Public Understanding of Science
http://pus.sagepub.com/

Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic meat

Afrodita Marcu, Rui Gaspar, Pieter Rutsaert, Beate Seibt, David Fletcher, Wim Verbeke and Julie Barnett

Public Understanding of Science published online 19 February 2014
DOI: 10.1177/0963662514521106

The online version of this article can be found at:
http://pus.sagepub.com/content/early/2014/02/17/0963662514521106

Published by:
SAGE
http://www.sagepublications.com

Article

P | U | S

Public Understanding of Science
1–16

DOI: 10.1177/0963662514521106
pus.sagepub.com
SAGE

Analogies, metaphors, and wondering about the future: Lay sense-making around synthetic meat

Afrodita Marcu
University of Southampton, UK

Rui Gaspar
Instituto Universitário de Lisboa, Portugal

Pieter Rutsaert
Ghent University, Belgium

Beate Seibt
University of Oslo, Norway

David Fletcher
White October, Oxford, UK

Wim Verbeke
Ghent University, Belgium

Julie Barnett
University of Bath, UK

Abstract

Drawing on social representations theory, we explore how the public make sense of the unfamiliar, taking as the example a novel technology: synthetic meat. Data from an online deliberation study and eighteen focus groups in Belgium, Portugal and the UK indicated that the various strategies of sense-making afforded different levels of critical thinking about synthetic meat. Anchoring to genetic modification, metaphors like 'Frankenfoods' and commonplaces like 'playing God' closed off debates around potential applications of synthetic meat, whereas asking factual and rhetorical questions about it, weighing up pragmatically its risks and benefits, and envisaging changing current mentalities or behaviours in order to adapt to scientific developments enabled a consideration of synthetic meat's possible implications for agriculture, environment, and society. We suggest that research

Corresponding author:
Afrodita Marcu, School of Psychology, University of Southampton, Highfield Campus, Southampton, SO17 1BJ, UK.
Email: A.M.Marcu@soton.ac.uk

on public understanding of technology should cultivate a climate of active thinking and should encourage questioning during the process of sense-making to try to reduce unhelpful anchoring.

Keywords
anchoring, commonplaces, metaphors, online deliberation, social representations, synthetic meat

1. Introduction

Research on public perceptions of science and technology, including biotechnology, nanotechnology, and synthetic biology, has generally focused on the attitudes, perceptions, opinions, and representations that people hold (Bäckström, Pirttilä-Backman and Tuorila, 2003; Scheufele and Lewenstein, 2005; Siegrist et al., 2008). Moreover, it has noted how what is novel and unfamiliar is rendered familiar by being located (or anchored) in existing frames of knowledge (Kronberger, Holtz and Wagner, 2012; Courvoisier, Clémence and Green, 2013). However, such studies often fail to mention at what point in the innovation process public opinion is sought. It is arguably important to acknowledge at what point in the research and development stage of a technology public understanding of it is sought out so as to be able to distinguish between 'raw' sense-making of unfamiliarity and the expressions of attitudes or opinions which involve a certain degree of familiarity. Although the public can form opinions even in the absence of factual knowledge (Scheufele and Lewenstein, 2005), it has been recognised that often little attention is paid to how opinions are formed in the context of unfamiliarity or what resources are deployed to help deal with the unfamiliar (Davies, 2011). Indeed, some have argued that the studying of public understanding of and engagement with technology 'upstream' in the process of innovation (Macnaghten, Kearnes and Wynne, 2005) may present certain advantages: firstly, it can offer the opportunity to explore how opinions on emerging technologies are created and what semantic frames and discursive resources are used to support their development. Secondly, it can help anticipate emerging ethical or social issues thus helping to minimise unnecessarily disruptive public controversies. Therefore, the public's unfamiliarity with novel technologies can offer the appropriate context in which to observe how people deal with unfamiliarity 'unadulterated' by media coverage, and identify which more familiar technologies the new object of knowledge might be compared to (Kronberger et al., 2012). In this paper we take an emerging food technology – synthetic meat – as the example, and we explore how the public make sense of the unfamiliar. Synthetic meat (henceforth, SYNM), also known as *lab-grown, cultured*, or *in-vitro* meat, is produced by culturing living muscle cells taken from farm animals such as pigs in individual culture wells containing antibiotics and serum extracted from cow foetuses (Jha, 2013). While the world's first synthetic meat burger was unveiled and publicly consumed in August 2013, the mass production of SYNM faces many challenges (Post, 2012) and currently there is little public debate around it or research on public perceptions of its acceptability. Some studies have explored media coverage of SYNM, which has been focused on its potential benefits, the production process, and the timescale of production (Goodwin and Shoulders, 2013). SYNM thus provides an ideal context in which to locate an early consideration of how the process of making sense of the unfamiliar unfolds.

2. Public perceptions of science and technology

Consumer reasoning around agri-food technologies, including genetically modified organisms (GMOs), cloning, and nanotechnology, has been generally shown to be underpinned by considerations of unnaturalness, trust in science, risk management provision, ethics, risk and benefit

perceptions, uncertainty and unknown long-term effects, and concerns about wider implications of science for society (Siegrist, 2008; Palma-Oliveira et al., 2009; de Barcellos et al., 2010; Frewer et al., 2011; Rollin, Kennedy and Wills, 2011). Concerns about what is 'natural' and arguments of 'interfering with nature' pervade public responses to biotechnology, such as GMOs (Tenbült et al., 2005) or cloning (Shepherd et al., 2007), and underpin the rejection of food technologies such as cloned beef (Aizaki, Sawada and Sato, 2011). Researchers have also shown that the public make sense of science and technology by engaging in cost–benefit analysis, e.g. in relation to GMOs (Marris et al., 2001), xenotransplantation (Michael and Brown, 2004), and nanotechnology (Scheufele and Lewenstein, 2005). Others have noted that the public's discourses around biotechnology are often infused with metaphors like 'Frankenstein' (Huxford, 2000; Coleman and Ritchie, 2011), tropes like 'playing God' (van den Belt, 2009; Dragojlovic and Einsiedel, 2013), and analogies and comparisons (Michael and Brown, 2004; Davies, 2011).

The objects of study at the core of assessing people's reasoning have usually been consumers' *perceptions, attitudes*, or *thoughts* towards new food technologies such as nanotechnology use in foods and food packaging (Siegrist et al., 2008). The degree of knowledge the public are assumed to have prior to the examination of their reactions to novel technologies varies; for example in Siegrist et al.'s (2008) study, stimulus material is provided to elicit public reactions. Curiously, little attention has been paid to how participants themselves might acknowledge their lack of knowledge and whether and how they might articulate information needs, although some studies have noted the questions the public have about new technology: 'what is the difference between GMOs and when someone makes a graft in their garden?', or 'when they decided to create GMOs, what vision of the world did they have for later?' (Marris et al., 2001: 48–49). However, people's queries have rarely been considered as potentially providing valuable insights into public sense-making around unfamiliar technologies. Instead, one key approach to exploring how people deal with the unfamiliar has been provided by social representations theory.

3. Social representations theory: Turning the unfamiliar into familiar

Social representations theory (SRT) is a theoretical paradigm particularly concerned with how the public make sense of the unfamiliar and how they transform scientific concepts into common-sense. Within this paradigm, social representations (SRs) are socially constructed images, symbols, ideas, and thoughts that permeate common-sense and everyday thinking (Moscovici, 1984). SRs are shaped by group identities and interests, by cultural, historical and political factors, and traditional and social media play a key role in their diffusion. SRT has been used to study public understanding of climate change (Smith and Joffe, 2013), but also public perceptions of novel foods (Bäckström et al., 2003), unfamiliar risks like Lyme disease (Marcu, Uzzell and Barnett, 2011), and public understanding of science and technology such as particle acceleration (Courvoisier et al., 2013), electricity networks (Devine-Wright and Devine-Wright, 2009) or biotechnology (Bauer and Gaskell, 1999). SRs are constituted via two main processes: *anchoring*, i.e. 'the attempt to settle a new, and therefore strange, meaning into the established geography of symbols of a community', and *objectification*, i.e. giving a new object of knowledge 'a concrete, almost "natural" face' (Jovchelovitch, 2001: 173). It is the first process, anchoring, that is of particular interest in shedding light on how people deal with the unfamiliar and how they might understand SYNM by comparing it to more familiar concepts or technologies.

However, to the extent that what is novel is understood in terms of existing knowledge, the anchoring of new technologies will be constrained by current SRs (McKinlay and Potter, 1987) and as such, it will 'remove from the field of thought what is specific and different about the new

event' (Joffe, 2002: 565). Thus the use of familiar anchors may not always enhance an understanding of novel concepts, products, or technologies, particularly when the existing anchors are problematic or contentious (Michael and Brown, 2004). Thus it is unclear to what extent a focus on the anchoring process facilitates a consideration of the unfamiliar. Some recent work within SRT has suggested this analysis of anchoring may be too simplistic, suggesting that certain objects of knowledge, such as the representation of mental illness, are sometimes anchored in ways that maintain them in an 'unfamiliar position' (Rose, 2000; de-Graft Aikins, 2012), particularly when they threaten the established order. Therefore, novel technologies deemed as disruptive to existing social values or practices may be anchored in ways that enable people to distance themselves from them, and may thus be 'actively kept unfamiliar' (de-Graft Aikins, 2012: 7.9). At the same time, one might argue that sometimes anchors are not readily available and that people might engage in a process of seeking suitable familiar notions and objects to enable their understanding of the new and unfamiliar.

Our main research questions concerned the process of sense-making around SYNM. First, what strategies underpin the way in which people seek to make sense of SYNM? Secondly, how is the 'familiar', to which SYNM is anchored, constituted, and what patterns of reasoning do such anchors afford? Finally, to what extent does anchoring reduce unfamiliarity?

4. Methods

Design

We explored how people make sense of SYNM in an individual online deliberation study and in a separate but related focus group study so as to get two lenses on lay sense-making around SYNM: one situated in a setting affording more time for individual reasoning but with little explicit access to the views of others, and the other, within the conventions and dynamics of social interaction. Both studies were conducted in Belgium, Portugal and the UK as part of the European Union FP7-funded research project FoodRisC (Barnett et al., 2011). The online deliberation platform (VIZZATA™) was developed to explore citizen engagement and deliberation in the form of an asynchronous dialogue between participants and the research team (Barnett et al., 2008). VIZZATA™ encourages participants to ask questions and make comments on the study material, to signal their wish to obtain answers, and to receive individual responses from the research team prior to returning to a second phase of the study. It thus particularly lends itself to considering new information and to providing both enquiry and comment about this.

Both the online study and the focus group discussions were structured around the provision and consideration of information (termed *content testers* within VIZZATA™) on various nutritional and non-nutritional risks and benefits of natural red meat. After this, a YouTube video on synthetic meat was presented in English in all three countries. It is the analysis of the questions and comments about this video that is the focus of this paper.

Participants

One hundred and seventy-four participants from Belgium, Portugal and the UK participated in the online study. All participants consumed red meat at least once a week. Seventy respondents, 34 females and 36 males, *age range* = 18 to 60, left comments and/or questions in relation to the SYNM video. The eighteen focus groups (six in each country) comprised 109 consumers, 58 females and 51 males, *age range* = 21 to 65. The participants were recruited in July 2012 (online study) and October 2012 (focus groups). Table 1 presents the breakdown of gender in the two studies across the three countries.

Table 1. The online and focus group participants' gender across the three countries.

	Portugal (n = 60)		Belgium (n = 59)		UK (n = 60)	
Study	Females	Males	Females	Males	Females	Males
Online study	10	13	12	11	14	10
Focus groups	20	17	20	16	18	18

Table 2. Summary of the demographics of the online and focus group participants.

Demographic	Online study	Focus groups
Total participants	70	109
Percentage of women	51.4%	53.2%
Most prevalent age group	31–35 (24.3%)	41–50 (32.1%)
Percentage of parents	52.9%	50.5%
Percentage of urban residents	54.3%	59%
Most prevalent educational level	College education (64.3%)	College or university (37.6%)
Financial status (7-point scale of being well-off)	M = 3.97, SD = 1.62	M = 4.70, SD = 1.24
Frequency of red meat consumption	2–3 times a week (41.4%)	2–3 times a week (52.3%)
Hours spent daily on internet	M = 9.69, SD = 11.94	M = 2.92, SD = 2.00

The online respondents and the focus group participants had similar profiles in terms of demographics and meat consumption frequency, see Table 2.

Materials

The 2-minute long YouTube video *Would You Eat Synthetic Meat?* had been produced for the Royal Institution of Australia in 2011 and described SYNM with self-explanatory animations without containing too rich a description of SYNM. We considered non-text-based stimulus material to be a richer and more accessible way of introducing a novel technology (see the online Appendix for the transcript of the video).

Procedure

In the online study, the participants watched the video and left questions and comments, indicating to which of these the responses from the research team were required. All the Belgian and Portuguese participants could understand English though they recorded their responses to the video in their own language. These were subsequently translated into English. All questions and comments were aligned in content themes, and the research team worked closely to provide consistent responses across the three national samples. These were first constructed in English and then translated into Dutch and Portuguese, respectively. The participants received responses within 10 days of the first study phase. We aimed to strike a balance between providing consistent responses across the participants whilst tailoring these to each participant's questions. Seventy online participants left a total of 88 questions and comments in relation to the SYNM video with similar numbers of participants from each country: Portugal (n = 23), Belgium (n = 23) and the UK (n = 24).

In the focus group study, the participants were encouraged to express views and ask questions in relation to the video. It was explained that the moderator (a member of the research team) would

not be able to respond to their questions during the session but that more information would be provided at the end of the group. The video was presented in the original English version in the Belgian and the Portuguese focus groups and a subsequent debriefing revealed that it was understood without any linguistic problems.

Analytic approach

The analysis of the comments and questions was supported by the NVivo software (QSR International Pty Ltd, 2010), and was informed by thematic analysis (Braun and Clarke, 2006), where themes deemed to represent recurring patterns of meaning within the data set were identified. The use of a contextualised analysis acknowledged that the sense-making around SYNM would take place within the context of the wider study discussion around the risks and benefits of red meat, and from the participants' subject position as meat eaters.

5. Results

We constructed six themes that reflected the process of sense-making: *Asking questions; Making analogies to the familiar; Metaphors as semantic packages; Establishing polarities; Commonplaces as bottom-line arguments*; and *Pragmatic reasoning*. Next to each participant quote from the online study we indicate participant identification, country (BE = Belgium, PT = Portugal, and UK = United Kingdom), gender (F, M), and age group. Next to each focus group participant quote we indicate focus group (FG) session, country, gender, and age.

Asking questions

Two strategies of sense-making were evident in the questions that were asked about SYNM. The first was of wondering whereby people asked factual and rhetorical questions about SYNM, expressed puzzlement, or speculated about future scenarios. For example some wondered about the implications of SYNM for human health – often noted as a reaction to new technologies:

> Will synthetic meat be healthy in the long term? Will this be extensively tested before it will appear on the market? (Online353, BE, M, 31–35)

> The meat produced in the laboratory, what risks does it have? What differs at the cellular level, at vitamin level, what differs from real meat? (FG2, PT, M, 42)

Participants wondered about the type of society we might live in where SYNM would be produced and consumed, and their questions bore similarities to those about the long-term consequences of GMOs identified by Marris et al. (2001). Some of this wondering, however, was linked to highly pragmatic considerations, for example about the implications for farm animals and the farming industry:

> What would happen to the animals that were not required anymore? (Online456, UK, M, 36–40)

M, 34: And what happens to the farmers?
F, 40: What happens to the livestock? What happens to it all?
M, 35: Yeah, do you just leave it, does it all die off, or then you kill off, you know, animals? (FG5, UK)

The second question-asking strategy involved a search for anchors that would enable the participants to locate SYNM in relation to everyday consumption practices. Specifically, the participants sought to establish similarity between SYNM and 'natural' meat – the very object that SYNM was being created to replace – predominantly through questions about appearance, taste, price, and nutritional content:

> What is the taste of synthetic meat? Is it really the same? (Online297, PT, F, 25–30)

> And does that look like real meat? (FG1, BE, F, 33)

> What kind of meat are they going to produce? What quantity, what type of format? Because if I want to eat a big calf chop, I'll go to a restaurant and I'm seeing the chop there, and if I buy this type of meat, I'll buy what? (FG3, PT, M, 50)

This theme reflects a process of sense-making where people engaged in seeking anchors to provide a framework for understanding SYNM. At the same time, the questions about the potential long-term implication of SYNM for society indicated a process of wondering where participants engaged in speculative thinking and envisaged future scenarios. While the questions about the similarity of SYNM to natural meat sought to reduce unfamiliarity, wondering about future scenarios seemed to maintain unfamiliarity and heighten uncertainty.

Making analogies to the familiar

The participants also made sense of SYNM by anchoring it to familiar and established objects and technologies through the use of analogies, whereby similarities were drawn in terms of production, uncertainty over long-term consequences, potential risks, or existing public debates. Such analogies reflected a process of anchoring that often served to highlight the potential risks or benefits of SYNM, and to justify its rejection or acceptance. Chief among anchors were GMOs and cloning, which enabled participants to claim that SYNM could pose risks to human health or to the environment:

> It's like the transgenic cereals, for decades it has been discussed and there isn't a conclusion yet whether or not it impacts the body, I think that only after several years will we see whether or not it has an impact. (FG2, PT, M, 43)

> Like Dolly, the sheep, that also didn't live very long … this also a bit [like] cloning. How long did she survive? (FG4, BE, F, 36)

> It's the same discussion as with those GM crops. (FG5, BE, M, 43)

While reference to other biotechnologies was used by some to express disquiet over SYNM, others used anchors to highlight technological progress as an inevitable aspect of human society:

> People also make new life through in-vitro, and this is already generally accepted (I mean by having children). (Online367, BE, F, 41–50)

> M, 53: It's like GM. It's true what they say, just grow stem cells and you have meat. It sounds really simple. In light of the animal industry and the bio-industry … My main fear is that there is

something we don't know or should be taking care of … We might get sick or our DNA might become modified in some way. We turn into zombies. It looks good but…

F, 60: We don't know enough about it.

M, 37: I also have the same opinion. But if you think about it, there are already a number of things where we have intervened with nature and where we got used to. For example the fact that a chicken lays an egg every day, it's not like this in nature. Or a cow keeps giving milk. We are doing this already for a long time. And this is again a step ahead. (FG3, BE)

In many instances, the anchoring process showed that previously 'unfamiliar' technologies were now used as anchors in a largely uncontested manner as the anchors rested on implicit similarities in terms of human intervention. Only rarely did people question the similarity between SYNM and other biotechnologies:

> Can I ask, is this also going into the same process about the cow that they've managed to produce, the GM cow that doesn't actually have protein in its milk? (FG3, UK, M, 25)

Within the focus groups the use of anchors was generally socially shared. Some participants, however, expressed different reasons for anchoring SYNM to GMOs – the anchor had multiple hooks, as it were – as illustrated in the excerpt below. One participant thought that SYNM was different from GMOs because it did not involve living organisms, whereas another considered SYNM similar to GMOs because it constituted an unnecessary technological development:

M, 35: We are messing with some systems which might create unforeseen results. I still think this is different than GM because that's about living organisms and here it isn't about that.

F, 36: For me this is the same as GM … It's about a piece of meat here, for me this is not necessary, no thank you! (FG4, BE)

There was also some reflection on the anchors that were being used and how they are likely to be perceived by others:

> On a personal level I can see people comparing this to GM food or cloning. (Online462, UK, F, 51)

> I think the future is going through this, but it has to have a name that is not so artificial and that does not scare people, because 'in-vitro meat' scares everyone; I think they can associate it with a child inside a test tube. (FG3, PT, M, 33)

Metaphors as semantic packages

The sense-making process included the use of science-fiction metaphors like *zombies, Frankenfoods, mutants*, or *Jurassic Park* which served to locate SYNM in futuristic dystopian human societies as depicted in science-fiction films. As noted previously, science-fiction frames can guide the understanding of unfamiliar science like nanotechnology (Davies, 2011):

> I suppose this is what is meant by 'Frankenfoods'? I don't know that I would be comfortable eating synthetic/lab-grown meat. (Online456, UK, M, 36–40)

> I do not look forward to a world where Soylent Green[1] derivatives are the only meat options. (Online450, UK, M, 51+)

> Yeah, it's like a horror film really, become a mutant… (FG2, UK, M, 22)

> This reminds me of science-fiction, like that machine (what's it called again?) where you type something and the right dish or product gets sprayed on your plate. (Online367, BE, F, 41–50)

Such metaphors filled the gap in the participants' knowledge and offered a conceptual scaffold for their reasoning. In line with Coleman and Ritchie's (2011) analysis of metaphors in biopolitical discourse, the science-fiction metaphors provided the participants with 'semantic packages' such as 'monster-out-of-control', 'irresponsible scientist' and 'monster movies' that guided their understanding but at the same time limited the scope for alternative interpretations. Coleman and Ritchie argue that such science-fiction metaphors can be used without much 'cognitive scrutiny' (they term these *under-the-radar metaphors*), as they 'are stripped of counter-meanings' and ultimately 'can have the effect of side-tracking readers from critical thought' (2011: 39).

Establishing polarities

While much sense-making involved analogies and similarities, there were also many instances in which SYNM was understood through a mechanism akin to antithesis whereby it was compared to things it was *different* from, such as natural meat or the traditional process of meat production:

> Doesn't appear to me like a very healthy meat because it's not in contact with the environment, is not outdoors, in the laboratory it seems very chemical. (FG5, PT, F, 50)

> I think there would be a different taste and a different structure. An animal that ran outside compared to something that didn't see or smell air, I think this would differ in taste and structure. (FG6, BE, M, 44)

The participants viewed the manufacturing of SYNM out of living cells as being against nature (cf. Bäckström et al., 2003), where 'nature' was used as an ideology in the sense that naturalness was constructed as safe and healthy while anything synthetic was viewed not only as carrying risks but also as having ethical implications:

> I find it unnatural and would never eat it. Could be carcinogenic according to me. This goes against nature, which is being destroyed already enough. (Online393, BE, M, 31–35)

> It's scary to think that we will be eating a genetically manipulated meat, without its going through a process of natural and traditional production. (Online321, PT, M, 41–50)

This process of drawing contrasts shows that the common-sense understanding of SYNM relied on implicit dichotomies such as *natural*/*artificial, nature*/*science, evolved*/*designed*, known as *themata* in social representations theory (Moscovici, 1993) and which have been shown to underpin ethical concerns around biotechnology like synthetic biology (van den Belt, 2009). SRT researchers have long recognised that lay sense-making often involves distinctions, antinomies, or oppositions (Marková, 2003) and indeed we find evidence of this in the understanding of SYNM.

Commonplaces as bottom-line arguments

Another strategy through which participants made sense of SYNM was the use of certain figurative constructions, also known as commonplaces, which are general arguments, observations, or

formulaic phrases that speakers can use in any context (Lanham, 1968; Myers, 2007), particularly when people are uncertain what to think or have little knowledge about an issue (Lassen, 2008). The most frequently occurring commonplaces in our participants' talk were *playing God* and *interfering with nature*, often found in lay reasoning around biotechnology such as GMOs (Tenbült et al., 2005):

> Maybe I am too conservative on that aspect but we shouldn't play God, we shouldn't clone animals … no… (FG4, BE, F, 36)

> I do not like the idea of eating synthetic meat. It seems too strange and we shouldn't be messing about with nature. (Online442, UK, F, 25–30)

M, 34: And the fact that you're playing with nature…
F, 40: It's a bit like Jurassic Park…
M, 35: You're playing God, aren't you?
M, 34: You are God, yeah, you know, and [we'd be] consuming that, so … That has issues. (FG5, UK)

Such commonplaces are situated in wider socio-cultural narratives around biotechnology to which individuals can appeal for rhetoric resources, and support past observations that the trope of 'playing God' is closely entwined with the Frankenstein theme in ethical debates around biotechnology (van den Belt, 2009). Commonplaces such as this acted as bottom-line arguments (Shepherd et al., 2007) and served to close off further discussion of SYNM.

Pragmatic reasoning

The participants made sense of SYNM also by engaging in a cost–benefit analysis whereby they weighed up the potential advantages and disadvantages of SYNM, thus echoing public understanding of other relatively unfamiliar science such as xenotransplantation (Michael and Brown, 2004). This strategy of sense-making, which we term pragmatic reasoning, involved comparing SYNM to other biotechnologies that seemed to carry uncertain risks and benefits (GMOs), to other familiar risks (cancer), and to other objects ultimately found to pose risk (asbestos):

> I think it's good and necessary that this research is done. However I do feel we need to watch out with genetic modification, like they do now with maize. The consequences are only visible after one or a few generations. And if this has catastrophic consequences, we only notice it if it's too late. I don't know if this meat has the exact same DNA. (Online352, BE, M, 31–35)

> It could solve a lot of problems if there is no harm, the question remains how it will be 20 years later? The same with asbestos which was used a lot and now gives cancer. (FG4, BE, M, 35)

The participants thus evinced dilemmatic thinking and expressed ambivalence – a reaction often found in relation to emerging technologies (Macnaghten et al., 2005) – as they could simultaneously envisage the benefits and costs of SYNM. Issues of risk control, governance, and wider social and ethical implications were raised, as in the past in relation to other food technologies like GMOs (Marris et al., 2001):

> I understand that as the population grows so will our need for food and I think that is a brilliant solution if you can get it to work. Unfortunately I don't think people will want to eat it, I would be very wary in trying it just because it's man-made and for no other reason. (Online482, UK, F, 25–30)

> As long as it's been tested and it's safe for humans and has no harmful effects then I think this is great. As it's very clear with the ever increasing population [that] something has to be done. (Online509, UK, F, 36–40)

We would concur with Macnaghten et al. and argue that the pragmatic reasoning shows that SYNM, like other emerging technologies, can provide 'fertile ground in which the moral dilemmas of modernity are rehearsed' (2005: 279), in our case, between environmental concerns and scientific progress bearing unknown consequences.

Another line of pragmatic reasoning was the 'taking hold' of the unfamiliar prior to anchoring it (Moscovici, 1984) and rejecting it in its entirety. These participants argued that humans should change consumption practices to avoid the need for SYNM to be created in the first place, thus discounting the need to engage with the concept at all:

> It seems wiser to change behaviour amongst the population instead of putting synthetic meat on the market. (Online405, BE, F, 41–50)

> To me it is an idea that shocks me a bit. I would prefer the option of eating less, eating something else, replace this option honestly. It's just not common-sense how the production is done. It is so unknown that I prefer not to try. I would more easily stop eating meat. (FG2, PT, F, 38)

Some participants talked about a 'shift in mentality' and felt that a new way of thinking about meat, food, society, and the environment is needed in order to understand SYNM. Thus transforming new scientific concepts into everyday common-sense sometimes involved participants in reflecting that a process of 'familiarisation' was really about how humans can adapt to scientific progress and cultural change:

> We are in 2012, but in 2050 maybe we'll have this. Fiction goes beyond reality, because I look back historically and see many things that we did make and that my grandparents and great-grandparents had some difficulty accepting and today are absolutely normal. […] Changing mentalities. Minds change. (FG6, PT, M, 51)

> We can't escape the reality; one day will be like this, as much as it costs us. For example, hundreds of years ago we could not imagine a juice made with artificial things, and I say juice as other things that are now part of our daily diet and we don't think about it. This is evolution, whether we like it or not and we can't escape it. Maybe in 20 years or more, this will be part of our diet. (FG4, PT, M, 41)

This resonates with the idea that SRs are both a condition and a consequence of new technologies, and that through a process of 'double accommodation' the public and the science adapt to each other (Bauer and Gaskell, 1999).

6. Discussion

In this study we explored the nature of lay reasoning around synthetic meat (SYNM) as a novel biotechnology using a social representations approach as we were interested in how new scientific knowledge was translated into common-sense. We were particularly interested in what strategies might underpin the way in which people would seek to make sense of SYNM, what would emerge as the 'familiar' to which SYNM would be anchored and the types of arguments, claims, and reasoning such anchors would afford.

The sense-making strategies used to discuss SYNM included asking questions about SYNM and wondering about its societal implications; anchoring SYNM to familiar objects, notions, and

technologies; using metaphors as semantic frames and commonplaces as bottom-line arguments; pragmatic yet dilemmatic reasoning involving weighing up the potential risks and benefits of SYNM and possible future scenarios. Broadly speaking, these strategies of sense-making afforded various levels of openness and critical thinking in relation to SYNM: the anchoring of SYNM to past contentious issues like GMOs, the use of science-fiction metaphors like 'Frankenfoods' and commonplaces like 'playing God' and 'messing with nature' limited the scope for understanding SYNM in its own right and closed off debates around its potential applications and benefits. By contrast, the factual and rhetorical questions about SYNM, the pragmatic reasoning, and the acknowledgement of the need to move beyond existing frames of knowledge enabled more critical thinking around SYNM and a consideration of its future implications for the environment, society, agriculture and human–animal relationships.

As regards the questions that the participants raised, some of these sought to establish the validity of anchoring SYNM to 'natural' meat while others involved wondering about future scenarios pertaining to SYNM production. Our participants' questions also unveiled a process of wondering, especially in relation to envisaging future scenarios around SYNM, which indicated active thinking and considerations of a potential reconfiguration of nature and society. The questions involved less anchoring and thus seemed to open the possibility for the participants to seek out the new and the unfamiliar and even to maintain the sense of uncertainty as to the future. The focus in this analysis on the questions people asked, and the use of a method that enabled this, revealed something of the way in which people try to make sense of new information. Perhaps surprisingly the focus of much social science is on seeking participants' answers to researchers' questions. However, there is a strong basis for considering the value of questions in the education literature where, for example, the questions that children ask are considered as an indicator of their science interest (Baram-Tsabari et al., 2006). Online studies of information seeking provide a forum where the questions people ask can be easily captured and analysed (Falchetti, Caravita and Sperduti, 2007).

The process of anchoring was largely underpinned by analogies, metaphors, and contrasts. The participants compared SYNM to other food technologies like GMOs, whereby the similarity between SYNM and other biotechnologies was grounded in notions of 'tampering with nature' and in past public debates around biotechnologies. Such analogies suggest that the sense-making around SYNM was not produced, but rather *re*-produced as it was constrained by past and present SRs around biotechnology (cf. McKinlay and Potter, 1987), and bring support to the suggestion that analogies can serve as discursive tools when one is making sense of the unfamiliar (Davies, 2011). In a way, the participants did not necessarily make sense of SYNM itself, but rather used it as an opportunity to express their general distrust of corporate exploitations of biotechnology. Therefore, in line with our research question about the role of anchoring in reducing unfamiliarity, we would argue that the anchoring of SYNM to familiar objects or technologies did not necessarily facilitate its understanding and that anchoring does not always reduce unfamiliarity, especially when the anchors themselves are contentious (cf. Michael and Brown, 2004). Some instances of anchoring, such as to GMOs or cloning, seemed to close off further exploration of SYNM as a new technology and did not stimulate the seeking of new knowledge. In line with a recent critique of anchoring (de-Graft Aikins, 2012), it could be argued that the analogies to past contentious biotechnologies maintained SYNM in a rather 'unfamiliar place' which imbued SYNM with connotations of risk, strangeness, and unnaturalness. This enabled the participants to play down the challenges SYNM might pose to their current consumption practices or attitudes towards meat production. This perhaps links with our observation that SYNM was almost never anchored to the issue often considered to be a most familiar referent around risk and meat – that of Bovine Spongiform Encephalopathy (BSE).

Sense-making was often underpinned by science-fiction metaphors which arguably highlighted 'anti-science themes intrinsic to science-fiction' (Huxford, 2000: 187) while at the same time allowed the participants to understand SYNM as something yet to happen in a distant, perhaps dystopic, future. Similarly to the analogies to other biotechnologies, these metaphors directed the participants into 'familiar channels of cognition' (Huxford, 2000: 188) which somewhat excluded alternative views. Together, the analogies and the metaphors show that the familiar was constituted in terms of both real objects of knowledge, i.e. biotechnologies like GMOs, as well as fictional notions, i.e. popular science-fiction imagery like Frankenstein, Jurassic Park, or mutants.

Somewhat similarly to the metaphors, certain commonplaces – 'messing with nature' and 'playing God' – were invoked in the participants' discourses and served to close off further discussion of SYNM, especially as 'nature' and 'God' were used in an uncontested manner. We would echo past work noting that metaphors and tropes used in biotechnology discourse 'are stripped of counter-meanings by their very nature, thus leaving little opportunity for cognitive processing' (Coleman and Ritchie, 2011: 39). Indeed, the semantic frames offered by the science-fiction metaphors and by the commonplaces discouraged alternative frames of interpretation such as animal welfare or environmental degradation. While the metaphors contributed to the process of anchoring (e.g. *Frankenfoods* enabled analogies to GMOs), the commonplaces acted to close off further discussion of potential risks and benefits of SYNM.

Regarding the two methods used, we found that the online and the focus group participants employed similar interpretative repertoires when making sense of SYNM, with few differences between the three countries. Thus in both individual and group settings, people drew on socially shared anchors and appealed to common social representations of science and technology. Overall, more frequent and richer instances of anchoring were observed in the comments than in the questions, whether online or offline. In line with our analysis of this theme, this might suggest that the function of questions is not necessarily to seek to locate the unfamiliar with the familiar but also to consider the new and the unfamiliar. Arguably people articulated questions more clearly online than in the focus groups, as in the latter there was a propensity for participants to agree with one another and for their opinions to converge. Driven perhaps by social conventions around group interactions and the need to establish a common frame of reference this ties in with the observation that when discussing novel technologies in a group people can become more certain in their opinions about a technology but not necessarily more supportive of it (Kronberger et al., 2012). This highlights the value of exploring sense-making individually where participants are not considering the issue in the immediate context of others' opinions. Conducting studies online that allow for interaction and feedback yet provide space for thought and consideration seems to offer a promising option for complementing group-based work.

We acknowledge that, as with much social research, it may be the most interested, and perhaps most knowledgeable participants who participate most fully, or indeed who chose to take part in the research at all. It was certainly the case that there were many participants who did not leave questions or comments in VIZZATA™ and whose contribution in the focus group discussion of the video was minimal. It may be that the sense-making strategies we identified are by definition only deployed by those who are interested in the subject. On the other hand, even if variations in participation can be equated with variations in interest, it may be that the nature and range of sense-making strategies deployed are similar for those with more or less interest in the subject matter.

To conclude, much of the reasoning around SYNM mirrored that around other biotechnologies, in particular GMOs and cloning, and many participants drew parallels in this sense. This raises issues about how one might encourage fresh consideration of new technologies. Given that in our study the questions people asked enabled people to wonder about the possibilities, it could be suggested that in those areas where a new technology is likely to inherit 'a complex web of

disenchantment, tension and ill-feeling' caused by previous technological controversies (Kearnes and Wynne, 2007: 132), the public should be encouraged to ask questions as much as to express their opinions. We believe that encouraging and eliciting questions during the process of sense-making, and thus the seeking of the new and unfamiliar, might stimulate the public to embrace a more critical (or reflective) use of anchors and to understand the new objects of knowledge in their own terms. There may thus be particular value within the public communication of science and technology of encouraging question asking as a way of cultivating a climate of open and active thinking.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was conducted as part of the European *FoodRisC* project: *Perceptions and communication of food risks/benefits across Europe: development of effective communication strategies*, which was funded under the 7th Framework Programme (2007–2013) of the European Commission under the theme *Food, Agriculture and Fisheries, and Biotechnology*, grant agreement no. 245124.

Note

1. *Soylent Green* is an American science-fiction film from 1973 which describes a society set in the year 2022 facing environmental destruction, overpopulation, and food scarcity. 'Soylent Green' is a product secretly made by the government from human corpses which is then rationed and fed to the population.

References

Aizaki H, Sawada M and Sato K (2011) Consumers' attitudes toward consumption of cloned beef: The impact of exposure to technological information about animal cloning. *Appetite* 57(2): 459–466.

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

Baram-Tsabari A, Sethi RJ, Bry L and Yarden A (2006) Using questions sent to an Ask-A-Scientist site to identify children's interests in science. *Science Education* 90(6): 1050–1072.

Barnett J, Fife-Schaw C, Shepherd R, Timotijevic L, Fletcher J and Fletcher D (2008) *Online Deliberative Engagement: A Pilot Study*. A report for the Wellcome Trust. London: The Wellcome Trust.

Barnett J, McConnon A, Kennedy J, Raats M, Shepherd R, Verbeke W, Fletcher J, Kuttschreuter M, Lima L, Wills J and Wall P (2011) Development of strategies for effective communication of food risks and benefits across Europe: Design and conceptual framework of the FoodRisC project. *BMC Public Health* 11: 308.

Bauer MW and Gaskell G (1999) Towards a paradigm for research on social representations. *Journal for the Theory of Social Behaviour* 29(2): 163–186.

Braun V and Clarke V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology* 3(2): 77–101.

Coleman C-L and Ritchie L (2011) Examining metaphors in biopolitical discourse. *Lodz Papers in Pragmatics* 7(1): 29–59.

Courvoisier N, Clémence A and Green EGT (2013) Man-made black holes and Big Bangs: Diffusion and integration of scientific information into everyday thinking. *Public Understanding of Science* 22(3): 287–303.

Davies SR (2011) How we talk when we talk about nano: The future in laypeople's talk. *Futures* 43(3): 317–326.

de Barcellos MD, Kügler JO, Grunert KG, Van Wezemael L, Pérez-Cueto FJA, Ueland Ø and Verbeke W (2010) European consumers' acceptance of beef processing technologies: A focus group study. *Innovative Food Science & Emerging Technologies* 11(4): 721–732.

de-Graft Aikins A (2012) Familiarising the unfamiliar: Cognitive polyphasia, emotions and the creation of social representations. *Papers on Social Representations* 21(1): 7.1–7.28.

Devine-Wright H and Devine-Wright P (2009) Social representations of electricity network technologies: Exploring processes of anchoring and objectification through the use of visual research methods. *British Journal of Social Psychology* 48(2): 357–373.

Dragojlovic N and Einsiedel E (2013) Playing God or just unnatural? Religious beliefs and approval of synthetic biology. *Public Understanding of Science* 22(7): 869–885.

Falchetti E, Caravita S and Sperduti A (2007) What do laypersons want to know from scientists? An analysis of a dialogue between scientists and laypersons on the web site Scienzaonline. *Public Understanding of Science* 16(4): 489–506.

Frewer LJ, Bergmann K, Brennan M, Lion R, Meertens R, Rowe G, Siegrist M and Vereijken C (2011) Consumer response to novel agri-food technologies: Implications for predicting consumer acceptance of emerging food technologies. *Trends in Food Science & Technology* 22(8): 442–456.

Goodwin JN and Shoulders CW (2013) The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science* 95(3): 445–450.

Huxford J (2000) Framing the future: Science fiction frames and the press coverage of cloning. *Continuum: Journal of Media & Cultural Studies* 14(2): 187–199.

Jha A (2013) Synthetic meat: How the world's costliest burger made it on to the plate. *The Guardian*, 5 August, p. 10.

Joffe H (2002) Social representations and health psychology. *Social Science Information* 41(4): 559–580.

Jovchelovitch S (2001) Social representations, public life, and social construction. In: Deaux K and Philogène G (eds) *Representations of the Social: Bridging Theoretical Traditions*. Oxford: Blackwell, pp. 165–182.

Kearnes M and Wynne B (2007) On nanotechnology and ambivalence: The politics of enthusiasm. *NanoEthics* 1(2): 131–142.

Kronberger N, Holtz P and Wagner W (2012) Consequences of media information uptake and deliberation: Focus groups' symbolic coping with synthetic biology. *Public Understanding of Science* 21(2): 174–187.

Lanham R (1968) *A Handlist of Rhetorical Terms*. Berkeley, CA: University of California Press.

Lassen I (2008) Commonplaces and social uncertainty: Negotiating public opinion. *Journal of Risk Research* 11(8): 1025–1045.

Macnaghten P, Kearnes MB and Wynne B (2005) Nanotechnology, governance, and public deliberation: What role for the social sciences? *Science Communication* 27(2): 268–291.

Marcu A, Uzzell D and Barnett J (2011) Making sense of unfamiliar risks in the countryside: The case of Lyme disease. *Health & Place* 17(3): 843–850.

Marková I (2003) *Dialogicality and Social Representations: The Dynamics of Mind*. Cambridge: Cambridge University Press.

Marris C, Wynne B, Simmons P and Weldon S (2001) *Public Perceptions of Agricultural Biotechnologies in Europe: Final Report of the PABE Research Project*. Lancaster: University of Lancaster.

McKinlay A and Potter J (1987) Social representations: A conceptual critique. *Journal for the Theory of Social Behaviour* 17(4): 471–487.

Michael M and Brown N (2004) The meat of the matter: Grasping and judging xenotransplantation. *Public Understanding of Science* 13(4): 379–397.

Moscovici S (1984) The phenomenon of social representations. In: Farr RM and Moscovici S (eds) *Social Representations*. Cambridge: Cambridge University Press, pp. 3–70.

Moscovici S (1993) Introductory address to the First International Conference on Social Representations, Ravello, 1992. *Papers on Social Representations* 2: 160–170.

Myers G (2007) Commonplaces in risk talk: Face threats and forms of interaction. *Journal of Risk Research* 10(3): 285–305.

Palma-Oliveira JM, Gaspar de Carvalho R, Luis S and Vieira M (2009) Knowing much while knowing nothing: Perceptions and misperceptions about nanomaterials. In: Linkov I and Steevens J (eds) *Nanomaterials: Risks and Benefits*. Dordrecht, Netherlands: Springer, pp. 437–463.

Post M (2012) Cultured meat from stem cells: Challenges and prospects. *Meat Science* 92(3): 297–301.

QSR International Pty Ltd (2010) NVivo qualitative data analysis software, Version 9.

Rollin F, Kennedy J and Wills J (2011) Consumers and new food technologies. *Trends in Food Science & Technology* 22(2–3): 99–111.

Rose D (2000) Analysis of moving images. In: Bauer MW and Gaskell G (eds) *Qualitative Researching with Text, Image and Sound: A Practical Handbook*. London: SAGE, pp. 246–262.

Scheufele D and Lewenstein B (2005) The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research* 7(6): 659–667.

Shepherd R, Barnett J, Cooper H, Coyle A, Moran-Ellis J, Senior V and Walton C (2007) Towards an understanding of British public attitudes concerning human cloning. *Social Science & Medicine* 65(2): 377–392.

Siegrist M (2008) Factors influencing public acceptance of innovative food technologies and products. *Trends in Food Science & Technology* 19(11): 603–608.

Siegrist M, Stampfli N, Kastenholz H and Keller C (2008) Perceived risks and perceived benefits of different nanotechnology foods and nanotechnology food packaging. *Appetite* 51(2): 283–290.

Smith N and Joffe H (2013) How the public engages with global warming: A social representations approach. *Public Understanding of Science* 22(1): 16–32.

Tenbült P, de Vries NK, Dreezens E and Martijn C (2005) Perceived naturalness and acceptance of genetically modified food. *Appetite* 45(1): 47–50.

van den Belt H (2009) Playing God in Frankenstein's footsteps: Synthetic biology and the meaning of life. *NanoEthics* 3(3): 257–268.

Would You Eat Synthetic Meat? (2011) National Enabling Technologies Strategy Expert Forum and the Department of Innovation, Industry, Science and Research, Australian Government. 29 September. Available at: http://www.youtube.com/watch?v=iO9q_paCcWA

Author biographies

Afrodita Marcu is a social psychologist and research fellow at the University of Southampton, UK. Her research interests reside in the areas of risk perception, risk communication, and social representations of risk, and her current work explores what motivates people to be vaccinated or to take antiviral medicines against pandemic flu.

Rui Gaspar has a PhD in Social Psychology and is a research fellow at the Centro de Investigação e Intervenção Social (CIS), ISCTE-IUL and assistant professor at the Department of Psychology, University of Évora. His teaching and research focus on social psychology applied to consumer, health and environmental issues.

Pieter Rutsaert is working as a postdoctoral fellow at the social sciences division of the International Rice Research Institute in the Philippines on the development of effective value chains in South East Asia. He has a background in agricultural economics and consumer behaviour, and specific expertise in experimental auctions, food risk communication and social media.

Beate Seibt is a social psychologist and Associate Professor at the University of Oslo, Norway. Her research interests are in basic and applied aspects of emotion and motivation. After her training in Germany and the Netherlands, she worked in Lisbon on various projects concerning health behaviour, interpersonal and intergroup relations, and the EU-funded FoodRisC project.

David Fletcher is the founder of the software development company White October, based in Oxford, UK. He was the technical lead on the development of the proof of concept for the VIZZATA™ tool in 2008 and has subsequently led its development.

Wim Verbeke is the Chairman of the Department of Agricultural Economics at Ghent University. He is a professor in agro-food marketing and consumer behaviour, whose expertise pertains to food consumer science and the impact of personal difference variables, information and communication on food choice. He has published extensively on understanding determinants of consumer decision-making and food consumption.

Julie Barnett is a Professor of Health Psychology at the University of Bath, UK. She has particular research interests in public appreciations of risk, the role of technology in health care, processes of public engagement and social media.