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

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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

1. Introduction

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)[1], 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.)

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

[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.

foreign dishes (Meiselman & Bell, 1991). Wolfson and Oshinsky (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.

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).

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 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 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 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).

2. Material and methods

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).

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).

2.3 Measures

The quantitative measures used in this study are described in Table 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.

229 **Table 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)	$\alpha = .947$
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)	$\alpha = .918$

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3. Results

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.

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 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 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.

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 2, $\alpha = .947$) and behavioural intentions (a composite of the five items shown in Table 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 5. 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 5. 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.

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 1 – 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.

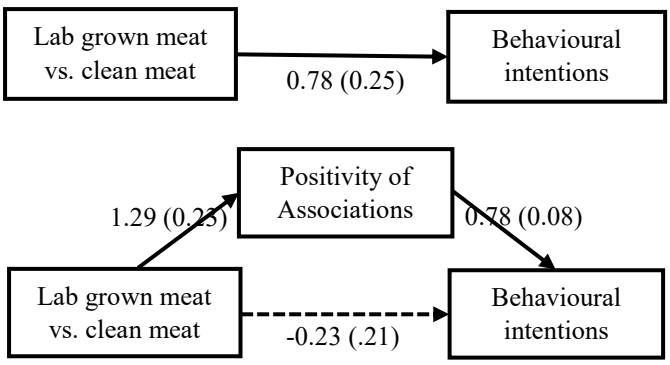

Fig 1. Results of the mediation analysis for 'lab grown meat' (dummy coded 0) vs. 'clean meat' (dummy coded 1) on behavioural intentions.

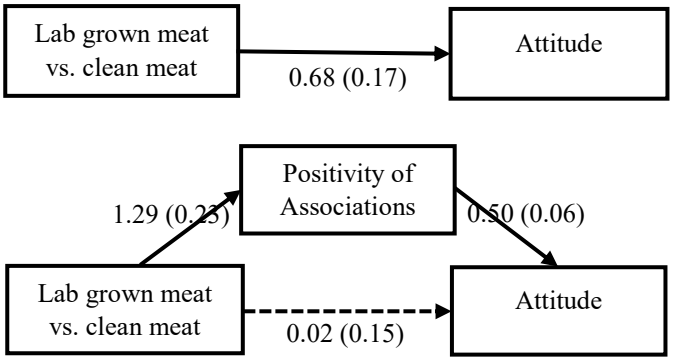

Fig 2. Results of the mediation analysis for 'lab grown meat' (dummy coded 0) vs. 'clean meat' (dummy coded 1) on attitudes.

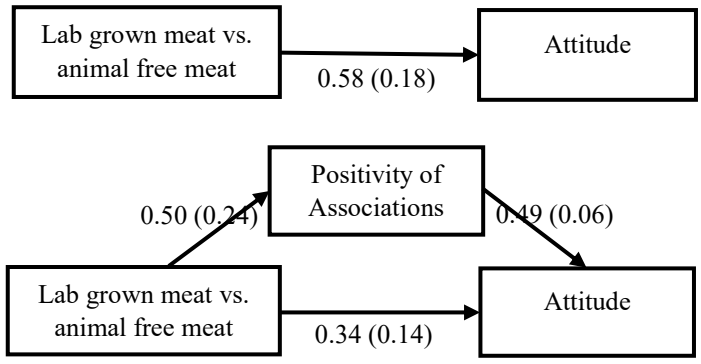

Fig 3. Results of the mediation analysis for 'lab grown meat' (dummy coded 0) vs. 'animal free meat' (dummy coded 1) on attitudes.

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

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.

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.

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.

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'.

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. 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.

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.

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Appendices

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.

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Julie Barnett declares no competing interests.