat which is grown from animal cells without the need to raise animals. It should not be confused with meat substitutes such as soy, since it is real animal meat it has the same taste, texture, and the same or better nutritional content as conventionally-produced meat."

Next, participants gave one word that they first thought of when they thought about cultured meat. This was an open question, and was later used to identify illegitimate responses. Participants also indicated how familiar they were with cultured meat on a 5-point Likert scale (1 = Not at all familiar, 5 = very familiar).

Participants were then allocated to one of three experimental conditions. These conditions (shown below) contained an image and a short piece of text. They corresponded to three different framings that cultured meat could be presented in.

Table 8.2: Text and images presented to participants in each condition.

Societal benefits	**High-tech**	**Same meat**
Clean meat has many benefits for society like reducing harm to the environment and helping animals.	Clean meat is made using highly advanced technology in a state of the art laboratory.	Clean meat tastes like conventional meat, is increasingly affordable and can be healthier to eat.
		

Next, participants were asked to rate their attitude towards cultured meat on a 5-point Likert scale (1 = Very favorable, 5 = Very unfavorable).

Participants were then asked to rate their agreement with five statements about cultured meat on 5-point Likert scales (1 = Strongly disagree, 5 = Strongly agree). The statements were about cultured meat's healthiness, safety, environmental friendliness, sensory quality, and benefits for society. Next, participants rated four concerns about cultured meat using 5-point Likert scales (1 = Not at all concerned, 5 = Extremely concerned). The concerns were about cost, taste, naturalness, and safety. These are common concerns and benefits identified by Bryant and Barnett (2018).

Finally, participants rated their willingness to eat cultured meat using 5-point Likert scales (1 = Definitely yes, 5 = Definitely No). Participants were asked about their willingness to try cultured meat, willingness to buy cultured meat regularly, willingness to eat cultured meat as a replacement for conventionally produced meat, and willingness to eat cultured meat compared to plant-based meat substitutes. These measures were adapted from Wilks and Phillips (2017).

During analysis, we removed 47 illegitimate or duplicate responses. We also computed diet based on foods which participants said they ate. Finally, we recalibrated all Likert scales such that higher numbers represented more positive opinions of cultured meat. This involved reverse coding the attitude rating, concern ratings, and behavioral intentions ratings.

8.2.3 Experimental design

We opted for an experimental design whereby participants would see one of three framings before answering questions about cultured meat. This approach is fairly common in similar research (Bryant et al. 2019; Siegrist, Sutterlin & Hartmann 2018) as it allows for direct comparison between groups who have seen different information. While some authors (Bekker et al. 2017) have used repeated measures designs (before/after information), we decided to avoid this approach since participants might be anchored to responses they give before reading additional information. Indeed, Bekker et al. (2017) implemented a Solomon four-group design to rule out such effects.

These three framings were chosen because they represent common discourses on cultured meat. Potential societal benefits, the technical scientific nature of the product, and the sensory similarity to conventional meat are all themes which occur in media coverage of the topic (Laestadius & Caldwell 2015). Furthermore, they are well-defined and distinct from one another in that they foreground a different aspect of the technology, and could therefore be expected to produce different perceptions to some extent.

It is worth noting that we did not include a control group as such. We could have asked a control group about their perceptions of cultured meat after reading basic facts about the product with no framing. However, such a presentation of information is unlikely to occur in the media. Moreover, one could argue that there is no such thing as 'no framing' in this context – any information we could give about cultured meat would, by definition, focus on some aspects more than others, and therefore would frame the product in some way. Therefore, we decided not to include a control group in the conventional sense.

It is also worth noting that some measures (e.g. about taste, healthiness, and benefits to society) asked about things which were explicitly mentioned in some of the experimental manipulations. For example, the 'same meat' framing mentions that 'Clean meat tastes like conventional meat', and we might therefore expect responses to reflect this. We should bear in mind the content of the messages when interpreting the results; higher agreement with statements about aspects of the technology mentioned in the descriptions is to be expected, and can be taken as confirmation that participants have engaged with and believed the material. Of course, this may not be the case, and beliefs about specific aspects of the technology may not be sensitive to such information if it is not deemed credible.

8.3 Results

8.3.1 Overall findings

Before examining differences between experimental groups, we looked at the findings across all experimental conditions. Our findings are comparable to those observed in previous U.S. studies: we found that 64.6% of participants were probably or definitely willing to try cultured meat, which is very similar to the rates observed in previous research (Bryant et al. 2019; Wilks and Phillips 2017). Only 18.4% were probably or definitely not willing to try cultured meat, whilst 16.9% were unsure.

Similarly optimistic rates were found with regards to participants' willingness to buy cultured meat regularly (49.1% were probably or definitely willing to do this; 24.5% were probably or definitely not willing to; 26.4% were undecided) and willingness to eat cultured meat as a replacement for conventional meat (48.5% were probably or definitely willing to do this; 26.6% were probably or definitely not willing to; 24.9% were undecided). Of the 243 participants who currently ate plant-based meat substitutes, 49.8% were somewhat or much more likely to eat cultured meat; 25.5% were somewhat or much less likely, and 24.7% were undecided.

Overall, this indicates a fairly high willingness to eat cultured meat regardless of framing, with almost two thirds of participants being willing to try it, and almost half willing to buy it regularly and eat it instead of conventional meat. This indicates a substantial potential market for cultured meat, and provides evidence that cultured meat could displace a considerable amount of demand for conventional meat.

8.3.1.1 Demographic variations in acceptance

Previous research has discussed demographic variations in acceptance of clean meat, and some studies have found higher acceptance amongst men, younger people, and omnivores (see Bryant & Barnett, 2018). To test for significant differences in acceptance between demographic groups, we conducted a series of three one-way between-group ANOVAs with gender, age, region, and diet as independent variables, and the range of acceptance measures as dependent variables. No significant differences were found between respondents from different regions.

In terms of gender, we detected several significant differences between men and women. In line with previous research, men had more positive views of cultured meat than women, on average. These differences were significant with respect to attitude, perceived safety, perceived taste, perceived benefits for society, willingness to try, willingness to buy regularly, willingness to replace conventional meat, and willingness to eat over plant-based alternatives ($p < .05$). However, men were more concerned about the cost compared to women ($p = .01$).

Age was also a factor which affected views on cultured meat. Younger people generally had more positive views than older people, with a steady decline in attitudes in older age groups. Curiously, the 56+ age group was an exception here – people in this group tended to have more positive views than those in the 36-45 and 46-55 age groups. Significant differences were found in the different age groups' attitudes, perceived taste, perceived benefits for society, willingness to try, willingness to buy regularly, willingness to replace conventional meat, and willingness to eat compared to plant-based alternatives ($p < .05$).

Participants with different diets also had differing views on cultured meat. We observed interesting differences between vegetarians/vegans and those who eat meat/fish. Vegetarians/vegans were significantly less willing to try cultured meat than meat/fish-eaters ($p = .014$) and significantly less willing to eat cultured meat compared to plant-based alternatives ($p = .01$), but meat/fish-eaters had significantly higher concerns about the taste, naturalness, and safety of the product ($p < .05$). This probably reflects a relative lack concern on the part of vegetarians/vegans, who were not intending to eat the product anyway. This partly reflects the findings of Wilks and Phillips (2017), who similarly found vegetarians/vegans to be more positive about some aspects of cultured meat, but relatively unwilling to eat it themselves.

8.3.1.2 Word associations

Participants gave word associations immediately after learning about cultured meat. Word associations is a technique which has been used in previous research to explore consumer perceptions of novel products (Bryant & Barnett 2019; Roininen et al 2006). A codebook was developed based on common categories which the word associations fit into. Each word was then categorized independently by both researchers. We agreed on the categories of 83.5% of the words; the remaining words were categorized after consultation between the researchers. The categories of words given by consumers are shown in Table 8.3.

Table 8.3: Word associations given by participants learning about cultured meat.

Category	No. of words	Percentage	Example words
Artificial	73	15.2	Fake, unnatural, artificial
Science	54	11.3	Scientific, laboratory, chemicals
Positive	50	10.4	Good, awesome, super
Natural	40	8.3	Natural, no hormones, unprocessed
Unusual	35	7.3	Weird, strange, different
Food	27	5.6	Beef, calories, steak
Healthy	26	5.4	Fat-free, healthy, good for health
Clean	25	5.2	Sterilized, washed, soap
Disgust	24	5.0	Disgusting, yuck, gross
Other	18	3.8	Options, jars, grown
Taste	16	3.3	Tasty, bland, delicious
Food technology	14	2.9	GMOs, cultured meat, laboratory meat
Interesting	12	2.5	Interesting, intriguing
Animals	10	2.1	Chicken, fish, pig
Ethical	10	2.1	Ethical, cruelty-free, humane
Fear	10	2.1	Unsafe, danger, creepy
Negative	9	1.9	Abomination, dystopia, never
Safety	7	1.5	Safe, safety, passes regulation
Uncertainty	7	1.5	Confusing, why, unobtainable
Environment	5	1.0	Sustainable, biofriendly, green
Special diet	5	1.0	Vegetarian, Halal, Kosher
Cost	3	0.6	Expensive, pricey, cost
Total	480	100	

8.3.2 Experimental findings

Before proceeding with analysis, we wanted to verify that key demographic and familiarity variables associated with cultured meat acceptance had been evenly distributed across experimental conditions. To this end, we tested for significant differences between experimental groups using Chi square and ANOVA tests as appropriate.

Chi square tests reveal that there are no significant differences between conditions in the proportions of participants in each gender ($\chi^2 = 4.009$, $p = .405$), age group ($\chi^2 = 8.762$, $p = .363$), region ($\chi^2 = 6.726$, $p = .347$), or diet ($\chi^2 = 10.463$, $p = .106$). ANOVA tests reveal no significant differences between conditions in the proportion of participants who had heard of cultured meat ($F(2,477) = 1.530$, $p = .218$) or the familiarity with cultured meat ($F(2,477) = .895$, $p = .409$). Given no significant differences between experimental conditions with respect to these variables, we can rule this out as a source of bias.

8.3.2.1 Attitudes and beliefs

We tested for significant differences in attitudes and beliefs between experimental conditions using one-way ANOVA analyses. The results (shown in Table 8.3) indicate several significant differences ($p < .05$) between experimental conditions, indicating that the framing had a statistically significant effect on key attitudes and beliefs about cultured meat.

Within rows, mean values which are significantly different using Tukey's HSD ($p < .05$) are denoted using different subscript letters. Values which share a subscript letter are not significantly different.

Table 8.4: ANOVAS showing differences between experimental conditions in attitudes and beliefs.

Variable	ANOVA (2, 477)	Societal benefits M (σ)	High tech M (σ)	Same meat M (σ)
Attitude	$F = 5.711, p = 0.004$	3.45_a (1.13)	3.11_b (1.32)	3.55_a (1.20)
Belief that cultured meat is healthy	$F = 5.093, p = 0.007$	3.43_{ab} (0.98)	3.23_b (1.12)	3.60_a (1.00)
Belief that cultured meat is safe	$F = 3.247, p = 0.040$	3.56_{ab} (1.08)	3.40_b (1.12)	3.71_a (1.01)
Belief that cultured meat is good for the environment	$F = 3.336, p = 0.036$	3.98_a (0.99)	3.40_b (1.08)	3.97_a (0.94)
Belief that cultured meat tastes the same as conventional meat	$F = 3.003, p = 0.051$	3.27_a (1.07)	3.40_{ab} (1.08)	3.56_b (1.06)
Belief that cultured meat has benefits for society	$F = 0.760, p = 0.468$	3.70_a (1.02)	3.63_a (1.08)	3.78_a (1.02)
Concern about cost	$F = 0.935, p = 0.393$	2.70_a (1.19)	2.53_a (1.09)	2.57_a (1.19)
Concern about taste	$F = 0.534, p = 0.587$	2.38_a (1.05)	2.26_a (1.06)	2.36_a (1.22)
Concern about naturalness	$F = 2.055, p = 0.129$	2.40_a (1.19)	2.14_a (1.18)	2.36_a (1.24)
Concern about safety	$F = 1.064, p = 0.346$	2.15_a (1.15)	1.99_a (1.15)	2.16_a (1.16)

As shown here, the experimentally manipulated framing had a statistically significant effect on attitude, belief that cultured meat is healthy, belief that cultured meat is safe, and belief that cultured meat is good for the environment (although no pairwise comparisons were significantly different for the latter variable). Conversely, although the omnibus ANOVA showed no significant effect on the belief that cultured meat tastes the same as conventional meat, post-hoc tests did show a significant pairwise difference. No significant differences were found on the belief that cultured meat has benefits for society, or on any measures of concern about cost, taste, naturalness, or safety.

In each case, the 'same meat' framing was shown to be conducive to the most positive attitudes, whereas the 'high tech' framing was shown to be conducive to the least positive attitudes.

8.3.2.2 Behavioral intentions

Next, we tested for significant differences between framings in behavioral intentions using a one-way ANOVA. A similar pattern of results emerges with respect to behavioral intentions, as shown in Table 8.4.

Table 8.5: ANOVAs showing differences between experimental conditions in behavioral intentions

Variable	ANOVA (2, 477)	Societal benefits M (σ)	High tech M (σ)	Same meat M (σ)
Willingness to try cultured meat	$F = 9.808, p < 0.001$	3.79_a (1.10)	3.30_b (1.55)	3.85_a (1.62)
Willingness to eat cultured meat regularly	$F = 7.313, p = 0.001$	3.50_a (1.10)	3.03_b (1.33)	3.48_a (1.21)
Willingness to replace conventional meat	$F = 5.488, p = 0.004$	3.37_a (1.16)	3.03_b (1.36)	3.49_a (1.24)
Willingness to eat compared to plant-based meat substitutes	$F = 4.834, p = 0.008$	3.42_{ab} (1.20)	3.10_b (1.27)	3.51_a (1.23)

Again, participants who saw the 'high tech' framing were significantly less willing to try cultured meat, buy cultured meat regularly, eat cultured meat as a replacement for conventional meat, and eat cultured meat compared to plant-based meat substitutes compared to those who saw other framings.

Although these differences were significant, the effect sizes were relatively small. It should be noted that perceptions of cultured meat are likely to be changed by further information, and may not be stable over time.

8.4. Discussion & Conclusion

In this study, we demonstrated that the framing of cultured meat has a significant effect on many attitudes and beliefs about the product, as well as behavioral intentions towards it. Our results somewhat mirror the findings of Siegrist, Sutterlin and Hartmann (2018), who found that more technical descriptions of cultured meat lead to lower acceptance compared to less technical descriptions. This is probably because the information in the 'high tech' condition (particularly the image) were evocative of an image of science and unnaturalness. Siegrist and Sutterlin (2017) demonstrated that perceived naturalness of cultured meat mediated the acceptability of risk.

8.4.1 Implications

These findings offer important insight for those publicizing and promoting cultured meat. While more research is clearly needed in terms of the frames currently used both by companies in the industry and the media, existing work suggests that the most common frame used thus far may be the least effective in garnering consumer acceptance. As noted previously, many of the media reports have featured images like the petri dish and used terminology like "test tube meat" to introduce this concept and the products associated with it to the public. While fledgling ventures might welcome media interest and the benefits associated with earned media, these findings suggest that the frames favored by the media might do more harm than good. At the same time, this must be weighed against the benefits of increased consumer familiarity (Bryant & Barnett 2018). Since more familiar consumers are more likely to say they would eat cultured meat, it may be the case that any coverage is better than no coverage, regardless of framing.

The findings may also inform future decisions for the messaging of this product, once the products are close to launching and dedicated advertising and marketing campaigns are underway. A quick perusal of comments by company executives, venture capitalists and supporting institutions in this area suggest a laudable commitment to transparency in terms of the production process. The outcomes of the research here argue for a high level of intentionality in how the process is shared with the public. Perhaps the most effective approach would be to have that information readily available for consumers who seek it, but not to have the high tech process as the dominant frame in promotional materials. Instead, producers should consider shifting their frame from discussing the production process to discussing product features and societal benefits. This should be done both in terms of paid and earned media activities.

Whilst producers and traditional media outlets have a certain degree of control over what framings are employed in discussions of cultured meat, social media represents a domain in which such control is substantially limited. Fellenor et al. (2017) have demonstrated how social media, compared to traditional media, can lead to substantially different framings, with certain groups selecting and emphasizing different 'frame fragments' (p. 1174) as they share information. As the authors comment, the curated nature of social media news feeds can lead to individuals having different aspects of a concept highlighted or backdropped. In this context, this may lead to a variety of personalized frames. Notably, such frames are likely outside the control of cultured meat producers and traditional media sources. The same is true of those developed through other unconventional media such as blogs.

8.4.2 Contributions to the field

This article contributes to the field in several important ways. First, it advances the conversation on multimodal frames through its consideration of responses to image and text combinations. As these combinations reflect the type of messaging that most consumers are exposed to in contemporary marketing and promotional efforts, it deepens understanding of consumer reactions in contexts with a variety of messaging modes. Second, this article contributes to the growing field of research on very new products (VNP) and specifically the marketing of products associated with advanced technological processes. As more and more of these types of products are introduced into the marketplace, it is important for the field to further develop a focus on consumer responses to them Finally, and perhaps most importantly, this research offers a noteworthy addition to a fledgling but growing area of interest in a wide host of issues surrounding the food technology of cultured meat. It complements work done by Goodwin and Shoulders (2013) and Dilworth and McGregor (2015) who identified varied media frames of cultured meat in different countries and offers an invitation for additional research in this area. Indeed, stories about cultured meat frequently feature 'science themed' photos similar to the one used in the process framing condition here (e.g. New York Times 2018; Wall Street Journal 2017). As this product moves through the concept phase to the production process and finally to market, researchers in a wide host of disciplines can make significant contributions not only to their fields of study, but also to society as they explore this transformative technology.

8.4.3 Limitations

There are several limitations to acknowledge here. Firstly, the data is subject to well-known concerns about the quality of self-reported data. Data which is self-reported rather than observed is likely to be biased in some predictable ways; participants may report their past behaviors inaccurately due to poor memory, or their intended behaviors may not represent what they actually do due to poor forecasting. Moreover, some participants may give socially desirable answers, particularly when the subject is moralized, potentially leading them to over-report their intention to eat cultured meat in this case.

Secondly, we have some concerns about the data quality. Data was collected from Amazon MTurk, which has recently been subject to concerns about bots answering surveys (Wired 2018). Indeed, we identified 47 responses which seemed not to be genuine (most had given nonsensical answers to text input questions) but it is difficult to know whether more went unnoticed. This is likely to be a problem for any researchers using online survey response platforms, and such problems have recently been well documented with MTurk.

Finally, the external validity of an online study which asks participants about a future product is inevitably limited. Whilst we gave all participants information about cultured meat, it is possible that this information would be interpreted differently in the context of taking an online survey compared to making actual purchase decisions in a restaurant or store. Indeed, seeing just an image and a strapline may be a contrived way to consume information, although arguably this could be similar to a headline and image in media.

Overall, there are some concerns about data quality and the external validity of the survey, however these are minor concerns and we have taken steps to mitigate these where possible.

8.4.4 Future Research

Future research on the topic of framing new technologies could explore how producers attempt to influence media frames, how successful they are in promoting their preferred frames, and the downstream effect on consumer attitudes. Systematically comparing the frames used by producers with those present in media reports using content analysis could highlight which aspects of reality each choose to foreground. This will be particularly relevant to other consumer technologies which may become available imminently, and which can be readily interpreted in different ways, for example self-driving vehicles.

In terms of consumer research in relation to cultured meat specifically, the field would benefit from rigorous content analyses of frames used by both producers and the media over the last five to seven years. What are the dominant frames presented to consumers both by producers through their own promotional materials like YouTube videos and by journalists in their stories? Have these frames changed over time? Do these frames differ from those which occur on social media? And finally, how are consumer perceptions and intentions influenced by the frames they encounter and have these changed over time?

Future research on cultured meat acceptance, meanwhile, could attempt to track consumer attitudes over time. Such a longitudinal design could allow researchers to attempt to observe the real effect of relevant news on consumer attitudes. Observing shifts in specific beliefs and attitudes could provide a way to observe the changes that take place when consumer attitudes shift over time, and could provide a method for measuring the master frame through which consumers interpret cultured meat. Moreover, it would be able to test the idea that acceptance will increase over time as people become more familiar with the product and products become commercially available.

Finally, further exploration of public opinions of cultured meat on social media and blogs may be warranted. As we have discussed, social media may lead to a variety of personalized frames which are outside the control of producers and traditional media outlets. Such an environment could lead to further insights about important narratives about cultured meat as they develop.

8.5 References

Andrews, J. Craig, Richard G. Netemeyer, Jeremy Kees, and Scot Burton. 2014. "How graphic visual health warnings affect young smokers' thoughts of quitting." *Journal of Marketing Research* 51, no. 2: 165-183.

Arora, Raj. 2008. "Price bundling and framing strategies for complementary products." *Journal of Product & Brand Management* 17, no. 7: 475-484. https://doi.org/10.1108/10610420810916371

Augoustinos, Martha, Shona Crabb, and Richard Shepherd. 2010. "Genetically modified food in the news: media representations of the GM debate in the UK." *Public Understanding of Science 19*, no. 1: 98-114.

Barbara, Latifa, Gilles Grolleau, Assia Houfaf Khoufaf, Youcef Meriane, and Naoufel Mzoughi. 2018. "Positional concerns and framing effects in financial preferences." *The Quarterly Review of Economics and Finance 68*: 183-189.

BBC. (2018, October 15.) "Would you eat slaughter-free meat?" Accessed 30 October 2018 at https://www.bbc.co.uk/news/world-us-canada-45865403

Bekker, Gerben A., Arnout RH Fischer, Hilde Tobi, and Hans CM van Trijp. "Explicit and implicit attitude toward an emerging food technology: The case of cultured meat." *Appetite 108* (2017): 245-254.

Biswas, Dipayan, and Stacy Landreth Grau. "Consumer choices under product option framing: loss aversion principles or sensitivity to price differentials?." *Psychology & Marketing* 25, no. 5 (2008): 399-415. https://doi.org/10.1002/mar.20217

Botelho, David, and Hilda Kurtz. 2008. "The introduction of genetically modified food in the United States and the United Kingdom: A news analysis." *The Social Science Journal 45*, no. 1: 13-27.

Bryant, Christopher, Joanna E. Anderson, Kathryn E. Asher, Che Green, and Kristopher Gasteratos. 2019. "Strategies for overcoming aversion to unnaturalness: The case of clean meat." *Meat science 154*: 37-45.

Bryant, Christopher, and Julie Barnett. 2018. "Consumer acceptance of cultured meat: A systematic review." *Meat Science,* no. 143, 8-17. https://doi.org/10.1016/j.meatsci.2018.04.008

Bryant, Christopher J., and Julie C. Barnett. 2019. "What's in a name?: Consumer perceptions of in vitro meat under different names." *Appetite 137*: 104-113.

Buhrmester, Michael, Tracy Kwang, and Samuel D. Gosling. 2011. "Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data?" *Perspectives on psychological science,* no. 6(1), 3-5. https://doi.org/10.1037/e527772014-223

Chang, Chun-Tuan. 2012. "Missing ingredients in cause-related advertising: The right formula of execution style and cause framing." *International Journal of Advertising* 31, no. 2: 231-256. https://doi.org/10.2501/ija-31-2-231-256

Cho, Yoon-Na. 2014. "Different shades of green consciousness: The interplay of sustainability labeling and environmental impact on product evaluations." *Journal of business ethics* 128, no. 1: 73-82. https://doi.org/10.1007/s10551-014-2080-4

Cox Han, Lori, and Brian Robert Calfano. 2018. "Conflict and Candidate Selection: Game Framing Voter Choice." *American Politics Research* 46, no. 1: 169-186. https://doi.org/10.1177/1532673x17715258

Cress, Daniel M., and David A. Snow. 2000. "The outcomes of homeless mobilization: The influence of organization, disruption, political mediation, and framing." *American Journal of Sociology* 105, no. 4: 1063-1104. https://doi.org/10.1086/210399

De Vreese, Claes, and Hajo Boomgaarden. 2003. "Valenced news frames and public support for the EU." *Communications* 28, no. 4: 361-381. https://doi.org/10.1515/comm.2003.024

Degreef, Filip. 2018. "Understanding New Food Technologies and Trust in Food: Framing Analysis of Food Additives and Food Radiation (1960-1995)." *Who Decides?: Competing Narratives in Constructing Tastes, Consumption and Choice*: 223-246. https://doi.org/10.1163/9789004365247_014

Dilworth, Tamsin, and Andrew McGregor. 2015. "Moral steaks? Ethical discourses of in vitro meat in academia and Australia." *Journal of Agricultural and Environmental Ethics,* no. 28(1), 85-107. https://doi.org/10.1007/s10806-014-9522-y

Donovan, Robert J., and Geoffrey Jalleh. 1999. "Positively versus negatively framed product attributes: The influence of involvement." *Psychology & Marketing* 16, no. 7: 613-630. https://doi.org/10.1002/(sici)1520-6793(199910)16:7%3C613::aid-mar4%3E3.0.co;2-f

Druckman, James N. 2001. "The implications of framing effects for citizen competence." *Political Behavior* 23, no. 3: 225-256.

Du, Li, and Christen Rachul. 2012. "Chinese newspaper coverage of genetically modified organisms." *BMC Public Health 12*, no. 1: 326.

Entman, Robert M. 1993. "Framing: Toward clarification of a fractured paradigm." *Journal of Communication* 43, no. 4: 51-58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x

Eyck, Toby A. Ten, and Melissa Williment. 2003. "The national media and things genetic: Coverage in the New York Times (1971–2001) and the Washington Post (1977-2001)." *Science Communication 25*, no. 2: 129-152.

Feiereisen, Stephanie, Veronica Wong, and Amanda J. Broderick. 2013. "Is a Picture Always Worth a Thousand Words? The Impact of Presentation Formats in Consumers' Early Evaluations of Really New Products (RNP s)." *Journal of Product Innovation Management* no. 30: 159-173. https://doi.org/10.1111/jpim.12069

Fellenor, John, Julie Barnett, Clive Potter, Julie Urquhart, J. D. Mumford, and C. P. Quine. "The social amplification of risk on Twitter: The case of ash dieback disease in the United Kingdom." *Journal of Risk Research 21*, no. 10 (2018): 1163-1183.

Frewer, Lynn J., Susan Miles, and Roy Marsh. 2002. "The media and genetically modified foods: evidence in support of social amplification of risk." *Risk Analysis: An International Journal 22*, no. 4: 701-711.

Gamson, William A. 1992. “Talking Politics”. Cambridge: Cambridge University Press.

Geise, Stephanie, and Christian Baden. 2014. "Putting the image back into the frame: Modeling the linkage between visual communication and frame-processing theory." *Communication Theory* 25, no. 1: 46-69. https://doi.org/10.1111/comt.12048

Gibson, Katie L. 2009. "Undermining Katie Couric: The discipline function of the press." *Women & Language* 32, no. 1.

Gitlin, Todd. 1980. *The Whole World is Watching.* Berkeley: University of California Press.

Goffman, Erving. 1974. *Frame analysis: An essay on the organization of experience*. Cambridge: Harvard University Press. https://doi.org/10.2307/2064022

Graber, Doris A. 1990. "Seeing is remembering: How visuals contribute to learning from television news." *Journal of communication* 40, no. 3: 134-156. https://doi.org/10.1111/j.1460-2466.1990.tb02275.x

Hollywood, Jamie & Madsen Pirie. 2018. *Don't Have A Cow Man: The Prospects for Lab Grown Meat.* The Adam Smith Institute. London.

Hopkins, Patrick D. 2015. Cultured meat in western media: “The disproportionate coverage of vegetarian reactions, demographic realities, and implications for cultured meat marketing.” *Journal of Integrative Agriculture,* no. 14(2), 264-272. https://doi.org/10.1016/s2095-3119(14)60883-2

Iyengar, Shanto. 1994. *Is anyone responsible?: How television frames political issues*. Chicago: University of Chicago Press. https://doi.org/10.2307/2075856

Iyengar, Shanto. 1996. "Framing responsibility for political issues." *The Annals of the American Academy of Political and Social Science* 546, no. 1: 59-70. https://doi.org/10.1177/0002716296546001006

Iyer, Aarti, Joanna Webster, Matthew J. Hornsey, and Eric J. Vanman. 2014. "Understanding the power of the picture: The effect of image content on emotional and political responses to terrorism." *Journal of Applied Social Psychology* 44, no. 7: 511-521. https://doi.org/10.1111/jasp.12243

Kalaitzandonakes, Nicholas, Leonie A. Marks, and Steven S. Vickner. 2004. "Media coverage of biotech foods and influence on consumer choice." *American Journal of Agricultural Economics 86*, no. 5: 1238-1246.

Ku, Hsuan-Hsuan, Chien-Chih Kuo, Ching-Luen Wu, and Chih-Ying Wu. 2012. "Communicating green marketing appeals effectively: The role of consumers' motivational orientation to promotion versus prevention." *Journal of advertising* 41, no. 4: 41-50. https://doi.org/10.1080/00913367.2012.10672456

Laestadius, Linnea I. 2015. “Public perceptions of the ethics of in-vitro meat: Determining an appropriate course of action.” *Journal of Agricultural and Environmental Ethics,* no. 28(5), 991-1009. https://doi.org/10.1007/s10806-015-9573-8

Laestadius, Linnea I., and Mark A. Caldwell. "Is the future of meat palatable? Perceptions of in vitro meat as evidenced by online news comments." *Public health nutrition 18*, no. 13 (2015): 2457-2467.

Listerman, Thomas. 2010. "Framing of science issues in opinion-leading news: international comparison of biotechnology issue coverage." *Public Understanding of Science 19*, no. 1: 5-15.

Marks, Leonie A., Nicholas G. Kalaitzandonakes, Kevin Allison, and Ludmila Zakharova. 2003. "Media coverage of agrobiotechnology: did the butterfly have an effect?." *Journal of Agribusiness* 21, no. 345-2016-15206: 1.

Marks, Leonie A., Nicholas Kalaitzandonakes, Lee Wilkins, and Ludmila Zakharova. 2007. "Mass media framing of biotechnology news." *Public Understanding of Science 16*, no. 2: 183-203.

Maeseele, Pieter A., and Dimitri Schuurman. 2008. "Biotechnology and the popular press in Northern Belgium: A case study of hegemonic media discourses and the interpretive struggle." *Science Communication 29*, no. 4: 435-471.

McCarthy, John D. 1994. "Activists, authorities, and media framing of drunk driving." *New Social Movements: From Ideology to Identity*: 133-167. Philadelphia: Temple University Press.

McInerney, Claire, Nora Bird, and Mary Nucci. 2004. "The flow of scientific knowledge from lab to the lay public: The case of genetically modified food." *Science Communication 26*, no. 1: 44-74.

New York Times. 2018, September 30. *Meat Labs Pursue a Once-Impossible Goal: Kosher Bacon.* Accessed 26 February 2019 at https://www.nytimes.com/2018/09/30/technology/meat-labs-kosher-bacon.html

Olsen, Mitchell C., Rebecca J. Slotegraaf, and Sandeep R. Chandukala. 2014. "Green claims and message frames: how green new products change brand attitude." *Journal of Marketing* 78, no. 5: 119-137. https://doi.org/10.1509/jm.13.0387

Phillips, Diane M., and William K. Hallman. 2013. "Consumer risk perceptions and marketing strategy: the case of genetically modified food." *Psychology & Marketing* 30, no. 9: 739-748. https://doi.org/10.1002/mar.20642

Post, Mark. 2012. Cultured meat from stem cells: Challenges and prospects. *Meat Science,* no. 92(3), 297-301. https://doi.org/10.1016/j.meatsci.2012.04.008

Roininen, Katariina, Anne Arvola, and Liisa Lähteenmäki. "Exploring consumers' perceptions of local food with two different qualitative techniques: Laddering and word association." *Food quality and preference 17*, no. 1-2 (2006): 20-30.

Roy, Rajat, and Piyush Sharma. 2015. "Scarcity appeal in advertising: Exploring the moderating roles of need for uniqueness and message framing." *Journal of Advertising* 44, no. 4: 349-359. https://doi.org/10.1080/00913367.2015.1018459

Scheufele, Dietram A. 1999. "Framing as a theory of media effects." *Journal of Communication* 49, no. 1: 103-122. https://doi.org/10.1093/joc/49.1.103

Semetko, Holli A., and Patti M. Valkenburg. 2000. "Framing European politics: A content analysis of press and television news." *Journal of Communication* 50, no. 2: 93-109. https://doi.org/10.1111/j.1460-2466.2000.tb02843.x

Semino, Elena, Zsófia Demjén, and Jane Demmen. 2016. "An integrated approach to metaphor and framing in cognition, discourse, and practice, with an application to metaphors for cancer." *Applied Linguistics 39*, no. 5: 625-645.

Shah, Dhavan V., David Domke, and Daniel B. Wackman. 1996. "To Thine Own Self Be True" Values, Framing, and Voter Decision-Making Strategies." *Communication Research* 23, no. 5: 509-560. https://doi.org/10.1177/009365096023005001

Siegrist, Michael. 2008. "Factors influencing public acceptance of innovative food technologies and products." *Trends in Food Science & Technology* 19, no. 11: 603-608. https://doi.org/10.1016/j.tifs.2008.01.017

Siegrist, M., & Sütterlin, B. 2017. "Importance of perceived naturalness for acceptance of food additives and cultured meat." *Appetite, 113*, 320-326. https://doi.org/10.1016/j.appet.2017.03.019

Siegrist, Michael, Bernadette Sütterlin, and Christina Hartmann. 2018. "Perceived naturalness and evoked disgust influence acceptance of cultured meat." *Meat science,* no. 139, 213-219. https://doi.org/10.1016/j.meatsci.2018.02.007

Snow, David A., and Robert D. Benford. 1992. "Master frames and cycles of protest." *Frontiers in Social Movement Theory* no. 133: 155.

Tankard Jr, James W. 2001. "The empirical approach to the study of media framing." In *Framing Public Life*, pp. 111-121. New York: Routledge. https://doi.org/10.4324/9781410605689

Tewksbury, David, and Dietram A. Scheufele. 2007. "Special issue on framing, agenda setting, & priming: Agendas for theory and research." *Journal of Communication* 57, no. 1: 8-8. https://doi.org/10.1111/j.1460-2466.2006.00337.x

Tversky, Amos, and Daniel Kahneman. 1986. "Rational choice and the framing of decisions." *Journal of Business* S251-S278. https://doi.org/10.1017/cbo9780511803475.013

Verbeke, Wim, Afrodita Marcu, Pieter Rutsaert, Rui Gaspar, Beate Seibt, Dave Fletcher, and Julie Barnett. 2015. "'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom." *Meat Science,* no. 102, 49-58. https://doi.org/10.1016/j.meatsci.2014.11.013

Vicente Mariño, Miguel, and Pablo López Rabadán. 2009. "Current results of research on framing: solid international progress and start of the specialty in Spain." *Zer: Journal of Communication Studies 14*, no. 26.

Vicsek, Lilla. 2013. ""Gene-fouled or gene-improved?" Media framing of GM crops and food in Hungary." *New Genetics and Society 32*, no. 1: 54-77.

Vilella-Vila, Marta, and Joan Costa-Font. 2008. "Press media reporting effects on risk perceptions and attitudes towards genetically modified (GM) food." *Journal of Socio-Economics 37*, no. 5: 2095.

Wall Street Journal. 2017, June 27. *Hampton Creek Aims at New Market: Growing Meat.* Accessed 26 February 2019 at https://www.wsj.com/articles/hampton-creek-aims-at-new-market-growing-meat-1498592294

Wilks, Matti, and Clive J. Phillips. 2017. "Attitudes to in vitro meat: A survey of potential consumers in the United States." *PloS one,* 12(2), e0171904. https://doi.org/10.1371/journal.pone.0171904

Wired. 2018, August 17. *A Bot Panic Hits Amazon's Mechanical Turk.* Accessed January 14 2019 at https://www.wired.com/story/amazon-mechanical-turk-bot-panic/

As we have shown, different media frames around cultured meat can affect consumer acceptance. In particular, those frames which forefront the cutting edge science with imagery of lab equipment etc. lead to more negative perceptions than alternative frames which focus on the technology's benefits. Media analyses have shown that, although the content of articles about cultured meat is often positive and focuses on the benefits (Goodwin & Shoulders, 2013), they also frequently discuss cultured meat through the lens of an unnatural scientific product (Dilworth & McGregor, 2015).

As we discuss in this study, it is possible that such frames, though they lead to more negative perceptions of cultured meat, are somewhat inevitable given the nature of cultured meat as a news item. Moreover, cultured meat advocates are likely to have limited opportunities to impact the entire frame of media coverage, although they may be able to impact some aspects of it. Therefore, my seventh study investigated another more subtle way to influence acceptance in a way which can be deployed more reliably: nomenclature.

This declaration concerns the article entitled:	
What's in a Name? Consumer Perceptions of In Vitro Meat Under Different Names	
Publication status (tick one)	
Draft manuscript [ ] **Submitted** [ ] **In review** [ ] **Accepted** [ ] **Published** [X]	
Publication details (reference)	Bryant, C. J., & Barnett, J. C. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite*, *137*, 104-113.
Copyright status (tick the appropriate statement)	
I hold the copyright for this material [X]	Copyright is retained by the publisher, but I have been given permission to replicate the material here [ ]
Candidate's contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** Predominantly executed (90%). I came across the idea of experimenting with nomenclature in the cultured meat field at the time, and gathered some appropriate names to test. **Design of methodology:** Predominantly executed (75%). Designed measures, procedure, and analysis plan with input from Julie. **Experimental work:** Predominantly executed (90%). Administered data collection, cleaned and analysed data. **Presentation of data in journal format:** Predominantly executed (90%). Wrote first and final drafts of the paper with input from Julie.
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.
Signed	C J Bryant — **Date** 29 June 2020

Data Access Statement: We do not have permission to share the data from this study.

Ethics: This study received ethical approval from the University of Bath Psychology Research Ethics Committee.

9. What's In a Name? Consumer Perceptions of In Vitro Meat under Different Names

Abstract

In vitro meat (IVM) grown from animal cells is approaching commercial viability. This technology could enable consumers to circumvent the ethical and environmental issues associated with meat-eating. However, consumer acceptance of IVM is uncertain, and is partly dependent on how the product is framed. This study investigated the effect of different names for IVM on measures of consumer acceptance. Participants (N = 185) were allocated to one of four conditions in an experimental design in which the product name was manipulated to be 'clean meat', 'cultured meat', 'animal free meat', or 'lab grown meat'. Participants gave word associations and measures of their attitudes and behavioral intentions towards the product. The results indicated that those in the 'clean meat' and 'animal free meat' conditions had significantly more positive attitudes towards IVM than those in the 'lab grown meat' condition, and those in the 'clean meat' condition had significantly more positive behavioural intentions towards IVM compared to those in the 'lab grown meat' condition. Mediation analyses indicated that the valence of associations accounted for a significant amount of the observed differences, suggesting that anchoring can explain these differences. We discuss these results in the context of social representations theory and give recommendations for future research.

9.1 Introduction

9.1.1 In vitro meat

In vitro meat (IVM) is meat which can be grown from animal stem cells rather than being taken from a slaughtered animal. In recent years, researchers in the Netherlands and the USA have developed proof of concept products (BBC, 2013; Wall Street Journal, 2017b), and it has been reported that IVM will be commercially available by 2021 (CBS News, 2018). Advocates of the technology claim that, compared to conventional meat production, IVM will be better for the environment, animal welfare, global food security and public health (Bhat & Bhat, 2011; Schaefer & Savulescu, 2014; Tuomisto & de Mattos, 2011). Conversely, others show concern for the potential impact on farming traditions and livelihoods, as well as the possibility that IVM production will require more energy than conventional meat (Mattick, Landis, Allenby, & Genovese, 2015; Verbeke, Marcu, et al., 2015).

However, perhaps the most significant challenge for IVM to overcome is that of consumer acceptance (Sharma, Thind, & Kaur, 2015). Despite the putative benefits associated with IVM, some consumers have concerns about the product (Bryant & Barnett, 2018). Surveys indicate that between 16% and 66% of consumers say they would eat IVM (The Grocer, 2017; Wilks & Phillips, 2017)[8], whilst qualitative studies reveal that common objections include the perceived unnaturalness of IVM, as well as perceived risks to human health and concerns about the price and taste (Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015).

One possible reason for the wide variation in consumer acceptance recorded by different studies is the terminology used to describe IVM. Studies of consumer acceptance have variously referred to ‘cultured meat’ (The Grocer, 2017), ‘in vitro meat’ (Wilks & Phillips, 2017), ‘artificial meat’ (YouGov, 2013), and ‘synthetic meat’ (Marcu et al., 2015), amongst other terms. As Friedrich (2016) has argued, the term used to describe IVM is likely to have an impact on the subsequent impressions people form of the product, and ultimately may have a role in determining whether the public accepts or rejects this technology. For this reason, producers, investors, and advocates of IVM have started to use the term ‘clean meat’ in order to promote consumer acceptance (ibid.)

9.1.2 The importance of naming

It is widely acknowledged that the name given to an object or phenomenon can affect subsequent evaluations and impressions of it. Notably, Bertrand and Mullainathan (2004) have shown that résumés with names typical of white people (Emily and Greg) received 50% more invitations to interview compared to otherwise identical résumés with names typical of black people (Lakisha and Jamal). Furthermore, Laham, Koval, and Alter (2012) demonstrate that names which are easier to pronounce are judged more positively, finding that people prefer a fictional political candidate called Mr Smith over an otherwise-identical candidate called Mr Colquhoun.

This phenomenon has also been demonstrated in a food context (Spence & Piqueras-Fiszman, 2014). Altering the names of dishes has been shown to affect consumers’ perceptions of their country of origin (Bell & Paniesin, 1992) and can even increase perceived authenticity of foreign dishes (Meiselman & Bell, 1991). Wolfson and Oshinsky

[8] The variability in these results is likely due to a number of methodological differences between different surveys including the samples used, the way the question is phrased, and the way in vitro meat is framed.

(1966), meanwhile, found some evidence that labelling (as opposed to not labelling) liquid food for astronauts increased liking ratings. However, the content of the label is also likely to be important, and may have different effects on different perceived characteristics of the food in question: Schuldt and Hannahan (2013) demonstrated that 'organic' labels on food increased perceived healthiness, but decreased anticipated liking. Sommers (2012) points to an example of how naming has been used to increase food sales in practice, explaining that the unappetising 'Patagonian toothfish' was successfully rebranded as 'Chilean sea bass'. Similarly, Kunst and Hohle (2016) demonstrate that the names given to some meats may serve to make them more appealing; they showed that referring to 'cow' or 'pig' on a menu in place of 'beef' or 'pork' increased both empathy and disgust, decreasing willingness to eat meat and increasing willingness to choose an alternative vegetarian dish.

9.1.3 Social representations theory

Social representation theory, in part, seeks to explain the process through which a community makes sense of new, unfamiliar concepts (Moscovici, 1961). Marcu et al. (2015, p. 3) use this theoretical lens, and note that the process of anchoring '…is of particular interest in shedding light on how people deal with the unfamiliar and how they might understand [IVM] by comparing it to more familiar concepts or technologies.' Whilst the authors find some evidence that people do, indeed, anchor IVM to existing technologies (in particular genetically modified (GM) food, and cloning) in order to form understandings of it, they do not explore the idea that such anchors may be different if the same concept was introduced by a different name. Given that the video used to introduce participants to IVM in this study referred to 'synthetic meat' and 'lab-grown steak', it is perhaps unsurprising that participants were prone to what the authors called 'unhelpful anchoring' (p. 2), which seemed to be conducive to negative attitude formation.

Indeed, the perception that IVM is unnatural is one of the most frequently observed objections by consumers (Hart Research Associates, 2017; Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015; Wilks & Phillips, 2017), yet many of the most widely-used names for IVM (including 'in-vitro meat', 'synthetic meat', 'artificial meat', 'lab-grown meat' and 'cultured meat') seem to encourage, if not invoke, this very perception. In her exploration of the types of anchoring, Höijer (2011) explores 'anchoring in antinomies', a concept which Marková (2003) has argued is based on dialogicality, or the 'capacity to make distinctions, to think in oppositions, polarities or antinomies.' (Höijer, 2011, p. 10). Through this lens, calling IVM 'artificial meat' highlights its antinomy to 'natural meat'. Similarly, calling IVM 'clean meat' may imply that conventional meat is 'dirty', a feature of this name highlighted by Forbes (2016).

9.1.4 The present study

Given that there are significant barriers to consumer acceptance of IVM (Sharma et al., 2015), and that names are likely to affect consumer perceptions of unfamiliar products, this study sought to explore how four different proposed names for IVM are associated with consumer attitudes and relevant behavioural intentions. The names used were (1) 'cultured meat', (2) 'clean meat', (3) 'lab-grown meat', and (4) 'animal-free meat'. Although other terms are also widely used (see Table 9,1), we decided to test names which are conceptually distinct. We did not, for example, test either 'artificial meat' or 'synthetic meat', since these are likely to be perceived as quite similar by consumers. In order to avoid confusion between the naming conditions and the concept, we use IVM throughout this paper to refer to the concept generically, but do not test this name directly.

These names were selected from many possible names which have been used by various published studies, advocacy groups, and the media (see Table 9.1). ‘Cultured meat’ has been widely used in the IVM community, including by the NGO New Harvest. ‘Clean meat’ is a term which has been advocated by The Good Food Institute (Friedrich, 2016) as being conducive to higher consumer acceptance, and is also often used in the IVM community, and recently, more widely (Friedrich, 2018). ‘Lab-grown meat’ is a term often used by the media, perhaps because it intuitively describes the concept in lay terms, and also perhaps because it sounds more sensational compared to alternatives. ‘Animal-free meat’ is a lesser used term, but one which we are including here because it accurately describes what the product is and is a key feature of it.

Table 9.1: Various names used to refer to IVM in academia, advocacy groups, and the media.

Name	Source(s)	Reception
Cultured meat	Bekker, Fischer, Tobi, and van Trijp (2017)*	Participants in this experimental study had slightly negative explicit attitudes towards cultured meat overall, and negative implicit attitudes.
	Hart Research Associates (2017)*	Focus group participants had overall negative reactions to cultured meat, in particular to this name.
	The Grocer (2017)*	16% of UK consumers in this survey said they would eat ‘“cultured meat” grown in a laboratory’
Lab-grown meat	Pew Research (2014)*	20% of US consumers in this survey said they would eat ‘meat that was grown in a lab’
	The Washington Post (2016)	
Animal-free meat	Bhat and Bhat (2011)	We do not have any empirical data on consumer responses to the use of this term
	Next Nature (2011)	
Clean meat	The Good Food Institute (2017)	In a choice experiment and self-reported measures of purchase intent, consumers preferred ‘clean meat’ to other terms such as ‘meat 2.0’, ‘cultured meat’, and ‘pure meat’ (though overall there was no significant difference with ‘safe meat’)
	Animal Charity Evaluators (2017)	In a choice experiment, consumers were significantly more likely to prefer ‘clean meat’ over conventional meat compared to ‘cultured meat’
In-vitro meat	Verbeke, Sans, and Van Loo (2015)*	24% of Dutch participants in this experimental study were ‘surely’ willing to try ‘In vitro meat, which is also called “cultured meat”’
	The Huffington Post (2014)	
	Hocquette et al. (2015)*	Between 9.2% and 19.2% of survey respondents thought that consumers would buy in vitro meat
Synthetic meat	Verbeke, Marcu, et al. (2015)*	European focus group participants perceived many societal benefits for the environment and for animals, but few personal benefits. They also worried about many aspects of synthetic meat, including the effect on human health, and the impact on farming livelihoods and rural landscapes.
	Marcu et al. (2015)*	

Artificial meat	YouGov (2013)*	19% of UK consumers in this survey said they would eat 'artificial meat that can be grown in a laboratory'
	Time (2016)	
Shmeat	National Geographic (2014)	We do not have any empirical data on consumer responses to the use of these terms
Frankenmeat	NBC News (2013)	
Test tube meat	CNN (2014)	
	The Daily Mail (2016)	

** Indicates that the source is a study of consumer acceptance; for these sources, we also describe how IVM was received by study participants.*

The Good Food Institute (2017) and Animal Charity Evaluators (2017) have conducted studies on this question in an advocacy context; both found that consumers were significantly more likely to prefer IVM over conventional meat when it was called 'clean meat' compared to 'cultured meat'. As well as hypothetical choice experiments, The Good Food Institute (2017) also reported self-reported purchase likelihood measured on a 7-point Likert scale. Whilst some academic studies have used hypothetical choice experiments and self-reported purchase likelihood, many have measured other beliefs about IVM as key outcome variables: Verbeke, Sans, et al. (2015) report on perceived healthiness, taste and sustainability among other things, whilst Siegrist, Sütterlin, and Hartmann (2018) have demonstrated the importance of perceived naturalness and evoked disgust in determining behavioural intentions towards IVM. Therefore, as well as behavioural intentions, the present study measures agreement with a number of key attitude and belief items regarding IVM. Importantly, a key part of this study was the use of a word association task, enabling us to explore the concepts anchored to and associated with each name.

Word association is a method which has been used in a variety of studies examining attitudes towards food (Ares, Giménez, & Gámbaro, 2008; Guerrero et al., 2010; Roininen, Arvola, & Lähteenmäki, 2006). It is a method which 'could serve as quick and convenient tools in exploring consumer perceptions for new and undefined concepts' and is 'able to grasp affective and less conscious aspects of respondents' mindsets better than methods that use more direct questioning' (Roininen et al., 2006, p. 21). In this context, it will allow us to explore the associations people have with each of the proposed names, thereby enabling us to get a sense of how anchoring plays a role in attitude formation with regards to unfamiliar concepts.
Accordingly, the research questions we asked are:

1. Which associations do people make with the different names used to refer to IVM?
2. How does the name used to refer to IVM affect attitudes about it?
3. How does the name used to refer to IVM affect behavioural intentions?

It is hoped that the present work will not only expand understanding of how food naming affects subsequent attitudes and behavioural intentions towards novel food technologies, but that it will also be relevant to the IVM community as it decides how best to refer to the product in the future (see Friedrich, 2016).

9.2. Material and methods

9.2.1 Design and manipulations

This study used an experimental between-subjects design whereby participants were randomly allocated to one of four conditions, corresponding to the four proposed names for IVM: (1) 'cultured meat', (2) 'clean meat', (3) 'lab-grown meat', and (4) 'animal-free meat'.

Once participants were allocated to a condition, they then only saw IVM referred to by the corresponding name, and were given otherwise identical descriptions of the concept.

First, participants were given information about the study, but were not told that the names they saw would be experimentally manipulated. They were asked to verify that they were aged 18 or over, and were asked to give consent to take part. They then completed a practice word association task, in which they were shown the word 'JUGGLER' and asked to write down up to four words, phrases, thoughts, feelings, or images that came to their mind. They were then asked to rate on a scale of 5-point scale of 'Very Negative' to 'Very Positive' how they felt about each association they gave (following Ares & Deliza, 2010; Roininen et al., 2006).

After completing the practice word association task, participants were then shown the term for IVM they had been allocated, and again asked to give the first four associations that came to mind and rate each of them on the same 5-point scale. Participants had not, at this point, been given a description of what IVM is, and therefore were giving associations based on the name only. Next, participants were given the following description of IVM, where [X] was replaced by their allocated term: '[X] is meat which is grown from cells taken from an animal who is not killed, rather than being taken from a slaughtered animal.' Apart from the name, the description given to each participant was identical.

Participants then responded to 21 attitude items and 5 behavioural intention items (described below). Next, they gave demographic information, including gender, age, level of education, diet, and their familiarity with IVM prior to participation in the study. Finally, participants were debriefed – this included telling participants about the nature of the study, and that the name they were shown was experimentally manipulated. Participants were thanked and given a unique code to claim their compensation ($0.50).

9.2.2 Participants

Participants for this study were recruited through Amazon MTurk, an online platform commonly used for survey or experimental research (Wilks & Phillips, 2017; Yuan & Purver, 2015). This recruitment method is less costly and results in a more diverse and representative sample compared to convenience sampling (i.e. recruiting university students, e.g. Bekker et al. (2017), Verbeke, Sans, et al. (2015)). Further, several analyses have concluded that MTurk is generally a valid and reliable tool for participant recruitment (Berinsky, Huber, & Lenz, 2012; Buhrmester, Kwang, & Gosling, 2011; Paolacci, Chandler, & Ipeirotis, 2010; Rand, 2012).

A power analysis indicated that 180 participants were needed based on 4 groups and anticipating a medium effect size of 0.25 (Cohen, 1992). In total, we recorded 241 survey responses. We removed 48 incomplete responses, and further removed five participants who gave nonsensical answers to text fields, two which were duplicates, and one which did not give their age. Therefore, 185 participants were included in the analysis: 49 in the 'animal free meat' condition, 48 in the 'clean meat' and 'cultured meat' conditions, and 40 in the 'lab grown meat' condition.

Participants were 57.8% male (42.2% female), and their ages ranged from 20 – 68 (mean = 34.86, SD = 10.38). Regrettably, participant country was not recorded, though Difallah, Filatova and Ipeirotis (2018) tell us that 75% of MTurk workers are in the USA. In any case, all participants spoke English, and there was no clear skew in the sample (although participants were more likely to be male and younger than a representative US sample).

9.2.3 Measures

The quantitative measures used in this study are described in Table 9.2. The behavioural intention items are adapted from the five items used by Wilks and Phillips (2017). Items are reported in this section with ‘[X]’ in place of the name for IVM used, which varied between experimental conditions. Many of the attitude items are taken from previous studies examining attitudes towards food (see Appendix A), though some are added for completeness based on the IVM literature. Some of these items were negative (i.e. stronger agreement with the item indicated a negative, rather than a positive, perception of IVM.) Therefore, these items (denoted by a * in Appendix A) were reverse scored before composite measures were created such that higher values represent more positive perceptions.

Table 9.2: Items, response options, and reliability measures for the quantitative measures used

Measure	Items	Response Options	Reliability
Attitude	Eating [X] is likely to be healthy. [X] is likely to look, taste, smell, and feel the same as conventional meat. I think I could tell the difference between [X] and conventional meat. [X] is likely to contain chemicals or ingredients which should be avoided. [X] is likely to be safe for human consumption. I would trust [X]. [X] is unnatural. [X] is appealing to me. I feel positive about the development of [X]. The idea of [X] is disgusting. I feel comfortable about the idea of eating [X]. I would be anxious about eating [X]. Eating [X] would conflict with my values. I feel that I would have control over my decision to eat [X] or not. The production of [X] is a necessary scientific development. Others would disapprove of me eating [X]. [X] will have benefits for our society. Production of [X] is wise. Production of [X] is necessary. [X] is more environmentally friendly than conventional meat. Producing [X] poses a risk to society.	Strongly disagree (1) to Strongly agree (5)	α = .947
Behavioural intentions	I would be willing to try [X]. I would buy [X] regularly. I would eat [X] instead of conventional meat. I would rather eat [X] than soy-based meat substitutes or Quorn. I would pay more for [X] than for conventional meat.	Strongly disagree (1) to Strongly agree (5)	α = .918

9.3 Results

9.3.1 Preliminary analysis

Before conducting the main analysis, we tested whether there were any differences between conditions in relevant demographic features (age, gender, education, diet) and in familiarity with IVM, since these are all factors known to correlate with IVM acceptance (Wilks & Phillips, 2017). There were no significant differences between the experimental conditions for demographic variables.

However, those in the 'clean meat' condition were significantly less familiar with IVM than those in the 'lab grown meat' and 'cultured meat' conditions on a 3 point ordinal scale (never heard of IVM (1), heard of IVM (2), and already knew what IVM was (3)) ($F(3,181) = 4.77$, $p = .003$). Since this measure of familiarity was self-reported, it is possible that the names 'lab grown meat' and 'cultured meat' only seemed more familiar than 'clean meat' rather than participants in these conditions actually being more familiar with the concept.

If participants in some conditions were, indeed, more familiar with the concept than those in other conditions, this could confound results. However, it is likely that greater familiarity would lead to greater acceptance (Bryant & Barnett, 2018), and in this instance, the reverse was true: those claiming to be more familiar in the 'lab grown meat' and 'cultured meat' conditions actually also showed lower measures of acceptance in subsequent analyses. Therefore, we are confident that this difference is a result of how familiar the names seem rather than how familiar the participants actually were. Familiarity was therefore not included as a covariate in subsequent analyses.

9.3.2 Word associations

Before a description of IVM had been given, participants completed a word association task. They generated a total 721 words or phrases – where 338 of them were unique - an average of 3.90 per participant. They also rated the valence of each word or phrase they generated. Words were sorted into categories. Initial categories were identified, partly informed by themes observed in the literature on consumer acceptance of IVM. After consultation, these categories were adjusted and some words were reclassified. Next, three independent raters allocated the words to categories with an initial agreement rate of 67%, which increased to 97% after further discussion with one rater. The remaining 3% of ambiguous words were categorised after further consultation between the co-authors. Words were ultimately placed into 24 categories, and 19 words which could not be reliably categorised were put in a 'miscellaneous' category.

Table 9.3 shows the frequency and mean valence of words in each category overall, and within each naming condition. Each cell contains 4 values. The top-left value is the number of times this association appeared in the condition in total. This is shown as a percentage of the total associations given in the condition in parentheses. The bottom-left value is the number of participants who gave associations in this category within each condition. The bottom-right value is the mean valence score (from -2, very negative to +2, very positive). As shown, some types of association were much more prevalent in some naming conditions than in others.

Table 9.3: Frequency and valence of associations in each category given for each name.

	Total	Animal Free Meat	Clean Meat	Cultured Meat	Lab Grown Meat
Artificial/unnatural	59 (8.2%) 46, -1.24	20 (10.5%) 14, -1.10	5 (2.7%) 5, -0.60	9 (4.8%) 9, -1.22	25 (15.7%) 18, -1.48
Science	52 (7.2%) 32, 0.54	17 (8.9%) 10, 0.71	6 (3.2%) 4, -0.50	18 (9.6%) 11, 0.78	11 (6.9%) 7, 0.45
Type of meat	51 (7.1%) 31, 1.00	8 (4.2%) 4, 1.00	21 (11.4%) 11, 1.19	14 (7.5%) 10, 0.79	8 (5.0%) 6, 0.88
Health/Nutrition	51 (7.1%) 42, 1.43	15 (7.9%) 13, 1.60	29 (15.7%) 22, 1.38	5 (2.7%) 5, 1.00	2 (1.3%) 2, 2.00
Disgust	43 (6.0%) 28, -1.51	9 (4.7%) 6, -1.78	3 (1.6%) 2, -1.67	9 (4.8%) 8, -1.67	22 (13.8%) 12, -1.32
Tasty	38 (5.3%) 29, 1.45	5 (2.6%) 5, 1.20	20 (10.8%) 16, 1.45	7 (3.7%) 4, 1.71	6 (3.8%) 4, 1.33
Unusual/novel	38 (5.3%) 31, 0.18	11 (5.8%) 11, 0.09	1 (0.5%) 1, 1.00	11 (5.9%) 8, 0.55	15 (9.4%) 11, -0.07
Positive	37 (5.1%) 26, 1.35	5 (2.6%) 4, 1.40	11 (5.9%) 11, 1.27	10 (5.3%) 6, 1.40	11 (6.9%) 5, 1.36
Vegetarian/Vegan	34 (4.7%) 23, 0.41	29 (15.3%) 19, 0.41	2 (1.1%) 1, 1.00	-	3 (1.9%) 3, 0.00
Meat preparation	33 (4.6%) 26, 0.73	2 (1.1%) 2, -0.50	14 (7.6%) 12, 0.93	16 (8.6%) 11, 0.63	1 (0.6%) 1, 2.00
Texture or characteristics	29 (4.0%) 22, -0.03	4 (2.1%) 4, 0.00	7 (3.8%) 6, 0.57	13 (7.0%) 9, -0.08	5 (3.1%) 3, -0.80
Clean	29 (4.0%) 27, 1.28	2 (1.1%) 2, 1.00	20 (10.8%) 19, 1.40	4 (2.1%) 4, 1.25	3 (1.9%) 2, 0.67
Uncertainty/ scepticism	27 (3.7%) 19, -0.96	12 (6.3%) 9, -0.83	2 (1.1%) 2, -1.00	8 (4.3%) 4, -1.38	5 (3.1%) 4, -0.60
Natural	25 (3.5%) 16, 1.68	3 (1.6%) 3, 1.67	20 (10.8%) 11, 1.70	2 (1.1%) 2, 1.50	-
Threats to health	24 (3.3%) 19, -1.46	3 (1.6%) 3, -1.00	3 (1.6%) 3, -1.67	6 (3.2%) 4, -1.17	12 (7.5%) 9, -1.67
Animal welfare	21 (2.9%) 19, 1.14	7 (3.7%) 6, 1.43	7 (3.8%) 6, 1.00	5 (2.7%) 5, 0.80	2 (1.3%) 2, 1.50
Miscellaneous	19 (2.6%) 16, 0.42	4 (2.1%) 3, 0.75	4 (2.2%) 4, 0.50	6 (3.2%) 6, 0.33	5 (3.1%) 3, 0.20
Animals/body parts	17 (2.4%) 14, 0.76	2 (1.1%) 2, 0.00	5 (2.7%) 5, 0.80	9 (4.8%) 6, 0.89	1 (0.6%) 1, 1.00
Food	17 (2.4%) 16, 0.71	8 (4.2%) 7, 0.38	2 (1.1%) 2, 1.00	5 (2.7%) 5, 0.80	2 (1.3%) 2, 1.50
Negative	17 (2.4%) 13, -0.76	3 (1.6%) 3, -0.67	-	10 (5.3%) 7, -0.80	4 (2.5%) 3, -0.75
Alternative names	16 (2.2%) 11, 0.75	3 (1.6%) 3, 1.00	1 (0.5%) 1, -2.00	5 (2.7%) 4, 1.00	7 (4.4%) 3, 0.86
Price	16 (2.2%) 15, -0.94	2 (1.1%) 2, -1.50	1 (0.5%) 1, -1.00	7 (3.7%) 6, -0.57	6 (3.8%) 6, -1.17
Environment	15 (2.1%) 12, 0.93	7 (3.7%) 6, 1.29	1 (0.5%) 1, -2.00	6 (3.2%) 4, 1.00	1 (0.6%) 1, 1.00
Not tasty	13 (1.8%) 11, -1.46	9 (4.7%) 7, -1.33	-	2 (1.1%) 2, -2.00	2 (1.3%) 2, -1.50
Grand Total	**721 (100%) 185, 0.31**	**190 (100%) 49, 0.19**	**185 (100%) 48, 0.99**	**187 (100%) 48, 0.28**	**159 (100%) 40, -0.30**

A one-way ANOVA test indicated significant differences in the mean valence assigned to associations in the different naming conditions [$F(3,181) = 11.19$, $p < .001$]. Post-hoc analyses using Tukey's HSD revealed that those in the 'clean meat' condition gave significantly more positive associations compared to those in the 'lab grown meat' condition ($p < .001$), those in the 'cultured meat' condition ($p = .007$) and those in the 'animal free meat' condition ($p = .002$). There were no significant differences between the other names. Participants gave these word associations having read the name only, i.e. without a description of IVM. However, measures of attitudes and behavioural intentions were taken after participants had been given a description of IVM. The subsequent analysis therefore addresses the second and third research questions in a context where participants have all had the same information about what IVM is but in the context of one of the 4 names.

9.3.3 Effect of names on attitudes and behavioural intentions

A one-way MANOVA was used to analyse the effect of the different names on attitudes and behavioural intentions towards IVM. Using the experimentally manipulated name as the independent variable, we included two dependent variables: attitude (a composite of the 21 items shown in Table 9.2, $\alpha = .947$) and behavioural intentions (a composite of the five items shown in Table9.2, $\alpha = .918$)..

We then used Pillai's trace to test for significant differences between the experimental groups. Pillai's trace is considered one of the most robust test statistics for use in a MANOVA, and is widely used in analysis of this kind. We found there was a significant effect of name on attitudes and behavioural intentions towards IVM [$V = 0.107$, $F(6,362) = 3.415$, $p = .003$]. Separate univariate ANOVAs reveal that there were significant effects on attitudes towards IVM [$F(3,181) = 5.796$, $p = .001$) and behavioural intentions [$F(3,181) = 3.905$, $p = .010$).

The mean scores and standard deviations for each dependent variable in each experimental condition are shown in Table 9.4. Post-hoc pairwise comparisons were conducted using the Games-Howell test, which is a non-parametric test similar to Tukey's HSD, but it does not assume equal variances between groups. For each variable, significant differences between conditions are denoted with subscript letters. Means which are not significantly different share a subscript letter, whilst means which do not share a subscript letter are significantly different. For example, with respect to attitude, we can see that there is no significant difference between 'clean meat' and 'cultured meat', since they both share the subscript letter a. However, 'clean meat' is significantly different from 'lab grown meat', since they do not share a subscript letter.

Table 9.4. Mean scores and standard deviations of dependent variables across experimental conditions.

	Animal Free Meat	**Clean Meat**	**Cultured Meat**	**Lab Grown Meat**
Attitude	3.34_{a} (0.81)	3.43_{a} (0.74)	3.22_{ab} (0.81)	2.76_{b} (0.89)
Behavioural Intentions	3.08_{ab} (1.05)	3.35_{a} (0.98)	3.17_{ab} (1.00)	2.58_{b} (1.35)

These analyses address the second and third research questions, and allow us to conclude that the names used to refer to IVM are associated with significantly different attitudes and behavioural intentions towards it. The name 'clean meat' produced significantly more positive attitudes and behavioural intentions towards IVM compared to the name 'lab grown meat', but did not differ significantly from the other names tested. The name 'animal free meat' also produced significantly more positive attitudes towards IVM compared to the name 'lab grown meat' but there was no difference in behavioural intentions.

9.3.4 Mediation using word association valence

Based on the results of the MANOVA, we further subjected each of the significantly different outcomes to mediation analyses using the method described by Hayes (2017) and used by Siegrist et al. (2018). We wanted to test the extent to which the significant differences in attitude and behavioural intentions between naming conditions were mediated by the positivity of the associations participants gave in the word association task.

Mediation analysis is used to understand the mechanism through which an independent variable (name) affects a dependent variable (attitude and behaviour). In this case, we are testing the idea that the valence of immediate associations with certain names are what is really driving the differences in attitude and behavioural intentions between groups. In other words, different names cause different associations, and these associations result in different attitudes and intentions.

The mean valence (from -2 to +2) participants gave to their word associations was used as a mediator. Dummy variables were used to compare outcome variables between pairs of names for which significant differences were found. The outcomes of these analyses are shown in Figures 9.1 – 9.3. Nonstandardized coefficients and standard errors are presented for each path, which can be interpreted similarly to regression coefficients. Significant effects ($p < .05$) are depicted with solid lines and nonsignificant effects ($p > .05$) with dotted lines. Where a significant direct effect becomes insignificant in the presence of the mediating variable of association valence, this can be interpreted as meaning that the association valence accounts for the effect. Note that we only ran these analyses for variables and pairs of names for which significant differences existed.

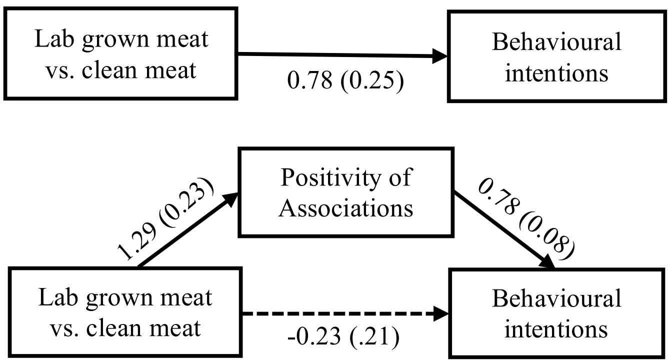


Fig 9.1. Results of the mediation analysis for 'lab grown meat' (dummy coded 0) vs. 'clean meat' (dummy coded 1) on behavioural intentions.

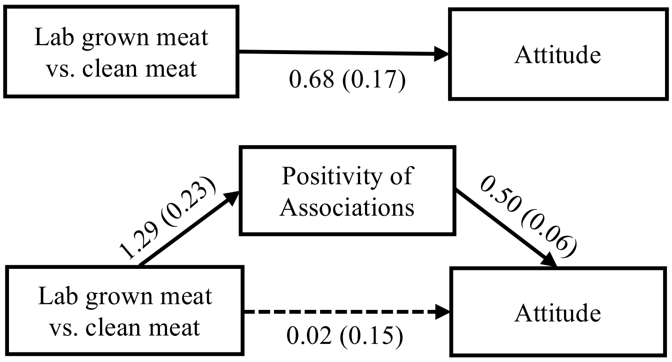


Fig 9.2. Results of the mediation analysis for ‘lab grown meat’ (dummy coded 0) vs. ‘clean meat’ (dummy coded 1) on attitudes.

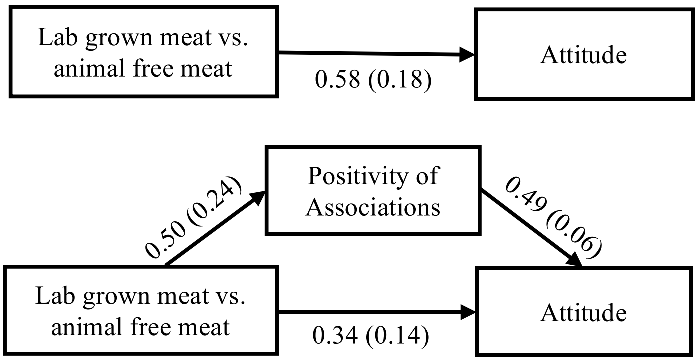


Fig 9.3. Results of the mediation analysis for ‘lab grown meat’ (dummy coded 0) vs. ‘animal free meat’ (dummy coded 1) on attitudes.

As shown in Figures 9.1 and 9.2, the effect of the name ‘clean meat’ compared to ‘lab grown meat’ on attitudes and behavioural intentions towards IVM was fully mediated by the positivity of associations participants gave. In other words, when controlling for the positivity of associations, there was no longer an effect of the name on attitudes ($p = 0.87$) and behavioural intentions ($p = 0.29$). Figure 9.3, meanwhile, shows that the effect of the name ‘animal free meat’ compared to ‘lab grown meat’ on attitudes towards IVM was partially mediated by the positivity of associations. That is to say, when controlling for positivity of associations, the effect of the name on attitudes to IVM was less strong, but was still significant ($p = .02$).

9.4. Discussion

In this experimental study, we manipulated the name used to describe IVM, and observed the subsequent effect on consumers’ associations, attitudes, and behavioural intentions towards the product.

9.4.1 Immediate associations

The word association exercise highlights the truism that any possible name for IVM carries with some connotations and associations. Since there is no possible name free of such associations, there is no 'neutral' name in terms of consumer perceptions. Perhaps in the future, this distinction will be less important, and IVM will simply be called 'meat' – as Shapiro (2018) points out, we no longer refer to the product of freezers as 'artificial ice'. Nonetheless, insofar as we want to distinguish IVM from conventional meat in the short term, it must be called something.

The name 'lab grown meat' evoked the most negative associations overall. This is largely due to the highest proportion of associations with artificiality/unnaturalness (15.7%) and disgust (13.8%), themes identified by Verbeke, Marcu et al. (2015) in focus groups where participants were introduced to IVM using the term 'synthetic meat'. This term also led to the highest proportion of associations with unusualness/novelty (9.4%), perhaps serving to identify IVM as something outside of the normal. Importantly, participants in this condition were also most likely to associate the term with threats to health (7.5%), a perception which has been linked to perceived unnaturalness (Laestadius, 2015; Siegrist, Sutterlin & Hartmann, 2018).

The name 'animal free meat' appeared to confuse consumers, who gave the highest number of associations with vegetarianism/veganism (15.3%), including words like 'soy' and 'tofu'. Beyond causing straightforward conflation with other product categories, this name might position IVM as a product for vegetarians, which would likely limit its appeal to meat-eaters (Bacon & Krpan, 2018). This would be a bad strategy overall, since we know that meat-eaters are more likely to find IVM appealing than vegetarians (Wilks & Phillips, 2017). Participants in this condition also gave associations to do with uncertainty/scepticism (6.3%) which likely stemmed from the apparent contradictions in this name; indeed, some reported associations like 'impossibility' and 'oxymoron'.

The name 'cultured meat' evoked the most associations related to science (9.6%) which were not rated negatively, but are conceptually similar to deviations from nature. Indeed, as Marcu et al. (2015) found, consumers often make sense of IVM by establishing polarities, including nature vs. science. This is reflected in the relatively high number of generically negative associations (5.3%). Furthermore, participants in this condition gave many associations related to meat preparation (8.6%) including 'processed', 'salted', and 'cured', indicating that people might conflate 'cultured meat' with other types of meat product, as discussed by Friedrich (2016).

Finally, the name 'clean meat' most commonly evoked associations with healthiness/nutrition (15.7%), tastiness (10.8%), cleanness (10.8%), and naturalness (10.8%). Whilst some interpretations of the word 'clean' were negative in this context (one participant gave the association 'bleach'), this name evoked the most positive associations, and the mean valence of associations was significantly higher for this name compared to all the other names. Many of the associations given in this condition (e.g. 'organic', 'no antibiotics', 'lean', and 'no fat') indicate that the name 'clean meat' was associated with positive qualities of other products.

9.4.2 Attitudes and intentions

Whilst some associations suggested that the terms 'clean meat', 'cultured meat', and 'animal free meat' may have been misunderstood by some consumers, it is interesting that these terms were associated with more positive attitudes and intentions towards IVM after participants were told what the terms referred to. We found significant differences between terms in measures of attitude and behavioural intentions for consumers who had read a description of IVM in which only the name varied. Therefore, the effect of the name on consumer perceptions is legitimate, and not based on misconceptions about the product.

Whilst attitudes towards 'animal free meat' and 'clean meat' were significantly more positive than those towards 'lab grown meat, the only significant difference in behavioural intentions was between 'lab grown meat' and 'clean meat'. This may be a result of highlighting the issue of animal use: whilst a surprisingly large proportion of consumers believe in treating farmed animals well and even banning slaughterhouses, very few actually align their behaviours with these beliefs in the form of vegetarianism (Sentience Institute, 2017). Therefore, highlighting this aspect of IVM led to relatively positive effects on attitudes, but little effect on behavioural intentions.

We also found some evidence that the valence of the immediate associations participants had for the different names mediated subsequent attitudes, beliefs, and behavioural intentions. This provides support for the view that it is differences in the valence of immediate associations, rather than other aspects of the names, which explains subsequent differences in attitudes. This mechanism supports the structure of social representations theory, which discusses naming as a component of anchoring (Höijer, 2011). By anchoring IVM to more positively valenced associations, participants in this study appeared to locate it in a network of non-threatening concepts, and subsequently develop more positive attitudes and intentions towards it.

Indeed, social representations theory would predict that naming unfamiliar concepts (as opposed to not naming them at all) should affect the shared attitudes we form towards them. It is said that anchoring a concept '…draws the unfamiliar into existing psychological categories, thereby locating the strange or foreign within the familiar.' (Fraser & Burchell, 2001, p. 274). This study provides empirical evidence to support the view that it is important not just *whether* concepts are named, but *how* they are named. Moscovici (1984, p. 35) wrote '…it is obvious that naming is not a purely intellectual operation aiming at a clarity of logical coherence. It is an operation related to a social attitude.' Here, we found evidence to support this, and further demonstrating how nomenclature can affect subsequent evaluations and intentions towards unfamiliar objects. Indeed, this is likely to be relevant to other domains in which people form attitudes towards unfamiliar technologies, and possibly social and political ideas.

Alongside naming, classification is also discussed as an important aspect of anchoring (Höijer, 2011). Whilst classification was not addressed in this study, it is likely to be relevant to studying IVM acceptance, especially given ongoing efforts to restrict the definition of meat in the US (Quartz, 2018). Social representations theory would suggest that whether IVM is ultimately classified as meat, or something other than meat, will have an important role in anchoring and shaping consumer perceptions. This classification taking place will provide an ideal opportunity to study these processes further.

9.4.3 Applications

As well as theoretical implications, these findings are informative for those communicating about IVM in the media. As we have seen the term 'lab grown meat' lead to the most negative associations, attitudes, and intentions towards IVM. Although media coverage f IVM has been overall positive about the ethical and environmental potential of the technology (Goodwin & Shoulders, 2013), it has tended to use the term 'lab grown meat'. This may be because the term appears to be associated with the least conceptual confusion about IVM, but as we have shown, it also likely causes people to focus on unnaturalness, a frame which could be conducive to committing the naturalistic fallacy in subsequent decision-making (Laestadius, 2015). Those seeking to highlight positive aspects of IVM should consider using the term 'clean meat' alongside a clear description of the concept.

Indeed, advocates in the area encourage adoption of this term in order to promote acceptance (Friedrich, 2016). This strategy reflects a recognition that names matter, and that IVM will be come to be widely known by some name, none of which are free of connotations.

More recently, IVM producers and others have started to use the name 'cell-based meat', a term which some believe will be worse for consumer acceptance (Medium, 2018). Indeed, Stephens et al. (2018) note that many names for IVM have been used over the years, and that some may come to be replaced by others in future. By providing a detailed analysis of how and why various names are linked to different kinds of responses, the current work provides a basis for informed speculation about the possible interpretations of different possible names. 'Cell-based meat', for example, might evoke many of the same associations of science and unnaturalness which led consumers in the current study to have negative associations around 'lab grown meat'.

9.4.4 Limitations

There are several potential limitations of this study to acknowledge. Firstly, it is possible that participants in this study anchored their evaluations to their initial associations more than they would in reality because they had to write them down and rate them. Whilst we cannot rule this possibility out based on the study design, the attitudes and intentions data is in line with findings of previous studies which did not include this word association element (Animal Charity Evaluators, 2017; The Good Food Institute, 2017). Secondly, the sample was not limited geographically, or to native English speakers. Whilst all participants understood English, it is likely that associations and evaluations are formed differently in a non-native language (Geipel, Hadjichristidis & Surian, 2016) and cultural differences may mean that associations with these terms are different in different countries. Thirdly, this was a relatively small sample compared to other studies in this thesis. The sample size was determined based on anticipating a medium effect size (Cohen, 1992). In fact, a larger sample may have identified other significant differences between names (previous research has found significant differences between 'clean' and 'cultured') but at the time of data collection, this study did not have specific funding unlike the others in the thesis, and therefore its sample size was limited. Finally, well-known limitations of self-reported data apply here: participants may have given inaccurate or exaggerated responses due to poor awareness and/or social desirability bias.

9.5 Conclusion

This study demonstrated that consumers' associations, attitudes, and behavioural intentions towards IVM vary depending on the associations elicited by different product names.
This study provides the necessary context for interpreting existing survey data on consumer acceptance of IVM, which has tended to describe IVM as being grown in a lab (Pew Research, 2014; YouGov, 2013). If those producing and marketing IVM are sensitive to the relevant evidence, they are likely to achieve higher acceptance than such survey data would suggest, given the significantly higher intentions to consume IVM when it is called 'clean meat'. Indeed, advocates might adopt other terms, which importantly should evoke positive associations.

One further avenue for future IVM research is nomenclature in different languages. While IVM is largely unfamiliar, the terms used to refer to it are likely to be contested, as we have shown. Direct translations of any of these English names may not make sense in different languages, and it is likely that different names would lead to different levels of consumer acceptance in any language. Further research might also address the possible effect of other characteristics of communications about IVM on consumer acceptance. Demonstrably, nomenclature matters, but it is likely that consumer acceptance of IVM will also depend on the benefits marketers choose to focus on, media coverage of the concept, and features of the product itself. All of these, like nomenclature, can be considered features of public communication about IVM, and all will likely affect consumer acceptance.

9.6 References

Animal Charity Evaluators. (2017). "Clean" Meat or "Cultured" Meat: A Randomized Trial Evaluating the Impact on Self-Reported Purchasing Preferences. Retrieved 13 June, 2017, from https://animalcharityevaluators.org/blog/clean-meat-or-cultured-meat-a-randomized-trial-evaluating-the-impact-on-self-reported-purchasing-preferences/

Ares, G., & Deliza, R. (2010). Studying the influence of package shape and colour on consumer expectations of milk desserts using word association and conjoint analysis. *Food quality and Preference, 21*(8), 930-937.

Ares, G., Giménez, A., & Gámbaro, A. (2008). Understanding consumers' perception of conventional and functional yogurts using word association and hard laddering. *Food quality and Preference, 19*(7), 636-643.

Bacon, L., & Krpan, D. (2018). (Not) Eating for the environment: The impact of restaurant menu design on vegetarian food choice. *Appetite, 125*, 190-200.

BBC. (2013). World's first lab-grown burger is eaten in London. Retrieved 09 January, 2017, from http://www.bbc.co.uk/news/science-environment-23576143

Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245-254.

Bell, R., & Paniesin, R. (1992). The influence of sauce, spice, and name on the perceived ethnic origin of selected culture-specific foods *Product Testing with Consumers for Research Guidance: Special Consumer Groups, Second Volume*: ASTM International.

Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for experimental research: Amazon. com's Mechanical Turk. *Political Analysis, 20*(3), 351-368.

Bertrand, M., & Mullainathan, S. (2004). Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination. *The American Economic Review, 94*(4), 991-1013.

Bhat, Z. F., & Bhat, H. (2011). Animal-free meat biofabrication. *American Journal of Food Technology, 6*(6), 441-459.

Bredahl, L. (2001). Determinants of consumer attitudes and purchase intentions with regard to genetically modified food–results of a cross-national survey. *Journal of Consumer Policy, 24*(1), 23-61.

Bryant, C. J., & Barnett, J. C. (2018). Consumer Acceptance of Cultured Meat: A Systematic Review. *Meat Science, 143*, 8-17. doi: https://doi.org/10.1016/j.meatsci.2018.04.008

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk a new source of inexpensive, yet high-quality, data? *Perspectives on psychological science, 6*(1), 3-5.

Cardello, A. V. (2003). Consumer concerns and expectations about novel food processing technologies: effects on product liking. *Appetite, 40*(3), 217-233. doi: http://dx.doi.org/10.1016/S0195-6663(03)00008-4

CBS News. (2018). Lab-grown meat could be in restaurants by 2021. Retrieved January 23, 2019 from https://www.cbsnews.com/news/mosa-meat-lab-grown-meat-could-be-restaurants-by-2021/

CNN. (2014). How test-tube meat could be the future of food. Retrieved February 21, 2017, from http://edition.cnn.com/2014/04/30/tech/innovation/cultured-meat/

Cohen, J. (1992). A power primer. *Psychological bulletin, 112*(1), 155.

Difallah, D., Filatova, E., & Ipeirotis, P. (2018, February). Demographics and dynamics of mechanical turk workers. In *Proceedings of the eleventh acm international conference on web search and data mining* (pp. 135-143). ACM.

Eiser, J. R., Miles, S., & Frewer, L. J. (2002). Trust, perceived risk, and attitudes toward food technologies1. *Journal of Applied Social Psychology, 32*(11), 2423-2433.

Forbes. (2016). How The Term 'Clean Meat' Could Undermine The Alternative Meat Movement. Retrieved February 7, 2017, from http://www.forbes.com/sites/eveturowpaul/2016/10/17/how-the-term-clean-meat-could-undermine-the-alternative-meat-movement/#44192aed5b41

Fraser, C., & Burchell, B. (2001). *Introducing Social Psychology*. Cambridge: Polity Press.

Frewer, L. J., Howard, C., Hedderley, D., & Shepherd, R. (1997). Consumer attitudes towards different food-processing technologies used in cheese production—The influence of consumer benefit. *Food quality and Preference, 8*(4), 271-280.

Frewer, L. J., Howard, C., Hedderley, D., & Shepherd, R. (1999). Reactions to information about genetic engineering: Impact of source characteristics, perceived personal relevance, and persuasiveness. *Public Understanding of Science, 8*(1), 35-50.

Frewer, L. J., Howard, C., & Shepherd, R. (1998). The influence of initial attitudes on responses to communication about genetic engineering in food production. *Agriculture and Human Values, 15*(1), 15-30.

Friedrich, B. (2016). "Clean Meat": The "Clean Energy" of Food. Retrieved 13 December, 2016, from http://www.gfi.org/clean-meat-the-clean-energy-of-food

Friedrich, B. (2018). "Clean Meat" Is Catching On: A Reflection on Nomenclature. Retrieved June 14, 2018, from https://www.gfi.org/clean-meat-is-catching-on-a-reflection-on

Geipel, J., Hadjichristidis, C., & Surian, L. (2016). Foreign language affects the contribution of intentions and outcomes to moral judgment. *Cognition, 154*, 34-39.

Goodwin, J. N., & Shoulders, C. W. (2013). The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science, 95*(3), 445-450. doi: 10.1016/j.meatsci.2013.05.027

Grunert, K. G., Bech-Larsen, T., Lähteenmäki, L., Ueland, Ø., & Åström, A. (2004). Attitudes towards the use of GMOs in food production and their impact on buying intention: The role of positive sensory experience. *Agribusiness, 20*(1), 95-107.

Guerrero, L., Claret, A., Verbeke, W., Enderli, G., Zakowska-Biemans, S., Vanhonacker, F., . . . Scalvedi, L. (2010). Perception of traditional food products in six European regions using free word association. *Food quality and Preference, 21*(2), 225-233.

Hart Research Associates. (2017). Perceptions of Cellular Agriculture: Key Findings from Qualitative Research. Washington, DC: Hart Research Associates.

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*: Guilford Publications.

Hocquette, A., Lambert, C., Sinquin, C., Peterolff, L., Wagner, Z., Bonny, S. P. F., . . . Hocquette, J. F. (2015). Educated consumers don't believe artificial meat is the solution to the problems with the meat industry. *Journal of Integrative Agriculture, 14*(2), 273-284. doi: 10.1016/S2095-3119(14)60886-8

Höijer, B. (2011). Social representations theory. *Nordicom Rev, 32*, 3-16.

Honkanen, P., & Verplanken, B. (2004). Understanding attitudes towards genetically modified food: The role of values and attitude strength. *Journal of Consumer Policy, 27*(4), 401-420.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31-36.

Kunst, J. R., & Hohle, S. M. (2016). Meat eaters by dissociation: How we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite, 105*, 758-774. doi: 10.1016/j.appet.2016.07.009

Laestadius, L. (2015). Public Perceptions of the Ethics of In-vitro Meat: Determining an Appropriate Course of Action. *Journal of Agricultural & Environmental Ethics, 28*(5), 991-1009. doi: 10.1007/s10806-015-9573-8

Laestadius, L. I., & Caldwell, M. A. (2015). Is the future of meat palatable? Perceptions of in vitro meat as evidenced by online news comments. *Public Health Nutrition, 18*(13), 2457-2467. doi: 10.1017/S1368980015000622

Laham, S. M., Koval, P., & Alter, A. L. (2012). The name-pronunciation effect: Why people like Mr. Smith more than Mr. Colquhoun. *Journal of Experimental Social Psychology, 48*(3), 752-756.

Magnusson, M. K., & Hursti, U.-K. K. (2002). Consumer attitudes towards genetically modified foods. *Appetite, 39*(1), 9-24.

Marcu, A., Gaspar, R., Rutsaert, P., Seibt, B., Fletcher, D., Verbeke, W., & Barnett, J. (2015). Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic meat. *Public Understanding of Science, 24*(5), 547-562. doi: 10.1177/0963662514521106

Marková, I. (2003). *Dialogicality and social representations: The dynamics of mind*: Cambridge University Press.

Mattick, C. S., Landis, A. E., Allenby, B. R., & Genovese, N. J. (2015). Anticipatory Life Cycle Analysis of In Vitro Biomass Cultivation for Cultured Meat Production in the United States. *Environmental Science & Technology, 49*(19), 11941-11949. doi: 10.1021/acs.est.5b01614

Medium. (2018). Clean Meat and Cell-Based Meat: What's in a Name? Retrieved February 21, 2019 from https://medium.com/@PaulShapiro/clean-meat-and-cell-based-meat-whats-in-a-name-d4366431deb7

Meiselman, H. L., & Bell, R. (1991). The effects of name and recipe on the perceived ethnicity and acceptability of selected Italian foods by British subjects. *Food quality and Preference, 3*(4), 209-214. doi: http://dx.doi.org/10.1016/0950-3293(91)90035-D

Moscovici, S. (1961). *La psychanalyse, son image et son public.* Paris: Presses Universitaires de France.

Moscovici, S. (1984). The Phenomenon of Social Representations. In R. Farr & S. Moscovici (Eds.), *Social Representations* (pp. 3-69). Cambridge: Cambridge University Press.

National Geographic. (2014). Meat, Shmeat. Retrieved Febraury 21, 2017, from http://theplate.nationalgeographic.com/2014/09/16/meat-shmeat/

NBC News. (2013). It's (not) alive! Franken-meat lurches from the lab to the frying pan. Retrieved February 20, 2017, from http://www.nbcnews.com/science/its-not-alive-franken-meat-lurches-lab-frying-pan-6c10835458

Next Nature. (2011). Animal-Free Meat Could Put a Hold on Global Warming. Retrieved February 21, 2017, from https://www.nextnature.net/2011/07/animal-free-meat-could-put-a-hold-on-global-warming/

Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010). Running experiments on amazon mechanical turk. *Judgment and Decision Making, 5*(5), 411-419.

Pew Research. (2014). U.S. Views of Technology and the Future: Science in the next 50 years.

Quartz. (2018). US ranchers want to use the federal government as a proxy to fight high-tech meat companies. Retrieved June 14, 2018, from https://qz.com/1249622/the-us-beef-industry-is-divided-over-whether-to-call-clean-meat-meat/

Rand, D. G. (2012). The promise of Mechanical Turk: How online labor markets can help theorists run behavioral experiments. *Journal of theoretical biology, 299*, 172-179.

Roininen, K., Arvola, A., & Lähteenmäki, L. (2006). Exploring consumers' perceptions of local food with two different qualitative techniques: Laddering and word association. *Food quality and Preference, 17*(1), 20-30.

Saba, A., & Vassallo, M. (2002). Consumer attitudes toward the use of gene technology in tomato production. *Food quality and Preference, 13*(1), 13-21.

Savadori, L., Savio, S., Nicotra, E., Rumiati, R., Finucane, M., & Slovic, P. (2004). Expert and public perception of risk from biotechnology. *Risk analysis, 24*(5), 1289-1299.

Schaefer, G. O., & Savulescu, J. (2014). The Ethics of Producing InVitro Meat. *Journal of Applied Philosophy, 31*(2), 188-202. doi: 10.1111/japp.12056

Scholderer, J., & Frewer, L. J. (2003). The biotechnology communication paradox: Experimental evidence and the need for a new strategy. *Journal of Consumer Policy, 26*(2), 125-157.

Schuldt, J. P., & Hannahan, M. (2013). When good deeds leave a bad taste. Negative inferences from ethical food claims. *Appetite, 62*, 76-83.

Sentience Institute. (2017, November 20). *Survey of US Attitudes Towards Animal Farming and Animal-Free Food October 2017.* Retrieved 21 February, 2019, from https://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017

Shapiro, P. (2018). *Clean Meat.* New York: Gallery Books.

Sharma, S., Thind, S. S., & Kaur, A. (2015). In vitro meat production system: why and how? *Journal of Food Science and Technology-Mysore, 52*(12), 7599-7607. doi: 10.1007/s13197-015-1972-3

Siegrist, M., Sütterlin, B., & Hartmann, C. (2018). Perceived naturalness and evoked disgust influence acceptance of cultured meat. *Meat Science, 139*, 213-219.

Sommers, S. (2012). What's in a Name? What your name says about you (and how it says it). Retrieved February 21, 2017, from https://www.psychologytoday.com/blog/science-small-talk/201207/whats-in-name

Spence, C., & Piqueras-Fiszman, B. (2014). Tastes Great, But What do We Call It? The Art and Science of Food Description *The Perfect Meal* (pp. 71-107): John Wiley & Sons, Ltd.

Stephens, N., Dunsford, I., Di Silvio, L., Ellis, M., Glencross, A., & Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science & Technology, 78*, 155-166.

Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences (4th ed.)*. Hillsdale, NJ: Erlbaum.

Tan, H. S. G., Verbaan, Y. T., & Stieger, M. (2016). How will better products improve the sensory-liking and willingness to buy insect-based foods? *Food Research International*.

Tanaka, Y. (2004). Major Psychological Factors Affecting Acceptance of Gene-Recombination Technology. *Risk analysis, 24*(6), 1575-1583.

Tenbült, P., de Vries, N. K., Dreezens, E., & Martijn, C. (2005). Perceived naturalness and acceptance of genetically modified food. *Appetite, 45*(1), 47-50.

The Daily Mail. (2016). First test-tube MEATBALL revealed: Startup claims lab grown meat will be on shelves within three years and says raising animals to eat will soon be 'unthinkable'. Retrieved February 21, 2017, from http://www.dailymail.co.uk/sciencetech/article-3428438/First-test-tube-MEATBALL-revealed-Startup-claims-lab-grown-meat-shelves-three-years-says-raising-animals-eat-soon-unthinkable.html

The Good Food Institute. (2017). Clean Meat: The Naming of Tissue-Engineered Meat. Retrieved 13 June, 2017, from http://mfait.gfi.org/the-naming-of-clean-meat

The Grocer. (2017). Meat the future... and how to market it. Retrieved February 21, 2017, from http://www.thegrocer.co.uk/buying-and-supplying/categories/meat/meat-the-future-and-how-to-market-it/546754.article

The Huffington Post. (2014). A Future With In Vitro Meat Is Closer Than You Think. Retrieved February 21, 2017, from http://www.huffingtonpost.ca/robert-bolton/in-vitro-meat_b_5909836.html

The Washington Post. (2016). Lab-grown meat is in your future, and it may be healthier than the real stuff. Retrieved February 21, 2017, from https://www.washingtonpost.com/national/health-science/lab-grown-meat-is-in-your-future-and-it-may-be-healthier-than-the-real-stuff/2016/05/02/aa893f34-e630-11e5-a6f3-21ccdbc5f74e_story.html?utm_term=.339bff30314d

Time. (2016). You Asked: Should I Be Nervous About Lab-Grown Meat? Retrieved February 21, 2017, from http://time.com/4490128/artificial-meat-protein/

Titchener, G. D., & Sapp, S. G. (2002). A comparison of two approaches to understanding consumer opinions of biotechnology. *Social Behavior and Personality: an international journal, 30*(4), 373-381.

Townsend, E., & Campbell, S. (2004). Psychological determinants of willingness to taste and purchase genetically modified food. *Risk analysis, 24*(5), 1385-1393.

Tuomisto, H. L., & de Mattos, M. J. T. (2011). Environmental Impacts of Cultured Meat Production. *Environmental Science & Technology, 45*(14), 6117-6123. doi: 10.1021/es200130u

Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Science, 102*, 49-58. doi: 10.1016/j.meatsci.2014.11.013

Verbeke, W., Sans, P., & Van Loo, E. J. (2015). Challenges and prospects for consumer acceptance of cultured meat. *Journal of Integrative Agriculture, 14*(2), 285-294. doi: 10.1016/S2095-3119(14)60884-4

Wall Street Journal. (2017a). Hampton Creek Aims at New Market: Growing Meat. Retrieved 08 August, 2017, from https://www.wsj.com/articles/hampton-creek-aims-at-new-market-growing-meat-1498592294

Wall Street Journal. (2017b). Startup Serves Up Chicken Produced From Cells in Lab. Retrieved 13 June, 2017, from https://www.wsj.com/articles/startup-to-serve-up-chicken-strips-cultivated-from-cells-in-lab-1489570202

Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PloS one, 12*(2), e0171904.

Wolfson, J., & Oshinsky, N. S. (1966). Food Names and Acceptability. *Journal of Advertising Research, 6*(1), 21-23.

YouGov. (2013). No British demand for fake meat. Retrieved August 13, 2017, from https://yougov.co.uk/news/2013/08/05/no-demand-fake-meat/

Yuan, Z., & Purver, M. (2015). Predicting emotion labels for chinese microblog texts *Advances in Social Media Analysis* (pp. 129-149): Springer.

9.7 Appendices

Appendix 9A: Items used in the attitude measure with previous studies/justifications.

No.	Item	Previous Studies
1	Eating [X] is likely to be healthy.	Magnusson and Hursti (2002); Tenbült, de Vries, Dreezens, and Martijn (2005)
2	[X] is likely to look, taste, smell, and feel the same as conventional meat.	Cardello (2003); Tan, Verbaan, and Stieger (2016)
3	I think I could tell the difference between [X] and conventional meat. *	Cardello (2003); Tan et al. (2016)
4	[X] is likely to contain chemicals or ingredients which should be avoided. *	The Grocer (2017) found that 56% of respondents cited this as a concern
5	[X] is likely to be safe for human consumption.	Frewer, Howard, Hedderley, and Shepherd (1997); Tanaka (2004); Titchener and Sapp (2002)
6	I would trust [X].	Eiser, Miles, and Frewer (2002); Tanaka (2004)
7	[X] is unnatural. *	Frewer et al. (1997); Tenbült et al. (2005); Townsend and Campbell (2004)
8	[X] is appealing to me.	None. Added for completeness.
9	I feel positive about the development of [X].	Honkanen and Verplanken (2004)
10	The idea of eating [X] is disgusting. *	Townsend and Campbell (2004)
11	I feel comfortable about the idea of eating [X].	None. Added for completeness.
12	I would be anxious about eating [X]. *	Frewer, Howard, Hedderley, and Shepherd (1999); Frewer, Howard, and Shepherd (1998)
13	Eating [X] would conflict with my values. *	Honkanen and Verplanken (2004)
14	I feel that I would have control over my decision to eat [X] or not.	Magnusson and Hursti (2002); Saba and Vassallo (2002)
15	The production of [X] is a necessary scientific development.	Frewer et al. (1997); Frewer et al. (1998); Tenbült et al. (2005)
16	Others would disapprove of me eating [X]. *	Saba and Vassallo (2002)
17	[X] will have benefits for society.	Magnusson and Hursti (2002); Scholderer and Frewer (2003)
18	Production of [X] is wise.	Bredahl (2001); Grunert, Bech-Larsen, Lähteenmäki, Ueland, and Åström (2004); Scholderer and Frewer (2003)
19	Producing [X] is ethical.	Magnusson and Hursti (2002); Townsend and Campbell (2004)
20	Producing [X] poses a risk to society. *	Frewer et al. (1998); Savadori et al. (2004)
21	[X] is more environmentally friendly than conventional meat.	None. Added for completeness.

We saw in this study that different names for cultured meat invoked different associations, which subsequently affected consumers' attitudes and behavioural intentions towards it. This was a more effective method of impacting consumer acceptance than argumentation, as in the naturalness study, and may be more practical/actionable for advocates, for whom nomenclature is an important way to leverage their influence to promote consumer acceptance.

In the two years since the publication of our systematic review (Bryant & Barnett, 2018) there has been a vast increase in empirical research on this topic, of which I am proud to be a part. Researchers from around the world have continued to investigate how people see cultured meat, building an ever more complete picture of public attitudes. My eighth study is an updated review of the empirical research on consumer acceptance of cultured meat.

This declaration concerns the article entitled:									
Consumer Acceptance of Cultured Meat: An Updated Review									
Publication status (tick one)									
Draft manuscript		**Submitted**	X	**In review**		**Accepted**		**Published**	
Publication details (reference)	Bryant, C. & Barnett, J. (forthcoming). Consumer Acceptance of Cultured Meat: An Updated Review. *International Journal of Molecular Science.*								
Copyright status (tick the appropriate statement)									
I hold the copyright for this material		Copyright is retained by the publisher, but I have been given permission to replicate the material here							
Candidate's contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** 90%. Conducted the review with Julie's help. **Design of methodology:** 90%. Conducted the review with Julie's help. **Presentation of data in journal format:** 75%. Wrote the first and final manuscript with input from Julie.								
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.								
Signed		**Date**	29 June 2020						

10. Consumer Acceptance of Cultured Meat: An Updated Review

Abstract

Cultured meat is one of a number of alternative proteins which can help to reduce demand for meat from animals in the future. As cultured meat nears commercialisation, research on consumers' perceptions of the technology has proliferated. We build on our 2018 systematic review to identify 26 empirical studies on consumer acceptance of cultured meat published in peer reviewed journals since then. We find support for many of the findings of our previous review, as well as novel insights into the market for cultured meat. We find evidence for a substantial market for cultured meat in many countries, as well as markets and demographics which are particularly open to the concept. Consumers mostly identified animal- and environment-related benefits, but there is plenty of potential to highlight personal benefits such as health and food safety. The safety of cultured meat and its nutritional qualities are intuitively seen as risks by some consumers, although some recognise potential benefits in these areas. Evidence suggests that acceptance can be increased with positive information, as well as frames which invoke more positive associations. Implications for researchers and advocates are discussed.

10.1 Introduction

Our current meat production system is resource intensive, harmful to the environment, cruel to animals, and linked to a number of public health issues including animal-transmitted pandemics and antibiotic resistance (IPCC, 2018; Lymbery & Oakshotte, 2014; Mathew, Cissell & Liamthong, 2007; Oliver, Murinda & Jayarao, 2011). Yet global demand for meat is forecast to increase rapidly as the world population grows (OECD/FAO, 2018). Evidence suggests that the current system is not sustainable and if we want to mitigate the associated environmental and public health risks without needing to substantially reduce consumption, an alternative means of meat production is required.

Cultured meat grown from animal cells is one proposed way to address these issues, as its production entails far less environmental and public health harm, as well as avoiding animal slaughter (Post et al., 2020; Tuomisto, 2019). Although it is not yet available to consumers, cultured meat has some distinct advantages over other forms of alternative protein. Unlike plant-based meats which emulate meat using plant proteins, cultured meat is real animal protein and therefore has unique potential to replace animal products directly, addressing concerns that some consumers may have about the ingredients and relative nutrition of plant-based meats. Unlike insects which are also touted as an alternative protein, cultured meat allows consumers to continue eating traditional and familiar meat species and avoid killing animals for food.

Recent years have seen significant shifts in institutions as they prepare for the arrival of cultured meat and related ‘cellular agriculture’ products. While investors and established meat industry players have moved capital to back the new technology, regulators and lobbyists have begun to discuss its regulation (Kateman, 2020; Purdy, 2020). The most optimistic cultured meat companies currently estimate that they will be selling products before the end of 2021 (Foote, 2020). As cultured meat gets closer to reality, research on consumer acceptance has proliferated.

Since our 2018 systematic review of the peer-reviewed empirical research on consumer acceptance of cultured meat (Bryant & Barnett, 2018), investigation in the area has flourished. Our initial systematic review contained 14 studies; since its publication, the number of peer-reviewed empirical studies on the topic has more than doubled, while studies in the grey literature continue to blossom. Their findings support existing literature and also shed light on previously unexplored aspects of consumer psychology with respect to cultured meat.

Our previous review discussed the research in terms of overall acceptance, common objections, doubts and uncertainty, and positive perceptions (Bryant & Barnett, 2018). Some of the major themes included demographic predictors of acceptance, the issue of perceived unnaturalness and related food safety issues, speculation about taste and price, discussion of feasibility, ethical status, and regulation, and perceived benefits principally for animals and the environment. More recent studies develop these themes and explore new ones.

In this paper, we provide an updated review of the empirical literature on consumer acceptance of cultured meat published in peer reviewed journals. It is our intention to synthesize the findings and assess the field to provide a picture of what we know and what is yet to be explored.

10.2 Methods

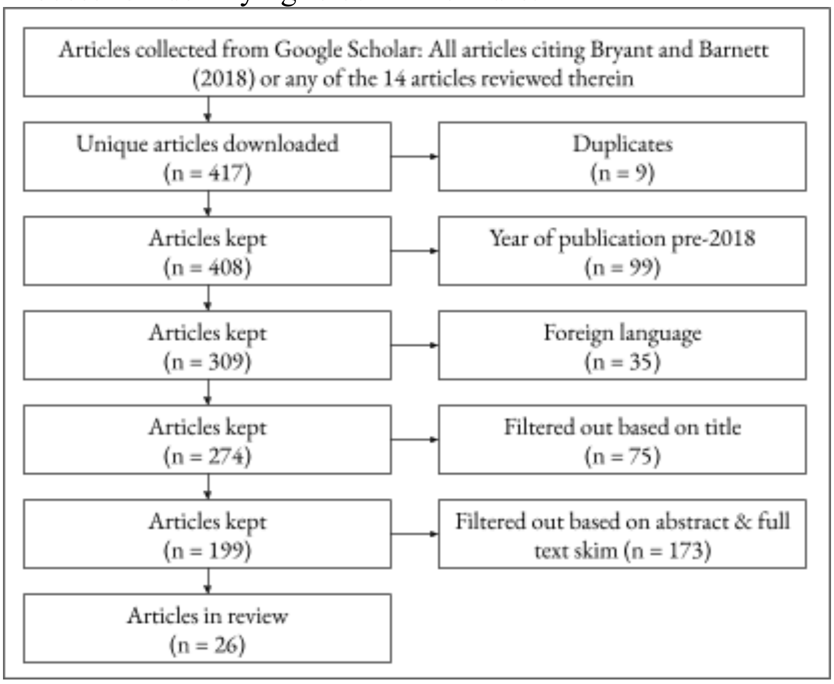
In order to identify new empirical studies in the space, we used citation tracking on Google Scholar from our 2018 review and the 14 empirical studies contained therein. We note that it is possible, though unlikely, that studies could exist which do not cite any of the existing literature on the topic - such studies would be missed using this method. We note further that all of the studies contained in this review would have been identified using the same search term as in our 2018 review. Altogether, these 15 papers had 417 unique citations on Google Scholar. We filtered these 417 papers according to the inclusion criteria in Table 10.1.

Table 10.1: Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
1. Focus on consumer perceptions of cultured meat 2. Presents original empirical data 3. Published in a peer reviewed journal 4. Published since 2018 (inclusive) 5. English language	1. Sources which do not discuss consumer perceptions of cultured meat 2. Review articles which do not include original empirical data 3. Book chapters, conference papers, and unpublished theses and white papers 4. Articles already reviewed in Bryant and Barnett (2018)

Applying these criteria, we filtered the literature according to the process shown in Figure 10.1.

Figure 10.1: Process for identifying relevant literature.



Through this process, we identified 26 studies relevant for inclusion in the review. In the remainder of the paper, we first list the key details of these studies, and then discuss the key themes observed across the literature.

10.3 Studies Reviewed

Table 10.2 contains the key details of the 26 studies included in this review.

Table 10.2: Key details of 26 studies included in the review

Study	Method	Sample	Key findings
Arora, Brent and Jaenicke (2020)	Survey	394 Mumbai adults	There are distinct groups of consumers who prefer each of four different protein sources: chana (21%), conventional meat (27.5%), plant-based meat (32%) or cultured meat (19.6%). Consumers were willing to pay a small premium for cultured meat compared to conventional meat.
Bryant, Anderson, Asher, Green and Gasteratos (2019)	Experimental	1,185 US adults, census balanced	The arguments that cultured meat is natural, and that naturalness should not matter tend not to persuade consumers, and resulted in lower acceptance than discussing general benefits without addressing naturalness. Arguing for the unnaturalness of conventional meat was relatively effective, though this argument may not be politically feasible for a co-operative market strategy.
Bryant and Barnett (2019)	Experimental	185 adults recruited online	The name used to describe cultured meat has a significant effect on consumers' attitudes and behavioural intentions, with 'clean meat' resulting in significantly more positive attitudes than 'lab-grown meat' ('cultured meat' and 'animal-free meat' were not significantly different from either of the first two names). This effect was mediated by the positivity of word associations, suggesting that the mechanism is associative.
Bryant and Dillard (2019)	Survey	480 US adults, generally representative	A frame focused on the high-technology/scientific nature of cultured meat resulted in significantly less positive attitudes and intentions compared to frames focused on the societal benefits of cultured meat, or its similarity to conventional meat.
Bryant, Szejda, Parekh, Deshpande and Tse (2019)	Experimental	3,030 adults in the US, India, and China, generally representative	There are substantial markets for cultured meat (and plant-based meat) in China, India, and the USA, and acceptance of both is significantly higher in China and India compared to the USA. While some demographic predictors of acceptance such as being a meat-eater and being left-leaning predicted cultured meat acceptance across countries, specific attitudinal predictors varied. Disgust predicted cultured meat rejection in the USA only, whilst acceptance in China was driven by perceived healthiness and safety, and ethical considerations were uniquely predictive of acceptance in India.

Circus and Robison (2019)	Survey	139 UK adults, convenience samples, disproportionately meat reducers	Cultured meat was preferred to insects, but plant-based meat was preferred to cultured meat. Meat attachment was positively related to cultured meat acceptance. People generally held congruent views with respect to societal views of, and personal willingness to eat cultured meat.
Dupont and Fiebelkorn (2020)	Survey	718 German children and adolescents (mean age 13.67, 57% female)	Participants preferred cultured meat burgers to insect burgers, though they broadly found both disgusting. Attitudes towards specific product formats are important for children. Those higher in neophobia and disgust sensitivity were less likely to want to eat cultured meat.
Egolf, Hartmann and Siegrist (2019)	Survey	313 Swiss adults, nat rep	Cultured meat rejection was predicted by disgust. Although cultured meat was considered the most beneficial of three food technologies included, it was more accepted than GMOs but less accepted than a synthetic food additive.
Geipel, Hadjichristidis and Klesse (2018)	Experimental	161 MTurk participants (mostly female, young) German-speaking	Consumers are more likely to say they would eat cultured meat when asked about it in a foreign language (vs. their native language). The effect was mediated by disgust.
Gomez-Luciano, de Aguiar, Vriesekoop and Urbano (2019a)	Survey	729 adults in the UK, Spain, Brazil, and the Dominican Republic	Meat alternatives were generally more appealing to to higher income groups, and cultured meat was more appealing to the European countries than the non-European countries. Perceived healthiness, nutrition, and safety were important predictors of willingness to pay for cultured meat across countries.
Gomez-Luciano, Vriesekoop and Urbano (2019b)	Survey	401 adults from the Dominican Republic and Spain	Participants generally preferred cultured meat to insects, but preferred plant-based meat to cultured meat. Cultured meat was generally rated worse than alternatives on perceived healthiness, safety, nutrition, sustainability, and price. Being male and having higher education were predictors of choosing alternative proteins.
Grasso, Hung, Olthof,	Survey	1,825 community-dwelling older adults (65+) in the UK,	Cultured meat was the least preferred alternative protein, chosen by just 6% of participants compared to plant-based protein (58%), single-cell protein

Verbeke and Brouwer (2019)		the Netherlands, Poland, Spain, and Finland	(20%) and insect-based protein (9%). Compared to the UK, participants were in the Netherlands (23%) and Finlalnd (14%) were more likely to eat cultured meat, whilst those in Spain (5%) and Poland (39%) were less likely. Anticipated price and taste were predictors of cultured meat acceptance, as well as food fussiness and green eating behaviour.
Koch, van Ittersum and Bolderdijk (2018)	Experimental	145 Dutch participants	Cultured meat was perceived to violate norms, which caused moral disgust and subsequent rejection by consumers.
Lupton and Turner (2018)	Online focus group discussion	30 Australian adults	Participants recognised the benefits of cultured meat for society, but generally considered it unnatural, not fresh, not nutritious, potentially harmful, and lacking in taste. Cultured meat was considered less natural and less nutritious than insects.
Mancini and Antonioli (2019)	Survey	525 Italian adults, generally representative	The majority (54%) were willing to try cultured meat. People generally agreed with the positive external effects of cultured meat (for animals, the environment, and food security) but gave lower ratings to its intrinsic characteristics (safety, taste, and nutrition). Predictors of acceptance included youth, higher education, higher familiarity, and being a meat-eater.
Mancini and Antonioli (2020)	Experimental	525 Italian adults, generally representative	Providing consumers with additional positive information about cultured meat increased acceptance, including willingness to buy, but not willingness to try.
Michel and Siegrist (2019)	Survey	632 German participants	Subjective importance of naturalness predicted cultured meat acceptance. Those who consider naturalness to be important are less likely to consider cultured meat natural, and are less likely to consume cultured meat.
Rolland, Markus and Post (2020)	Experimental	193 adults who lived close to Maastricht	Acceptance of cultured meat was increased by the provision of positive information, and by a (simulated) tasting experience. Of three conditions, information about the personal benefits of cultured meat led to a significantly higher improvement in attitudes than information about the

			quality and taste, though information about the societal benefits produced an improvement in attitudes no different from the other two conditions. All participants ate what they believed was a cultured meat burger, and rated it as better tasting than a conventional burger despite a lack of objective difference.
Shaw and Mac Con Iomaire (2019)	Focus groups	312 Irish adults Convenience sample, roughly stratified to include young and old rural and urban participants	Participants generally characterised cultured meat as unnatural, and had related safety concerns. They expressed trust in Irish meat, and distrust in food companies and food labelling regulations. In particular, they showed concern about the implications of cultured meat for Irish farmers. Participants generally expected cultured meat to have an inferior taste and texture, and expected it to be cheaper than conventional meat. Environmental benefits were seen as most important, whilst safety was the biggest concern. Characteristics associated with acceptance included being younger, being male, and living in an urban area.
Specht, Rumble and Buck (2020)	Twitter analysis	2,763 Tweets from inside the USA over a 6 month period	Tweets discussing cultured meat generally discussed eight themes: legality and marketing, sustainability,; acceptance, business, animal concerns, science and technology, health concerns, and timeline. Influencers discussing this topic included philanthropists, government officials, journalists and writers, and animal advocates. Interested groups included top news and tech influencers, vegan groups, and agricultural interests, as well as media personalities Joe Rogan. Discourse was found to be driven by specific events in the media.
Tucker (2018)	Focus groups	69 New Zealand participants in 19 focus groups	Generally, participants considered cultured meat unnatural, and not ‘real meat’, though some acknowledged potential environmental benefits.

Valente, Fiedler, Heidemann and Molento (2019)	Survey	626 Brazilians Snowball sample from two towns, disproportionately female and well-educated	Many participants perceived problems with conventional meat, principally around animal welfare but also with respect to the environment and human health. Though 81% knew little or nothing about cellular agriculture, 39% said they would eat cultured meat with no conditions and a further 24% said it depends on factors such as taste, healthiness, price, and further information. Just 15% said they would not eat cultured meat (22% said don't know). The biggest motivators were animal welfare, the environment, health, and trying alternatives, whilst the major concerns were affordability, healthiness, ethics, and a lack of research.
Van der Weele and Driessen (2019)	Focus groups	~45 people in the Netherlands, including older and younger groups	Overall, reflecting on cultured meat caused people to reveal deep ambivalence about eating animals. Younger people generally wondered about whether they would eat cultured meat; older people wondered about the transition at a societal and historical level. Generally, the conversations revealed a lot of ambivalence about eating meat.
Weinrich, Strack and Neugebauer (2020)	Survey	713 German adults, generally representative	Participants were moderately prepared to accept cultured meat: 57% would try it, 30% would buy regularly. Attitudes were structured in three dimensions: the strongest predictor of acceptance was perceived ethical benefits, followed by emotional objections, and optimism about global diffusion.
Wilks, Phillips, Fielding and Hornsey (2019)	Survey	1,193 US adults, generally representative	Food neophobia, political conservatism, and distrust of food scientists predicted rejection. Food hygiene sensitivity, food neophobia and conspiratorial ideation predicted absolute rejection. Naturalness sensitivity did not predict either measure of acceptance.
Zhang, Li and Bai (2020)	Survey	1,004 urban Chinese consumers	Despite most respondents having limited knowledge of cultured meat, most do not oppose it. Over 70% are willing to taste or purchase cultured meat, and consumers are willing to pay an average of 2.2% more than for conventional meat. Predictors of cultured meat acceptance included being younger, being male, having a higher level of education, and having higher trust in the government's regulation of food safety.

The remainder of the paper will discuss the major themes identified in these studies. We will first review overall acceptance, including representative survey results, comparisons with other alternative proteins, and which countries and demographic groups are most open to the concept. Next, we will discuss the perceived benefits of cultured meat identified in these studies, including to animals, the environment, health, food safety, and world hunger. We then highlight the key barriers to cultured meat acceptance, including safety and nutrition concerns related to the perception of unnaturalness, trust, disgust, food neophobia, economic anxieties, and ethical concerns. We also discuss two key uncertainties which will play a large role in determining consumer acceptance in the long term: price and taste. Finally, we review the growing volume of experimental and intervention research which aims to identify ways of increasing cultured meat acceptance.

10.4 Consumer Acceptance

In this section, we will review overall acceptance of cultured meat, including comparisons to other alternative proteins and comparisons across countries and demographic groups.

10.4.1 Overall Acceptance Rates

Our previous review found that survey data tended to show that most consumers would try cultured meat, but not necessarily use it as a replacement for conventional meat on an ongoing basis (Bryant & Barnett, 2018; Slade, 2018; Verbeke, Sans & Van Loo, 2015; Wilks & Phillips, 2017). Surveys are one of the most common methods used in research on cultured meat acceptance, and as such, six studies provide fresh estimates of overall acceptance with representative samples. In Table 10.3, we list all of the reported overall rates of acceptance from studies which had generally representative national samples in terms of gender and age. Studies which primarily used qualitative methods and/or non-representative samples are not included in this table.

Table 10.3: Representative surveys of cultured meat acceptance.

Study	Sample	Acceptance Rate
Bryant et al. (2019a)	1,185 adults in the US. Census balanced.	66.4% would try; 48.9% would eat regularly; 55.2% would eat instead of conventional meat
Bryant et al. (2019b)	3,030 adults in the US, India, and China.	US: 29.8% very or extremely likely to purchase China: 59.3% India: 48.7%
Bryant & Dillard (2019)	480 adults in the US.	64.6% would try; 24.5% would buy regularly; 48.5% would eat instead of conventional meat
Gomez Luciano et al. (2019a)	729 adults in the UK, Spain, Brazil, and the Dominican Republic.	Would purchase, UK: 20%; Spain: 42%; Brazil: 11.5%; Dominican Republic: 15%
Mancini & Antonioli (2019)	525 adults in Italy.	54% would try; 44% would buy; 23% would pay a premium
Weinrich, Strack & Neugebauer (2020)	713 adults in Germany.	57% would try; 30% would buy

As shown in Table 10.3, most studies find that a majority of consumers would at least try cultured meat, and substantial portions say they would eat it regularly or as a replacement for conventional meat. A number of studies support the view that substantial consumer markets exist for cultured meat across America, Europe, and Asia. Although question wording varied across studies (see Table 10.2 for details), these studies tended to follow previous work in giving descriptions of cultured meat followed by a series of Likert scale questions asking about willingness to eat.

10.4.2 Personal and Societal Considerations

One of the major themes identified in previous literature on cultured meat acceptance is the consideration of cost and benefits to the individual, as well as to society overall. Our previous review found that people typically perceive the benefits of cultured meat as accruing to society, but the risks accruing to themselves (Bryant & Barnett, 2018; Verbeke et al., 2015). More recent work appears to support this view (Lupton & Turner, 2018). Mancini and Antonioli (2019) demonstrated that Italian consumers were in agreement with respect to societal benefits, but there was less agreement regarding personal benefits such as taste, nutrition, and food safety.

The disconnect between societal benefits and perceived personal costs results in some consumers being in favour of cultured meat in principle, but preferring not to eat it themselves. Circus and Robison (2019) found this to be the case with cultured meat more than with other alternative proteins, though views on these issues were generally congruent. This may be because consumers are more likely to perceive personal risk from cultured meat compared to other alternative proteins (Gomez-Luciano et al., 2019b). People with this view may be late adopters, waiting to observe whether and how others adopt the technology (see Rogers, 2003).

Interestingly, experimental work has found no significant difference in consumer attitudes between frames which emphasize personal benefits and frames which emphasize societal benefits (Bryant & Dillard, 2019, Rolland et al., 2020). However, when compared to other frames also used in these studies, we do see some significant differences: in the case of Bryant and Dillard (2019), both a frame highlighting societal benefits and a frame highlighting personal benefits led to significantly more positive perceptions than a frame highlighting the technological/scientific aspect of cultured meat. In the case of Rolland et al. (2020) the personal benefits frame, but not the societal benefits frame, led to significantly more positive attitudes than a third 'meat quality and taste' frame did. This suggests that there could be some advantage of emphasizing personal over societal benefits.

The relative salience of societal vs. personal perspectives may differ for different people. In Dutch focus groups, Van der Weele and Driessen (2019) report that younger participants tended to prioritise talking about whether and how they would interact with cultured meat personally, whereas older participants tended to be more reflective on what a societal transition towards cultured meat might look like. Likewise, Bryant et al (2019a) found that different attitudes were associated with cultured meat acceptance in different countries - while disgust predicted rejection in the US, a positive ethical evaluation predicted acceptance in India.

10.4.3 Comparisons to Other Alternative Proteins and Food Technologies

Our previous review found some comparisons with other alternative proteins (Bryant & Barnett, 2018; Slade, 2018) though these were far more common in more recent literature.

While cultured meat has garnered attention for its novelty and revolutionary potential, some commentators have worried that a focus on novel technological solutions could cause researchers and resources to overlook other more immediately available alternatives (Bohm et al., 2018; van der Weele et al., 2019).

Meanwhile, others have suggested that we learn from other similar food technology innovations such as genetically modified organisms (GMOs; see Mohorcich & Reese, 2019). In particular, European advocates should be wary of similarities in perceptions of cultured meat and GMOs, given the legal status of the latter (Bryant & Barnett, 2018). Egolf et al. (2019) found that cultured meat was more acceptable to their Swiss sample compared to genetically modified food, which is encouraging news for cultured meat companies aiming to sell products in Europe.

Several studies have compared acceptance of cultured meat to insect protein. Entomophagy, the practice of eating insects, has become a part of the alternative protein conversation for some - however, the evidence broadly suggests that this is less appealing to consumers than cultured meat (Circus & Robison, 2019; Dupont & Fiebelkorn, 2020; Gomez Luciano et al., 2019b). This preference was observed in most studies which made the comparison (with the exception of Grasso et al. (2019)) and some authors report that consumers preferred cultured meat over eating insects even though they rated it as less natural and less healthy (Dupont & Fiebelkorn, 2020; Gomez-Luciano et al., 2019b).

There are also several comparisons of cultured meat to plant-based meat. These generally find that plant-based meat is acceptable to more consumers at this time (Cricus & Robison, 2019; Gomez-Luciano et al, 2019b; Grasso et al., 2019). This may be because plant-based meat is more familiar to consumers (Bryant et al., 2019b) - indeed, as it is already available, some will have already eaten it.

However, although there is a preference for plant-based meat on aggregate, other work indicates there is still a role for cultured meat to play. Arora, Brent and Jaenicke (2020) classified consumers in their Mumbai sample into one of four categories based on a latent class model of a discrete choice experiment. They found that consumers in this sample were fairly diverse in terms of their preferences for different protein sources: some, who were most likely to be vegetarian, preferred chana (21%); some, who were most likely to be Muslim, preferred conventional meat (27.5%); some preferred plant based meat (32%) while others preferred cultured meat (19.6%). The fairly even divide between these groups indicates that there is a role for a variety of alternative proteins catering to different consumers. In particular, Bryant et al. (2019b) found that compared to plant-based meat, cultured meat purchase intent was more positively predicted by diet, meat attachment, and meat consumption, thus being more appealing to heavier meat-eaters.

10.4.4 Country Comparisons

In our previous review, we observed that much of the empirical research on this topic focused on the US and Europe with less attention given to other parts of the world, and few surveys being distributed in more than one country, making international comparisons difficult (Bryant & Barnett, 2018). Since then, research in other parts of the world has flourished (Arora et al., 2020; Zhang et al., 2020) and several published studies have compared cultured meat acceptance across countries, identifying variations which could be used to optimise a cultured meat marketing approach.

Bryant et al. (2019b) found that consumers in India and China were significantly more positive about cultured meat than consumers in the US. Whilst these markets are yet to be explored in as much detail as the West, the analysis indicated that different attitudinal drivers could be relevant in different countries. Whilst purchase intentions in the US were predicted by disgust, consumers in China were mostly driven by perceived health and nutrition, whereas ethical priorities drove intentions in India. It is especially important to understand Chinese and Indian markets, given the large proportion of the global population (and therefore of future meat consumption) that these countries make up. Large numbers of farm animals, large numbers of consumers, and relatively permissive regulatory frameworks mean that Asia is likely to be the first consumer market for cultured meat (Lamb, 2019).

Gomez Luciano et al 2019a compared consumer responses to cultured meat in four countries. They found the highest acceptance by far in Spain (42%), followed by the UK (20%), the Dominican Republic (15%) and Brazil (11.5%). This is the first study which includes comparable acceptance data from South America, and indicates that these markets may be even more conservative than Europeans with respect to cultured meat (a continental group which data thus far have indicated as being the least accepting of cultured meat; Post et al., 2020).

Grasso et al 2019 compared acceptance amongst older adults in Europe, finding the highest acceptance in the Netherlands (a hub of cultured meat research in Europe), followed by Finland, the UK, Spain, and finally, far less accepting than other countries, Poland. This could be some evidence that cultured meat may be perceived more positively in pragmatic and progressive parts of Europe, whilst countries with more traditional values around food and related issues may be slower to adopt the technology.

10.4.5 Demographic Predictors

The quantitative data in this review provides a more detailed look at the groups to whom cultured meat will be most appealing. Some of these trends have been observed already in Bryant and Barnett (2018), whilst others are new and others are unclear.

Age. Previous research indicated that cultured meat would likely be more appealing to younger people than older people (Bryant & Barnett, 2018; Slade, 2018; Wilks & Phillips, 2017), and new data appears to confirm this (Bryant & Dillard, 2019; Mancini & Antonioli, 2019; Shaw & Mac Con Iomaire, 2019; Weinrich et al., 2020; Zhang, Li & Bai, 2020). Van der Weele & Driessen (2019) observed that older people tended to think about cultured meat in terms of the implied societal transition, whereas younger people tended to think about it in terms of their own consumption.

Gender. The previous review concluded that men tend to be more accepting of cultured meat than women (Bryant & Barnett, 2018; Slade, 2018; Wilks & Phillips, 2017), and this is confirmed by new data (Bryant & Dillard, 2019; Dupont & Feibelkorn, 2020; Gomez-Luciano et al., 2019b; Shaw & Mac Con Iomaire, 2019; Zhang, Li & Bai, 2020). One notable exception to this trend is the Chinese female participants in Bryant et al. (2019a), who reported higher purchase intent than their male counterparts. It is possible that this was due to a specific interpretation of likelihood of purchasing (for example, if women generally purchase food) since other research in China has found the gender trend in China to be the same as elsewhere, with men more likely to want to consume cultured meat (Zhang, Li & Bai, 2020).

Diet and meat consumption. It was observed in our previous review that cultured meat tends to be more appealing to meat-eaters compared to vegetarians (Bryant & Barnett, 2018; Wilks & Phillips, 2017), and this is now well-validated (Arora, Brent & Jaenicke, 2020; Bryant & Dillard, 2019; Mancini & Antonioli; Valente et al., 2019). Moreover, cultured meat seems to be more appealing to those who are higher in meat attachment (Bryant et al., 2019a; Circus & Robison, 2019), indicating that it may be the future protein of choice for the most committed carnivores.

Political orientation. Previous data had indicated that more left-wing/liberal people tended to be more accepting of cultured meat than more right-wing/conservative people (Bryant & Barnett, 2018; Wilks & Phillips, 2017), and again this is reflected in more recent analyses (Bryant et al., 2019a; Wilks et al., 2019). It is likely that this reflects increased concern on the political left with related issues such as animal welfare and environmental protection. This tends to be related to other predictors of acceptance such as being younger and living in urban centres.

Urbanness. Although there was some indication in previous literature that cultured meat was more appealing to those in urban centres (Bryant & Barnett, 2018; Tucker, 2014), this had yet to be tested robustly. Shaw and Mac Con Iomaire (2019) set out to test this difference in comparisons of young and old groups from rural or urban areas of Ireland. They found that participants in urban areas were more likely to say they would try cultured meat, and that undermining Irish farming communities was one of the major issues participants were concerned with.

Education. Our previous review found one study which identified higher education as a predictor of cultured meat acceptance (Bryant & Barnett, 2018; Slade, 2018).. Recent data has tended to find support for the view that cultured meat is likely more appealing to more educated consumers (Gomez-Luciano et al., 2019; Mancini & Antonioli, 2019; Weinrich et al., 2020; Zhang, Li & Bai, 2020).

Socioeconomic status. There has been some speculation about the impact of cultured meat on consumer inequality (see Bryant, 2020). Previous data had indicated that cultured meat could be more appealing to low income consumers in the US (Wilks & Phillips, 2017), although some New Zealand data suggested a different pattern (Tucker, 2014). A more recent study found that cultured meat tends to be more appealing to higher income consumers in India (Bryant et al., 2019a), meaning that the balance of data is unclear on this point. Gomez-Luciano et al. (2019a) observed that meat alternatives were more readily accepted in higher income countries, and speculate that those in lower income countries attach status to meat consumption to a greater extent.

Familiarity. Our previous review identified familiarity as a possible predictor of cultured meat acceptance, though we noted that this was yet to be tested statistically (Bryant & Barnett, 2018; Wilks & Phillips, 2017).. Recent studies further fortify this observation (Bryant et al., 2019a). Tucker (2018) reports focus group participants commenting that a lack of knowledge about cultured meat was a barrier for them, whilst Weinrich et al. (2020) identified prior knowledge about cultured meat as being conducive to positive views about its morality, and found this to be the strongest driver of acceptance. Low overall awareness of cultured meat (Valente et al., 2019) combined with research which again highlights the importance of food neophobia in cultured meat rejection (Bryant et al., 2019a; Dupont & Fiebelkorn, 2020; Wilks et al., 2019) means that there is plenty of room for educating the public about cultured meat, normalising the concept, and making it more well-known.

10.5 Perceived Benefits

There are some familiar benefits of cultured meat observed in the literature (see Bryant & Barnett, 2018). Whilst some of these are intrinsic to cultured meat, many consumers framed the appeal of cultured meat in terms of problems with conventional meat.

10.5.1 Problems with Conventional Meat

One of the major focuses of analysis by Van der Weele and Driessen (2019) is the deep ambivalence participants reported towards meat from animals. It appears that thinking about cultured meat triggers reflection on existing meat production methods - as the authors noted, many people who appear to accept animal farming are in fact deeply conflicted about the morality of killing animals for food. Although most people eat meat, it is a mistake to believe that there is a consensus on the morality of this even amongst omnivores.

New data from Valente et al. (2019) validate these concerns, observing that about half of their Brazilian sample saw problems with conventional meat consumption, and the majority of those related to animal suffering. Although Gomez-Luciano et al. (2019a) found that Brazil was the least accepting country surveyed about cultured meat, there is evidence that Brazilians tend to have higher concern for animal welfare than other nationalities (Anderson & Tyler, 2018). That said, Valente et al.'s (2019) sample was skewed towards urban-dwelling women, a group known to be more likely concerned with animal welfare (Bryant, 2019).

Tucker (2018) noted that many of their focus group participants spoke about the benefits of eating less meat in terms of saving money, experiencing different tastes, and benefiting their health, but oddly gave the same types of reasons for not wanting to cut down meat (price, taste, and nutrition). This suggests a complex relationship with meat from animals wrought with conflict and dissonance (see Rothgerber, 2020).

An experimental study found that messages focused on the problems with conventional meat tended to be more persuasive than those focusing on the benefits of cultured meat (Bryant et al., 2019a).

10.5.2 Animals

Ambivalence about the morality of meat consumption was the main theme emerging from Van der Weele and Driessen's (2019) focus groups, and avoiding animal suffering and slaughter was one of the major perceived benefits of cultured meat observed in previous research (Bryant & Barnett, 2018) . Reflecting on production methods for producing cultured meat, participants were invited to reflect on production methods for conventional meat. Participants expressed considerable regret about the animal suffering involved: many wondered why killing animals should be seen as normal and growing cells seen as abnormal. This is a frame discussed by Matti Wilks (2019) in her piece titled *'Cultured meat seems gross? It's much better than animal agriculture.'*

Many authors note that avoiding animal suffering and death was considered a key benefit of cultured meat by many consumers (Circus & Robison, 2019; Mancini & Antonioli, 2019; Rolland et al., 2020; Valente et al., 2019). Specht et al. (2020) in a study of the Twitter conversation around cultured meat found that discussion of animal welfare was one of the most prevalent themes. As well as poor conditions in animal farming, users mentioned slaughter specifically, indicating that cultured meat is likely seen as morally preferable to any process which involves killing an animal. Several users expressed an interest in feeding cultured meat to pets who cannot follow a vegetarian diet, a topic which has been explored in depth by Ward, Oven and Bethencourt (2019).

There is evidence that consumers do care about the animal suffering of meat production; Weinrich et al. (2020) found that perceiving cultured meat as an ethical product was the strongest driver of purchase intent in a representative German sample, whilst Bryant et al. (2019b) report that the ethical evaluation of cultured meat was especially important in India. Mancini and Antonioli (2020) found that extra information improved perceptions of the animal welfare implications of cultured meat, except for vegetarians.

10.5.3 Environment

Our previous review identified environmental benefits as one of the major perceived benefits of cultured meat, particularly in terms of reducing greenhouse gas emissions (Bryant & Barnett, 2018; Laestadius & Caldwell, 2015; Verbeke et al., 2015). More recent literature concurs: environmental benefits are also one of the most commonly perceived benefits of cultured meat for consumers, with some studies finding that this was more important than animal welfare benefits (Circus & Robison, 2019; Mancini & Antonioli, 2019; Shaw & Mac Con Iomaire, 2019; Valente et al., 2019). Such benefits include lower greenhouse gas emissions, and lower water and land use compared to conventional meat (Tuomisto, 2019). There is also evidence that positive perceptions of its environmental impact drive cultured meat acceptance (Grasso et al., 2019; Weinrich et al., 2019).

There is evidence that some consumers may assume cultured meat is harmful to the environment in virtue of being artificial or processed (Specht et al., 2020). Indeed, Tucker (2018) notes that while consumers did acknowledge environmental advantages of cultured meat, these points were generally overrun by a discourse of unnaturalness. Gomez-Luciano et al. (2019a) found that people tended to rate cultured meat as less sustainable than other alternative proteins, indicating that some intuit that cultured meat could cause environmental harm.

Mancini and Antonioli (2020) found that the perceived environmental-friendliness of cultured meat could be increased with an information intervention, indicating that educating consumers about the environmental advantages of cultured meat is likely to be valuable.

10.5.4 Health

Our previous review identified some potential health benefits of cultured meat consumers discussed, including reducing fat content (Bekker et al., 2017; Bryant & Barnett, 2018; Laestadius & Caldwell, 2015). That said, personal benefits of cultured meat such as potential health and food safety benefits tend to be less commonly perceived than societal benefits (Mancini & Antonioli, 2019). Although consumers rarely discussed potential health benefits unprompted, and evidence of perceived healthiness is limited, there is some evidence that health claims could drive acceptance.

Gomez Luciano et al. (2019a) found that, although cultured meat was considered tastier than insects or plant-based meat in some markets, it was generally considered the least healthy, nutritious, and safe alternative across countries. The perceived healthiness and nutrition of cultured meat were amongst the most important factors predicting willingness to pay for cultured meat across all the countries in their study. They found that the UK generally had the most positive perceptions of the healthiness of cultured meat compared to Spain, Brazil and the Dominican Republic.

Valente et al. (2019) report that 24% of their Brazilian participants said that their consumption of cultured meat would be dependent on more information about factors including healthiness. Though some had concerns about the healthiness of conventional meat, animals and the environment were more common factors motivating a move away from animal meat in this sample, as has been observed in most previous research (Bryant & Barnett, 20018).

10.5.5 Food safety

Our previous review identified some studies which discussed potential food safety benefits of cultured meat (Bryant & Barnett, 2018; Wilks & Phillips, 2017). Although it is relatively rarely identified unprompted, some studies suggested that consumers could be open to the potential for cultured meat improving food safety. Gomez Luciano et al. (2019a) found that perceived safety was a key predictor of acceptance across countries, yet many people are wary of the safety of cultured meat compared to alternatives (Gomez Luciano et al., 2019b).

The issue of food safety is particularly salient in China, where the conventional meat supply has regularly been subject to shortages, disease, and scandals (Huehmergarth, 2014); Zhang, Li and Bai (2020) highlight perceived food safety as being particularly relevant to cultured meat acceptance in China, finding that trust in the government's safety regulations was a key predictor of cultured meat acceptance.

10.5.6 World hunger

As in our previous review, recent studies find that some consumers perceive cultured meat as a way to address global hunger (Bryant & Barnett, 2018; Laestadius, 2015; Tucker, 2014). Mancini and Antonioli (2019) noted that participants cited reducing world hunger as one of the three most common benefits of cultured meat, behind avoiding harm to animals and protecting the environment. Weinrich et al. (2020) found that optimism about cultured meat's potential to solve global problems including world hunger and global warming was one key dimension of attitudes which influenced intentions to consume it. Though it was not as influential as other attitudes (such as beliefs about the ethical advantages, and emotional reactions of disgust to unnaturalness), 'global diffusion optimism' was associated with higher willingness to consume cultured meat.

10.6. Barriers to Acceptance

In this section, we review the major barriers to acceptance of cultured meat. Many of the major themes are similar to previously reviewed literature (Bryant & Barnett, 2018), though recent literature provides more detailed findings on a range of factors.

10.6.1 Unnaturalness

Perceived unnaturalness was one of the key themes in our previous review (Bryant & Barnett, 2018; Laestadius, 2015; Marcu et al., 2015), and was often at the root of disgust and health and safety concerns. Unnaturalness continues to play a central role in consumers' reasons to avoid cultured meat. Indeed, this was a key theme identified in many qualitative studies (Circus & Robison, 2019; Shaw & Mac Con Iomaire, 2019; Tucker, 2018), and appears to be a more basic objection than other barriers to acceptance such as perceived safety or ethical problems. For example, Bryant et al. (2019a) found that messages targeting perceived unnaturalness failed to persuade consumers that cultured meat was, in fact, natural, or that naturalness should not matter. Weinrich et al. (2020) provide some quantitative validation of the importance of naturalness, noting that this was a major component of 'emotional objections' which were a major driver of cultured meat rejection.

However, the perception of unnaturalness does not necessarily lead to rejection: Dupont and Feibelkorn (2020) observed that their young German sample found cultured meat to be less natural than insects, but preferred it nonetheless. Indeed, Michel and Siegrist (2019) demonstrate that subjective importance of naturalness predicted lower perceived naturalness of cultured meat, which in turn predicted lower consumption intention. These findings appear to suggest that those who are especially concerned about naturalness per se are likely to reject cultured meat. We note that subjective importance of naturalness is different from perceived unnaturalness; for example, one might agree that cultured meat is unnatural, but not consider this fact important.

There is one notable exception to this trend: Wilks et al. (2019) found that, whilst several psychographic factors such as food hygiene sensitivity, food neophobia and political conservatism did predict cultured meat rejection, naturalness bias did not. They also showed no correlation between naturalness bias and measures of cultured meat acceptance, indicating that this was not an issue of overfitting. It is notable that the strongest quantitative studies demonstrating that subjective importance of naturalness is a factor affecting cultured meat acceptance used European samples (Michel & Siegrist, 2020; Weinrich et al, 2020), whereas Wilks et al. (2019) used an American sample. Given the higher rates of cultured meat acceptance observed in the US compared to Europe (Surveygoo, 2018), it is plausible that naturalness is more of an important issue to Europeans than to Americans.

Lupton and Turner (2018) found that, whilst focus group participants greeted both insects and cultured meat with some amount of disgust, insects were considered more natural than cultured meat.

10.6.2 Safety Concerns

As we observed in our previous review, partly due to the perception of cultured meat as unnatural, it is common for consumers to have intuitive questions about its safety (Bryant & Barnett, 2018; Siegrist & Sutterlin, 2017; Verbeke et al., 2015). More recent research builds on this theme (Circus & Robison, 2019; Shaw & Mac Con Iomaire, 2019; Tucker, 2018). In particular, focus group and interview participants expressed anxiety about uncertainty about the long-term health effects of cultured meat (Shaw & Mac Con Iomaire, 2019), while Tucker (2018) notes that such fears appear to be extensions of concerns about unnaturalness. Experts are aware of this intuition, and have highlighted transparency around cultured meat health and safety as paramount to the industry's success (Tiberius et al., 2019).

While consumers are generally cautious about the safety of cultured meat (Mancini & Antonioli, 2019), this is also one attitude which appears to be particularly malleable given further information. Mancini and Antonioli (2020) note that perceived safety increased significantly when consumers were given additional information about cultured meat, and speculate that perceived safety could be greatly improved if cultured meat received approval from the European Food Safety Authority.

In an experimental setup, Rolland et al. (2020) found that a message about the personal benefits of cultured meat (the only message to say that cultured meat is safe, alongside other benefits) led to the largest increase in cultured meat acceptance. The authors also report that food safety was the second most common type of negative remark (behind price) but the fifth most common type of positive remark.

10.6.3 Nutrition Concerns

As observed in our previous review, a common concern reported by consumers in these studies was that cultured meat could be generally unhealthy or nutritionally inferior compared to conventional meat (Bryant & Barnett, 2018; Laestadius & Caldwell, 2015). This was also seen in more recent studies (Lupton & Turner, 2018; Mancini & Antonioli, 2019). Distinct from concerns about food safety, but similarly related to perceived artificiality, concerns of this type relate to the relative healthiness of cultured meat (Lupton & Turner, 2018).

Specht et al. (2020) report that some Twitter users expressed generic health concerns about cultured meat, which seemed to be associated with its perception as unnatural. However, generally, these were outweighed in the online conversation by possible health benefits from modifying the nutritional profile of cultured meat. More broadly, it seems that consumers assume cultured meat would not be as healthy as conventional meat (Shaw & Mac Con Iomaire, 2019).

Healthiness may be more or less important to different groups of consumers. Perceived healthiness was amongst the key predictors of purchase intent in China according to Bryant et al. (2019b). However, Dupont and Fiebelkorn (2020) found that interestingly, although their sample of German schoolchildren generally considered cultured meat less healthy than insects, they also tended to prefer it.

10.6.4 Trust

Trust was highlighted as a key issue in three studies, and though this was mentioned in some previous literature, our review did not explore this theme in detail (Bryant & Barnett, 2018). Shaw and Mac Con Iomaire (2019) highlight trust in their focus groups with Irish consumers. Consumers expressed both distrust in food companies and food labelling, as well as explicit trust in Irish meat and Irish farming. This was particularly prevalent for rural participants, who may have felt a personal connection to the source of the meat, a level of personal assurance it would be hard to emulate in the scale of a large cultured meat company.

Trust in regulatory bodies responsible for ensuring food safety is also an issue of importance. Zhang, Li and Bai (2020) found that consumers who had more trust in food safety government bodies were more accepting of cultured meat, and argue that informing consumers about the benefits of cultured meat via trusted sources can increase acceptance in China in particular.

Finally, Wilks et al. (2019) found that distrust of food scientists predicted rejection of cultured meat, whilst conspiratorial ideation predicted absolute opposition to cultured meat. This appears to suggest that conspiracy-inclined people who are inclined to distrust science, and perhaps institutions more broadly, are likely to oppose cultured meat.

10.6.5 Disgust

Our previous review identified several studies which mentioned disgust, and this was generally connected to perceived unnaturalness (Bryant & Barnett, 2018; Slade, 2018; Verbeke et al., 2015). Building on this theme, many recent studies mentioned disgust as a barrier to cultured meat adoption (Bryant & Barnett, 2018; Bryant et al., 2019b; Lupton & Turner, 2018; Weinrich et al., 2020). Disgust sensitivity and experienced disgust have been shown to predict cultured meat rejection (Dupont & Fiebelkorn, 2020; Weinrich et al., 2020;

Wilks et al., 2019), though interestingly cross-country studies suggest that this may be more influential in Western cultures (Bryant et al., 2019b).

Research has indicated that consumers find cultured meat less disgusting than GMOs (Egolf et al., 2019) and eating insects (Dupont & Fiebelkorn, 2020; Lupton & Turner, 2018), but more disgusting than synthetic food additives and similar food technology plant products (Egolf et al., 2019; Lupton & Turner, 2018). Interestingly, Dupont and Fiebelkorn (2020) found that their sample judged cultured meat to be less disgusting than eating insects, although they judged eating insects to be more natural and more healthy, indicating that a disgust reaction can be independent of evaluations which seem to be related. Similarly, Egolf et al. (2019) found that although participants found cultured meat more disgusting than a synthetic food additive, they also judged its benefits to society to be greater. Again, this highlights the emotional nature of the disgust response, and shows how it can occur independently of rational evaluations.

The heuristic associative emotional nature of the disgust responses is neatly illustrated in an experimental study by Geipel et al. (2018). The researchers found that German participants were more willing to try cultured meat when they were asked about it in their non-native English rather than their native German, and that this effect was mediated by evoked disgust. Similarly, Bryant and Barnett (2019) find that the positivity of associations was the key factor accounting for differences in the attitudes related to different cultured meat names.

Previous research has linked this disgust to perceived unnaturalness as food in Western cultures (Siegrist, Sutterlin & Hartmann, 2018), though more recent work contends that it instead stems from norm violation (Koch et al., 2020). This is an important distinction, because if we are addressing norm-violating moral disgust rather than food-related disgust, such objections are more likely to be surmountable in the future as cultured meat becomes more familiar. Indeed, this gives credence to the view that consumers objecting to the 'unnaturalness' of cultured meat are often objecting in fact to its unfamiliarity.

10.6.6 Neophobia

Whilst studies in our previous review alluded to aversion to an altogether novel food, this was not discussed in terms of neophobia (Bryant & Barnett, 2018). Food neophobia (Pliner & Hobden, 1992) has been identified as a key predictor of cultured meat rejection across countries in America, Europe, and Asia (Bryant et al., 2019b; Dupont & Fiebelkorn, 2020; Wilks et al., 2019). Grasso et al. (2019) identified 'food fussiness' as a barrier for cultured meat acceptance amongst older consumers in Europe. This may encompass some concepts of food neophobia alongside strong preferences for food to be prepared and served in a specific familiar way. Indeed, for some consumers, any type of novelty may be unwelcome. One exception of note here is Gomez-Luciano et al. (2019a), who report that neither food neophobia nor food technology neophobia predicted cultured meat rejection in their international sample, with the exception of food neophobia in Brazil.

10.6.7 Economic Anxieties

Consumers had concerns about the affordability of cultured meat (see section 7.1) but some also broader economic anxieties about the impact of the technology on farming and rural communities (Circus & Robison, 2019). Shaw and Mac Con Iomaire (2019) identified concern for farmers as a salient issue in their Irish focus groups. In particular, participants were aware of the centrality of beef farming to Ireland's rural economy, and wondered what impact cultured meat production would have on Irish farmers. Indeed, it is likely that cultured meat could result in fewer agricultural jobs (Bryant, 2020). Some experts and stakeholders have characterised cultured meat as an opportunity to re-evaluate the way we do agriculture (Bohm et al., 2018). This was mentioned in our previous review, but it is unclear whether such concerns would drive purchasing behaviour in practice (Bryant & Barnett, 2018).

10.6.8 Ethical Concerns

As we observed in our previous review, some studies discuss specific ethical concerns, like the possibility that cultured meat could harm animals from whom cells are taken (Bryant & Barnett, 2018; Circus & Robison, 2019) or that the industry may end up controlled by agents' whose interests are less noble than those of the pioneers, who are themselves often vegan (Stephens et al., 2019; Van der Weele & Driessen, 2019). However, it seems more common that consumers have general moral concerns about cultured meat, which are likely related to the theme of unnaturalness (Circus & Robison, 2019).

Koch et al. (2018) found that a key mechanism underpinning the rejection of cultured meat was moral disgust, which they demonstrate is linked to norm violation. Relatedly, Bryant et al. (2019b) found substantially higher levels of acceptance of cultured meat from 'normal' food animal species (cows, pigs, chickens, and fish in the West) compared to cultured meat from animals not normally eaten in the culture such as horses and dogs. Whilst there is no difference in principle in the morality of eating cultured meat from a pig or cultured meat from a dog, it is clear that the non-normalness of the latter means it is something that far fewer people would want to do. This finding is important because it suggests that, whilst discussions about cultured meat from unusual species and even 'ethical cannibalism' (Milburn, 2016) are philosophically interesting, products from non-traditional meat species are unlikely to find a large consumer base, and may arouse or exacerbate moral concerns with cultured meat.

10.7 Key Uncertainties

Research increasingly points to the importance of price and taste in consumer decisions about food (Fotopoulos et al., 2009; Januszewska, 2011). These are two key points which will decide the fate of cultured meat to a large extent, and they are well explored in new research.

10.7.1 Price

The importance of cultured meat price for consumers has been highlighted in several studies, and an anticipated high price was a perceived barrier to buying cultured meat identified by studies in our previous review (Bryant & Barnett; Laestadius & Caldwell, 2015; Verbeke et al., 2015). Price was highlighted as the major concern for Brazilian consumers by Valente et al. (2019), whilst Gomez Luciano et al. (2019a) found that price was a predictor of purchase intent in three of the four countries in their survey. The authors found that price tended to be more important to consumers than factors such as neophobia (Gomez Luciano et al., 2019b), commenting that overall, reducing the price of cultured meat will be crucial for mainstream consumers. Interestingly, their data showed that participants in the Domininican Republic were most likely to expect cultured meat would be cheaper than conventional meat, while Brazilians were the most likely to expect it would be more expensive.

There is mixed evidence on willingness to pay a premium for cultured meat. Mancini & Antonioli (2019) found that roughly equal proportions of their sample were willing to pay a premium (23.2%), were ‘maybe’ willing to pay a premium (20.8%), and were not willing to pay a premium (26.7%; those who indicated they would not try cultured meat did not answer this question). However, Shaw and Mac Con Iomaire (2019) found that both rural and urban Irish consumers would expect to pay less money for cultured meat.

Conversely, Rolland et al 2020 found that, with participants who had tasted and broadly liked ‘cultured meat’, 58% were willing to pay a premium, averaging 37% above the price of conventional meat. This reflects a higher willingness to pay than other studies, most likely due to the circumstance of having a sensory experience with what participants believed to be cultured meat. However, the researchers also observed that price was by far the most common form of negative comment, accounting for 36% of negative remarks (not all participants made negative remarks). This suggests that some consumers are likely willing to pay a premium, but others certainly are not and will be price sensitive. Mancini and Antonioli (2020) found that willingness to pay a premium was increased with additional information.

10.7.2 Sensory experience

In our previous review, we found some evidence that consumers tended to expect cultured meat to be worse tasting than conventional meat, and to have an inferior texture and appearance (Bryant & Barnett, 2018; Tucker, 2014; Verbeke et al., 2015). More recent evidence suggests that consumers have relatively low expectations for the taste of cultured meat, tending to view it as not fresh, lacking in taste, and worse than conventional meat (Lupton & Turner, 2018; Shaw & Mac Con Iomaire, 2019). Moreover, Mancini and Antonioli (2019) show that expected taste strongly predicted purchase intent, demonstrating a need to reassure consumers of the sensory experience of cultured meat as a central feature of messaging.

However, some findings can reframe these low consumer expectations as an opportunity. Rolland et al. (2020) found that consumers who tried two pieces of the same meat rated a piece marked ‘cultured meat’ as being tastier than a piece marked ‘conventional meat’. It is likely that this occurred due to their prior expectations of the cultured meat tasting worse, and pleasant surprise on finding it did not. Taste was amongst the most common themes in the positive remarks participants made in this study.

10.8 Increasing Acceptance

Our previous review included some studies which showed that additional information about cultured meat could influence consumers’ views, and that less technical explanations and higher perceived market share were associated with increased acceptance (Bekker et al., 2017; Bryant & Barnett, 2018; Slade, 2018; Verbeke, Sans & Van Loo, 2015). This section will discuss experimental studies which demonstrated an effect on acceptance of certain interventions.

Several recent studies have demonstrated that cultured meat acceptance can be increased by providing additional positive information. Zhang, Li and Bai (2020) found that providing additional information about the environmental benefits of cultured meat increased acceptance amongst urban Chinese consumers. Mancini and Antonioli (2020) found that providing additional positive information about cultured meat significantly increased various measures of acceptance including willingness to buy, but not willingness to try.

Rolland et al. (2020) found that additional information about various benefits of cultured meat significantly increased acceptance, and tasting what participants thought to be cultured meat significantly increased acceptance further. The authors tested three types of information (societal benefits, personal benefits, and meat quality and taste). They found that, while all three led to significant increases in acceptance, information about personal benefits led to a significantly greater increase than the other information conditions. This provides evidence that messages aiming to persuade consumers to adopt cultured meat should focus primarily on the benefits to the consumer (rather than the benefits to society, the environment, or animals). Verbeke et al. (2015) noted that the latter tend to be more obvious to participants to begin with.

Nomenclature and terminology is also important. Bryant and Barnett (2019) found that different names had a significant effect on measures of acceptance. We found that 'clean meat' led to significantly higher acceptance than 'lab grown meat', with 'cultured meat' and 'animal free meat' scoring somewhere in between. Further, we showed that the difference between groups was accounted for by the positivity of associations participants gave. This indicates that the mechanism by which nomenclature affects acceptance is by anchoring to concepts which are more or less appealing in the context. Similarly, Geipel et al. (2018) found that German participants reading about cultured meat in their non-native English (vs. their native German) experienced less disgust, and subsequently had higher willingness to eat it. The authors note that this foreign language effect has been observed in other contexts, appearing to make people behave in a more utilitarian manner (Costa et al., 2014).

Another issue impacting cultured meat acceptance is framing. Bryant & Dillard 2019 found that frames which emphasized the societal benefits of cultured meat or its similarity to conventional meat led to significantly higher measures of acceptance compared to frames which emphasized the cutting-edge science aspect of the technology. We note that, while this frame including imagery such as test tubes and lab coats is less conducive to acceptance, it has understandably been one of the major frames used to discuss the topic in the media.

Finally, Bryant et al. (2019a) found modest differences between experimental groups who read different messages about naturalness. A group who read about the unnaturalness of conventional meat were more persuaded than groups who read about the naturalness of cultured meat, or the irrelevance of naturalness. Manipulation checks indicated that the latter two frames here were ineffective at changing the targeted belief, and they were subsequently less persuasive than a control group, which read about benefits of cultured meat unrelated to naturalness. This is evidence that drawing comparisons to the existing system is an effective method for dealing with charges of unnaturalness. As other research has noted, reflecting on cultured meat may represent an opportunity to reflect on conventional meat, and realise that existing production methods are far from ideal (Van der Weele & Driessen, 2019).

10.9 Discussion

The themes and trends observed in this review can inform strategies for increasing the future market share of cultured meat, displacing more demand for meat from animals and the harm that its production entails. In particular, there are lessons for cultured meat advocates in terms of market segmentation, message content, and marketing strategy.

First, there is good evidence that different profiles of consumer are likely to prefer different forms of alternative protein. Cultured meat, therefore, will be one of several types of alternative protein competing in the market alongside plant-based meat, insects, and other protein sources. Evidence suggests that cultured meat is likely to be particularly appealing to the heaviest meat-eaters (Bryant et al., 2019b; Circus & Robison, 2019), and that it is likely particularly unappealing to those high in disgust sensitivity and/or neophobia (Bryant et al., 2019b; Wilks et al., 2019). Acknowledging a wide range in perceptions of cultured meat, producers should focus initially on those most enthusiastic consumers until the price decreases and the concept becomes more familiar.

Secondly, pro-cultured meat messages may take a variety of approaches. Generally, rather than responding to criticism that cultured meat is unnatural, advocates should focus on the benefits that the technology can bring (Bryant et al., 2019a; Mohorcich & Reese, 2019). Marketers may choose to lean into the moral uncertainty around conventional animal agriculture, bringing attention to an ethical issue which many meat-eaters do not typically think about and framing cultured meat as the transparent and trustworthy option. However, producers should take care when moralising the issue, since this approach could be off-putting not only to consumers, but also to conventional meat producers, whose investment may be vital to their success (Bryant et al., 2019a).

Other messages may highlight the environmental benefits of cultured meat, though some evidence suggests that messages focusing on personal benefits such as improvements to product healthiness and safety are likely to be the most persuasive (Rolland et al., 2020). Indeed, a focus on the potential safety benefits of cultured meat in terms of avoiding antibiotic resistance and zoonotic pandemics could be especially effective, as it addresses one of the most common concerns about cultured meat (food safety) in a frame which compares it to current system, which many view as far from ideal (Van der Weele & Driessen, 2019).

Thirdly, the long term success of cultured meat will depend on its ability to compete with conventional meat in terms of price and taste. Experts generally agree that cultured meat is unlikely to be price competitive with conventional meat in the near future (Bohm et al., 2018; Tiberius et al, 2019). This is seen as a significant barrier to mainstream adoption, and some have suggested that cultured meat will cater to an elite niche (Bohm et al., 2018) or will need to offer consumers additional health benefits to justify the higher price (Tiberius et al., 2019). As with any technology, it is likely that the price of cultured meat will fall over time as producers compete and production methods become more efficient.

Recent research validates the finding that most consumers anticipate cultured meat having an inferior taste, texture, and appearance. This pessimism about the quality of cultured meat can be seen as an opportunity - cultured meat companies which can convincingly emulate the taste and texture of a burger patty stand to exceed consumers' expectations. Indeed, the high trialability of cultured meat compared to other technological innovations allows consumers to try the key aspects for themselves with little commitment (see Rogers, 2003). Experts in the field view it as paramount to create a product which emulates not only the taste, but the texture and the smell of conventional meat (Tiberius Borning & Seeler 2019).

10.10. Conclusion

Overall, recent research on consumer acceptance of cultured meat confirms many of the broad findings observed in previous research, and develops these insights further to examine particular ways in which specific attitudes inform consumer opinions, how these may vary, and how they might be malleable to change.

The evidence suggests that while most people see more societal than personal benefits of eating cultured meat, there is a large potential market for cultured meat products in many countries around the world. Cultured meat is generally seen as more acceptable than other food technologies like GMOs, and more appealing than other alternative proteins like insects. Although it is not as broadly appealing as plant-based protein, evidence suggests it may be more uniquely positioned to appeal to meat-lovers who are resistant to other alternative proteins, and it is more appealing to certain demographic groups.

Many consumers have mixed feelings about meat from animals, and often recognise the benefits of cultured meat for animals and the environment. Potential safety improvements or nutritional enhancements are currently areas where there could be benefits, but where consumers tend to perceive risks currently due to the perception of unnaturalness and violation of norms. Cultured meat producers and advocates should aim to build trust, facilitate understanding of the technology, and explain how cultured meat could improve outcomes in these areas. Since neophobia and norm violation play an important role in cultured meat rejection, it is likely that this will decrease over time.

Ultimately, taste and price will be huge determinants of market success for cultured meat. While some consumers may be willing to pay a premium for cultured meat, most are not, so displacing serious demand for animal meat requires a price-competitive product. Consumers tend to have low expectations for the taste and texture of cultured meat, which may be a good thing for cultured meat producers. Unlike some other types of innovation, cultured meat is highly trialable (see Rogers, 2003) meaning that consumers can 'try before they buy'. Consumers are much more likely to buy cultured meat if they are able to verify the taste first.

Attitudes towards cultured meat can be improved with information about its benefits, but the message frame and the associations one provokes with one's language may be more important than the content of the message per se, at least in the short term. Experts consider that taste and texture are vitally important, as well as transparency around health and safety. They also project that cultured meat will be expensive at first, perhaps only available to elite consumers and possibly carrying health claims to justify the additional price.

Public perceptions of cultured meat are varied and consider a range of benefits and risks. Opinions are malleable by information and framing, but ultimately product characteristics such as price and taste will play a key role in determining the market success of cultured meat. Advocates should be wary of the associations consumers may form if they perceive cultured meat as unnatural - they may then infer that it is unhealthy or damaging to the environment.

Key issues like health and safety of the meat supply can become talking points for the cultured meat industry, which currently suffers the intuition that its allegedly unnatural products could be unsafe, but in fact can improve the safety of the food supply. Highlighting ways that cultured meat can help avoid zoonotic disease outbreaks and reduce the use of antibiotics by removing unpredictable and dirty animals from the production process is likely to be an intuitively appealing message which turns a potential barrier into an argument in the technology's favour.

More broadly, developers of alternative proteins should be aware that cultured meat represents a product which is appealing to a certain type of consumer. Those who are concerned about naturalness might prefer to eat insects, while those who are lower in meat attachment or are vegetarian will prefer plant proteins. In the diverse protein landscape of the future, there is room for a variety of solutions.

10.11 References

Anderson, J. & Tyler, L. (2018). *Attitudes Toward Farmed Animals in the BRIC Countries.* Faunalytics. Available at https://faunalytics.org/wp-content/uploads/2018/09/BRIC-Full-Report.pdf

Bryant, C. J., Anderson, J. E., Asher, K. E., Green, C., & Gasteratos, K. (2019). Strategies for overcoming aversion to unnaturalness: The case of clean meat. *Meat science, 154*, 37-45.

Bryant, C. J., & Barnett, J. C. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite, 137*, 104-113.

Bryant, C., & Dillard, C. (2019). The Impact of Framing on Acceptance of Cultured Meat. Frontiers in Nutrition, 6, 103.

Bryant, C. J., Szejda, K., Deshpande, V., Parekh, N., & Tse, B. (2019). A Survey of Consumer Perceptions of Plant-Based and Clean Meat in the USA, India, and China. *Frontiers in Sustainable Food Systems, 3*, 11.

Circus, V. E., & Robison, R. (2019). Exploring perceptions of sustainable proteins and meat attachment. *British Food Journal, 121*(2), 533-545.

Costa, A., Foucart, A., Hayakawa, S., Aparici, M., Apesteguia, J., Heafner, J., & Keysar, B. (2014). Your morals depend on language. *PloS one, 9*(4), e94842.

Foote, N. (2020, January 15). *Cultured meat could be on the EU market 'as early as 2022'.* EURACTIV. Available at https://www.euractiv.com/section/agriculture-food/news/cultured-meat-could-be-on-the-eu-market-as-early-as-2022/

Fotopoulos, C., Krystallis, A., Vassallo, M., & Pagiaslis, A. (2009). Food Choice Questionnaire (FCQ) revisited. Suggestions for the development of an enhanced general food motivation model. *Appetite, 52*(1), 199-208.

Geipel, J., Hadjichristidis, C., & Klesse, A. K. (2018). Barriers to sustainable consumption attenuated by foreign language use. *Nature Sustainability, 1*(1), 31-33.

Gómez-Luciano, C. A., de Aguiar, L. K., Vriesekoop, F., & Urbano, B. (2019). Consumers' willingness to purchase three alternatives to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic. *Food Quality and Preference, 78*, 103732.

Grasso, A. C., Hung, Y., Olthof, M. R., Verbeke, W., & Brouwer, I. A. (2019). Older Consumers' Readiness to Accept Alternative, More Sustainable Protein Sources in the European Union. *Nutrients, 11*(8), 1904.

Huehnergarth, N. (2014, July 11). *China's Food Safety Issues Worse Than You Thought.* Food Safety News. Available at https://www.foodsafetynews.com/2014/07/chinas-food-safety-issues-are-worse-than-you-thought/

Januszewska, R., Pieniak, Z., & Verbeke, W. (2011). Food choice questionnaire revisited in four countries. Does it still measure the same?. *Appetite, 57*(1), 94-98.

Kateman, B. (2020, February 17). *Will Cultured Meat Soon Be A Common Sight In Supermarkets Across The Globe?* Forbes. Available at https://www.forbes.com/sites/briankateman/2020/02/17/will-cultured-meat-soon-be-a-common-sight-in-supermarkets-across-the-globe/#651b62917c66

Lamb, C. (2019, March 19). *Cultured Meat Will Likely Debut in Asia, Not Silicon Valley. Here's Why.* The Spoon. Available at https://thespoon.tech/cultured-meat-will-likely-debut-in-asia-not-silicon-valley-heres-why/

Lupton, D., & Turner, B. (2018). Food of the Future? Consumer Responses to the Idea of 3D-Printed Meat and Insect-Based Foods. *Food and Foodways, 26*(4), 269-289.

Mancini, M. C., & Antonioli, F. (2019). Exploring consumers' attitude towards cultured meat in Italy. *Meat science, 150*, 101-110.

Milburn, J. (2016). Chewing over in vitro meat: animal ethics, cannibalism and social progress. *Res Publica, 22*(3), 249-265.

OECD/FAO. (2018). *OECD-FAO Agricultural Outlook 2018-2027.* Available at http://www.agri-outlook.org/commodities/Agricultural-Outlook-2018-Meat.pdf

Purdy, C. (2020). *The Billion Dollar Burger.* London: Hachette.

Shaw, E., & Mac Con Iomaire, M. (2019). A comparative analysis of the attitudes of rural and urban consumers towards cultured meat. *British Food Journal.*

Tuomisto, H. L. (2019). The eco-friendly burger: Could cultured meat improve the environmental sustainability of meat products?. *EMBO reports, 20*(1), e47395.

Valente, J. D. P. S., Fiedler, R. A., Sucha Heidemann, M., & Molento, C. F. M. (2019). First glimpse on attitudes of highly educated consumers towards cell-based meat and related issues in Brazil. *PloS one, 14*(8), e0221129.

Van Der Weele, C., & Driessen, C. (2019). How normal meat becomes stranger as cultured meat becomes more normal; Ambivalence and ambiguity below the surface of behaviour. *Frontiers in Sustainable Food Systems, 3*, 69

Ward, E., Oven, A., & Bethencourt, R. (2019). *The Clean Pet Food Revolution.* Brooklyn: Lantern Books.

Weinrich, R., Strack, M., & Neugebauer, F. (2019). Consumer acceptance of cultured meat in Germany. *Meat science*, 107924.

Wilks, M., Phillips, C. J., Fielding, K., & Hornsey, M. J. (2019). Testing potential psychological predictors of attitudes towards cultured meat. *Appetite, 136*, 137-145.

This declaration concerns the article entitled:

Culture, meat, and cultured meat

Publication status (tick one)

Draft manuscript		**Submitted**		**In review**		**Accepted**	X	**Published**	

Publication details (reference)	Bryant, C. (forthcoming). Culture, meat, and cultured meat. *Journal of Animal Science.*

Copyright status (tick the appropriate statement)

I hold the copyright for this material	X	Copyright is retained by the publisher, but I have been given permission to replicate the material here	

Candidate's contribution to the paper (provide details, and also indicate as a percentage)	The candidate contributed to / considerably contributed to / predominantly executed the… **Formulation of ideas:** 100% **Design of methodology:** 100% **Experimental work:** 100% **Presentation of data in journal format:** 100%
Statement from Candidate	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature.

Signed	C Bryant	**Date**	29 June 2020

11. Culture, meat, and cultured meat

Abstract

Cultured meat grown in vitro from animal cells has the potential to address many of the ethical, environmental, and public health issues associated with conventional meat production. However, as well as overcoming technical challenges to producing cultured meat, producers and advocates of the technology must consider a range of social issues, including consumer appeal and acceptance, media coverage, religious status, regulation, and potential economic impacts. Whilst much has been written on the prospects for consumer appeal and acceptance of cultured meat, less consideration has been given to the other aspects of the social world which will interact with this new technology. Here, each of these issues is considered in turn, forming a view of cultured meat as a technology with a diverse set of societal considerations and far-reaching social implications. It is argued that the potential gains from a transition to cultured meat are vast, but that cultural phenomena and institutions must be navigated carefully for this nascent industry to meet its potential.

11.1 Introduction

Our current meat production system is resource intensive, has negative environmental impacts, entails animal suffering, and is linked to a number of public health issues including animal-transmitted pandemics and antibiotic resistance (IPCC, 2018; Lymbery & Oakshotte, 2014; Mathew, Cissell & Liamthong, 2007; Oliver, Murinda & Jayarao, 2011). Yet global demand for meat is forecast to increase rapidly as the world population grows (McLeod, 2011).

One proposed solution to decrease our consumption of meat from animals is the development and utilization of cultured meat, which can be grown from animal cells without animal slaughter (Post, 2012). In addition to eliminating the need for animal slaughter, cultured meat is associated with far less harm to the environment in terms of greenhouse gas emissions and land and water use (Tuomisto, 2019). Cultured meat could become available commercially within a few years (Lucas, 2019).

Recent years have seen a proliferation of research on consumer acceptance of cultured meat (Bryant & Barnett, 2018; Bryant & Barnett, 2019; Van der Weele & Driessen, 2019; Wilks, Phillips, Fielding & Hornsey, 2019). However, Stephens et al. (2018) have argued that the social discourse around cultured meat must move beyond narrow conceptions of consumer acceptance and consider broader societal issues. Therefore, this article will consider a range of important cultural phenomena and institutions which will interact with cultured meat: media coverage, religions, regulations, and economic impacts.

11.2 Media Coverage

The media is an important source of information to the public, and likely plays a crucial role in shaping public perceptions of food technologies (Frewer, Howard & Shepherd, 1995). Indeed, there is some evidence that media coverage of cultured meat shapes public opinion by highlighting certain aspects of the concept (Laestadius & Caldwell, 2015).

Much of the early media coverage of cultured meat in the U.S. and Europe has been neutral or positive, frequently discussing the challenges with conventional animal agriculture and the relative benefits of cultured meat in terms of animal welfare, the environment, food security, and human health (Goodwin & Shoulders, 2013). This positive coverage is likely due, in part, to the sources of information used; these included New Harvest, People for the Ethical Treatment of Animals, cultured meat researchers, and academics (Goodwin & Shoulders, 2013).

This may partially explain the more positive attitudes of those who are more familiar with the concept, since they presumably become familiar through the media. Bekker et al. (2017) found that positive or negative information about cultured meat shifted individuals' opinions in that direction, but that those who were already familiar with the concept were less influenced by the information. Therefore, this early positive coverage is certainly a good thing for cultured meat, since resulting positive attitudes will be likely to endure.

However, there are certainly aspects of the technology which invite unflattering media coverage. In an analysis of Australian print media, Dilworth and McGregor (2015) found that unnaturalness was the most commonly discussed theme. The authors speculate that stakeholders such as farming lobbies could capitalize on this narrative to undermine consumer acceptance, commenting that 'embodied responses based on deeply entrenched ideas of food and nature are not easily overcome' (p. 103). Further, the authors identify a number of less common narratives which generally frame cultured meat in a negative way:

that increasing reliance on technological solutions undermines the process of genuine social change, that meat production is a way of connecting with nature, and that continuing to instrumentalise animals in a way which simply sidesteps the issues may undermine the animal liberation movement. Hopkins and Dacey (2008) have discussed each of these arguments, and concluded that they are not valid reasons to oppose cultured meat.

Interestingly, Hopkins (2015) demonstrated that media coverage of cultured meat has given undue focus to vegetarians' opinions of cultured meat. This is despite their lower propensity to want to eat it compared to meat-eaters (Bryant et al., 2019; Wilks & Phillips, 2017), although they are more likely to recognize its benefits for animals and the environment (Wilks & Phillips, 2017). One could argue that, with the aim of reducing animal product consumption, it is unimportant whether vegetarians would eat cultured meat - indeed, the idea that cultured meat is 'for vegetarians' could undermine its appeal to meat-eaters.

Bryant and Dillard (2019) demonstrate how different frames one might encounter in media coverage of cultured meat can affect consumer perceptions. The researchers found that those who saw a frame which emphasized the 'high tech' elements of cultured meat were significantly less likely to want to eat it compared to those who saw frames which emphasized the societal benefits of cultured meat, or its sensory similarity to conventional meat. At this stage, it is likely that most of the coverage of cultured meat will frame it primarily as scientific discovery. This is because news on the topic is likely to relate to new advancements in the technology, and media coverage of conceptually similar food technologies has been primarily event-driven (Botelho & Kurtz, 2008; Marks, Kalaitzandonakes, Allison & Zakharova, 2003).

11.3. Religion

The religious status of cultured meat is an issue which has received attention in various religious communities, and has been one strand of the wider cultural debate (Hopkins, 2015). Notably, this is an issue for the world's 1.8 billion Muslims, 1.1 billion Hindus, half a billion Buddhists, and over 10 million Jews (Hackett & McClendon, 2017). Comprising almost half of the global population, these people all follow religions with specific rules and customs around meat consumption.

Survey data from nationally representative samples of 3,030 people in the US, India, and China (Bryant et al., 2019) contains data from Jews (n=23), Muslims (n=193), Hindus (n=730), and Buddhists (n=139) on which cultured meat products they would be willing to eat. This can give some empirical insight into the views of adherents to these various religions. Respondents in this study were given the following description of 'clean meat':

"One food innovation is called clean meat. This type of meat is identical at the cellular level to conventional meat. This is real meat grown directly from animal cells. Clean meat is produced in a clean facility, similar to a brewery. The process does not involve raising and slaughtering farm animals. The final product has an identical taste and texture to conventional meat. Clean meat offers significant benefits for human health, the environment, and animal welfare. Several companies have already successfully produced and taste-tested clean meat. The products will be available for retail purchase in 1-5 years."

11.3.1 Judaism

In Judaism, most rabbis agree that cultured meat itself is kosher, though some say the cells must come from a kosher slaughtered animal (Bleich, 2013; Kenigsberg & Zivotofsky, 2020). Indeed, the rabbi who will ultimately decide whether cultured meat is kosher via the Orthodox Union's kosher certification scheme, the largest in the world (Fischer, 2016), appears enthusiastic about the concept (Purdy, 2018). However, there are interesting questions about whether cultured meat could allow kosher-observing Jews to consume otherwise prohibited foods.

The first question is whether cultured meat consumed with dairy would be kosher. The second is whether cultured pork would be kosher. Both rest on the question of whether cultured meat is considered to be meat in a religious sense, or is pareve, meaning it is considered to be something other than meat or dairy (Sokol, 2013; McDonald, 2018). For a more complete discussion of the kosher status of cultured meat, see Kenigsberg and Zivotofsky (2020).

Table 11.1: Jewish participants who would eat each type of cultured meat.

Judaism (n = 23)			
	Currently eat	**Find cultured meat appealing**	**Difference**
Beef	87.0%	69.6%	- 17.4%
Poultry	91.3%	69.6%	- 21.7%
Pork	60.9%	60.9%	0%
Lamb/Goat	65.2%	60.9%	- 4.3%

Amongst the 23 Jewish people in Bryant et al.'s (2019) survey data, 61% said they currently ate pork, and 61% said they would eat cultured pork. This was slightly lower than the proportion who would eat cultured beef (70%) or chicken (70%), but still a majority. Notably, pork was the only meat for which there was no overall preference for conventional meat - for all other species, fewer respondents said they would eat cultured meat than currently ate conventional meat. Our data did not allow us to interpret whether participants would eat cultured meat and dairy together.

11.3.2 Islam

In Islam, the relevant question is whether cultured meat is halal. Hamdan et al. (2018) argue that, based on Quran scripture and interpretation by prominent Islamic jurists, cultured meat is halal if the cells used are from a halal slaughtered animal and no blood or animal-based serum is used in the production process. However, since the origin of the cells is central to the halal status of cultured meat, halal meat from pigs and other haram species is unlikely to be approved (Purdy, 2018).

Indeed, survey data appears to confirm this: of 193 Muslims, 58% would eat cultured beef, 68% would eat cultured lamb or goat meat, and 49% would eat cultured chicken, but only 28% would eat cultured pork (Bryant et al., 2019).

Table 11.2: Muslim participants who would eat each type of cultured meat.

Islam (n = 193)			
	Currently eat	**Find cultured meat appealing**	**Difference**
Beef	64.8%	57.5%	- 7.3%
Poultry	74.6%	48.7%	- 25.9%
Pork	30.1%	27.5%	- 2.6%
Lamb/Goat	81.3%	67.9%	- 13.4%

As in Judaism, a significant proportion of adherents to Islam indicated that they do eat conventional pork, despite this being prohibited in the religion. This highlights the fact that many people of all different religions do not strictly follow the prescribed dietary guidelines (Rarick, Falk, Barczyk & Feldman, 2011).

11.3.3 Hinduism

Many Hindus interpret *ahimsā*, the principle of non-violence, as requiring vegetarianism, although this is not explicit in Hindu texts (Dudek, 2013). The focus on non-violence means that vegetarian Hindus are likely to see cultured meat as a way of avoiding harming animals, and some may decide it is permissible to eat. Some have suggested that cultured beef is unlikely to be accepted in Hinduism, since cows are considered sacred (Mattick, Wetmore & Allenby, 2015).

Table 11.3: Hindu participants who would eat each type of cultured meat.

Hinduism (n = 730)			
	Currently eat	**Find cultured meat appealing**	**Difference**
Beef	18.2%	18.9%	+ 0.7%
Poultry	67.5%	68.1%	+ 0.6%
Pork	18.5%	19.6%	+ 1.1%
Lamb/Goat	61.4%	64.4%	+ 3.0%

Again, survey data appears to confirm this. Of 730 Hindus in the dataset, 65% would eat cultured goat and 68% would eat cultured chicken, but only 20% would eat cultured pork and 19% would eat cultured beef (Bryant et al., 2019). Interestingly, Hindus were the only religious group who were overall more willing to eat cultured meat than conventional meat for all relevant species, perhaps highlighting the motivation to avoid harming animals. Notably, just 24% of the Hindus in this dataset were vegetarian, again marking a departure from the diets we might expect in this religious group.

11.3.4. Buddhism

Less has been written about the permissibility of cultured meat in Buddhism. Though many practicing Buddhist monks refrain from eating meat, only 1.4% of those identifying as Buddhist (most of whom were in China) were vegetarian or vegan in this data (Bryant et al., 2019). That said, 81% would eat cultured beef, 73% would eat cultured pork, 66% would eat cultured goat, and 61% would eat cultured chicken.

Table 11.4: Buddhist participants who would eat each type of cultured meat.

Buddhism (n = 139)			
	Currently eat	**Find cultured meat appealing**	**Difference**
Beef	87.8%	81.3%	- 6.5%
Poultry	82.0%	61.2%	- 20.8%
Pork	81.3%	73.4%	- 7.9%
Lamb/Goat	69.8%	65.5%	- 4.5%

Overall, we observe a majority of religious consumers being open to eating cultured meat in principle, with some evidence of avoidance of cultured meat from species which are not allowed in the religion (e.g. pork in Islam and beef in Hinduism). That said, a sizable portion of respondents in all religions appeared not to adhere strictly to the diets prescribed by their religion, meaning that many nominally religious people are unlikely to be sensitive to religious rulings on the permissibility of cultured meat per se.

11.4 Regulation

Recent years have seen increasing clarity over the regulatory frameworks for marketing cultured meat in the European Union and the United States. However, some important issues are yet to be addressed. A central issue in both markets is whether cultured meat will be considered meat.

11.4.1 European Union

In Europe, cultured meat will likely require approval from the European Food Safety Authority (EFSA) under the Novel Foods Regulation (EU) No (2015/2283) (Froggart & Wellesley, 2019; Merten-Lentz, 2018; Verzijden, 2019). This regulation is primarily designed to ensure that new foods are safe to consume, labelled properly so as not to mislead consumers, and not nutritionally disadvantageous compared with existing food they seek to replace (European Commission, n.d.). It is not yet clear what type of nutritional and toxicological evidence EFSA would require to approve cultured meat. Moreover, since there is no pre-market consultation process, it is likely that producers in Europe will have to 'learn by doing' through EFSA applications (Verzijden, 2019).

As Froggart and Wellesley (2019) have argued, it is likely that cultured meat products will be required to carry a name or label which clearly specifies the production process. The Food Information to Consumers Regulation (2011/1169) requires that food labelling is clear, precise, and easily understandable (European Commission, 2016). Newly approved novel foods, meanwhile, may be subject to further labelling requirements under the Novel Foods Regulation (Froggart & Wellesley, 2019).

Additionally, there are some questions about whether cultured meat will be able to be marketed as meat (Froggart & Wellesley, 2019). The Food Information to Consumers Regulation currently defines meat as 'skeletal muscles of mammalian and bird species recognized as fit for human consumption with naturally included or adherent tissues.' Skeletal muscle, in turn, is defined as 'muscles under the voluntary control of the somatic nervous system.' (European Commission, 2016). The current definition, therefore, would seem to exclude cultured meat.

If cultured meat products contain ingredients which are genetically modified, they will instead be subject to Regulation (EC) No 1829/2003 on genetically modified food and feed (Froggart & Wellesley, 2019). Decisions taken under this regulation are based on risk assessments as well as public acceptance and economic considerations. In practice, cultured meat products with a genetically modified component are less likely to be permitted in Europe, given heavy restrictions on genetically modified foods already in place and generally poor public perceptions of the technology (Eurobarometer, 2010).
Whilst cultured meat would be approved at the level of the European Union, it is likely that any required inspections and enforcement would be carried out by member states (Verzijden, 2019). European producers, therefore, need to be aware of both European and national legislation.

11.4.2 United States

There is somewhat less clarity around the regulatory framework in the US. Verzijden (2019) has identified some of the major differences from the EU as being the presence of a pre-market consultation mechanism, consistency in the bodies regulating and enforcing regulation, and the shared jurisdiction of cultured meat regulation between the US Department of Agriculture (USDA) and the Food and Drug Administration (FDA). At present, it seems that the FDA will regulate the pre-harvest production process and materials, and the USDA will regulate post-harvest processes including monitoring and labelling. However, as Verzijden (2019) points out, the existing agreement between these bodies is not binding, and the situation may therefore change. Moreover, individual states may have additional regulations.

Cultured meat may fall outside of the Federal Meat Inspection Act's definition of meat, which defines meat as coming from an animal carcass (Sanchez, 2018). While this was thought to be determinative of which agency should have jurisdiction over cultured meat regulation, it appears that this is no longer the case. However, this is still a relevant issue for the question of whether cultured meat will be allowed to be marketed as meat.

In both the US and the EU, cultured meat may not be defined as 'meat' under existing regulations. However, it is possible that such definitions will be revised to include cultured meat, especially given the presence of health and allergy concerns (Simon, 2018). Although meat allergy is rare in adults, a significant portion of potential consumers could have allergic reactions to eating meat, especially beef and poultry (Restani, Ballabio, Tripodi & Fiocchi, 2009)[9]. Since cultured meat is meat on a molecular level, it is extremely likely that those who are allergic to certain types of meat will also be allergic to cultured meat. Labelling which fails to adequately describe a product could lead to serious health risks for consumers (Watson, 2018). However, there are increasing attempts from meat industry incumbents to prohibit the term 'meat' from being used in the labelling of cultured meat products (Flynn, 2019).

11.5 Economic Impacts

One area worthy of further discussion is the potential economic impacts cultured meat will have. There are concerns around the impact of cultured meat on animal farmers, the potential for the consolidation of food production under large corporations, and concerns about how the relative price of cultured meat could impact inequality (Bonny et al., 2015; Stephens et al., 2018).

11.5.1 Agricultural employment

Concerns about the impact of cultured meat on animal farmers are evident in various legislative attempts to restrict cultured meat (Flynn, 2019). Indeed, cultured meat and related technologies may eventually replace livestock farming (Phillips and Wilks, 2019). Whilst just 4.4% of EU employment is in agriculture (Eurostat, 2017), this percentage is much higher in less developed parts of the world (Roser, 2019). Moreover, many of those who

[9] One particularly common form of red meat allergy is alpha-gal syndrome. This is caused by an immune system reaction to a sugar molecule which can enter the blood through tick bites (Mayo Clinic, 2019). It may be possible for cultured meat to be engineered to exclude alpha-gal, thus making products appropriate for alpha-gal syndrome sufferers, but further research on this is needed.

work in agriculture are concentrated in rural areas where the economy is largely dependent on agriculture (Kurrer & Lawrie, 2018).

Whilst cultured meat production will no doubt create new jobs, these would require an entirely different set of skills to current agricultural workers, who tend to have a lower level of education than the general population (Eurostat, 2017). Bonny et al. (2015) have argued that animal farmers may end up providing a small and premium niche of the overall meat market. They may respond by adopting agroecology concepts to improve sustainability and/or adopting biotechnologies such as cloning and genetic modification. Alternatively, they may switch to producing crops for human consumption or biofuels (Kurrer & Lawrie, 2018).

Nonetheless, it is likely that a significant shift towards cultured meat production and away from conventional animal agriculture will mean that many people currently employed in animal agriculture lose their jobs. This is, of course, a problem for these individuals. However, it is self-evidently untenable in the long run to insist that all of the existing jobs in any given sector must continue to exist.

There are countless examples throughout history of jobs which technology rendered obsolete. Most notably, the Luddites of the textile industry in England in the 19th century destroyed machinery to protest against the job losses the technology created. Likewise, a ‘knocker-upper’ was someone who was employed to knock on workers’ windows to wake them up before alarm clocks were widespread. There is no doubt that the individuals in these occupations would have been worse off without those jobs - but does anybody today think that society would be better off if textile machinery or alarm clocks had been banned to save them? One could, of course, create many more jobs in farming tomorrow by banning combine harvesters. Deliberately pursuing less efficient production in order to create or preserve jobs in a free market is neither sustainable nor desirable.

This point is perhaps best illustrated by an allegory about an economist visiting a country with a planned economy. On visiting a construction site, the economist noticed that the project had employed hundreds of workers with shovels instead of using any modern machinery or equipment. He asked why there were no machines, and the foreman told him that this way, more jobs were created. The economist responded that if the objective was to create jobs rather than finish the construction project, they should take away the workers’ shovels and have many more workers with teaspoons instead (Tanner, 2015).

11.5.2 Consolidating food production

Others have expressed concerns about the consolidation of food production under a smaller number of actors with greater capital (Driessen & Korthals, 2012; Hocquette, 2016). Indeed, consolidation in the food industry in general could result in oligopolies exerting pressure on suppliers, limiting consumer choice, and driving industrialization (Heinrich Böll Stiftung, 2017). Perhaps more pertinently still, cultured meat production may only be feasible in countries with sturdy energy infrastructure and a highly educated workforce. This has led Hocquette (2016) and Stephens et al. (2018) to speculate that cultured meat could exacerbate economic inequality between countries, as well as within.

However, it is not yet clear what shape the cultured meat industry will take. As with many of the social questions, this is dependent on as-yet-unknown aspects of the technology: for instance, Van der Weele and Driessen (2013) offer the alternative ‘pig-in-the-backyard’ vision where the technology is democratized and communities can produce their own meat from locally kept animals. In any case, production of cultured meat will require the production of inputs for culture media, and it is possible that these inputs could still be produced in existing agricultural systems.

11.5.3 Consumer inequality

Finally, some have worried that cultured meat may exacerbate inequalities between the rich and the poor (Bonny et al., 2015; Cole & Morgan, 2013; Stephens et al., 2018). Bonny et al. (2015) have speculated that cultured meat could feed the masses cheaply, leaving real meat the preserve of the wealthy. Conversely, Cole and Morgan (2013) have worried that cultured meat, being substantially more expensive than conventional meat, would allow the wealthy to eat meat without moral consequence, leaving only the poor reduced to killing animals for their food.

Interestingly, the economics of cultured meat production mean that both of these visions may hold some truth. Whilst the cost of producing cultured meat has fallen rapidly in recent years, it is likely that it will still be more expensive than its conventional counterpart when it first comes to market (González & Koltrowitz, 2019). Some commentators believe it will first be available at a premium price in restaurants only (Purdy, 2019). During this stage, cultured meat may be seen as a luxury or novelty only available to the rich or those with access to exclusive outlets. Given these conditions, consuming cultured meat could convey wealth and status.

However, in the longer term, cultured meat will become cheaper to produce, and could be cheaper than conventional meat if it is made more efficiently (Fountain, 2013). At this time, any prestige associated with cultured meat consumption will likely be diminished as it becomes commonplace. Indeed, we have seen the same process play out with other foods: salt, now ubiquitous and even maligned, was once so valuable that it was used to pay soldiers (Salt Association, n.d.).

The cost of producing cultured meat is likely to be relatively high initially, but decrease over time. This will likely mean that it is, at first, only available to affluent consumers, but may become increasingly common as the price falls. The price of cultured meat production falling below the price of conventional meat production may represent a tipping point for meat production worldwide.

11.6 Conclusion

Cultured meat is a technology with the potential to alleviate the ethical, environmental, and public health concerns associated with conventional meat production including greenhouse gas emissions, land and water use, antibiotic resistance, foodborne and zoonotic diseases, and animal slaughter. However, beyond overcoming technical challenges in perfecting and scaling up the production process, producers and advocates of cultured meat must consider its relation to a range of social and cultural phenomena and institutions.

These two sets of challenges are inextricably linked, because many of the uncertainties around regulation, religious classification, and economic impacts relate to specific elements of the production process which are unknown or proprietary. For example, the use of animal serum has implications for the halal status of cultured meat, while the scalability of production processes has implications for the shape of the cultured meat industry.

With respect to regulation and religious dietary restrictions, one can easily lose sight of the original objectives. For example, the European Union's Novel Food Regulation has ensuring food safety as a central objective, yet related legislation might mean cultured meat cannot be labeled as meat, putting consumers with allergies at risk. Similarly, halal slaughter was originally conceived based on the principle of reducing animal suffering (Withnall, 2014), yet may now require animals used in cultured meat production to be killed for their meat to be permissible in Islam (Hamdan et al., 2018). One must hope that the spirit of the law will prevail over the letter of the law in these cases.

Cultured meat producers face a range of technical challenges, and many of these are upstream from social challenges. It is important to consider how cultured meat might interact with these important cultural forces, and in some cases production decisions can be made to optimize outcomes with regards to the societal issues discussed here. Careful navigation of these challenges can ensure that cultured meat can fulfil its potential to alleviate animal suffering and environmental degradation.

11.7 References

Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245-254.

Bleich, J. D. (2013). Survey of Recent Halakhic Periodical Literature. *Tradition: A Journal of Orthodox Jewish Thought, 46*(4), 48-62.

Bonny, S. P., Gardner, G. E., Pethick, D. W., & Hocquette, J. F. (2015). What is artificial meat and what does it mean for the future of the meat industry? *Journal of Integrative Agriculture, 14*(2), 255-263.

Botelho, D., & Kurtz, H. (2008). The introduction of genetically modified food in the United States and the United Kingdom: A news analysis. *The Social Science Journal, 45*(1), 13-27.

Bryant, C., & Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. *Meat Science, 143*, 8-17.

Bryant, C. J., & Barnett, J. C. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite, 137*, 104-113.

Bryant, C., & Dillard, C. (2019). The Impact of Framing on Acceptance of Cultured Meat. *Frontiers in Nutrition, 6*, 103.

Bryant, C. J., Szejda, K., Deshpande, V., Parekh, N., & Tse, B. (2019). A Survey of Consumer Perceptions of Plant-Based and Clean Meat in the USA, India, and China. *Frontiers in Sustainable Food Systems, 3*, 11.

Dilworth, T., & McGregor, A. (2015). Moral steaks? Ethical discourses of in vitro meat in academia and Australia. *Journal of Agricultural and Environmental Ethics, 28*(1), 85-107.

Driessen, C. and Korthals, M., 2012. Pig towers and in vitro meat: Disclosing moral worlds by design. *Social Studies of Science, 42*(6), pp.797-820.

Dudek, S. G. (2013). *Nutrition essentials for nursing practice.* Lippincott Williams & Wilkins.

Eurobarometer. (2010). Biotechnology. Accessed 13 January 2020 at https://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_341_en.pdf

European Commission. (n.d.) *Novel food*. Accessed 15 April 2019 at https://ec.europa.eu/food/safety/novel_food_en

European Commission. (2016). *Food information to consumers – legislation.* Accessed 13 May 2019 at https://ec.europa.eu/food/safety/labelling_nutrition/labelling_legislation_en

Eurostat. (2017). Archive: *Farmers in the EU - statistics.* Eurostat Statistics Explained. Accessed 09 May 2019 at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Farmers_in_the_EU_-_statistics

Fischer, J. (2016). Markets, religion, regulation: Kosher, halal and Hindu vegetarianism in global perspective. *Geoforum, 69,* 67-70.

Flynn, D. (2019 April 03). *3 states join contested Missouri ban on using "meat" on cell-cultured product labels.* Food Safety News. Accessed 09 May 2019 at https://www.foodsafetynews.com/2019/04/3-states-join-contested-missouri-ban-on-using-meat-on-cell-cultured-product-labels/

Fountain, H. (2013, May 12) Building a $325,000 burger. The New York Times. Accessed 29 January 2020 at https://www.nytimes.com/2013/05/14/science/engineering-the-325000-in-vitro-burger.html

Frewer, L. J., Howard, C., & Shepherd, R. (1995). Genetic engineering and food: what determines consumer acceptance? *British Food Journal, 97*(8), 31-36.

Froggart, A. & Wellesley, L. (2019). *Meat Analogues: Considerations for the EU.* Chatham House. Accessed 29 November 2019 at https://www.chathamhouse.org/publication/meat-analogues-considerations-eu#

González, A. & Koltrowitz, S. (2019, July 9). The $280,000 lab-grown burger could be a more palatable $10 in two years. Reuters. Accessed 29 January 2020 at https://uk.reuters.com/article/us-food-tech-labmeat/the-280000-lab-grown-burger-could-be-a-more-palatable-10-in-two-years-idUKKCN1U41W8

Goodwin, J. N., & Shoulders, C. W. (2013). The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science, 95*(3), 445-450.

Hackett, C. & McClendon, D. (2017). *Christians remain world's largest religious group, but they are declining in Europe.* Pew Research. Accessed 29 November 2019 at https://www.pewresearch.org/fact-tank/2017/04/05/christians-remain-worlds-largest-religious-group-but-they-are-declining-in-europe/

Hamdan, M. N., Post, M. J., Ramli, M. A., & Mustafa, A. R. (2018). Cultured Meat in Islamic Perspective. *Journal of Religion and Health, 57*(6), 2193-2206.

Heinrich Böll Stiftung. (2017). *Agrifood Atlas: Facts and figures about the corporations that control what we eat.*

Hopkins, P. D. (2015). Cultured meat in western media: The disproportionate coverage of vegetarian reactions, demographic realities, and implications for cultured meat marketing. *Journal of Integrative Agriculture, 14*(2), 264-272.

Hopkins, P. D., & Dacey, A. (2008). Vegetarian meat: Could technology save animals and satisfy meat eaters? *Journal of Agricultural and Environmental Ethics, 21*(6), 579-596.

Hocquette, J.F. (2016). Is in vitro meat the solution for the future?. *Meat science, 120*, pp.167-176.

IPCC. (2018). Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Intergovernmental Panel on Climate Change.

Kenigsberg, J. & Zivotofsky, A. (2020). A Jewish Religious Perspective on Cellular Agriculture. Frontiers in Sustainable Food Systems (3)128.

Kurrer, C. & Lawrie, C. (2018). *What if all our meat were grown in a lab?* European Parliamentary Research Service. Accessed 07 May 2019 at http://www.europarl.europa.eu/RegData/etudes/ATAG/2018/614538/EPRS_ATA(2018)614538_EN.pdf

Laestadius, L. I., & Caldwell, M. A. (2015). Is the future of meat palatable? Perceptions of in vitro meat as evidenced by online news comments. *Public health nutrition, 18*(13), 2457-2467.

Lucas, A. (2019, October 10). *Lab-grown meat start-up raises $14 million to build production plant.* CNBC. Accessed 29 November 2019 at https://www.cnbc.com/2019/10/10/future-meat-technologies-a-lab-grown-meat-start-up-raises-14-million-dollars.html

Lymbery, P. & Oakshotte, I. (2014). *Farmageddon: The true cost of cheap meat.* Bloomsbury Publishing.

Marks, L. A., Kalaitzandonakes, N. G., Allison, K., & Zakharova, L. (2003). Media coverage of agrobiotechnology: did the butterfly have an effect? *Journal of Agribusiness, 21*(345-2016-15206), 1-20.

Mathew, A. G., Cissell, R., & Liamthong, S. 2007. Antibiotic resistance in bacteria associated with food animals: a United States perspective of livestock production. *Foodborne Pathogens and Disease, 4*(2), 115-133.

Mattick, C. S., Wetmore, J. M., & Allenby, B. R. (2015). An anticipatory social assessment of factory-grown meat. *IEEE Technology and Society Magazine, 34*(1), 56-64.

Mayo Clinic. (2019, July 13). Alpha-gal syndrome. Accessed 12 January 2020 at https://www.mayoclinic.org/diseases-conditions/alpha-gal-syndrome/symptoms-causes/syc-20428608

McDonald, M. (2018, December 14). *Emergence of Lab-Grown Meat Poses New Questions for Religious Leaders.* The Wall Street Journal. Accessed 23 April 2019 at https://www.wsj.com/articles/emergence-of-lab-grown-meat-poses-new-questions-for-religious-leaders-11544834277

McLeod, A. (2011). *World Livestock 2011 - Livestock in Food Security.* Food and Agriculture Organization of the United Nations (FAO).

Merten-Lentz, K. (2018 December 12). *In vitro meat: regulatory issues in the US and the EU.* Keller and Heckan LLP. Accessed 13 May 2019 at https://tomorrowsfoodandfeed.khlaw.com/2018/12/vitro-meat-regulatory-issues-us-eu/

Oliver, S. P., Murinda, S. E., & Jayarao, B. M. 2011. Impact of antibiotic use in adult dairy cows on antimicrobial resistance of veterinary and human pathogens: a comprehensive review. *Foodborne pathogens and disease, 8*(3), 337-355.

Phillips, C. J., & Wilks, M. (2019). Is There a Future for Cattle Farming?. In *Environmental, Health, and Business Opportunities in the New Meat Alternatives Market (pp. 239-259).* IGI Global.

Post, M. J. (2012). Cultured meat from stem cells: Challenges and prospects. *Meat science, 92*(3), 297-301.

Purdy, C. (2018, January 22). Silicon Valley wrestles with religion. Is high-tech "clean meat" kosher and halal? Quartz. Accessed April 23 2019 at https://qz.com/1184370/jews-and-muslims-are-considering-whether-high-tech-clean-meat-is-kosher-and-halal/
Purdy, C. (2019, April 17). The first cell-cultured meat will cost about $50. Quartz. Accessed 29 January 2020 at https://qz.com/1598076/the-first-cell-cultured-meat-will-cost-about-50/

Rarick, C., Falk, G., Barczyk, C., & Feldman, L. (2011). Is it kosher? No, it's halal: a new frontier in niche marketing. In Proceedings of the International Academy for Case Studies (Vol. 18, No. 1, pp. 51-56).

Restani, P., Ballabio, C., Tripodi, S., & Fiocchi, A. (2009). Meat allergy. *Current Opinion in Allergy and Clinical Immunology, 9*(3), 265-269.

Roser, M. (2019). *Employment in Agriculture.* Our World In Data. Accesed May 09 2019 at https://ourworldindata.org/employment-in-agriculture

Salt Association. (n.d.). Roman Times. Accessed 29 January 2020 at https://www.saltassociation.co.uk/education/salt-history/roman-times/

Sanchez, A. (2018). *Laws and Regulations Concerning Cell-Cultured Meat and Cellular Agriculture.* Food and Drug Law Institute. Accessed 13 May 2019 at https://www.fdli.org/2018/02/update-laws-regulations-concerning-cell-cultured-meat-cellular-agriculture/

Simon, M. (2018 July 16). *What* Is *Meat, Anyway? Lab-Grown Food Sets Off a Debate.* Wired. Accessed 13 May 2019 at https://www.wired.com/story/what-is-meat-anyway/

Sokol, S. (2013, August 10). *Orthodox groups debate kashrut of lab-grown meat.* The Jerusalem Post. Accessed 23 April 2019 at https://www.jpost.com/Jewish-World/Jewish-News/Orthodox-groups-debate-kashrut-of-lab-grown-meat-322642

Stephens, N., Di Silvio, L., Dunsford, I., Ellis, M., Glencross, A., & Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science & Technology, 78*, 155-166.

Tanner, M. Who Would Not Favor Economic Growth? Cato Institute. Accessed 13 January 2020 at https://www.cato.org/publications/commentary/who-would-not-favor-economic-growth

Tuomisto, H. L. (2019). The eco-friendly burger: Could cultured meat improve the environmental sustainability of meat products?. EMBO reports, 20(1), e47395.

Van der Weele, C., & Driessen, C. (2013). Emerging profiles for cultured meat; ethics through and as design. Animals, 3(3), 647-662.

Van Der Weele, C., & Driessen, C. (2019). How normal meat becomes stranger as cultured meat becomes more normal; Ambivalence and ambiguity below the surface of behaviour. *Frontiers in Sustainable Food Systems, 3*, 69.

Verzijden, K. (2019 March 15). *Regulatory pathways for clean meat in the EU and the US - differences & analogies.* Food Health Legal. Accessed 13 May 2019 at http://foodhealthlegal.com/?p=985

Watson, E. (2018, October 25). Cell-based meat cos: Please stop calling us 'lab-grown' meat… and we don't use antibiotics in full-scale production. Food Navigator USA. Accessed 29 November 2019 at https://www.foodnavigator-usa.com/Article/2018/10/25/Cell-based-meat-cos-Please-stop-calling-us-lab-grown-meat-and-we-don-t-use-antibiotics-in-full-scale-production

Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PloS one, 12*(2), e0171904.

Wilks, M., Phillips, C. J., Fielding, K., & Hornsey, M. J. (2019). Testing potential psychological predictors of attitudes towards cultured meat. *Appetite, 136*, 137-145.

Withnall, A. *Halal meat: What is it and why is it so controversial?* The Independent. Accessed 29 November 2019 at https://www.independent.co.uk/life-style/food-and-drink/what-is-halal-meat-the-big-questions-about-religious-slaughter-answered-9331519.html

This final study sought to contextualise the nascent cultured meat market, exploring how this technology will interact with existing institutions and how the social context will affect individual acceptance. Clearly, there are many open questions about how cultured meat will be treated by the media, regulators, religions, and the broader food economy. All of these factors will affect consumer acceptance of cultured meat in ways which cannot be accounted for here.

In my final chapter, I will review the contribution I have made in this thesis, discuss the implications of this work for a range of stakeholders, acknowledge some shortcomings, and identify a research agenda for accelerating the future of sustainable protein.

12. Discussion

In this section, I will summarise and expand upon my contribution to knowledge. I will also discuss the implications of this work for researchers, policymakers, advocates, cultured meat companies, and for the future of our food system. I will review some of the key limitations to the work in this thesis, and finally I will recommend areas of focus for future research.

12.1 Contribution

In this section, I provide a summary of the findings across the studies in this thesis, and compare the effect sizes in different studies to draw some general principles about maximising cultured meat sales.

12.1.1 Summary of studies

In this thesis, I first built a moral case against animal agriculture based on animal suffering (Chapter 1). I have developed a model for transitioning to vegetarianism which identifies and elucidates a number of psychological barriers to developing moral concern for farmed animals (Chapter 3; Bryant, Prosser & Barnett, forthcoming). Further, I have provided evidence that many meat-eaters agree that vegetarian and vegan diets are ethical, environmentally-friendly, and healthy, but practical factors such as taste, price, and convenience prevent many people from adopting these diets (Chapter 4; Bryant, 2019). I argue, therefore, that high quality affordable animal product alternatives are key to addressing the major practical barriers to behavioural change.

Turning to the field of cellular agriculture, I focused on public perceptions of cultured meat. This is a technology with the potential to emulate animal meat, meaning that consumers can maintain largely the same food habits and routines, but circumvent the unfortunate side effects of meat production. We reviewed the existing literature on consumer acceptance of cultured meat, finding that many consumers expressed food safety concerns, which are linked to the perception of unnaturalness. We also found that the majority of existing literature focused disproportionately on Western consumers, ignoring important opportunities to displace future animal product demand in developing countries (Chapter 5; Bryant & Barnett, 2018).

In order to address this deficit, we conducted a survey comparing consumer acceptance of cultured and plant-based meat in the USA, India, and China (Chapter 6; Bryant et al., 2019a). We found that China and India had significantly higher acceptance of both products, highlighting important market opportunities for alternative proteins in Asia. This study has formed the basis for further exploration of the Asian markets for alternative proteins (Arora et al., 2020; Dempsey & Bryant, 2020), and many companies and investors are increasingly looking at opportunities in Asia (Lamb, 2019). It also identified several demographic predictors of cultured meat acceptance, informing producers about who their early customers are likely to be.

To address concerns about food safety and unnaturalness, I conducted a series of experimental studies to identify the best ways to name, frame, and explain cultured meat. We observed modest differences between consumers exposed to different explanations about naturalness (Chapter 7; Bryant et al., 2019b), with stronger effects observed from studies manipulating the frame (Chapter 8; Bryant & Dillard, 2019) and the name (Chapter 9; Bryant & Barnett, 2019) of cultured meat. This highlights the importance of heuristics in evaluating unfamiliar concepts. Whilst rational arguments and evidence should be what ultimately informs food technology policy, it is likely that this is in fact swayed to a larger extent by public sentiment, which in turn is more vulnerable to heuristics and affect based rather than rational appeals. This is especially the case where a complex and contested policy making process with a variety of advocacy positions pertains to topics on which public opinion may be easily soured. In other words, being right about the relevant facts may not be enough if the idea proves deeply unpopular.

I provided an updated review of the literature on cultured meat acceptance two years on (Chapter 10; Bryant & Barnett, forthcoming). I find that many of the themes identified in qualitative literature mirror those observed in previous research, and that quantitative work continues to converge on questions of which demographics will buy cultured meat first and what consumers' major thoughts and concerns are. However, more recent research has illuminated the potential for several types of alternative proteins appealing to different consumer groups, and experimented with interventions to increase cultured meat acceptance.

Finally, broadening the scope beyond consumer acceptance, I considered the wider social and institutional forces affecting and affected by cultured meat (Chapter 11; Bryant, 2020a). The media, religions, and regulation are all potentially important sources of influence on public opinion with respect to cultured meat. Considering the economic impact of the technology, I identified several areas for concern and discussed how we should think about these phenomena in a global context.

12.1.2 Market selection, heuristic framing, and systematic arguing

As shown in Table 12.1, all of the empirical studies in this thesis observed a difference based on the intervention or comparison contained therein. There are three distinct levels of effect size observable here, which pertain to three different types of comparisons. Some studies looked at the difference in cultured meat acceptance between different markets (Bryant et al., 2019a), whereas others looked at how attitudes can be shaped within markets using either arguments targeting the systematic route to changing beliefs (Bryant et al., 2019b) or associative techniques like naming and framing targeting the heuristic route (Bryant & Barnett, 2019; Bryant & Dillard, 2020). Therefore, the comparisons made in the different empirical studies in this thesis can be categorised either as markets, systematic, or heuristic.

First, the naturalness ('explaining') study was the only one which failed to find any significant differences between experimental groups based on the main behavioural measures. This was despite a large sample size, consultation with experts on the intervention text, and optimisation following piloting. Compared to the other interventions and comparisons in this thesis, this was arguably the most cognitively demanding of participants. Unlike changing the name or images, as in other studies, a fairly detailed debunking of the naturalistic fallacy did not seem to be effective. Indeed, the condition in this experiment which yielded the most positive responses towards cultured meat was arguing that conventional meat is also unnatural - which, in itself, is an example of a fallacy with respect to the charge that cultured meat is unnatural (the 'tu quoque' fallacy occurs when someone asserts their opponent has also done wrong without addressing the charge of the wrong they are alleged to have done). The fairly sobering conclusion of this might be that honestly engaging with and responding to specific concerns around unnaturalness is unlikely to be as effective as simply avoiding the naturalness framing. Indeed, Wilks et al. (2019) have since found that perceived naturalness, unlike other factors measured, did not significantly predict cultured meat acceptance. Mohorčich and Reese (2019) recommend focusing on the positive aspects of the technology rather than responding to specific concerns about naturalness, a strategy partially validated by this data.

Table 12.1: Effect sizes observed in different empirical studies.

Study	**Effect size on behavioural measure**	**Effect size interpretation (Cohen, 1998)**	**Type of comparison**
Explaining (Bryant et al., 2019b)	$\eta^2 = .005$	No significant effect	Systematic
Naming (Bryant & Barnett, 2018)	$\eta^2 = .061$	Medium	Heuristic
Framing (Bryant & Dillard, 2019)	$\eta^2 = .030$	Small - medium	Heuristic
Cross-country (Bryant et al., 2019a)	**Between countries:** $\eta^2 = .081$ **Within countries:** USA adjusted $R^2 = .500$ China adjusted $R^2 = .494$ India adjusted $R^2 = .548$	**Between countries:** Medium **Within countries:** Large	Market

Second, the naming and framing studies found moderate significant effects of experimental interventions on behavioural intentions. These were studies in which participants from the same pool saw different messages. Unlike the naturalness study, where participants were required to read a passage about cultured meat and understand a specific argument about it, these studies presented cultured meat in a different frame in a more salient way (one study altered the name, the other altered a photograph and one sentence description.) The larger effect sizes from these studies compared to the naturalness study could be interpreted as meaning that these more salient frame changes sway opinion more reliably than detailed arguments, thus creating an argument for optics over substance in persuasion. One could argue that participants in this type of online survey are very likely to be processing information heuristically rather than systematically, and this is likely true (Berinsky, Margolis & Sances, 2013) However, this is also true of consumers in the market, who tend to process information on food labels quickly using heuristic techniques (Bialkova & van Trijp, 2010; Antúnez et al., 2013) . Therefore, framing and naming may be more important than explaining in the battle for public opinion.

However, this interpretation is surely short-sighted: regardless of the optics, the battle for the future of meat production must be won on merit. Although consumer opinions of cultured meat are important, they are likely to be mediated by the conditions created by regulators, as consumers are likely to take government endorsement as a strong signal of safety. Indeed, without the substance to make it to market, talking about the product framing is meaningless.

Finally, the effect size observed in the cross-country study was the largest by a wide margin. This indicates that the differences between markets are far more substantial than the differences one can make within markets by varying messaging. Cultured meat producers and advocates should pay attention to this finding, as it indicates that exploring international markets might be a more promising route to maximising sales than marketing domestically.

This analysis also enabled me to examine the impact of demographic and attitudinal predictors on cultured meat intentions. Political views, diet, food neophobia and familiarity with cultured meat all predicted acceptance across countries. There is potentially high acceptance amongst left-leaning urban omnivores who are not averse to trying new foods; this suggests that making cultured meat available to the right audience may be more important than perfecting messaging. As well as identifying the markets in which cultured meat will enjoy high demand at a country level, marketers can also identify segments within those countries which are likely to be particularly enthusiastic about the concept. Given that cultured meat is likely to be available first in small quantities, identifying these innovators is likely to be of vital importance.

12.2 Implications

In this section, I discuss some of the ongoing issues surrounding cultured meat as it comes to market. I first outline a framework for thinking about the adoption of new technologies and apply this to cultured meat. Next, I discuss the industry's strategy on naming cultured meat products, and consider the other component of anchoring within social representations theory: categorisation. In particular, I discuss whether cultured meat will, or should, be categorised as meat. I give brief consideration to the possibility of over-cautious regulation, and consider how cultured meat will impact the agricultural sector. I also argue that cultured meat may help to end the dissonance around eating animals. Finally, I consider related products, arguing that although insects represent a relatively healthy and sustainable source of protein, their consumption entails ethical problems, and highlighting the potential for other cellular agriculture products to precede cultured meat to market.

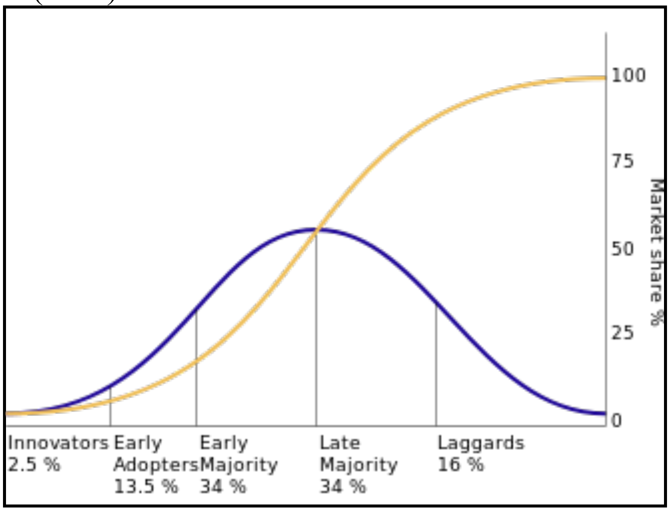
12.2.1 Diffusion of innovations

Many of the studies in this thesis have focused on which messages most effectively persuade representative samples of consumers on average. However, this approach may have failed to consider the dynamics of cultured meat coming to market. It is widely agreed by those in the industry that when cultured meat first becomes available to consumers, it will be in small quantities and at high prices (Askew, 219). Although we know from research that the vast majority of consumers are not willing to pay more for cultured meat (Shaw & Mac Con Iomaire, 2019), this might prove to be irrelevant if there are only very small quantities of cultured meat available, as long as there are a minority of enthusiastic supporters who are willing to pay high prices.

Indeed, this appears to be the case. Our research found that, although 45.1% of U.S. consumers were 'not at all likely' to pay more for cultured meat, 17.7% were 'very' or 'extremely likely' to pay more. In the Indian sample, this figure was 47.4% - in China, it was 52.5% (Bryant et al., 2019b). Other research gives cultured meat advocates cause for cautious optimism on this front, also. In our latest literature review, we observe again that cultured meat acceptance fluctuates widely across studies depending on samples, question framing, and information given - but even the most pessimistic projections estimate that 11.5% would eat cultured meat (Gomez Luciano et al., 2019).

This insight should be considered alongside Rogers' (2003) diffusion of innovations model (see Figure 12.1). The model provides a framework for analysing how new innovations spread and are adopted in the population. Centrally, the model posits that market adoption of innovations follows an S-curve, capturing only a small share of the market initially ('innovators') before slowly spreading to a larger segment ('early adopters') and then growing exponentially ('majority') and slowing again while the 'laggards' eventually adopt it.

Figure 12.1: Rogers' (2003) diffusion of innovations model



(Source: *https://en.wikipedia.org/wiki/Diffusion_of_innovations)*

It appears that the empirical data tends to confirm this view. As discussed, an enthusiastic minority of consumers are likely excited to adopt cultured meat and are willing to pay a premium for it. However, as Wilks et al. (2019) highlight, around one in three consumers in the U.S. are in absolute opposition to the technology, and say they would not consume cultured meat under any conditions. These groups represent the early adopters and the laggards, respectively. The majority here may be persuadable - as we have demonstrated, measures of cultured meat acceptance are sensitive to experimental manipulation to some extent. However, it is likely that these consumers (who are neither enthusiastic cultured meat supporters nor neophobic cultured meat opposers) will not resist cultured meat, but they will also not buy it unless it can compete with conventional meat on price and quality. They may also be waiting for more information such as details of safety regulation or waiting for others to adopt cultured meat first as a signal of safety (Slade, 2018).

Price, quality, and market share are all variables which will change in cultured meat's favour over time as the technology improves and becomes more efficient and accessible. Therefore, it seems possible that the optimal strategy for the industry in the short term is to focus on the minority of enthusiastic supporters, establish regulatory and logistical frameworks, and continue research to increase product quality whilst decreasing price, a trend which Zaraska (2016) estimates will be a significant one in cellular agriculture. However, manufacturers must also be aware of a significant minority who are opposed to cultured meat; if these groups were motivated to organise, they could apply pressure on supply chains to reject cultured meat and eventually legislate against it, as was the case for GMOs in Europe (Mohorcich & Reese, 2019).

In aiming to accelerate the adoption of cultured meat, producers should aim to find the innovators and early adopters who are willing to pay a premium for the product. In time, we can expect the majority to adopt cultured meat when it is competitive on price and quality. Focusing on which markets to target is likely to be a better strategy for maximising sales in the short term than trying to persuade undecided or oppositional consumers. However, if we are to move to a phase where the majority of people are not eating meat from animals, an awareness of potential consumer issues and which frames best address those will help to accelerate the change.

12.2.2 Language and the fate of animals

In courts, parliaments, and marketing departments, the battle over meat nomenclature is being fought. Advocates for animals and advocates for the animal industry understand that names shape perceptions, and perceptions shape behaviours. The issue of what we decide to call a handful of products will ultimately play an important role in determining how many more billion animals go to slaughterhouses.

Although the experiments conducted in the course of this PhD found that one of the best ways to increase consumer acceptance of cultured meat was to shift the nomenclature towards 'clean meat', the industry has since largely abandoned this term. Though it gained a lot of traction, and was the title of at least two books (Filko, 2019; Shapiro, 2018), it was ultimately thought to be unhelpful to a nascent industry trying to get buy-in from industry incumbents. Calling cultured meat 'clean', it was argued, had the clear implication that conventional meat is 'dirty', a framing that would be unacceptable to would-be investors from the meat industry (Turow-Paul, 2016; Watson, 2018).

At one stage, cultured meat companies argued that 'clean meat' was literally cleaner - Memphis Meats demonstrated that conventional meat bought in California supermarkets was laden with bacteria and antibiotics, whilst their cultured meat was clean (Schwartz, 2016). It is possible that such arguments will be used in the future when cultured meat is price-competitive and it is necessary to persuade people to switch - indeed, one study in this thesis showed that messages 'attacking' conventional meat played better than messages 'defending' cultured meat (Bryant et al., 2019b). However, in the short term, it seems prudent to avoid antagonising industry gatekeepers, many of whom are eager to be part of the disruption rather than to be disrupted (Garces, 2019). Given the considerable political and economic weight of animal agriculture, having such players lobbying in favour of cultured meat rather than against it (Odenheimer, 2018) is likely a difference of existential importance to this nascent industry.

The irony of the animal agriculture lobby objecting to potentially misleading language around food products will not be lost on some. The reality of animal products labelled 'humane' or 'free range' is often far from the image that such labels imply to consumers (Strom, 2017; Krantz, 2019). Those familiar with common farming practices will recognise the inadequacy of industry terms such as 'process' and 'harvest' for describing the act of using a knife to take an animal's life (Croney & Reynnells, 2008). If we allow such insidious euphemisms when discussing animal products, it is vital to challenge those who employ them when they insist that rival products must be identified in the least appealing terms possible. We know that product names affect purchase intent in a given market (Bryant & Barnett, 2019). The fate of billions of animals rests on what language a handful of regulators decide to permit.

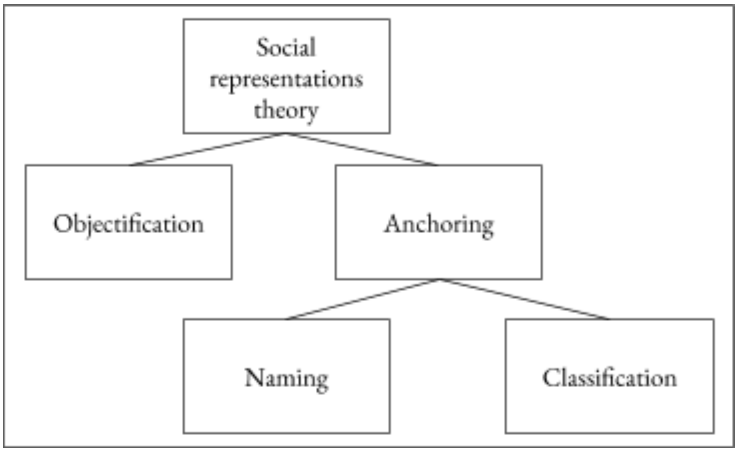
12.2.3 Classification as meat or non-meat

In one chapter, I explored how nomenclature would impact cultured meat acceptance, and discussed cultured meat in terms of social representations theory (Bryant & Barnett, 2019). Moscovici (2001) has written about social representations theory comprising two parts - objectification (whereby a concept is translated into a physical, tangible item, e.g. the 2013 cultured meat hamburger) and anchoring (whereby a concept is located with reference to other, more familiar concepts). According to Moscovici (2001), anchoring has two further sub-components: naming and classification (see Figure 12.2). We have demonstrated that consumers' perceptions of cultured meat vary with naming - it is likely that the same is true of classification as meat or non-meat.

This aspect of how cultured meat is conceptualised and socially represented is becoming increasingly relevant and contested. In several contexts with practical implications for millions of consumers, an increasingly important question is being contested: 'Is cultured meat meat?' (Bryant, 2020a).

The answer to this question has implications for how cultured meat is regulated, marketed, and treated by various religions. The answer may vary in different interpretations: for example, it may be that cultured meat is considered meat in Islam, and therefore halal pork is not possible, but considered non-meat in Judaism, and therefore kosher pork is possible. It may be appropriate to have cultured meat be subject to some of the safety regulations which apply to conventional meat, while others might not be relevant.

Figure 12.2: Social representations theory (Moscovici, 2001).



Regulation. Predictably, various bodies with financial interests in the classification of cultured meat have weighed in on this question. Whilst some bodies representing animal farmers in the U.S. have argued against cultured meat being called meat, others have argued that it should be considered meat so that its production is subject to the same safety regulations as conventional meat (Ronholm, 2018; Piper, 2019). Of course, it is likely that different safety regulations will be relevant for the different products, but there is nevertheless a split in how the incumbent industry should classify cultured meat (Piper, 2019; Sevrick, 2018). Further complicating this is the North American Meat Institute's support of classifying cultured meat as meat, not to disadvantage but to advantage the technology - this is a body which represents Tyson and Cargill, two large meat processors which have stakes in cultured meat companies. Interests on both sides are arguing about the classification of cultured meat, and there is further disagreement about which classification (meat or non-meat) would advantage the technology.

Religion. In religious terms, there is a question to be asked about the letter versus the spirit of religious laws. Both kosher and halal, the two major religious proscriptions about meat consumption, were originally intended to kill animals in ways which minimised suffering (Withnall, 2014). Neither of these religions, when conceiving these practices, could foresee the possibility of effective animal stunning techniques, far less cellular agriculture. There is some precedent of this view: notably, the British Halal Association's decision to allow animal stunning for halal-labeled products, although it is arguably outside the strict religious definition of halal slaughter (Withnall, 2014).

In the case of cultured meat, compassionate religious pragmatists might see the value in reducing animal suffering, and endorse the technology regardless of its adherence to scripture. Indeed, there is already evidence of this amongst leading Jewish thinkers, including the head of Israel's Orthodox Union which makes important decisions about kosher certifications (Bryant, 2020a). Whether cultured meat falls in a strict religious definition of 'meat' may become secondary to a consideration for the spirit of the law. If these religious rules were intended to reduce animal suffering, then one can imagine that their authors might have approved of cultured meat had it been conceivable at the time.

Alternative proteins. As well as conventional meat, cultured meat could become classified as a meat alternative alongside plant-based meats. We explored consumer acceptance of both plant-based and cultured meat (Bryant et al., 2019b), and found some evidence that cultured meat might be able to reach more committed meat-lovers than plant-based meat. In the U.S. omnivorism predicted acceptance of cultured meat, but not plant-based meat - in other words, cultured meat is uniquely appealing to meat-eaters in a way which plant-based meat is not. Additionally, more frequent meat consumption predicted acceptance of cultured meat, but not plant-based meat, in China - again pointing to the relatively high appeal of cultured meat to meat-lovers.

It is entirely possible that we observe these unique appeals of cultured meat because it is closer to conventional meat than plant-based meat alternatives. Indeed, I have argued that since it is the same at a cellular level, it ought to be classified as meat for practical purposes (Bryant, 2020a). This evidence appears to support this view - classifying cultured meat as 'meat' to a greater extent than plant-based meat seems intuitive to most people (McCauley, 2018). Therefore, there is a far stronger case for classifying cultured meat as meat, and good reason to think that this classification will be most useful, safe, and intuitive to consumers.

In any case, there is no reason for us to be slaves to existing definitions of 'meat'. As I have argued, it is possible that cultured meat falls outside the legal definitions of 'meat' in Europe and the USA (Bryant, 2020a). Does this mean that cultured meat should not be allowed to be labeled 'meat', and that it should not be subject to the same rules that apply to conventional meat? Or does it mean that we need to broaden our definitions of meat? As Shapiro (2018) has argued, electric cars are not best categorised as 'non-cars', since they clearly have the same function and form as petrol cars. As such, it is clearly practical and unobjectionable to call them cars, as it is to classify cultured meat as meat.

12.2.4 A caution about regulation

Cultured meat producers and advocates must be wary of the possibility of regulatory restriction. Given the many similarities in perceptions of cultured meat to perceptions of genetically modified foods (Bryant & Barnett, 2018), it is possible that cultured meat could meet similar challenges (Bryant, 2020a). This has been acknowledged by researchers, who have now sought to draw on the lessons learned from GMOs for cultured meat (Mohorčich & Reese, 2019). Interestingly, this research concluded that the adoption of such technologies can be halted by a small number of consumers, particularly in markets where buyers in a supply chain exert more pressure on sellers than the reverse (i.e. customers can easily switch supermarkets, and supermarkets have large buying power from producers). Mohorčich and Reese (2019) highlight that, in response to consumer pressure, food retailers began to avoid GMOs as policy before they were banned at a regulatory level.

Some (unpublished) research has found that, while negative messages about cultured meat producers reduce the consumer appeal of cultured meat, positive messages do not increase its appeal relative to no information (Beaudoin, Rabl, Rupanagudi & Sheikh, 2018). This indicates that parties with an interest in maintaining conventional farming may be able to influence public opinion against cultured meat more effectively than its advocates can influence opinion in the other direction. Already, there is some evidence of this being attempted: in particular, American meat unions have pushed for aggressive restrictions around cultured meat, refusing to call it meat and using language like ‘fake’ and ‘lab grown’ (Abbott, 2018; Popper, 2019).

There is a lot to lose from failing to regulate cultured meat properly and fairly. The environmental advantages, the public health implications, and the huge reduction in farm animal suffering are all opportunities to be taken, and yet over-aggressive regulation (whether or not this follows action from retailers or salient public concerns) may prevent them from being realised. It is not clear how many gains have not been made due to the EU’s rejection of GMOs. An analogous failure to allow cultured meat would represent a serious missed opportunity with respect to policy issues of vital importance such as climate change and public health.

12.2.5 Farming and rural communities

One group for whom this field has major implications is farmers. This includes animal farmers, who may find a declining market for their animals, and those who can move to producing new crops and inputs necessary for cultured meat (Cosgrove, 2017). Since this shift will represent a threat and an opportunity for different types of farmer, one might say the overall impact on farmers of a move to a cultured meat system is uncertain. However, one of the premises for cultured meat having a lower environmental impact than conventional meat is that it will require fewer resources, which ultimately means less labour input overall.

As I have argued, prioritising the retention of agricultural jobs over all else is simply not economically feasible (Bryant, 2020a). Deliberately choosing production methods which are less efficient and require more labour and other inputs will inevitably lead to a more expensive product. Furthermore, there is good evidence that compared to cultured meat, rearing animals is harmful to the environment, harms animals, and creates public health liabilities (Post et al., 2020; Schaefer & Savalescu, 2014; Tuomisto, 2019). The harms of animal agriculture are likely to far outweigh its benefits (see Section 1.3.3.3). We should be wary of our desire to protect existing jobs in industries which we would not wish to expand.

Nonetheless, macroeconomic arguments are unlikely to be much comfort to the individual farmer who loses his livelihood. Authors have speculated that such a shift could exacerbate inequality by displacing relatively low-skilled jobs with relatively high-skilled jobs and displacing food production in the global south (Bryant, 2020a; Stephens et al., 2018). It is possible that this will be part of a wider trend of technological advancements displacing the need for human workers in various parts of the economy; some have estimated that this could lead to 35% of UK jobs being displaced (Frey & Osborne, 2017).

Governments will need to address this possibility in the medium term - the ‘rise of the robots’ has already been a theme in the 2020 US Presidential election, with one candidate proposing a universal basic income as a solution (Stevens & Grullón Paz, 2020). Whether this is feasible is outside the scope of this thesis; suffice to say that governments must have plans in place to support those displaced from animal farming (and other susceptible industries) when this shift takes place. One can imagine farming communities suffering, and perhaps becoming analogous to the ex-mining communities of today if there are insufficient supports in place.

12.2.6 An end to dissonance

If society ever wakes up to the moral wrongness of eating animals, how will we view the last holdouts who insist on the practice? In recent history, vegetarians have always been a small minority of the population of Western countries. It has been relatively easy to dismiss their views as fringe, and evidence suggests that many people assume they are mistaken about the relevant issues, in part because most people appear to disagree with them (Buddle, Bray & Ankeny, 2018).

One of the major implications of my research is that, for some people, cultured meat may represent the only way to curtail animal product consumption. I have shown that the heaviest meat consumers are those most likely to be interested in cultured meat (Bryant et al., 2019b) - these people may be unwilling to reduce their meat consumption without an equivalent substitution. Moreover, I have shown that the profile of cultured meat consumers differs somewhat from the profile of plant-based meat consumers, so both technologies can play a role in replacing animal products (Bryant et al., 2019b; Bryant & Barnett, forthcoming).

As I have argued, one's own meat consumption is likely to be a significant barrier to clear reasoning about farmed animal suffering (Bryant, Prosser & Barnett, forthcoming). In a society where the overwhelming majority of people eat meat, this produces an extremely limited ambient appreciation for this cause. It is likely, in this view, that individuals would be far more likely to express moral concern for farmed animals if they were not bound by their own (often unexamined) meat consumption.

If meat consumption can be divorced from killing animals, people who are unwilling to stop eating meat and unlikely to entertain such strong criticism of their own behaviour will have a new way of viewing animal ethics. Why, when one's own behaviour is not implicated, would one be inclined to construct justifications for harming animals? Following this logic, cultured meat is likely to be a way to remove the motivation from the motivated reasoning on this topic. This could pave the way to unbiased future discussions of animal ethics.

12.2.7 The ethics of entomophagy

One of the alternative proteins often discussed alongside plant-based and cultured meat is insects. Entomophagy, the practice of eating insects, is increasingly advocated as a way to meet our protein needs in a healthier and more sustainable way (Ramos-Elorduy, 2009). However, this is not a trend I support. While it is true that insects may represent a healthier and more sustainable choice, the ethical implications of entomophagy are often overlooked.

It is easy to dismiss the idea of insect suffering as inconsequential, intractable, or simply abstruse. However, Klein and Barron (2016b, p.1) argue 'that the insect brain supports functions analogous to those of the vertebrate midbrain and hence that insects may also have a capacity for subjective experience.' As Bentham (1789) said, the relevant question for moral consideration is whether a being can suffer. The capacity for subjective experience implies the capacity for suffering, and therefore insects have some moral value, however small.

People acknowledge the moral value of insects each time they avoid stepping on an ant, or put a bug outside rather than squash it. Where there is little cost to doing so, most people will avoid harming insects. Indeed, this may explain why consumers are far less likely to want to eat whole insects compared to processed insect products such as cricket flour

(Gmuer, Guth, Hartmann & Siegrist, 2016). Aside from a disgust reaction, eating whole fried crickets makes it quite salient that one's meal used to be conscious[10].

The ethical problems with entomophagy are, in my view, likely to be underestimated. This is because we evaluate each insect to be morally worth very little, and we fail to adequately compensate for the relatively high number of insects needed because of scale insensitivity (Bryant, Prosser & Barnett, forthcoming). Tomasik (2018) has argued that chicken consumption produces far more animal suffering than beef or pork consumption, because chickens are far smaller, meaning you need more of them to produce the same amount of calories, and they are easier to abuse. It is likely that insects are to chickens as chickens are to cows in this scenario: a meal might require one hundred insects, one chicken, or one hundredth of a cow.

12.2.8 Other products of cellular agriculture

A significant area not discussed thus far is other products made using cellular agriculture. As well as synthetic dairy and egg whites, a range of companies in this blossoming space are using cellular agriculture to produce animal-free leather, silk, and even rhino horn (Donaldson & Carter, 2016; Gasteratos, 2019). Whilst non-food products are unlikely to be met with consumer resistance of the same kind, perceptions of dairy and egg products produced through cellular agriculture are an interesting and neglected area of study. Indeed, compared to many types of meat, dairy production entails greater environmental harm (Ritchie & Roser, 2020) and egg production entails greater harm to animals (Tomasik, 2018). Advocates for either cause should therefore also be concerned with the success of these alternatives.

Crucially, some such alternatives are already here: in 2019, the company Perfect Day sold a pilot batch of ice cream made from synthetic dairy, and they will begin selling to industry in the near future (Watson, 2018). This is another concept to which consumers might anchor cultured meat: if cultured meat enters a market where synthetic dairy is already familiar and accepted by some, its similarity to an already-accepted product may reduce consumer rejection. Whether consumers will view synthetic dairy as sufficiently similar to cultured meat that this anchoring takes place is an open question.

Early data suggests that this 'foot-in-the-door' technique for marketing cultured meat may be quite feasible. Synthetic dairy is more appealing to consumers than cultured meat: in two comparable surveys, The Grocer found that just 16% of UK adults would buy cultured meat (Tatum, 2017), whereas 28% would purchase synthetic milk (Perkins, 2018). This may be because consumers can imagine synthetic milk being a more convincing simulation of cows' milk than cultured meat is of cows. In any case, relatively high acceptance of a technologically similar product is likely to be a positive signal for uncertain consumers.

Interestingly, Perkins (2018) observed that, although acceptance of synthetic milk was higher than for cultured meat, many of the same issues and barriers were mentioned, with consumers again primarily concerned about the naturalness and safety of ingredients.

[10] Although the details and extent of insect consciousness is debated, there is general consensus on the view that insects are very likely to have at least a basic form of awareness (Barron & Klein, 2016; Klein & Barron, 2016a; Mallat & Feinburg, 2016). Consciousness being entirely subjective, we can never know for sure that another being of any species is conscious (the so-called 'problem of other minds'; see Leudar & Costall, 2004).

12.3 Limitations

In this section, I will address some of the major limitations of the work in this thesis. Principally, I address concerns about the hypothetical nature of survey work about future technologies, the possibility that technological solutions command more research attention than they warrant, and the lack of qualitative insight generated.

12.3.1 Hypothetical preferences

All of the empirical consumer research on cultured meat herein is entirely hypothetical. Although some producers had claimed they would sell cultured meat before the end of 2018 (Pasha-Robinson, 2018), products are yet to become commercially available anywhere in the world. The latest estimates are that products will come to market in Europe by the end of 2022 (Foote, 2020). Therefore, these studies (and almost all others) are asking consumers whether they would eat a product which does not yet exist.

There is one exception to this trend, a study which provides an interesting view of this particular limitation. Rolland et al. (2020) had Dutch participants come into a lab and eat what they believed to be cultured meat under the guise of a taste test (in fact, participants were given conventionally-produced beef burgers and told that it was cultured meat). While the most optimistic survey data suggests that around two thirds of people would eat cultured meat (Bryant et al., 2019b; Wilks & Phillips, 2017), the proportion who ate what they believed to be cultured meat in this study was 100%.

There are some caveats to this finding relating to demand characteristics. Firstly, participants knew in advance that they were signing up for a food-related study, which may have resulted in a bias towards recruiting more adventurous eaters than the general population. Secondly, although participants were not explicitly encouraged to eat the cultured meat by researchers, it was clearly necessary for the task, so there will have been some degree of social pressure. Despite these shortcomings, the findings clearly provide evidence for the existence of a substantial number of people who are willing to try cultured meat in practice. Indeed, the researchers report that many participants were displeased to be told in debriefing that they had not really eaten cultured meat (Rolland et al., 2020).

Reliance on self-reported behaviour or self-reported intentions is a problem for studying food choice more broadly. Peacock (2018) reviewed several alternative options for measuring food consumption which do not rely on self-report, including: using retail scanner data from sources such as Nielsen; using customer loyalty card data; using biomarkers predictive of animal product consumption; and collaborating with restaurants, stores and institutional dining services. The author concluded that there could be some technical challenges to acquiring reliable retail scanner or loyalty card data, and biomarkers are generally too intrusive and expensive while lacking reliability. Direct collaborations with food outlets, however, represents a potentially promising path to more reliable food choice data for research.

12.3.2 Neglecting alternative strategies

One limitation of this focus on cultured meat is that it may neglect other alternatives. As van der Weele, Feindt, van der Goot, van Mierlo and van Boekel (2019) have argued, substantial uncertainty around the specifics of cultured meat production means that it is unlikely to compare favourably in terms of environmental impact (and, indeed, feasibility) compared to alternatives like increasing legume consumption and entomophagy.

In the time since I started my PhD, the quality, quantity, and availability of plant-based meat replacements has increased dramatically. In the UK, one can now find convincing plant-based alternatives to most meaty favourites on almost every high street (Bryant, 2020b). Animal-free versions of signature dishes at KFC, Burger King, and Subway may make veganism easier and more convenient, but it is only the start of a mainstream market for vegan options. As fast food companies, restaurants, and supermarkets compete for customers, plant-based offerings will only get better and cheaper. This means that the scale of the sacrifice one makes in giving up meat will decrease substantially - at some point, these alternatives may be tastier, healthier, and cheaper than meat from animals. Such advances could make cultured meat unnecessary.

Even without advances in animal product alternatives, convincing people not to eat animals may become easier over time. Given that individuals take their moral cues from others to a large extent (Bandura, 1969; Nisan, 1987), any given individual is more likely to give up animal products the more other people are giving up animal products. Indeed, some data suggests that people are more likely to consider vegetarianism the more vegetarians they know (Lea & Worsley, 2001; Worsley & Skrzypiec, 1998). One has to think that there is a 'tipping point' exists whereby a vocal minority of vegans are able to exert considerable social pressure on the majority of ambivalent meat-eaters (see Gladwell, 2006). Defending factory farming is a very different proposition in a world where 5% are vegetarian than it is in a world where 25% or 50% are vegetarian.

My decision to focus on cultured meat is motivated in part by its potential to replace animal consumption entirely. While some people are content with legumes, and more than ever are satisfied with plant-based meat (Reinicke, 2019), it is extremely likely that some portion of the population will always want to eat meat from animals. Cultured meat is the only technology which can divorce meat consumption from killing animals.

Moreover, MacAskill (2015) argues that when considering areas to work on to maximise positive impact, one should assess the project's scale, tractability, and neglectedness. One individual can make a useful contribution to the extent that an area is currently neglected by other researchers. Research on encouraging vegetarianism, for example, has received increasing interest over the past number of years (Ruby, 2012). Therefore, the impact of me working on this area would be minimal in terms of my contribution compared to the impact of me working on cultured meat acceptance. Other factors may favour other approaches - for example, a focus on options which are already technologically feasible appears much more tractable.

Therefore, the increasingly mainstream status of plant-based meat alternatives and the possibility of reaching a 'vegetarian tipping point' represent two alternative approaches I might have taken to achieve the same ends. My main priority is not to maximise consumption of cultured meat, but to minimise animal suffering. The former is only a means to the latter. Although cultured meat has some distinct advantages over these alternatives (in particular, its long term ability to genuinely replace meat from animals with minimal change to the consumer experience), my future work will focus on other solutions which are more immediately to hand. That said, this niche focus on cultured meat has enabled me to be more productive as an individual than I might have been had I chosen to focus on more mainstream solutions. Therefore, although my work thus far may have neglected viable alternatives, the additional career capital obtained through my niche focus may enable me to promote a variety of animal product alternatives to a greater degree in my future career. For a full discussion of the value of focusing on relatively neglected cause areas, see MacAskill (2015).

12.3.3 Limited qualitative insights

Finally, as discussed in Chapter 2, the work in this thesis has been almost entirely quantitative and therefore has added limited qualitative insight. Although two of my studies contained word association tasks which allowed some qualitative analysis, I have argued above that for my prioritisation of the quantitative approach. As well as observing some thematic analysis in the qualitative work through my literature review, I chose to prioritise generalisability to maximise the impact of my research.

I was fortunate to be given the opportunity to take part in a fairly substantial extra-curricular qualitative research programme. Working with Collingwood Environmental Planning, I helped to design, run, and analyse workshops investigating public opinions of various food technologies (including cultured meat) on behalf of the Food Standards Agency. Through this experience, I have developed my perspective on consumer reactions to cultured meat in more detail, and come to have some appreciation for the unique challenges of the qualitative researcher.

12.4 Future research

In this section, I highlight areas of future research related to cultured meat and alternative proteins. I argue that research efforts must focus on overcoming the technical hurdles still related to cultured meat, and that social science can develop our understanding of how to best communicate about animal products, and how to create animal advocates.

Firstly, one of the main areas of research which should be a priority for scientists, funders, and research institutions is the technical science needed to develop cultured meat and other animal product alternatives. The data clearly show that, while people are largely on board with the arguments for meat reduction, they are generally unwilling to sacrifice the taste and convenience value of meat (Bryant, 2019). Therefore, developing competitive alternatives to minimize the need for consumer behaviour change is vital.

It is a privilege to contribute to the field of cellular agriculture as a social scientist, yet the reality is that affordable and scalable cultured meat is still the other side of significant scientific and technical hurdles (Post et al., 2020). The EU’s Horizon 2020 programme, which aims to fund research to address pressing environmental challenges, has funded two major alternative protein projects. The Smart Protein project (funded €8.2 million) and Protein2Food (funded €8.8 million) both aim to create plant- and fungi-based alternative proteins. However, public funding for cultured meat research is sorely lacking (see NewScientist, 2020). Other than a few million euros from the Dutch government in 2005 (Stephens et al., 2018), governments have largely failed to fund the vital technical research needed to realise the many benefits of this technology.

While I have favoured cultured and plant-based meat as a way to most easily meet consumers’ taste and convenience demands, those advocating for a reduction in meat may consider a range of options. Van der Weele et al. (2019) argue that these technological solutions have attracted attention for their novelty, but that straightforward replacement of animal products with beans and legumes is the most environmentally friendly and immediately available method of advocating for a decrease in meat consumption. Indeed, as the research shows, different consumers are likely to favour different alternatives (Bryant & Barnett, 2020).

Secondly, the development and marketing of alternative proteins should be considered as one of the 'prongs' of a wider strategy to reduce animal product consumption. Whilst such products will give people the opportunity to reduce their animal product consumption, they still require the impetus. Therefore, advocates of meat reduction should be optimistic about the arrival of better quality animal product alternatives, but should continue to highlight the reasons why people should be moving in this direction: animal farming causes harm to the planet, to public health, and to animals. Research in the field of effective animal advocacy should continue to investigate the most effective ways of communicating this in order to reduce demand for animal products.

Finally, beyond researching how to create vegetarians and vegans, part of my own research agenda will focus on how to create animal advocates and activists. Given that conversations and social media content account for 30% - 40% of the most important factors which first influenced vegetarian and vegans to change their diets (Cooney, 2014, McCormick, 2019), talking about the reasons to reduce animal product consumption and sharing information with others might be more important than individual diet. Personally, I have saved many more animals through advocacy than I have through my personal veganism, and while many vegans believe passionately in animal rights and reducing animal suffering, they may not realise that what they say is likely far more important than what they eat.

13. References

Abbott, C. (2018, March 27). *Lab Grown Meat Is Not Beef, Say Ranchers. Agriculture.* Available at https://www.agriculture.com/news/livestock/lab-grown-meat-iis-not-beef-say-ranchers

Animal Clock. (2020). *Annual U.K. Animal Slaughter Stats.* Available at https://animalclock.org/uk/

Antúnez, L., Vidal, L., Sapolinski, A., Gimenez, A., Maiche, A., & Ares, G. (2013). How do design features influence consumer attention when looking for nutritional information on food labels? Results from an eye-tracking study on pan bread labels. *International journal of food sciences and nutrition, 64*(5), 515-527.

Arora, R. S., Brent, D. A., & Jaenicke, E. C. (2020). Is India Ready for Alt-Meat? Preferences and Willingness to Pay for Meat Alternatives. *Sustainability, 12*(11), 4377.

Askew, K. (2019, December 17). *Cultured meat: Challenges and opportunities on the long road to market.* Food Navigator. Available at https://www.foodnavigator.com/Article/2019/12/17/Cultured-meat-and-the-long-road-to-market

Bailey, R., Froggatt, A., & Wellesley, L. (2014). *Livestock–climate change's forgotten sector.* Chatham House.

Bandura, A. (1969). Social learning of moral judgments. *Journal of Personality and Social Psychology, 11*(3), 275.

Barron, A. B., & Klein, C. (2016). What insects can tell us about the origins of consciousness. *Proceedings of the National Academy of Sciences, 113*(18), 4900-4908.

Bastian, B., & Loughnan, S. (2017). Resolving the meat-paradox: A motivational account of morally troublesome behavior and its maintenance. *Personality and Social Psychology Review, 21*(3), 278-299.

Baumann, F., & Bryant, C. (2019). *Cultured Meat Nutritional Enhancements Report*. Cellular Agriculture Society. Accessed October 21, 2020 at https://osf.io/preprints/tj96x/

Beaudoin, A., Rabl, V., Rupanagudi, R., & Sheikh, N. (2018). *Reducing the Consumer Rejection of Cultivated Meat.*

Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit attitude toward an emerging food technology: The case of cultured meat. *Appetite, 108*, 245-254.

Bekoff, M. (2015, June 12). Pigs Are Intelligent, Emotional, and Cognitively Complex. Accessed 30 January 2020 at https://www.psychologytoday.com/gb/blog/animal-emotions/201711/cows-science-shows-theyre-bright-and-emotional-individuals

Bekoff, M. (2017a, January 3). The World According to Intelligent and Emotional Chickens. Accessed 30 January 2020 at https://www.psychologytoday.com/gb/blog/animal-emotions/201701/the-world-according-intelligent-and-emotional-chickens

Bekoff, M. (2017b, November 2). Cows: Science Shows They're Bright and Emotional Individuals. Accessed 30 January 2020 at https://www.psychologytoday.com/gb/blog/animal-emotions/201711/cows-science-shows-theyre-bright-and-emotional-individuals

Bentham, J. (1789). A utilitarian view. *Animal rights and human obligations*, 25-26.

Berinsky, A. J., Margolis, M. F., & Sances, M. W. (2014). Separating the shirkers from the workers? Making sure respondents pay attention on self-administered surveys. *American Journal of Political Science, 58*(3), 739-753.

Bethlehem, J. (2010). Selection bias in web surveys. *International Statistical Review, 78*(2), 161-188.

Bialkova, S., & van Trijp, H. (2010). What determines consumer attention to nutrition labels? *Food quality and preference, 21*(8), 1042-1051.

Boaz, A., Grayson, L., Levitt, R., & Solesbury, W. (2008). Does evidence-based policy work? Learning from the UK experience. *Evidence & Policy: A Journal of Research, Debate and Practice, 4*(2), 233-253.

Brighton, B., Bhandari, M., Tornetta, P., & Felson, D. T. (2003). Hierarchy of evidence: from case reports to randomized controlled trials. *Clinical Orthopaedics and Related Research, 413*, 19-24.

Bryant, C. J. (2019a, September 3). *A Guide to Effective Animal Campaigning.* The Vegan Society. Accessed 03 February 2020 at https://www.vegansociety.com/about-us/research/research-news/project-update-guide-effective-animal-campaigning

Bryant, C. J. (2019b). We Can't Keep Meating Like This: Attitudes towards Vegetarian and Vegan Diets in the United Kingdom. *Sustainability, 11*(23), 6844.

Bryant, C. J. (2020a). Culture, meat, and cultured meat. *Journal of Animal Science.*

Bryant, C. J. (2020b). *What meat eaters really think about veganism - new research.* The Conversation. Accessed 30 March 2020 at https://www.theconversation.com/what-meat-eaters-really-think-about-veganism-new-research-129583

Bryant, C. J., Anderson, J. E., Asher, K. E., Green, C., & Gasteratos, K. (2019a). Strategies for overcoming aversion to unnaturalness: the case of clean meat. *Meat science, 154*, 37-45.

Bryant, C., & Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. *Meat science, 143*, 8-17.

Bryant, C. J., & Barnett, J. C. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite, 137*, 104-113.

Bryant, C., & Dillard, C. (2019). The Impact of Framing on Acceptance of Cultured Meat. *Frontiers in Nutrition, 6*, 103.

Bryant, C., Prosser, A., & Barnett, J. (forthcoming). *Going Veggie: Social and Psychological Barriers to Vegetarianism in an AIDA model.* Appetite.

Bryant, C. J., Szejda, K., Deshpande, V., Parekh, N., & Tse, B. (2019b). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China. *Frontiers in Sustainable Food Systems*, 3, 11.

Bryman, A. (2016). *Social Research Methods (5th ed.).*Oxford: Oxford University Press.

Buddle, E. A., Bray, H. J., & Ankeny, R. A. (2018). Why would we believe them? Meat consumers' reactions to online farm animal welfare activism in Australia. *Communication Research and Practice, 4*(3), 246-260.

Caldwell, K. (2017, August 03). *Perceptions of Farmed Fish Intelligence and Ability to Feel Pain and Pleasure.* Mercy For Animals. Available at https://mercyforanimals.org/perceptions-of-farmed-animal-intelligence

Caniça, M., Manageiro, V., Abriouel, H., Moran-Gilad, J., & Franz, C. M. (2019). Antibiotic resistance in foodborne bacteria. *Trends in Food Science & Technology, 84*, 41-44.

Cheng, W., Chen, H., Su, C., & Yan, S. (2013). Abundance and persistence of antibiotic resistance genes in livestock farms: a comprehensive investigation in eastern China. *Environment international, 61*, 1-7.

Circus, V. E., & Robison, R. (2019). Exploring perceptions of sustainable proteins and meat attachment. *British Food Journal.*

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences.* New York, NY: Routledge Academic.

Compassion in World Farming. (2012a). *The life of: pigs.* Accessed 17 September 2019 at https://www.ciwf.org.uk/media/5235118/The-life-of-Pigs.pdf

Compassion in World Farming. (2012b). *The life of: laying hens.* Accessed 17 September 2019 at https://www.ciwf.org.uk/media/5235024/The-life-of-laying-hens.pdf

Compassion in World Farming. (2012c). *The life of: dairy cows.* Accessed 17 September 2019 at https://www.ciwf.org.uk/media/5235185/the-life-of-dairy-cows.pdf

Connolly-Boutin, L., & Smit, B. (2016). Climate change, food security, and livelihoods in sub-Saharan Africa. *Regional Environmental Change, 16*(2), 385-399.

Cooney, N. (2014). *Large-scale survey of vegans, vegetarians, and meat reducers.* The Humane League Labs. Available at http://www.humaneleaguelabs.org/static/reports/2014/04/diet-change-and-demographic-characteristics1.pdf

Cosgrove, E. (2017, October 12). *What Do Farmers Think About Cultured Meat?* AgFunder News. Available at https://agfundernews.com/what-do-farmers-think-about-cultured-meat.html

Croney, C. C., & Reynnells, R. D. (2008). The ethics of semantics: Do we clarify or obfuscate reality to influence perceptions of farm animal production? *Poultry science, 87*(2), 387-391.

Crossley, N. (1996). *Intersubjectivity: The fabric of social becoming (Vol. 4*). London: Sage.

Degreef, F., & Scholliers, P. (2019). Trust in food in the modern period. *Food and Foodways, 27*(1-2), 1-13.

Delgado, C. L. (2003). Rising consumption of meat and milk in developing countries has created a new food revolution. *The Journal of Nutrition, 133*(11), 3907-3910.

Dempsey, C. & Bryant, C. (2020). *Cultured meat: do Chinese consumers have an appetite?* Cellular Agriculture Society.

Diener, E., & Crandall, R. (1978). *Ethics in social and behavioral research*. Chicago: University of Chicago Press.

Dilworth, T., & McGregor, A. (2015). Moral steaks? Ethical discourses of in vitro meat in academia and Australia. *Journal of Agricultural and Environmental Ethics, 28*(1), 85-107.

Donaldson, B. & Carter, C. (2016).*The Future of Meat Without Animals.* London: Roman & Littlefield International.

Durkheim, E. (1938). *The Rules of Sociological Method,* trans. Solavay, S.A. & Mueller, J. H. New York: Free Press.

Dugan, M., Aldai, N., Aalhus, J., Rolland, D., & Kramer, J. (2011). Trans-forming beef to provide healthier fatty acid profiles. *Canadian Journal of Animal Science, 91*(4), 545-556.

Easton, K. L., McComish, J. F., & Greenberg, R. (2000). Avoiding common pitfalls in qualitative data collection and transcription. *Qualitative health research, 10*(5), 703-707.

Eurostat. (2017). Archive: Farmers in the EU - statistics. Eurostat Statistics Explained. Accessed 09 May 2019 at https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Archive:Farmers_in_the_EU_-_statistics

Ferdowsian, H. R., & Barnard, N. D. (2009). Effects of plant-based diets on plasma lipids. *The American journal of cardiology, 104*(7), 947-956.

Feskens, E. J., Sluik, D., & van Woudenbergh, G. J. (2013). Meat consumption, diabetes, and its complications. *Current diabetes reports, 13*(2), 298-306.

Filko, N. (2019). *Clean Meat.* Stuttgart: LangenMüller.

Food and Agriculture Organization. (2006). *Livestock's long shadow: environmental issues and options.* Rome: Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization. (2011). *World Livestock 2011: Livestock in food security.* Rome: Food and Agriculture Organization of the United Nations.

Foote, N. (2020, January 15). *Cultured meat could be on the EU market 'as early as 2022'.* EURACTIV. Available at https://www.euractiv.com/section/agriculture-food/news/cultured-meat-could-be-on-the-eu-market-as-early-as-2022/

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change, 114*, 254-280.

Friedman, D. B., Kanwat, C. P., Headrick, M. L., Patterson, N. J., Neely, J. C., & Smith, L. U. (2007). Importance of prudent antibiotic use on dairy farms in South Carolina: a pilot project on farmers' knowledge, attitudes and practices. *Zoonoses and Public Health, 54*(9-10), 366-375.

Froggatt, A. & Wellesley, L. (2019). *Meat Analogues: Considerations for the EU*. Chatham House. Accessed 29 November 2019 at https://www.chathamhouse.org/publication/meat-analoguesconsiderations-eu#

Garcia, E., Ramos Filho, F. S. V., Mallmann, G. M., & Fonseca, F. (2017). Costs, benefits and challenges of sustainable livestock intensification in a major deforestation frontier in the Brazilian Amazon. *Sustainability, 9*(1), 158.

Garces, L. (2019). *Grilled: Turning Adversaries into Allies to Change the Chicken Industry.* London: Bloomsbury.

Gasteratos, K. (2019). 90 Reasons to Consider Cellular Agriculture. Available at https://dash.harvard.edu/bitstream/handle/1/38573490/90%20Reasons%20-%20Final%20Version%20for%20DASH.pdf

Gerbens-Leenes, P. W., Mekonnen, M. M., & Hoekstra, A. Y. (2013). The water footprint of poultry, pork and beef: A comparative study in different countries and production systems. *Water Resources and Industry, 1*, 25-36.

Gladwell, M. (2006). *The tipping point: How little things can make a big difference.* Boston: Little, Brown & Co.

Global Agriculture. (n.d.) *Industrial Agriculture and Small-scale Farming.* Accessed 30 January 2020 at https://www.globalagriculture.org/report-topics/industrial-agriculture-and-small-scale-farming.html

Gloor, L. (2019). *The Case for Suffering-Focused Ethics.* Center on Long-Term Risk. Available at https://longtermrisk.org/the-case-for-suffering-focused-ethics/

Gmuer, A., Guth, J. N., Hartmann, C., & Siegrist, M. (2016). Effects of the degree of processing of insect ingredients in snacks on expected emotional experiences and willingness to eat. *Food Quality and Preference, 54*, 117-127.

Gómez-Luciano, C. A., de Aguiar, L. K., Vriesekoop, F., & Urbano, B. (2019). Consumers' willingness to purchase three alternatives to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic. *Food quality and preference, 78*, 103732.

Goodwin, J. N., & Shoulders, C. W. (2013). The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science, 95*(3), 445-450.

Graça, J., Calheiros, M. M., & Oliveira, A. (2015). Attached to meat?(Un) Willingness and intentions to adopt a more plant-based diet. *Appetite, 95*, 113-125.

Griffin, D. R., & Speck, G. B. (2004). New evidence of animal consciousness. *Animal cognition, 7*(1), 5-18.

Haines, J., & Staley, L. (2004). *Risk Assessment Evaluation for Concentrated Animal Feeding Operations*. US Environmental Protection Agency—Office of Research and Development: Washington, DC, USA.

Hamdan, M. N., Post, M. J., Ramli, M. A., & Mustafa, A. R. (2018). Cultured meat in islamic perspective. *Journal of religion and health, 57*(6), 2193-2206.

Hammersley, M. (2017). On the role of values in social research: Weber vindicated?. *Sociological Research Online, 22*(1), 1-12.

Harris, S. (2011). *The moral landscape: How science can determine human values.* New York: Simon and Schuster.

Harris, S. (2018, January 11). Twitter. Accessed 31 January 2020 at https://twitter.com/SamHarrisOrg/status/951276362387591169

Herrero, M., Havlík, P., Valin, H., Notenbaert, A., Rufino, M. C., Thornton, P. K., ... & Obersteiner, M. (2013). Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. *Proceedings of the National Academy of Sciences, 110*(52), 20888-20893.

Hosie, R. (2017, August 7). *Aggressive vegans are putting a quarter of Britons off vegetarianism, finds study.* The Independent. Accessed 31 January 2020 at https://www.independent.co.uk/life-style/food-and-drink/vegans-aggressive-british-people-turn-off-vegetarianism-meat-dairy-study-a7880251.html

Hulshof, R. B. A., Berndt, A., Gerrits, W. J. J., Dijkstra, J., Van Zijderveld, S. M., Newbold, J. R., & Perdok, H. B. (2012). Dietary nitrate supplementation reduces methane emission in beef cattle fed sugarcane-based diets. *Journal of Animal Science, 90*(7), 2317-2323.

Hultin, G. (2017). *Lab-Grown Meat: Exploring Potential Benefits and Challenges of Cellular Agriculture*. Food & Nutrition. Accessed October 21, 2020 at https://foodandnutrition.org/march-april-2017/lab-grown-meat-exploring-potentialbenefits-challengescellular-agriculture/

Hume, D. (1739). *A Treatise of Human Nature*. London: John Noon.

Ibrahim, M., Porro, R., & Mauricio, R. M. (2010). Brazil and Costa Rica: deforestation and livestock expansion in the Brazilian Legal Amazon and Costa Rica: drivers, environmental degradation, and policies for sustainable land management. *Livestock in a changing landscape, Volume 2: experiences and regional perspectives*, 74-95.

IPCC. (2018). *Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Intergovernmental Panel on Climate Change.

Jenkins, D. J. A., Kendall, C. W. C., Faulkner, D. A., Kemp, T., Marchie, A., Nguyen, T. H., ... & Trautwein, E. A. (2008). Long-term effects of a plant-based dietary portfolio of cholesterol-lowering foods on blood pressure. *European journal of clinical nutrition, 62*(6), 781-788.

Kenigsberg, J. A., & Zivotofsky, A. Z. (2019). A Jewish religious perspective on cellular agriculture. *Frontiers in Sustainable Food Systems, 3*, 59.

Klein, C., & Barron, A. B. (2016a). Insect consciousness: Commitments, conflicts and consequences. Animal Sentience 1(9), 21.

Klein, C., & Barron, A. B. (2016b). Insects have the capacity for subjective experience. *Animal Sentience, 1*(9), 1.

Klous, G., Huss, A., Heederik, D. J., & Coutinho, R. A. (2016). Human–livestock contacts and their relationship to transmission of zoonotic pathogens, a systematic review of literature. *One Health, 2*, 65-76.

Krantz, R. (2019, January 30). *"Wild-caught," "organic," "grass-fed": what do all these animal welfare labels actually mean?* Vox. Available at https://www.vox.com/future-perfect/2019/1/30/18197688/organic-cage-free-wild-caught-certified-humane

Kurrer, C., & Lawrie, C. (2018). *What if all our meat was grown in a lab?* Scientific Foresight Unit, European Parliamentary Research Service. Available at https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/614538/EPRS_ATA(2018)614538_EN.pdf

Lamb, C. (2019, March 19). *Cultured Meat Will Likely Debut in Asia, Not Silicon Valley. Here's Why.* The Spoon. Available at https://thespoon.tech/cultured-meat-will-likely-debut-in-asia-not-silicon-valley-heres-why/

Latham, M. C. (1997). *Human nutrition in the developing world (No. 29)*. Food & Agriculture Organization. Rome.

Lea, E., & Worsley, A. (2001). Influences on meat consumption in Australia. *Appetite, 36*(2), 127-136.Leudar, I., & Costall, A. (2004). On the persistence of the 'Problem of Other Minds' in psychology: Chomsky, Grice and theory of mind. *Theory & Psychology, 14*(5), 601-621.

Low, P., Panksepp, J., Reiss, D., Edelman, D., Van Swinderen, B., & Koch, C. (2012). *The Cambridge declaration on consciousness.* In Francis Crick Memorial Conference (Vol. 7).

Lymbery, P. & Oakeshott, I. (2014). *Farmageddon: The True Cost of CheapMeat*. Bloomsbury Publishing: London.

Lynch, J., & Pierrehumbert, R. (2019). Climate impacts of cultured meat and beef cattle. *Frontiers in sustainable food systems, 3*, 5.

Lynch, M. (2000). Against Reflexivity as an Academic Virtue and Source of Privileged Knowledge. *Theory, Culture and Society, 17:* 26-54.

MacAskill, W. (2015). *Doing Good Better: Effective Altruism and a Radical New Way to Make a Difference.* London: Guardian Books.

Mallatt, J., & Feinberg, T. E. (2016). Insect consciousness: Fine-tuning the hypothesis. *Animal Sentience, 1*(9), 10.

Margulis, S. (2004). *Causes of Deforestation of the Brazilian Rainforest.* Washington DC: The World Bank.

Martin, M. J., Thottathil, S. E., & Newman, T. B. (2015). Antibiotics overuse in animal agriculture: a call to action for health care providers. *American Journal of Public Health 105*(12): 2409-2410.

Mathew, A. G., Cissell, R., & Liamthong, S. (2007). Antibiotic resistance in bacteria associated with food animals: a United States perspective of livestock production. *Foodborne Pathogens and Disease, 4*(2), 115-133.

Mattick, C. S., Landis, A. E., Allenby, B. R., & Genovese, N. J. (2015). Anticipatory life cycle analysis of in vitro biomass cultivation for cultured meat production in the United States. *Environmental science & technology, 49*(19), 11941-11949.

McCauley, M. (2018, July 18). *Consumer Reports survey: Consumers want clear labeling to distinguish "lab grown meat" from conventional meat.* Available at https://advocacy.consumerreports.org/press_release/consumer-reports-survey-consumers-want-clear-labeling-to-distinguish-lab-grown-meat-from-conventional-meat/

McCormick, B. (2019, March 04). *Why People Go Vegan: 2019 Global Survey Results.* Available at https://vomadlife.com/blogs/news/why-people-go-vegan-2019-global-survey-results

McEwen, S. A. (2006). Antibiotic use in animal agriculture: what have we learned and where are we going?. *Animal biotechnology, 17*(2), 239-250.

Mekonnen, M. M., & Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. *Ecosystems, 15*(3), 401-415.

Millman, O. (2019, April 8). *Burger King's plant-based Whopper gets glowing review - from a meat lobbyist.* The Guardian. Accessed September 20 2019 at https://www.theguardian.com/business/2019/apr/08/burger-king-impossible-whopper-plant-based-review-meat-lobbyist

Mohorčich, J., & Reese, J. (2019). Cell-cultured meat: Lessons from GMO adoption and resistance. *Appetite, 143*, 104408.

Moscovici, S. (2001). *Social representations: Essays in social psychology.* New York: NYU Press.

Nahimas, Y. (2018, May 02). *Lab-Grown Meat Is Getting Cheap Enough For Anyone To Buy.* Fast Company. Available at https://www.fastcompany.com/40565582/lab-grown-meat-is-getting-cheap-enough-for-anyone-to-buy

NewScientist. (2020, February 19). *Cultured meat needs a lot more government backing - for all our sakes.* Available at https://www.newscientist.com/article/mg24532703-200-cultured-meat-needs-a-lot-more-government-backing-for-all-our-sakes/

Nisan, M. (1987). Moral norms and social conventions: A cross-cultural comparison. *Developmental Psychology, 23*(5), 719.

Odenheimer, A. (2018, May 02). *Tyson Foods Makes Another Investment in Lab-Grown Meat.* Bloomberg. Available at https://www.bloomberg.com/news/articles/2018-05-02/u-s-food-giant-tyson-makes-first-investment-in-israel

Office for National Statistics. (2019). *Population estimates.* Available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates

O'Keefe, L., Mclachlan, C., Gough, C., Mander, S., & Bows-Larkin, A. (2016). Consumer responses to a future UK food system. *British Food Journal.*

Oliver, S. P., Murinda, S. E., & Jayarao, B. M. 2011. Impact of antibiotic use in adult dairy cows on antimicrobial resistance of veterinary and human pathogens: a comprehensive review. *Foodborne pathogens and disease, 8*(3), 337-355.

Pasha-Robinson, L. (2018, March 02). *Lab-grown 'clean' meat could be on sale by end of 2018, says producer.* The Independent. Available at https://www.independent.co.uk/news/science/clean-meat-lab-grown-available-restaurants-2018-global-warming-greenhouse-emissions-a8236676.html

Peacock, J. (2018). *Measuring Change in Diet for Animal Advocacy*. Humane League Labs. Accessed October 21, 2020 at https://assets.ctfassets.net/ww1ie0z745y7/1sHurac1JzOOSMwIunI8fH/dda7c264e30e71cc8499ff1d9f190f8c/E009R01-measuring-diet-animal-advocacy.pdf

Perkins, C. (2018, September 14). *'Test tube milk' more likely to win Brits than lab-grown meat.* The Grocer. Available at https://www.thegrocer.co.uk/sourcing/test-tube-milk-more-likely-to-win-brits-than-lab-grown-meat/571598.article

Piper, K. (2019, March 09). *The lab-grown meat industry just got the regulatory oversight it's been begging for.* Vox. Available at https://www.vox.com/future-perfect/2019/3/9/18255806/fda-usda-lab-grown-meat-cell-based-vegan-vegetarian

Pliner, P., & Hobden, K. (1992). Development of a scale to measure the trait of food neophobia in humans. *Appetite, 19*(2), 105-120.

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science, 360*(6392), 987-992.

Popper, N. (2019, February 09). *You Call That Meat? Not So Fast, Cattle Ranchers Say.* The New York Times. Available at https://www.nytimes.com/2019/02/09/technology/meat-veggie-burgers-lab-produced.html

Post, M. (2012). Cultured meat from stem cells: Challenges and prospects. *Meat science, 92*(3), 297-301.

Post, M., Levenberg, S., Kaplan, D., Genovese, N., Fu, J., Bryant, C., Moutsatsou, P., Negowetti, N., & Verzijden, K. (2020). Scientific, sustainability, and regulatory challenges of cultured meat. *Nature Food*.

Punch, K. (2013). *Introduction to Social Research: Quantitative & Qualitative Approaches (3rd ed.)* London: Sage.

Ramos-Elorduy, J. (2009). Anthropo-entomophagy: Cultures, evolution and sustainability. *Entomological Research, 39*(5), 271-288.

Reese, J. (2017, November 20). Survey of US Attitudes Towards Animal Farming and Animal-Free Food October 2017. Sentience institute. Accessed 17 September 2019 at https://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017

Reese, J. (2018). *The End of Animal Farming: How Scientists, Entrepreneurs, and Activists are Building an Animal-free Food System.* Boston: Beacon Press.

Reese, J. (2019, April 11). *US Factory Farming Estimates.* Available at https://www.sentienceinstitute.org/us-factory-farming-estimates

Reinicke, C. (2019, September 20). *A survey on plant-based 'meat' shows consumer interest is still strong — and it bodes well for companies like Beyond Meat and Impossible Foods.* Business Insider. Available at https://markets.businessinsider.com/news/stocks/plant-based-meat-demand-still-strong-new-study-shows-2019-9-1028542136

Ritchie, H. & Roser, M. (2020). *Employment in Agriculture.* Accessed 30 January 2020 at https://ourworldindata.org/employment-in-agriculture

Rivera, L. (2017, June 29). *The Truth Behind the Pork We Eat.* The Independent. Accessed 17 September 2019 at https://www.independent.co.uk/life-style/food-and-drink/pork-production-truth-pig-farming-uk-factory-hughfearnley-whittingstall-sienna-miller-mick-jagger-a7813746.html

Rogers, E. (2003). *Diffusion of Innovations. (Fifth edition)*. Free Press: New York

Rolland, N. C., Markus, C. R., & Post, M. J. (2020). The effect of information content on acceptance of cultured meat in a tasting context. *Plos one, 15*(4), e0231176.

Ronholm, B. (2018, September 25). *There's room on the hamburger bun for cell-cultured meat and politics.* Food Safety News. Available at https://www.foodsafetynews.com/2018/09/theres-room-on-the-hamburger-bun-for-cell-cultured-meat-and-politics/

Rothgerber, H. (2020). Meat-related cognitive dissonance: A conceptual framework for understanding how meat eaters reduce negative arousal from eating animals. *Appetite, 146*, 104511.

Rouhani, M. H., Salehi-Abargouei, A., Surkan, P. J., & Azadbakht, L. (2014). Is there a relationship between red or processed meat intake and obesity? A systematic review and meta-analysis of observational studies. *Obesity Reviews, 15*(9), 740-748.

Ruby, M. B. (2012). Vegetarianism. A blossoming field of study. *Appetite, 58*(1), 141-150.

Sarek, K., Savoie, J. & Moss, D. (2019). *From Humans in Canada to Battery Caged Chickens in the United States, Which Animals Have the Hardest Lives: Results.* Charity

Entrepreneurship. Accessed 20 September 2019 at http://www.charityentrepreneurship.com/blog/from-humans-in-canada-to-battery-caged-chickens-in-the-united-states-which-animals-have-the-hardest-lives-results

Sawant, A. A., Sordillo, L. M., & Jayarao, B. M. (2005). A survey on antibiotic usage in dairy herds in Pennsylvania. *Journal of dairy science, 88*(8), 2991-2999.

Schaefer, G. O., & Savulescu, J. (2014). The ethics of producing in vitro meat. *Journal of Applied Philosophy, 31*(2), 188-202.

Schwartz, A. (2016, July 07). *This startup is making real meatballs in a lab without killing a single animal.* Business Insider. Available at https://www.businessinsider.com/memphis-meats-is-making-lab-grown-meatballs-2016-7

Sevrick, K. (2018, May 10). *As lab-grown meat advances, U.S. lawmakers call for regulation.* Science. Available at https://www.sciencemag.org/news/2018/05/lab-grown-meat-advances-us-lawmakers-call-regulation

Shapiro, P. (2018). *Clean meat: How growing meat without animals will revolutionize dinner and the world.* New York: Gallery Books.

Shaw, E., & Iomaire, M. M. C. (2019). A comparative analysis of the attitudes of rural and urban consumers towards cultured meat. *British Food Journal.*

Siegrist, M., & Sütterlin, B. (2017). Importance of perceived naturalness for acceptance of food additives and cultured meat. *Appetite, 113*, 320-326.

Siegrist, M., Sütterlin, B., & Hartmann, C. (2018). Perceived naturalness and evoked disgust influence acceptance of cultured meat. *Meat science, 139*, 213-219.

Singer, P. (1991). *A Companion to Ethics.* Oxford: Blackwell Publishing.

Slade, P. (2018). If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite, 125*, 428-437.

Snowden, A., & Martin, C. R. (2011). Concurrent analysis: towards generalisable qualitative research. *Journal of Clinical Nursing, 20*(19-20), 2868-2877.

Stephens, N., & Ruivenkamp, M. (2016). Promise and ontological ambiguity in the in vitro meat imagescape: From laboratory myotubes to the cultured burger. *Science as culture, 25*(3), 327-355.

Stephens, N., Di Silvio, L., Dunsford, I., Ellis, M., Glencross, A., & Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science & Technology, 78*, 155-166.

Stevens, M. & Grullón Paz, I. (2020, March 18). *Andrew Yang's $1,000-a-Month Idea May Have Seemed Absurd Before. Not Now.* The New York Times. Available at https://www.nytimes.com/2020/03/18/us/politics/universal-basic-income-andrew-yang.html

Strom, S. (2017, January 31). *What to Make of Those Animal-Welfare Labels on Meat and Eggs.* The New York Times. Available at https://www.nytimes.com/2017/01/31/dining/animal-welfare-labels.html

Surveygoo. (2018). *Nearly one in three consumers willing to eat lab-grown meat, according to new research.* Available at https://www.datasmoothie.com/@surveygoo/nearly-one-in-three-consumers-willing-to-eat-lab-g/

Sun, Z.C., Yu, Q.L., & Lin, H. (2015). The environmental prospects of cultured meat in China. Journal of Integrative Agriculture, 14(2), 234-240.

Szejda, K., Dillard, C. & Urbanovich, T. (2019). *Initial Consumer Perceptions of Cellular Agriculture Nomenclature: A Qualitative Analysis of Word Associations.* The Good Food Institute. Available at https://www.gfi.org/images/uploads/2020/01/Dec-2019-CM-Nomenclature-Qual-Study-Word-Associations-FINAL-REPORT.pdf

Talbot, C., & Talbot, C. (2014). Sir Humphrey and the professors: What does Whitehall want from academics? *Policy@ Manchester*, 1-28.

Tatum, M. (2017, January 06). *Meat the future… and how to market it.* The Grocer. Available at https://www.thegrocer.co.uk/meat/meat-the-future--and-how-to-market-it/546754.article

The Good Food Institute. (2016). *Clean meat: The naming of tissue-engineered meat.* The Good Food Institute. Available at https://www.gfi.org/the-naming-of-clean-meat

Tomasik, B. (2018). *How Much Direct Suffering is Caused By Various Animal Foods?* Accessed 20 September 2019 at https://reducing-suffering.org/how-much-direct-suffering-is-caused-by-various-animal-foods/

Tucker, C. A. (2014). The significance of sensory appeal for reduced meat consumption. *Appetite, 81*, 168-179.

Tuomisto, H. L. (2019). The eco-friendly burger: Could cultured meat improve the environmental sustainability of meat products?. *EMBO reports, 20*(1), e47395.

Tuomisto, H. L., & Teixeira de Mattos, M. J. (2011). Environmental impacts of cultured meat production. *Environmental science & technology, 45*(14), 6117-6123.

Turow-Paul, E. (2016, October 17). *How The Term 'Clean Meat' Could Undermine The Alternative Meat Movement.* Forbes. Available at https://www.forbes.com/sites/eveturowpaul/2016/10/17/how-the-term-clean-meat-could-undermine-the-alternative-meat-movement/#7c435ded0a0b

Van der Weele, C., Feindt, P., van der Goot, A. J., van Mierlo, B., & van Boekel, M. (2019). Meat alternatives: an integrative comparison. *Trends in Food Science & Technology, 88*, 505-512.

Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015a). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat science, 102*, 49-58.

Verbeke, W., Sans, P., & Van Loo, E. J. (2015b). Challenges and prospects for consumer acceptance of cultured meat. *Journal of Integrative Agriculture, 14*(2), 285-294.

Viva!. (n.d.a). *Viva! Pig Fact Sheet*. Accessed 30 January 2020 at https://www.viva.org.uk/pigs/fact-sheet

Viva!. (n.d.b). *Laying Hen Farming Facts.* Accessed 30 January 2020 at https://www.viva.org.uk/egg-factsheet

Viva!. (n.d.c). *The Life of a Modern Dairy Cow.* Accessed 30 January 2020 at https://www.viva.org.uk/dark-side-dairy/life-modern-dairy-cow

Watson, E. (2018, July 25). *Perfect Day CEO talks vegan dairy: 'I would call them animal free dairy proteins, but people might fight me on that'.* Food Navigator USA. Available at https://www.foodnavigator-usa.com/Article/2018/07/25/Cellular-agriculture-Perfect-Day-CEO-talks-vegan-dairy-at-the-2018-IFT-show

Weber, M. (1919) *Science as a profession and a vocation*, in Bruun, H. and Whimster, S. (2012). Max Weber: Collected methodological writings. London: Routledge.

Welin, S., Gold, J., & Berlin, J. (2012). In vitro meat. *The Philosophy of Food, 39*, 292.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Jonell, M. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet, 393*(10170), 447-492.

Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PloS one, 12*(2), e0171904.

Wilks, M., Phillips, C. J., Fielding, K., & Hornsey, M. J. (2019). Testing potential psychological predictors of attitudes towards cultured meat. *Appetite, 136*, 137-145.

Withnall, A. (2014, May 07). *Halal meat: What is it and why is it so controversial?* The Independent. Available at https://www.independent.co.uk/life-style/food-and-drink/what-is-halal-meat-the-big-questions-about-religious-slaughter-answered-9331519.html

World Health Organization. (2015, October). *Q&A on the carcinogenicity of the consumption of red meat and processed meat.* Retrieved January 30 2020 from World Health Organization: https://www.who.int/features/qa/cancer-red-meat/en/

World Health Organization. (2018, February 08). *Antibiotic resistance.* Available at https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance

Worldometer. (2020a). *Countries in the world by population (2020).* Available at https://www.worldometers.info/world-population/population-by-country/

Worldometer. (2020b). *World Population Clock.* Accessed at https://www.worldometers.info/world-population/

Worsley, A., & Skrzypiec, G. (1998). Teenage vegetarianism: prevalence, social and cognitive contexts. *Appetite, 30*(2), 151-170.

YouGov. (2013, August 05). *No British demand for fake meat.* Available at https://yougov.co.uk/topics/politics/articles-reports/2013/08/05/no-demand-fake-meat

Zajonc, R. B. (2001). Mere exposure: A gateway to the subliminal. *Current directions in psychological science, 10*(6), 224-228.

Zaraska, M. (2016, May 02). Lab-grown meat is in your future, and it may be healthier than the real stuff. The Washington Post. Available at https://www.washingtonpost.com/national/health-science/lab-grown-meat-is-in-your-future-and-it-may-be-healthier-than-the-real-stuff/2016/05/02/aa893f34-e630-11e5-a6f3-21ccdbc5f74e_story.html

Zhong, V. W., Van Horn, L., Cornelis, M. C., Wilkins, J. T., Ning, H., Carnethon, M. R., ... & Norwood, A. F. (2019). Associations of dietary cholesterol or egg consumption with incident cardiovascular disease and mortality. *Jama, 321*(11), 1081-1095.

Appendices

Appendix A: Data management plan

Overview

1.1 Postgraduate Researcher: Christopher Bryant
1.2 Project title: Exploring consumer acceptance of cultured meat
1.3 Project start and end dates: 03 October 2016 – 30 June 2020
1.4 Project context: This project aims to explore what is known about consumer acceptance of 'cultured meat', which can be grown *in vitro* from animal cells. Although cultured meat will be available to consumers within a few years, little is known about how consumers might perceive the novel food. I will mainly use experimental methods to explore how consumers might perceive various aspects of cultured meat in various different contexts.

Defining your data

2.1 Where do your data come from? *First, I will synthesise the findings from a number of published studies on the topic of consumer acceptance of cultured meat in order to produce a systematic (and a narrative) review. This data will be taken from studies published in peer reviewed journals, but also from studies conducted by research and advocacy organisations.* *Second, the original data for my empirical studies will be obtained from online questionnaires with experimental manipulations. These will be carried out on Qualtrics and Guided Track, and participants will be recruited from MTurk, Positly, Respondi, and similar recruitment platforms.*
2.2 What formats are your data in? *My data will be exported from Qualtrics as Excel files (.xml) and SPSS files (.sav). The software required to access these file types are Microsoft Excel and Statistics Package for the Social Sciences. The University has licenses for both of these software packages, and it is extremely likely that this will remain the case.*
2.3 How often do you get new data? *All of my data will come from online surveys and experimental questionnaires. I have so far carried out eight online experiments and surveys, and will conduct at least two more. On average, I get new data every 4-6 months.*
2.4 How much data do you generate? *The data files for my first experiment were around 350 KB in total. I anticipate that my future studies will generate an equivalent, or slightly greater amount of data. Therefore, I anticipate that the total amount of data will be about 5MB.*
2.5 Who owns the data you generate? *According to my studentship agreement, the University owns all data I create, but I retain the copyright on publications based upon my data.*

Looking after your data

3.1 Where do you store your data? *My data is stored in my supervisor's area of the X: Drive. My supervisor and I both have access to this.*

3.2 How are your data backed up? *Data stored on the university research storage system is backed up by Computing Services. I make sure I copy the latest versions of my working files there each day.*
3.3 How do you structure and name your folders and files? *I have a project folder for my PhD overall, and sub-folders for each study. Data for each study are stored in one Excel file, and one SPSS file within the appropriate sub-folder. Since there are not numerous different data files, precise naming is not an issue. However, sub-folders also contain Word documents describing relevant differences between data files (formatting, new variables, etc.)*
3.4 How do you manage different versions of your files? *I keep every iteration of my data files, including original raw data. When making changes to data files, I note them in a Word document, and save them as a new version, amended with a number at the end of the filename. Through this process, I can see what changes have been made from the original data to each version of my files, and have a record of what each data file contains.*
3.5 What additional information is required to understand the data? *I keep the original data, as well as a record of what variables represent, the exact survey question wordings, and a document describing the contents of each data file.*

Archiving your data

4.1 What data should be kept or destroyed after the end of your project? *All of my data will be anonymised, and in some cases will be made Open Access when participants give consent for this. Data which is not to be made Open Access (i.e. from my first study) will be destroyed after 10 years have passed, in accordance with ESRC requirements.*
4.2 For how long should data be kept after the end of your project? *My funder requires that my data are kept for 10 years after the end of the project.*
4.3 Where will the data you keep be archived? *As required by my ESRC funding, I will submit my final data to the UK Data Service. Furthermore, data which is to be made Open Access will be published alongside relevant publications.*
4.4 When will data be moved into the archive? *I will archive the data when I submit my thesis.*
4.5 Who is responsible for moving data to the archive and maintaining them? *I am responsible for depositing my data in an archive and the archive service will maintain them.*

Sharing your data

5.1 Who else has a right to see or use this data during the project? *For data which is not Open Access, only my supervisor and I should have access to my data during the project. External collaborators will access data in some cases.*
5.2 What data should or shouldn't be shared openly and why? *For studies where informed consent is obtained for the data to be made Open Access, this will be done. However, for my first study, informed consent to make the data Open Access was not sought or obtained. Subsequently, this data will not be shared openly, since consent was not given.*
5.3 Who should have access to the final dataset and under what conditions?

Anonymised data for most of the studies will be made Open Access, in which case they will be accessible to all. Others will be able to download the data from the UK Data Service.
5.4 How will you share your final dataset? *The data can be downloaded from the UK Data Service, once users have registered. Most of the data will be made Open Access.*

Implementing your plan

6.1 Who is responsible for making sure this plan is followed? *I will take responsibility for carrying out the actions required by this plan and report them to my supervisor as appropriate.*
6.2 How often will this plan be reviewed and updated? *My supervisor and I will review this plan every 6 months and will agree updates if necessary.*
6.3 What actions have you identified from the rest of this plan? *Ensure that data files are all anonymised, and the order of each data file is maintained in the X: Drive.* *Ensure that informed consent to make data Open Access is obtained in future studies.*
6.4 What policies are relevant to your project? *The University of Bath Research Data Policy and the ESRC Research Data Policy are relevant to this project.*
6.5 What further information do you need to carry out these actions? *I will review this plan with my supervisor, and refer to the relevant policies, as well as the UK Data Service general guidance on data management for further information.*

Appendix B: Ratings of papers from Chapter 5 using Kmet, Lee, & Cook (2004)

	Study	Quality
Quantitative studies	Hocquette et al. *(2015)*	1.00
	Wilks and Phillips *(2017)*	1.90
	Siegrist and Sütterlin *(2017)*	1.50
	Bekker, Fischer, Tobi, and van Trijp *(2017)*	1.71
	Verbeke, Sans, and Van Loo *(2015)*	1.33
Qualitative studies	Verbeke, Marcu, et al. *(2015)*	1.60
	Marcu et al. *(2015)*	1.50
	O'Keefe et al. *(2016)*	1.50
	Tucker *(2014)*	1.30
	Laestadius and Caldwell *(2015)*	1.70
	Laestadius *(2015)*	1.50
	Bekker, Tobi, and Fischer *(2017)*	1.60

These ratings are on a scale of 0 (poor study quality) to 2 (good study quality). They are calculated as a composite of 14 different items for quantitative studies, and 10 items for qualitative studies. Each item is scored as a 2 (the study met the criteria), a 1 (the study partially met the criteria) or a 0 (the study did not meet the criteria). Some items in the quantitative evaluation tool can be scored N/A.

The criteria used for qualitative and quantitative studies are shown in the table below.

Evaluating quantitative studies	Evaluating qualitative studies
Question/objective sufficiently described?	Question/objective sufficiently described?
Study design evident and appropriate?	Study design evident and appropriate?
Method of subject/comparison group selection *or* source of information/input variables described and appropriate?	Context for the study clear?
Subject (and comparison group, if applicable) characteristics sufficiently described?	Connection to a theoretical framework/wider body of knowledge?
If interventional and random allocation was possible, was it described?	Sampling strategy described, relevant and justified?
If interventional and blinding of investigators was possible, was it reported?	Data collection methods clearly described and systematic?
If interventional and blinding of subjects was possible, was it reported?	Data analysis clearly described and systematic?
Outcome and (if applicable) exposure measure(s) well defined and robust to measurement/misclassification bias? Means of assessment reported?	Use of verification procedure(s) to establish credibility?
Sample size appropriate?	Conclusions supported by the results?
Analytic methods described/justified and appropriate?	Reflexivity of the account?
Some estimate of variance is reported for the main results?	
Controlled for confounding?	
Results reported in sufficient detail?	
Conclusions supported by the results?	

These criteria are described in more detail along with methods to judge them for a given study in Kmet, Lee and Cook (2004).