



Citation for published version:

Bryant, CJ & Barnett, JC 2019, 'What's in a name? Consumer perceptions of in vitro meat under different names', *Appetite*, vol. 137, pp. 104-113. <https://doi.org/10.1016/j.appet.2019.02.021>

DOI:

[10.1016/j.appet.2019.02.021](https://doi.org/10.1016/j.appet.2019.02.021)

Publication date:

2019

Document Version

Peer reviewed version

[Link to publication](#)

Publisher Rights

CC BY-NC-ND

University of Bath

Alternative formats

If you require this document in an alternative format, please contact:
openaccess@bath.ac.uk

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

What's In a Name? Consumer Perceptions of In Vitro Meat under Different Names

Christopher J. Bryant¹, Julie C. Barnett¹

¹University of Bath

The corresponding author is Christopher Bryant [C.J.Bryant@bath.ac.uk; 10 West, University of Bath, Claverton Down, Bath, BA2 7AY, UK]

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.

Keywords: In vitro meat; cultured meat; meat; consumer behavior; nomenclature; social representations theory

36 **1. Introduction**

37 **1.1 In vitro meat**

38 In vitro meat (IVM) is meat which can be grown from animal stem cells rather than being taken
39 from a slaughtered animal. In recent years, researchers in the Netherlands and the USA have
40 developed proof of concept products (BBC, 2013; Wall Street Journal, 2017b), and it has been
41 reported that IVM will be commercially available by 2021 (CBS News, 2018). Advocates of
42 the technology claim that, compared to conventional meat production, IVM will be better for
43 the environment, animal welfare, global food security and public health (Bhat & Bhat, 2011;
44 Schaefer & Savulescu, 2014; Tuomisto & de Mattos, 2011). Conversely, others show concern
45 for the potential impact on farming traditions and livelihoods, as well as the possibility that
46 IVM production will require more energy than conventional meat (Mattick, Landis, Allenby,
47 & Genovese, 2015; Verbeke, Marcu, et al., 2015).

48 However, perhaps the most significant challenge for IVM to overcome is that of consumer
49 acceptance (Sharma, Thind, & Kaur, 2015). Despite the putative benefits associated with IVM,
50 some consumers have concerns about the product (Bryant & Barnett, 2018). Surveys indicate
51 that between 16% and 66% of consumers say they would eat IVM (The Grocer, 2017; Wilks
52 & Phillips, 2017)¹, whilst qualitative studies reveal that common objections include the
53 perceived unnaturalness of IVM, as well as perceived risks to human health and concerns about
54 the price and taste (Laestadius & Caldwell, 2015; Verbeke, Marcu, et al., 2015).

55 One possible reason for the wide variation in consumer acceptance recorded by different
56 studies is the terminology used to describe IVM. Studies of consumer acceptance have
57 variously referred to ‘cultured meat’ (The Grocer, 2017), ‘in vitro meat’ (Wilks & Phillips,
58 2017), ‘artificial meat’ (YouGov, 2013), and ‘synthetic meat’ (Marcu et al., 2015), amongst
59 other terms. As Friedrich (2016) has argued, the term used to describe IVM is likely to have an
60 impact on the subsequent impressions people form of the product, and ultimately may have a
61 role in determining whether the public accepts or rejects this technology. For this reason,
62 producers, investors, and advocates of IVM have started to use the term ‘clean meat’ in order
63 to promote consumer acceptance (ibid.)

64 **1.2 The importance of naming**

65 It is widely acknowledged that the name given to an object or phenomenon can affect
66 subsequent evaluations and impressions of it. Notably, Bertrand and Mullainathan (2004) have
67 shown that résumés with names typical of white people (Emily and Greg) received 50% more
68 invitations to interview compared to otherwise identical résumés with names typical of black
69 people (Lakisha and Jamal). Furthermore, Laham, Koval, and Alter (2012) demonstrate that
70 names which are easier to pronounce are judged more positively, finding that people prefer a
71 fictional political candidate called Mr Smith over an otherwise-identical candidate called Mr
72 Colquhoun.

73 This phenomenon has also been demonstrated in a food context (Spence & Piqueras-Fiszman,
74 2014). Altering the names of dishes has been shown to affect consumers’ perceptions of their
75 country of origin (Bell & Paniesin, 1992) and can even increase perceived authenticity of

¹ 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.

76 foreign dishes (Meiselman & Bell, 1991). Wolfson and Oshinsky (1966), meanwhile, found
77 some evidence that labelling (as opposed to not labelling) liquid food for astronauts increased
78 liking ratings. However, the content of the label is also likely to be important, and may have
79 different effects on different perceived characteristics of the food in question: Schuldt and
80 Hannahan (2013) demonstrated that ‘organic’ labels on food increased perceived healthiness,
81 but decreased anticipated liking. Sommers (2012) points to an example of how naming has
82 been used to increase food sales in practice, explaining that the unappetising ‘Patagonian
83 toothfish’ was successfully rebranded as ‘Chilean sea bass’. Similarly, Kunst and Hohle (2016)
84 demonstrate that the names given to some meats may serve to make them more appealing; they
85 showed that referring to ‘cow’ or ‘pig’ on a menu in place of ‘beef’ or ‘pork’ increased both
86 empathy and disgust, decreasing willingness to eat meat and increasing willingness to choose
87 an alternative vegetarian dish.

88 **1.3 Social representations theory**

89 Social representation theory, in part, seeks to explain the process through which a community
90 makes sense of new, unfamiliar concepts (Moscovici, 1961). Marcu et al. (2015, p. 3) use this
91 theoretical lens, and note that the process of anchoring ‘...is of particular interest in shedding
92 light on how people deal with the unfamiliar and how they might understand [IVM] by
93 comparing it to more familiar concepts or technologies.’ Whilst the authors find some evidence
94 that people do, indeed, anchor IVM to existing technologies (in particular genetically modified
95 (GM) food, and cloning) in order to form understandings of it, they do not explore the idea that
96 such anchors may be different if the same concept was introduced by a different name. Given
97 that the video used to introduce participants to IVM in this study referred to ‘synthetic meat’
98 and ‘lab-grown steak’, it is perhaps unsurprising that participants were prone to what the
99 authors called ‘unhelpful anchoring’ (p. 2), which seemed to be conducive to negative attitude
100 formation.

101 Indeed, the perception that IVM is unnatural is one of the most frequently observed objections
102 by consumers (Hart Research Associates, 2017; Laestadius & Caldwell, 2015; Verbeke, Marcu,
103 et al., 2015; Wilks & Phillips, 2017), yet many of the most widely-used names for IVM
104 (including ‘in-vitro meat’, ‘synthetic meat’, ‘artificial meat’, ‘lab-grown meat’ and ‘cultured
105 meat’) seem to encourage, if not invoke, this very perception. In her exploration of the types
106 of anchoring, Höijer (2011) explores ‘anchoring in antinomies’, a concept which Marková
107 (2003) has argued is based on dialogicality, or the ‘capacity to make distinctions, to think in
108 oppositions, polarities or antinomies.’ (Höijer, 2011, p. 10). Through this lens, calling IVM
109 ‘artificial meat’ highlights its antinomy to ‘natural meat’. Similarly, calling IVM ‘clean meat’
110 may imply that conventional meat is ‘dirty’, a feature of this name highlighted by Forbes
111 (2016).

112 **1.4 The present study**

113 Given that there are significant barriers to consumer acceptance of IVM (Sharma et al., 2015),
114 and that names are likely to affect consumer perceptions of unfamiliar products, this study
115 sought to explore how four different proposed names for IVM are associated with consumer
116 attitudes and relevant behavioural intentions. The names used were (1) ‘cultured meat’, (2)
117 ‘clean meat’, (3) ‘lab-grown meat’, and (4) ‘animal-free meat’. Although other terms are also
118 widely used (see Table 1), we decided to test names which are conceptually distinct. We did
119 not, for example, test either ‘artificial meat’ or ‘synthetic meat’, since these are likely to be

120 perceived as quite similar by consumers. In order to avoid confusion between the naming
 121 conditions and the concept, we use IVM throughout this paper to refer to the concept
 122 generically, but do not test this name directly.

123 These names were selected from many possible names which have been used by various
 124 published studies, advocacy groups, and the media (see Table 1). ‘Cultured meat’ has been
 125 widely used in the IVM community, including by the NGO New Harvest. ‘Clean meat’ is a
 126 term which has been advocated by The Good Food Institute (Friedrich, 2016) as being
 127 conducive to higher consumer acceptance, and is also often used in the IVM community, and
 128 recently, more widely (Friedrich, 2018). ‘Lab-grown meat’ is a term often used by the media,
 129 perhaps because it intuitively describes the concept in lay terms, and also perhaps because it
 130 sounds more sensational compared to alternatives. ‘Animal-free meat’ is a lesser used term,
 131 but one which we are including here because it accurately describes what the product is and is
 132 a key feature of it.

133 **Table 1: Various names used to refer to IVM in academia, advocacy groups, and the**
 134 **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)	

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

137 The Good Food Institute (2017) and Animal Charity Evaluators (2017) have conducted studies
138 on this question in an advocacy context; both found that consumers were significantly more
139 likely to prefer IVM over conventional meat when it was called ‘clean meat’ compared to
140 ‘cultured meat’. As well as hypothetical choice experiments, The Good Food Institute (2017)
141 also reported self-reported purchase likelihood measured on a 7-point Likert scale. Whilst some
142 academic studies have used hypothetical choice experiments and self-reported purchase
143 likelihood, many have measured other beliefs about IVM as key outcome variables: Verbeke,
144 Sans, et al. (2015) report on perceived healthiness, taste and sustainability among other things,
145 whilst Siegrist, Sütterlin, and Hartmann (2018) have demonstrated the importance of perceived
146 naturalness and evoked disgust in determining behavioural intentions towards IVM. Therefore,
147 as well as behavioural intentions, the present study measures agreement with a number of key
148 attitude and belief items regarding IVM. Importantly, a key part of this study was the use of a
149 word association task, enabling us to explore the concepts anchored to and associated with each
150 name.

151 Word association is a method which has been used in a variety of studies examining attitudes
152 towards food (Ares, Giménez, & Gámbaro, 2008; Guerrero et al., 2010; Roininen, Arvola, &
153 Lähteenmäki, 2006). It is a method which ‘could serve as quick and convenient tools in
154 exploring consumer perceptions for new and undefined concepts’ and is ‘able to grasp affective
155 and less conscious aspects of respondents’ mindsets better than methods that use more direct
156 questioning’ (Roininen et al., 2006, p. 21). In this context, it will allow us to explore the
157 associations people have with each of the proposed names, thereby enabling us to get a sense
158 of how anchoring plays a role in attitude formation with regards to unfamiliar concepts.

159 Accordingly, the research questions we asked are:

- 160 1. Which associations do people make with the different names used to refer to IVM?
- 161 2. How does the name used to refer to IVM affect attitudes about it?
- 162 3. How does the name used to refer to IVM affect behavioural intentions?

163 It is hoped that the present work will not only expand understanding of how food naming affects
164 subsequent attitudes and behavioural intentions towards novel food technologies, but that it

165 will also be relevant to the IVM community as it decides how best to refer to the product in the
166 future (see Friedrich, 2016).

167 **2. Material and methods**

168 **2.1 Design and manipulations**

169 This study used an experimental between-subjects design whereby participants were randomly
170 allocated to one of four conditions, corresponding to the four proposed names for IVM: (1)
171 ‘cultured meat’, (2) ‘clean meat’, (3) ‘lab-grown meat’, and (4) ‘animal-free meat’. Once
172 participants were allocated to a condition, they then only saw IVM referred to by the
173 corresponding name, and were given otherwise identical descriptions of the concept.

174 First, participants were given information about the study, but were not told that the names
175 they saw would be experimentally manipulated. They were asked to verify that they were aged
176 18 or over, and were asked to give consent to take part. They then completed a practice word
177 association task, in which they were shown the word ‘JUGGLER’ and asked to write down up
178 to four words, phrases, thoughts, feelings, or images that came to their mind. They were then
179 asked to rate on a scale of 5-point scale of ‘Very Negative’ to ‘Very Positive’ how they felt
180 about each association they gave (following Ares & Deliza, 2010; Roininen et al., 2006).

181 After completing the practice word association task, participants were then shown the term for
182 IVM they had been allocated, and again asked to give the first four associations that came to
183 mind and rate each of them on the same 5-point scale. Participants had not, at this point, been
184 given a description of what IVM is, and therefore were giving associations based on the name
185 only. Next, participants were given the following description of IVM, where [X] was replaced
186 by their allocated term: ‘[X] is meat which is grown from cells taken from an animal who is
187 not killed, rather than being taken from a slaughtered animal.’ Apart from the name, the
188 description given to each participant was identical.

189 Participants then responded to 21 attitude items and 5 behavioural intention items (described
190 below). Next, they gave demographic information, including gender, age, level of education,
191 diet, and their familiarity with IVM prior to participation in the study. Finally, participants were
192 debriefed – this included telling participants about the nature of the study, and that the name
193 they were shown was experimentally manipulated. Participants were thanked and given a
194 unique code to claim their compensation (\$0.50).

195 **2.2 Participants**

196 Participants for this study were recruited through Amazon MTurk, an online platform
197 commonly used for survey or experimental research (Wilks & Phillips, 2017; Yuan & Purver,
198 2015). This recruitment method is less costly and results in a more diverse and representative
199 sample compared to convenience sampling (i.e. recruiting university students, e.g. Bekker et
200 al. (2017), Verbeke, Sans, et al. (2015)). Further, several analyses have concluded that MTurk
201 is generally a valid and reliable tool for participant recruitment (Berinsky, Huber, & Lenz,
202 2012; Buhrmester, Kwang, & Gosling, 2011; Paolacci, Chandler, & Ipeirotis, 2010; Rand,
203 2012).

204 A power analysis indicated that 180 participants were needed based on 4 groups and
205 anticipating a medium effect size of 0.25 (Cohen, 1992). In total, we recorded 241 survey
206 responses. We removed 48 incomplete responses, and further removed five participants who
207 gave nonsensical answers to text fields, two which were duplicates, and one which did not give
208 their age. Therefore, 185 participants were included in the analysis: 49 in the ‘animal free meat’

209 condition, 48 in the ‘clean meat’ and ‘cultured meat’ conditions, and 40 in the ‘lab grown meat’
210 condition.

211

212 Participants were 57.8% male (42.2% female), and their ages ranged from 20 – 68 (mean =
213 34.86, SD = 10.38). Regrettably, participant country was not recorded, though Difallah,
214 Filatova and Ipeirotis (2018) tell us that 75% of MTurk workers are in the USA. In any case,
215 all participants spoke English, and there was no clear skew in the sample (although participants
216 were more likely to be male and younger than a representative US sample).

217

218 **2.3 Measures**

219 The quantitative measures used in this study are described in Table 2. The behavioural intention
220 items are adapted from the five items used by Wilks and Phillips (2017). Items are reported in
221 this section with ‘[X]’ in place of the name for IVM used, which varied between experimental
222 conditions. Many of the attitude items are taken from previous studies examining attitudes
223 towards food (see Appendix A), though some are added for completeness based on the IVM
224 literature. Some of these items were negative (i.e. stronger agreement with the item indicated
225 a negative, rather than a positive, perception of IVM.) Therefore, these items (denoted by a *
226 in Appendix A) were reverse scored before composite measures were created such that higher
227 values represent more positive perceptions.

228

229 **Table 2: Items, response options, and reliability measures for the quantitative measures used**

Measure	Items	Response Options	Reliability
Attitude	<p>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.</p>	<p>Strongly disagree (1) to Strongly agree (5)</p>	<p>$\alpha = .947$</p>
Behavioural intentions	<p>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.</p>	<p>Strongly disagree (1) to Strongly agree (5)</p>	<p>$\alpha = .918$</p>

231 **3. Results**

232 **3.1 Preliminary analysis**

233 Before conducting the main analysis, we tested whether there were any differences between
234 conditions in relevant demographic features (age, gender, education, diet) and in familiarity
235 with IVM, since these are all factors known to correlate with IVM acceptance (Wilks &
236 Phillips, 2017). There were no significant differences between the experimental conditions for
237 demographic variables.

238 However, those in the ‘clean meat’ condition were significantly less familiar with IVM than
239 those in the ‘lab grown meat’ and ‘cultured meat’ conditions on a 3 point ordinal scale (never
240 heard of IVM (1), heard of IVM (2), and already knew what IVM was (3)) ($F(3,181) = 4.77, p$
241 $= .003$). Since this measure of familiarity was self-reported, it is possible that the names ‘lab
242 grown meat’ and ‘cultured meat’ only seemed more familiar than ‘clean meat’ rather than
243 participants in these conditions actually being more familiar with the concept.

244 If participants in some conditions were, indeed, more familiar with the concept than those in
245 other conditions, this could confound results. However, it is likely that greater familiarity
246 would lead to greater acceptance (Bryant & Barnett, 2018), and in this instance, the reverse
247 was true: those claiming to be more familiar in the ‘lab grown meat’ and ‘cultured meat’
248 conditions actually also showed lower measures of acceptance in subsequent analyses.
249 Therefore, we are confident that this difference is a result of how familiar the names seem
250 rather than how familiar the participants actually were. Familiarity was therefore not included
251 as a covariate in subsequent analyses.

252 **3.2 Word associations**

253 Before a description of IVM had been given, participants completed a word association task.
254 They generated a total 721 words or phrases – where 338 of them were unique - an average of
255 3.90 per participant. They also rated the valence of each word or phrase they generated. Words
256 were sorted into categories. Initial categories were identified, partly informed by themes
257 observed in the literature on consumer acceptance of IVM. After consultation, these categories
258 were adjusted and some words were reclassified. Next, three independent raters allocated the
259 words to categories with an initial agreement rate of 67%, which increased to 97% after further
260 discussion with one rater. The remaining 3% of ambiguous words were categorised after further
261 consultation between the co-authors. Words were ultimately placed into 24 categories, and 19
262 words which could not be reliably categorised were put in a ‘miscellaneous’ category.

263 Table 3 shows the frequency and mean valence of words in each category overall, and within
264 each naming condition. Each cell contains 4 values. The top-left value is the number of times
265 this association appeared in the condition in total. This is shown as a percentage of the total
266 associations given in the condition in parentheses. The bottom-left value is the number of
267 participants who gave associations in this category within each condition. The bottom-right
268 value is the mean valence score (from -2, very negative to +2, very positive). As shown, some
269 types of association were much more prevalent in some naming conditions than in others.

Table 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

271 A one-way ANOVA test indicated significant differences in the mean valence assigned to
 272 associations in the different naming conditions [$F(3,181) = 11.19, p < .001$]. Post-hoc analyses
 273 using Tukey’s HSD revealed that those in the ‘clean meat’ condition gave significantly more
 274 positive associations compared to those in the ‘lab grown meat’ condition ($p < .001$), those in
 275 the ‘cultured meat’ condition ($p = .007$) and those in the ‘animal free meat’ condition ($p =$
 276 $.002$). There were no significant differences between the other names.

277 Participants gave these word associations having read the name only, i.e. without a description
 278 of IVM. However, measures of attitudes and behavioural intentions were taken after
 279 participants had been given a description of IVM. The subsequent analysis therefore addresses
 280 the second and third research questions in a context where participants have all had the same
 281 information about what IVM is but in the context of one of the 4 names.

282 3.3 Effect of names on attitudes and behavioural intentions

283 A one-way MANOVA was used to analyse the effect of the different names on attitudes and
 284 behavioural intentions towards IVM. Using the experimentally manipulated name as the
 285 independent variable, we included two dependent variables: attitude (a composite of the 21
 286 items shown in Table 2, $\alpha = .947$) and behavioural intentions (a composite of the five items
 287 shown in Table 2, $\alpha = .918$).

288 We then used Pillai’s trace to test for significant differences between the experimental groups.
 289 Pillai’s trace is considered one of the most robust test statistics for use in a MANOVA, and is
 290 widely used in analysis of this kind. We found there was a significant effect of name on
 291 attitudes and behavioural intentions towards IVM [$V = 0.107, F(6,362) = 3.415, p = .003$].
 292 Separate univariate ANOVAs reveal that there were significant effects on attitudes towards
 293 IVM [$F(3,181) = 5.796, p = .001$] and behavioural intentions [$F(3,181) = 3.905, p = .010$].

294 The mean scores and standard deviations for each dependent variable in each experimental
 295 condition are shown in Table 5. Post-hoc pairwise comparisons were conducted using the
 296 Games-Howell test, which is a non-parametric test similar to Tukey’s HSD, but it does not
 297 assume equal variances between groups. For each variable, significant differences between
 298 conditions are denoted with subscript letters. Means which are not significantly different share
 299 a subscript letter, whilst means which do not share a subscript letter are significantly different.
 300 For example, with respect to attitude, we can see that there is no significant difference between
 301 ‘clean meat’ and ‘cultured meat’, since they both share the subscript letter a. However, ‘clean
 302 meat’ is significantly different from ‘lab grown meat’, since they do not share a subscript letter.

303 **Table 5. Mean scores and standard deviations of dependent variables across experimental**
 304 **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)

305

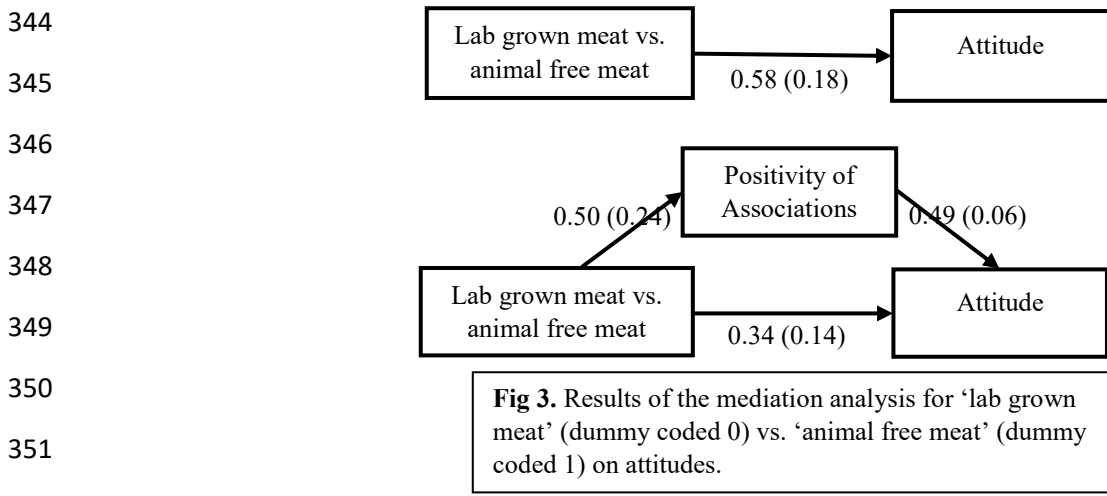
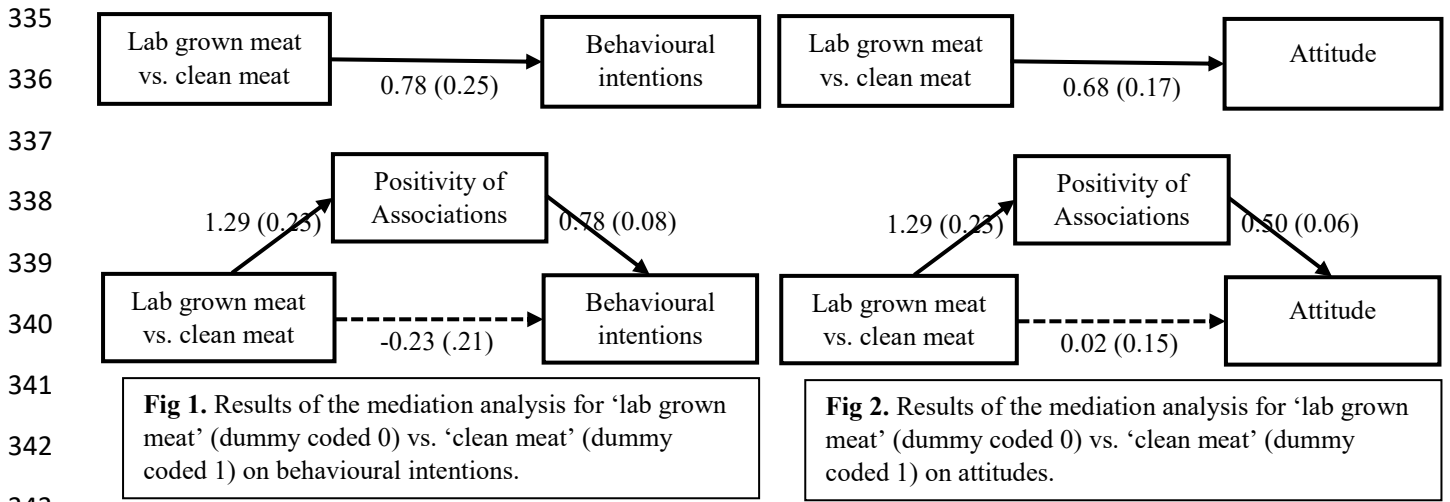
306 These analyses address the second and third research questions, and allow us to conclude that
307 the names used to refer to IVM are associated with significantly different attitudes and
308 behavioural intentions towards it. The name ‘clean meat’ produced significantly more positive
309 attitudes and behavioural intentions towards IVM compared to the name ‘lab grown meat’, but
310 did not differ significantly from the other names tested. The name ‘animal free meat’ also
311 produced significantly more positive attitudes towards IVM compared to the name ‘lab grown
312 meat’ but there was no difference in behavioural intentions.

313 **3.4 Mediation using word association valence**

314 Based on the results of the MANOVA, we further subjected each of the significantly different
315 outcomes to mediation analyses using the method described by Hayes (2017) and used by
316 Siegrist et al. (2018). We wanted to test the extent to which the significant differences in
317 attitude and behavioural intentions between naming conditions were mediated by the positivity
318 of the associations participants gave in the word association task.

319 Mediation analysis is used to understand the mechanism through which an independent
320 variable (name) affects a dependent variable (attitude and behaviour). In this case, we are
321 testing the idea that the valence of immediate associations with certain names are what is really
322 driving the differences in attitude and behavioural intentions between groups. In other words,
323 different names cause different associations, and these associations result in different attitudes
324 and intentions.

325 The mean valence (from -2 to +2) participants gave to their word associations was used as a
326 mediator. Dummy variables were used to compare outcome variables between pairs of names
327 for which significant differences were found. The outcomes of these analyses are shown in
328 Figures 1 – 3. Nonstandardized coefficients and standard errors are presented for each path,
329 which can be interpreted similarly to regression coefficients. Significant effects ($p < .05$) are
330 depicted with solid lines and nonsignificant effects ($p > .05$) with dotted lines. Where a
331 significant direct effect becomes insignificant in the presence of the mediating variable of
332 association valence, this can be interpreted as meaning that the association valence accounts
333 for the effect. Note that we only ran these analyses for variables and pairs of names for which
334 significant differences existed.



As shown in Figures 1 and 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 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 ($p = .02$).

362 **4. Discussion**

363 In this experimental study, we manipulated the name used to describe IVM, and observed the
364 subsequent effect on consumers' associations, attitudes, and behavioural intentions towards the
365 product.

366 **4.1 Immediate associations**

367 The word association exercise highlights the truism that any possible name for IVM carries
368 with some connotations and associations. Since there is no possible name free of such
369 associations, there is no 'neutral' name in terms of consumer perceptions. Perhaps in the future,
370 this distinction will be less important, and IVM will simply be called 'meat' – as Shapiro (2018)
371 points out, we no longer refer to the product of freezers as 'artificial ice'. Nonetheless, insofar
372 as we want to distinguish IVM from conventional meat in the short term, it must be called
373 something.

374 The name 'lab grown meat' evoked the most negative associations overall. This is largely due
375 to the highest proportion of associations with artificiality/unnaturalness (15.7%) and disgust
376 (13.8%), themes identified by Verbeke, Marcu et al. (2015) in focus groups where participants
377 were introduced to IVM using the term 'synthetic meat'. This term also led to the highest
378 proportion of associations with unusualness/novelty (9.4%), perhaps serving to identify IVM
379 as something outside of the normal. Importantly, participants in this condition were also most
380 likely to associate the term with threats to health (7.5%), a perception which has been linked
381 to perceived unnaturalness (Laestadius, 2015; Siegrist, Sutterlin & Hartmann, 2018).

382 The name 'animal free meat' appeared to confuse consumers, who gave the highest number of
383 associations with vegetarianism/veganism (15.3%), including words like 'soy' and 'tofu'.
384 Beyond causing straightforward conflation with other product categories, this name might
385 position IVM as a product for vegetarians, which would likely limit its appeal to meat-eaters
386 (Bacon & Krpan, 2018). This would be a bad strategy overall, since we know that meat-eaters
387 are more likely to find IVM appealing than vegetarians (Wilks & Phillips, 2017). Participants
388 in this condition also gave associations to do with uncertainty/scepticism (6.3%) which likely
389 stemmed from the apparent contradictions in this name; indeed, some reported associations
390 like 'impossibility' and 'oxymoron'.

391 The name 'cultured meat' evoked the most associations related to science (9.6%) which were
392 not rated negatively, but are conceptually similar to deviations from nature. Indeed, as Marcu
393 et al. (2015) found, consumers often make sense of IVM by establishing polarities, including
394 nature vs. science. This is reflected in the relatively high number of generically negative
395 associations (5.3%). Furthermore, participants in this condition gave many associations related
396 to meat preparation (8.6%) including 'processed', 'salted', and 'cured', indicating that people
397 might conflate 'cultured meat' with other types of meat product, as discussed by Friedrich
398 (2016).

399 Finally, the name 'clean meat' most commonly evoked associations with healthiness/nutrition
400 (15.7%), tastiness (10.8%), cleanness (10.8%), and naturalness (10.8%). Whilst some
401 interpretations of the word 'clean' were negative in this context (one participant gave the
402 association 'bleach'), this name evoked the most positive associations, and the mean valence
403 of associations was significantly higher for this name compared to all the other names. Many

404 of the associations given in this condition (e.g. ‘organic’, ‘no antibiotics’, ‘lean’, and ‘no fat’)
405 indicate that the name ‘clean meat’ was associated with positive qualities of other products.

406 **4.2 Attitudes and intentions**

407 Whilst some associations suggested that the terms ‘clean meat’, ‘cultured meat’, and ‘animal
408 free meat’ may have been misunderstood by some consumers, it is interesting that these terms
409 were associated with more positive attitudes and intentions towards IVM after participants
410 were told what the terms referred to. We found significant differences between terms in
411 measures of attitude and behavioural intentions for consumers who had read a description of
412 IVM in which only the name varied. Therefore, the effect of the name on consumer perceptions
413 is legitimate, and not based on misconceptions about the product.

414 Whilst attitudes towards ‘animal free meat’ and ‘clean meat’ were significantly more positive
415 than those towards ‘lab grown meat, the only significant difference in behavioural intentions
416 was between ‘lab grown meat’ and ‘clean meat’. This may be a result of highlighting the issue
417 of animal use: whilst a surprisingly large proportion of consumers believe in treating farmed
418 animals well and even banning slaughterhouses, very few actually align their behaviours with
419 these beliefs in the form of vegetarianism (Sentience Institute, 2017). Therefore, highlighting
420 this aspect of IVM led to relatively positive effects on attitudes, but little effect on behavioural
421 intentions.

422 We also found some evidence that the valence of the immediate associations participants had
423 for the different names mediated subsequent attitudes, beliefs, and behavioural intentions. This
424 provides support for the view that it is differences in the valence of immediate associations,
425 rather than other aspects of the names, which explains subsequent differences in attitudes. This
426 mechanism supports the structure of social representations theory, which discusses naming as
427 a component of anchoring (Höijer, 2011). By anchoring IVM to more positively valenced
428 associations, participants in this study appeared to locate it in a network of non-threatening
429 concepts, and subsequently develop more positive attitudes and intentions towards it.

430 Indeed, social representations theory would predict that naming unfamiliar concepts (as
431 opposed to not naming them at all) should affect the shared attitudes we form towards them. It
432 is said that anchoring a concept ‘...draws the unfamiliar into existing psychological categories,
433 thereby locating the strange or foreign within the familiar.’ (Fraser & Burchell, 2001, p. 274).
434 This study provides empirical evidence to support the view that it is important not just *whether*
435 concepts are named, but *how* they are named. Moscovici (1984, p. 35) wrote ‘...it is obvious
436 that naming is not a purely intellectual operation aiming at a clarity of logical coherence. It is
437 an operation related to a social attitude.’ Here, we found evidence to support this, and further
438 demonstrating how nomenclature can affect subsequent evaluations and intentions towards
439 unfamiliar objects. Indeed, this is likely to be relevant to other domains in which people form
440 attitudes towards unfamiliar technologies, and possibly social and political ideas.

441 Alongside naming, classification is also discussed as an important aspect of anchoring (Höijer,
442 2011). Whilst classification was not addressed in this study, it is likely to be relevant to studying
443 IVM acceptance, especially given ongoing efforts to restrict the definition of meat in the US
444 (Quartz, 2018). Social representations theory would suggest that whether IVM is ultimately
445 classified as meat, or something other than meat, will have an important role in anchoring and

446 shaping consumer perceptions. This classification taking place will provide an ideal
447 opportunity to study these processes further.

448 **4.3 Applications**

449 As well as theoretical implications, these findings are informative for those communicating
450 about IVM in the media. As we have seen the term ‘lab grown meat’ lead to the most negative
451 associations, attitudes, and intentions towards IVM. Although media coverage of IVM has been
452 overall positive about the ethical and environmental potential of the technology (Goodwin &
453 Shoulders, 2013), it has tended to use the term ‘lab grown meat’. This may be because the term
454 appears to be associated with the least conceptual confusion about IVM, but as we have shown,
455 it also likely causes people to focus on unnaturalness, a frame which could be conducive to
456 committing the naturalistic fallacy in subsequent decision-making (Laestadius, 2015). Those
457 seeking to highlight positive aspects of IVM should consider using the term ‘clean meat’
458 alongside a clear description of the concept. Indeed, advocates in the area encourage adoption
459 of this term in order to promote acceptance (Friedrich, 2016). This strategy reflects a
460 recognition that names matter, and that IVM will be come to be widely known by some name,
461 none of which are free of connotations.

462 More recently, IVM producers and others have started to use the name ‘cell-based meat’, a
463 term which some believe will be worse for consumer acceptance (Medium, 2018). Indeed,
464 Stephens et al. (2018) note that many names for IVM have been used over the years, and that
465 some may come to be replaced by others in future. By providing a detailed analysis of how and
466 why various names are linked to different kinds of responses, the current work provides a basis
467 for informed speculation about the possible interpretations of different possible names. ‘Cell-
468 based meat’, for example, might evoke many of the same associations of science and
469 unnaturalness which led consumers in the current study to have negative associations around
470 ‘lab grown meat’.

471 **4.4 Limitations**

472 There are several potential limitations of this study to acknowledge. Firstly, it is possible that
473 participants in this study anchored their evaluations to their initial associations more than they
474 would in reality because they had to write them down and rate them. Whilst we cannot rule this
475 possibility out based on the study design, the attitudes and intentions data is in line with
476 findings of previous studies which did not include this word association element (Animal
477 Charity Evaluators, 2017; The Good Food Institute, 2017). Secondly, the sample was not
478 limited geographically, or to native English speakers. Whilst all participants understood
479 English, it is likely that associations and evaluations are formed differently in a non-native
480 language (Geipel, Hadjichristidis & Surian, 2016) and cultural differences may mean that
481 associations with these terms are different in different countries. Finally, well-known
482 limitations of self-reported data apply here: participants may have given inaccurate or
483 exaggerated responses due to poor awareness and/or social desirability bias.

484

485 **5. Conclusion**

486 This study demonstrated that consumers' associations, attitudes, and behavioural intentions
487 towards IVM vary depending on the associations elicited by different product names.

488 This study provides the necessary context for interpreting existing survey data on consumer
489 acceptance of IVM, which has tended to describe IVM as being grown in a lab (Pew Research,
490 2014; YouGov, 2013). If those producing and marketing IVM are sensitive to the relevant
491 evidence, they are likely to achieve higher acceptance than such survey data would suggest,
492 given the significantly higher intentions to consume IVM when it is called 'clean meat'. Indeed,
493 advocates might adopt other terms, which importantly should evoke positive associations.

494 One further avenue for future IVM research is nomenclature in different languages. While IVM
495 is largely unfamiliar, the terms used to refer to it are likely to be contested, as we have shown.
496 Direct translations of any of these English names may not make sense in different languages,
497 and it is likely that different names would lead to different levels of consumer acceptance in
498 any language. Further research might also address the possible effect of other characteristics of
499 communications about IVM on consumer acceptance. Demonstrably, nomenclature matters,
500 but it is likely that consumer acceptance of IVM will also depend on the benefits marketers
501 choose to focus on, media coverage of the concept, and features of the product itself. All of
502 these, like nomenclature, can be considered features of public communication about IVM, and
503 all will likely affect consumer acceptance.

504 **References**

- 505 Animal Charity Evaluators. (2017). "Clean" Meat or "Cultured" Meat: A Randomized Trial
506 Evaluating the Impact on Self-Reported Purchasing Preferences. Retrieved 13 June, 2017,
507 from [https://animalcharityevaluators.org/blog/clean-meat-or-cultured-meat-a-randomized-](https://animalcharityevaluators.org/blog/clean-meat-or-cultured-meat-a-randomized-trial-evaluating-the-impact-on-self-reported-purchasing-preferences/)
508 [trial-evaluating-the-impact-on-self-reported-purchasing-preferences/](https://animalcharityevaluators.org/blog/clean-meat-or-cultured-meat-a-randomized-trial-evaluating-the-impact-on-self-reported-purchasing-preferences/)
- 509 Ares, G., & Deliza, R. (2010). Studying the influence of package shape and colour on
510 consumer expectations of milk desserts using word association and conjoint analysis. *Food*
511 *quality and Preference*, 21(8), 930-937.
- 512 Ares, G., Giménez, A., & Gámbaro, A. (2008). Understanding consumers' perception of
513 conventional and functional yogurts using word association and hard laddering. *Food quality*
514 *and Preference*, 19(7), 636-643.
- 515 Bacon, L., & Krpan, D. (2018). (Not) Eating for the environment: The impact of restaurant
516 menu design on vegetarian food choice. *Appetite*, 125, 190-200.
- 517 BBC. (2013). World's first lab-grown burger is eaten in London. Retrieved 09 January,
518 2017, from <http://www.bbc.co.uk/news/science-environment-23576143>
- 519 Bekker, G. A., Fischer, A. R., Tobi, H., & van Trijp, H. C. (2017). Explicit and implicit
520 attitude toward an emerging food technology: The case of cultured meat. *Appetite*, 108, 245-
521 254.
- 522 Bell, R., & Paniesin, R. (1992). The influence of sauce, spice, and name on the perceived
523 ethnic origin of selected culture-specific foods *Product Testing with Consumers for Research*
524 *Guidance: Special Consumer Groups, Second Volume: ASTM International.*
- 525 Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for
526 experimental research: Amazon. com's Mechanical Turk. *Political Analysis*, 20(3), 351-368.
- 527 Bertrand, M., & Mullainathan, S. (2004). Are Emily and Greg more employable than Lakisha
528 and Jamal? A field experiment on labor market discrimination. *The American Economic*
529 *Review*, 94(4), 991-1013.
- 530 Bhat, Z. F., & Bhat, H. (2011). Animal-free meat biofabrication. *American Journal of Food*
531 *Technology*, 6(6), 441-459.
- 532 Bredahl, L. (2001). Determinants of consumer attitudes and purchase intentions with regard
533 to genetically modified food—results of a cross-national survey. *Journal of Consumer Policy*,
534 24(1), 23-61.
- 535 Bryant, C. J., & Barnett, J. C. (2018). Consumer Acceptance of Cultured Meat: A Systematic
536 Review. *Meat Science*, 143, 8-17. doi: <https://doi.org/10.1016/j.meatsci.2018.04.008>
- 537 Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk a new
538 source of inexpensive, yet high-quality, data? *Perspectives on psychological science*, 6(1), 3-
539 5.

540 Cardello, A. V. (2003). Consumer concerns and expectations about novel food processing
541 technologies: effects on product liking. *Appetite*, 40(3), 217-233. doi:
542 [http://dx.doi.org/10.1016/S0195-6663\(03\)00008-4](http://dx.doi.org/10.1016/S0195-6663(03)00008-4)

543 CBS News. (2018). Lab-grown meat could be in restaurants by 2021. Retrieved January 23,
544 2019 from [https://www.cbsnews.com/news/mosa-meat-lab-grown-meat-could-be-restaurants-](https://www.cbsnews.com/news/mosa-meat-lab-grown-meat-could-be-restaurants-by-2021/)
545 [by-2021/](https://www.cbsnews.com/news/mosa-meat-lab-grown-meat-could-be-restaurants-by-2021/)

546 CNN. (2014). How test-tube meat could be the future of food. Retrieved February 21, 2017,
547 from <http://edition.cnn.com/2014/04/30/tech/innovation/cultured-meat/>

548 Cohen, J. (1992). A power primer. *Psychological bulletin*, 112(1), 155.

549 Difallah, D., Filatova, E., & Ipeirotis, P. (2018, February). Demographics and dynamics of
550 mechanical turk workers. In *Proceedings of the eleventh acm international conference on*
551 *web search and data mining* (pp. 135-143). ACM.

552 Eiser, J. R., Miles, S., & Frewer, L. J. (2002). Trust, perceived risk, and attitudes toward food
553 technologies1. *Journal of Applied Social Psychology*, 32(11), 2423-2433.

554 Forbes. (2016). How The Term 'Clean Meat' Could Undermine The Alternative Meat
555 Movement. Retrieved February 7, 2017, from
556 [http://www.forbes.com/sites/eveturowpaul/2016/10/17/how-the-term-clean-meat-could-](http://www.forbes.com/sites/eveturowpaul/2016/10/17/how-the-term-clean-meat-could-undermine-the-alternative-meat-movement/#44192aed5b41)
557 [undermine-the-alternative-meat-movement/#44192aed5b41](http://www.forbes.com/sites/eveturowpaul/2016/10/17/how-the-term-clean-meat-could-undermine-the-alternative-meat-movement/#44192aed5b41)

558 Fraser, C., & Burchell, B. (2001). *Introducing Social Psychology*. Cambridge: Polity Press.

559 Frewer, L. J., Howard, C., Hedderley, D., & Shepherd, R. (1997). Consumer attitudes
560 towards different food-processing technologies used in cheese production—The influence of
561 consumer benefit. *Food quality and Preference*, 8(4), 271-280.

562 Frewer, L. J., Howard, C., Hedderley, D., & Shepherd, R. (1999). Reactions to information
563 about genetic engineering: Impact of source characteristics, perceived personal relevance, and
564 persuasiveness. *Public Understanding of Science*, 8(1), 35-50.

565 Frewer, L. J., Howard, C., & Shepherd, R. (1998). The influence of initial attitudes on
566 responses to communication about genetic engineering in food production. *Agriculture and*
567 *Human Values*, 15(1), 15-30.

568 Friedrich, B. (2016). "Clean Meat": The "Clean Energy" of Food. Retrieved 13 December,
569 2016, from <http://www.gfi.org/clean-meat-the-clean-energy-of-food>

570 Friedrich, B. (2018). "Clean Meat" Is Catching On: A Reflection on Nomenclature.
571 Retrieved June 14, 2018, from <https://www.gfi.org/clean-meat-is-catching-on-a-reflection-on>

572 Geipel, J., Hadjichristidis, C., & Surian, L. (2016). Foreign language affects the contribution
573 of intentions and outcomes to moral judgment. *Cognition*, 154, 34-39.

574 Goodwin, J. N., & Shoulders, C. W. (2013). The future of meat: A qualitative analysis of
575 cultured meat media coverage. *Meat Science*, 95(3), 445-450. doi:
576 10.1016/j.meatsci.2013.05.027

- 577 Grunert, K. G., Bech-Larsen, T., Lähteenmäki, L., Ueland, Ø., & Åström, A. (2004).
578 Attitudes towards the use of GMOs in food production and their impact on buying intention:
579 The role of positive sensory experience. *Agribusiness*, 20(1), 95-107.
- 580 Guerrero, L., Claret, A., Verbeke, W., Enderli, G., Zakowska-Biemans, S., Vanhonacker, F., .
581 . . Scalvedi, L. (2010). Perception of traditional food products in six European regions using
582 free word association. *Food quality and Preference*, 21(2), 225-233.
- 583 Hart Research Associates. (2017). Perceptions of Cellular Agriculture: Key Findings from
584 Qualitative Research. Washington, DC: Hart Research Associates.
- 585 Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process*
586 *analysis: A regression-based approach*: Guilford Publications.
- 587 Hocquette, A., Lambert, C., Siquin, C., Peterloff, L., Wagner, Z., Bonny, S. P. F., . . .
588 Hocquette, J. F. (2015). Educated consumers don't believe artificial meat is the solution to the
589 problems with the meat industry. *Journal of Integrative Agriculture*, 14(2), 273-284. doi:
590 10.1016/S2095-3119(14)60886-8
- 591 Höijer, B. (2011). Social representations theory. *Nordicom Rev*, 32, 3-16.
- 592 Honkanen, P., & Verplanken, B. (2004). Understanding attitudes towards genetically
593 modified food: The role of values and attitude strength. *Journal of Consumer Policy*, 27(4),
594 401-420.
- 595 Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31-36.
- 596 Kunst, J. R., & Hohle, S. M. (2016). Meat eaters by dissociation: How we present, prepare
597 and talk about meat increases willingness to eat meat by reducing empathy and disgust.
598 *Appetite*, 105, 758-774. doi: 10.1016/j.appet.2016.07.009
- 599 Laestadius, L. (2015). Public Perceptions of the Ethics of In-vitro Meat: Determining an
600 Appropriate Course of Action. *Journal of Agricultural & Environmental Ethics*, 28(5), 991-
601 1009. doi: 10.1007/s10806-015-9573-8
- 602 Laestadius, L. I., & Caldwell, M. A. (2015). Is the future of meat palatable? Perceptions of in
603 vitro meat as evidenced by online news comments. *Public Health Nutrition*, 18(13), 2457-
604 2467. doi: 10.1017/S1368980015000622
- 605 Laham, S. M., Koval, P., & Alter, A. L. (2012). The name-pronunciation effect: Why people
606 like Mr. Smith more than Mr. Colquhoun. *Journal of Experimental Social Psychology*, 48(3),
607 752-756.
- 608 Magnusson, M. K., & Hursti, U.-K. K. (2002). Consumer attitudes towards genetically
609 modified foods. *Appetite*, 39(1), 9-24.
- 610 Marcu, A., Gaspar, R., Rutsaert, P., Seibt, B., Fletcher, D., Verbeke, W., & Barnett, J. (2015).
611 Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic
612 meat. *Public Understanding of Science*, 24(5), 547-562. doi: 10.1177/0963662514521106
- 613 Marková, I. (2003). *Dialogicality and social representations: The dynamics of mind*:
614 Cambridge University Press.

- 615 Mattick, C. S., Landis, A. E., Allenby, B. R., & Genovese, N. J. (2015). Anticipatory Life
616 Cycle Analysis of In Vitro Biomass Cultivation for Cultured Meat Production in the United
617 States. *Environmental Science & Technology*, 49(19), 11941-11949. doi:
618 10.1021/acs.est.5b01614
- 619 Medium. (2018). Clean Meat and Cell-Based Meat: What's in a Name? Retrieved February
620 21, 2019 from [https://medium.com/@PaulShapiro/clean-meat-and-cell-based-meat-whats-in-](https://medium.com/@PaulShapiro/clean-meat-and-cell-based-meat-whats-in-a-name-d4366431deb7)
621 [a-name-d4366431deb7](https://medium.com/@PaulShapiro/clean-meat-and-cell-based-meat-whats-in-a-name-d4366431deb7)
- 622 Meiselman, H. L., & Bell, R. (1991). The effects of name and recipe on the perceived
623 ethnicity and acceptability of selected Italian foods by British subjects. *Food quality and*
624 *Preference*, 3(4), 209-214. doi: [http://dx.doi.org/10.1016/0950-3293\(91\)90035-D](http://dx.doi.org/10.1016/0950-3293(91)90035-D)
- 625 Moscovici, S. (1961). *La psychanalyse, son image et son public*. Paris: Presses Universitaires
626 de France.
- 627 Moscovici, S. (1984). The Phenomenon of Social Representations. In R. Farr & S. Moscovici
628 (Eds.), *Social Representations* (pp. 3-69). Cambridge: Cambridge University Press.
- 629 National Geographic. (2014). Meat, Shmeat. Retrieved February 21, 2017, from
630 <http://theplate.nationalgeographic.com/2014/09/16/meat-shmeat/>
- 631 NBC News. (2013). It's (not) alive! Franken-meat lurches from the lab to the frying pan.
632 Retrieved February 20, 2017, from [http://www.nbcnews.com/science/its-not-alive-franken-](http://www.nbcnews.com/science/its-not-alive-franken-meat-lurches-lab-frying-pan-6c10835458)
633 [meat-lurches-lab-frying-pan-6c10835458](http://www.nbcnews.com/science/its-not-alive-franken-meat-lurches-lab-frying-pan-6c10835458)
- 634 Next Nature. (2011). Animal-Free Meat Could Put a Hold on Global Warming. Retrieved
635 February 21, 2017, from [https://www.nextnature.net/2011/07/animal-free-meat-could-put-a-](https://www.nextnature.net/2011/07/animal-free-meat-could-put-a-hold-on-global-warming/)
636 [hold-on-global-warming/](https://www.nextnature.net/2011/07/animal-free-meat-could-put-a-hold-on-global-warming/)
- 637 Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010). Running experiments on amazon
638 mechanical turk. *Judgment and Decision Making*, 5(5), 411-419.
- 639 Pew Research. (2014). U.S. Views of Technology and the Future: Science in the next 50
640 years.
- 641 Quartz. (2018). US ranchers want to use the federal government as a proxy to fight high-tech
642 meat companies. Retrieved June 14, 2018, from [https://qz.com/1249622/the-us-beef-](https://qz.com/1249622/the-us-beef-industry-is-divided-over-whether-to-call-clean-meat-meat/)
643 [industry-is-divided-over-whether-to-call-clean-meat-meat/](https://qz.com/1249622/the-us-beef-industry-is-divided-over-whether-to-call-clean-meat-meat/)
- 644 Rand, D. G. (2012). The promise of Mechanical Turk: How online labor markets can help
645 theorists run behavioral experiments. *Journal of theoretical biology*, 299, 172-179.
- 646 Roininen, K., Arvola, A., & Lähteenmäki, L. (2006). Exploring consumers' perceptions of
647 local food with two different qualitative techniques: Laddering and word association. *Food*
648 *quality and Preference*, 17(1), 20-30.
- 649 Saba, A., & Vassallo, M. (2002). Consumer attitudes toward the use of gene technology in
650 tomato production. *Food quality and Preference*, 13(1), 13-21.
- 651 Savadori, L., Savio, S., Nicotra, E., Rumiati, R., Finucane, M., & Slovic, P. (2004). Expert
652 and public perception of risk from biotechnology. *Risk analysis*, 24(5), 1289-1299.

- 653 Schaefer, G. O., & Savulescu, J. (2014). The Ethics of Producing InVitro Meat. *Journal of*
654 *Applied Philosophy*, 31(2), 188-202. doi: 10.1111/japp.12056
- 655 Scholderer, J., & Frewer, L. J. (2003). The biotechnology communication paradox:
656 Experimental evidence and the need for a new strategy. *Journal of Consumer Policy*, 26(2),
657 125-157.
- 658 Schuldt, J. P., & Hannahan, M. (2013). When good deeds leave a bad taste. Negative
659 inferences from ethical food claims. *Appetite*, 62, 76-83.
- 660 Sentience Institute. (2017, November 20). *Survey of US Attitudes Towards Animal Farming*
661 *and Animal-Free Food October 2017*. Retrieved 21 February, 2019, from
662 <https://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017>
- 663 Shapiro, P. (2018). *Clean Meat*. New York: Gallery Books.
- 664 Sharma, S., Thind, S. S., & Kaur, A. (2015). In vitro meat production system: why and how?
665 *Journal of Food Science and Technology-Mysore*, 52(12), 7599-7607. doi: 10.1007/s13197-
666 015-1972-3
- 667 Siegrist, M., Sütterlin, B., & Hartmann, C. (2018). Perceived naturalness and evoked disgust
668 influence acceptance of cultured meat. *Meat Science*, 139, 213-219.
- 669 Sommers, S. (2012). What's in a Name? What your name says about you (and how it says it).
670 Retrieved February 21, 2017, from [https://www.psychologytoday.com/blog/science-small-](https://www.psychologytoday.com/blog/science-small-talk/201207/whats-in-name)
671 [talk/201207/whats-in-name](https://www.psychologytoday.com/blog/science-small-talk/201207/whats-in-name)
- 672 Spence, C., & Piqueras-Fiszman, B. (2014). Tastes Great, But What do We Call It? The Art
673 and Science of Food Description *The Perfect Meal* (pp. 71-107): John Wiley & Sons, Ltd.
- 674 Stephens, N., Dunsford, I., Di Silvio, L., Ellis, M., Glencross, A., & Sexton, A. (2018).
675 Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in
676 cellular agriculture. *Trends in Food Science & Technology*, 78, 155-166.
- 677 Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences (4th ed.)*.
678 Hillsdale, NJ: Erlbaum.
- 679 Tan, H. S. G., Verbaan, Y. T., & Stieger, M. (2016). How will better products improve the
680 sensory-liking and willingness to buy insect-based foods? *Food Research International*.
- 681 Tanaka, Y. (2004). Major Psychological Factors Affecting Acceptance of Gene-
682 Recombination Technology. *Risk analysis*, 24(6), 1575-1583.
- 683 Tenbült, P., de Vries, N. K., Dreezens, E., & Martijn, C. (2005). Perceived naturalness and
684 acceptance of genetically modified food. *Appetite*, 45(1), 47-50.
- 685 The Daily Mail. (2016). First test-tube MEATBALL revealed: Startup claims lab grown meat
686 will be on shelves within three years and says raising animals to eat will soon be
687 'unthinkable'. Retrieved February 21, 2017, from
688 [http://www.dailymail.co.uk/sciencetech/article-3428438/First-test-tube-MEATBALL-](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)
689 [revealed-Startup-claims-lab-grown-meat-shelves-three-years-says-raising-animals-eat-soon-](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)
690 [unthinkable.html](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)

691 The Good Food Institute. (2017). Clean Meat: The Naming of Tissue-Engineered Meat.
692 Retrieved 13 June, 2017, from <http://mfait.gfi.org/the-naming-of-clean-meat>

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

696 The Huffington Post. (2014). A Future With In Vitro Meat Is Closer Than You Think.
697 Retrieved February 21, 2017, from [http://www.huffingtonpost.ca/robert-bolton/in-vitro-](http://www.huffingtonpost.ca/robert-bolton/in-vitro-meat_b_5909836.html)
698 [meat_b_5909836.html](http://www.huffingtonpost.ca/robert-bolton/in-vitro-meat_b_5909836.html)

699 The Washington Post. (2016). Lab-grown meat is in your future, and it may be healthier than
700 the real stuff. Retrieved February 21, 2017, from
701 [https://www.washingtonpost.com/national/health-science/lab-grown-meat-is-in-your-future-](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)
702 [and-it-may-be-healthier-than-the-real-stuff/2016/05/02/aa893f34-e630-11e5-a6f3-](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)
703 [21ccdbc5f74e_story.html?utm_term=.339bff30314d](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)

704 Time. (2016). You Asked: Should I Be Nervous About Lab-Grown Meat? Retrieved
705 February 21, 2017, from <http://time.com/4490128/artificial-meat-protein/>

706 Titchener, G. D., & Sapp, S. G. (2002). A comparison of two approaches to understanding
707 consumer opinions of biotechnology. *Social Behavior and Personality: an international*
708 *journal*, 30(4), 373-381.

709 Townsend, E., & Campbell, S. (2004). Psychological determinants of willingness to taste and
710 purchase genetically modified food. *Risk analysis*, 24(5), 1385-1393.

711 Tuomisto, H. L., & de Mattos, M. J. T. (2011). Environmental Impacts of Cultured Meat
712 Production. *Environmental Science & Technology*, 45(14), 6117-6123. doi:
713 10.1021/es200130u

714 Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., & Barnett, J. (2015).
715 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium,
716 Portugal and the United Kingdom. *Meat Science*, 102, 49-58. doi:
717 10.1016/j.meatsci.2014.11.013

718 Verbeke, W., Sans, P., & Van Loo, E. J. (2015). Challenges and prospects for consumer
719 acceptance of cultured meat. *Journal of Integrative Agriculture*, 14(2), 285-294. doi:
720 10.1016/S2095-3119(14)60884-4

721 Wall Street Journal. (2017a). Hampton Creek Aims at New Market: Growing Meat.
722 Retrieved 08 August, 2017, from [https://www.wsj.com/articles/hampton-creek-aims-at-new-](https://www.wsj.com/articles/hampton-creek-aims-at-new-market-growing-meat-1498592294)
723 [market-growing-meat-1498592294](https://www.wsj.com/articles/hampton-creek-aims-at-new-market-growing-meat-1498592294)

724 Wall Street Journal. (2017b). Startup Serves Up Chicken Produced From Cells in Lab.
725 Retrieved 13 June, 2017, from [https://www.wsj.com/articles/startup-to-serve-up-chicken-](https://www.wsj.com/articles/startup-to-serve-up-chicken-strips-cultivated-from-cells-in-lab-1489570202)
726 [strips-cultivated-from-cells-in-lab-1489570202](https://www.wsj.com/articles/startup-to-serve-up-chicken-strips-cultivated-from-cells-in-lab-1489570202)

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

729 Wolfson, J., & Oshinsky, N. S. (1966). Food Names and Acceptability. *Journal of*
730 *Advertising Research*, 6(1), 21-23.

731 YouGov. (2013). No British demand for fake meat. Retrieved August 13, 2017, from
732 <https://yougov.co.uk/news/2013/08/05/no-demand-fake-meat/>

733 Yuan, Z., & Purver, M. (2015). Predicting emotion labels for chinese microblog texts
734 *Advances in Social Media Analysis* (pp. 129-149): Springer.

735

736

737 **Appendices**738 **Appendix A: 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.

739 **Funding**

740 This work was completed as part of Christopher Bryant's PhD, which is funded by the
741 Economic and Social Research Council [Grant number: ES/J50015X/1].

742 **Competing Interests Statement**

743 Christopher Bryant is affiliated with the Cellular Agriculture Society, which promotes
744 cellular agriculture including in vitro meat, though does not receive any compensation.

745 Julie Barnett declares no competing interests.

746