The Online Genetically Modified Food Debate: Sociotechnical Imaginaries and Genetically Modified Animals

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ABSTRACT

The aim of this article is to investigate the sociotechnical imaginaries present in UK online news articles and below the line comments (the comment and debate spaces opened up underneath news articles) in connection with genetically modified animals. This article attempts to provide an answer through a qualitative study using discourse analysis. The findings reveal how sociotechnical imaginaries present in news articles depict genetically modified animals as 'other' in comparison to those bred through selective breeding. In the below the line comments, a key feature is monstrosity. Here, the sociotechnical imaginaries draw on the concept of 'other' along with Frankensteinian imagery. Nature also features in the sociotechnical imaginaries in the news articles. Journalists present genetic modification as overcoming nature, as well as scientists designing nature. The article concludes by discussing how sociotechnical imaginaries can bring invisible non-human animals to the fore.

KEYWORDS

Genetically Modified Animals, Sociotechnical Imaginaries, 'Other', Monster, Nature

Introduction

An analytic order is imposed on the natural world by splitting fauna into particular types of beings.[1] These splits create borders between species. The term animal encompasses all other species of animals except humans, and has inspired the use of phrases such as 'other animals', 'non-human animals', and 'other than human animals' (Carter and Charles 2011; Haraway 2016). To be human affords a uniqueness over other animals. The boundaries between human and non-human are not natural, but are constructed through the use of hegemonic discourses, which depend on the fundamental meanings of what it is to be 'human' or 'animal' in order to sustain the human/cultural subject separate from the animal/natural object. Throughout the remainder of this article, non-human animals will be referred to as animals.

Humans can influence the evolution of organisms through selective breeding by choosing which individuals mate, by cloning, and by genetically modifying organisms with genes from other species (Russell 2004). Genetic modification (GM) is where a gene from one species is inserted into the genome of another species (Phillips 2008). With this technology, human intervention occurs on the cellular or subcellular level (Russell 2004). The genetic modification of animals is causing a rethink of what is natural. There are now new opportunities for

[1] The author would like to thank the anonymous referees for their helpful feedback and advice.

redesigning, manipulating and controlling animals through molecular techniques (Twine 2007).

Literature Review

Sociotechnical Imaginaries

Sheila Jasanoff and Sang-Hyun Kim (2009, 120) first defined sociotechnical imaginaries as 'collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects'. They first used this concept to determine why nation states followed different technological trajectories even when facing the same benefits and challenges associated with nuclear power. Because of the many ways in which scientific and technological knowledge can enter into the meaning, materiality and morality of social life, this definition was lacking. Jasanoff (2015a, 4) has refined the definition of sociotechnical imaginaries to be 'collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology'. Jasanoff (2015a) does point out that the word 'desirable' is used because scientific and technological developments are often justified as being socially progressive, even though unforeseen risks and hazards may occur through the use of such developments. It is possible for both utopian and dystopian imaginings to occur (Jasanoff and Kim 2009). Even more so, 'multiple imaginaries can be spun from the same raw materials of invention and will' (Jasanoff 2015b, 339).

Charles Taylor (2002, 106) explains that the social imaginary is how 'people imagine their social existence, how they fit together with others, how things go on between them and their fellows, the expectations that are normally met, and the deeper normative notions and images that underlie these expectations'. Sociotechnical imaginaries allow individuals to make sense of what is happening in the world around them. Sociotechnical imaginaries also create a shared sense of belonging, and help construct meanings which enable collective interpretations of social reality (Jasanoff and Kim 2009). However, it needs to be acknowledged that there are many different perspectives for sociotechnical imaginaries, and hence, these are only partial perspectives (Braidotti 2019).

Different perspectives underpin social complexity. For example, science is important but it does not operate in isolation. As Jasanoff explains:

> […] scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments, and institutions – in short, in all the building blocks of what we term the social. The same can be said even more forcefully of technology. (2004, 3)

Scientific knowledge is produced because society supports its production (Irwin and Michael 2003). However, it is important to note that citizens attach different morals and values to scientific ideas and technological inventions (Jasanoff 2015a). Citizens may accept certain scientific ideas and technologies and not others. This is why sociotechnical imaginaries are useful in revealing the known and the desired sociotechnical present and futures.

In this study, sociotechnical imaginaries are used as the framework to analyse the online news articles and below the line comments. The use of sociotechnical imaginaries as a framework is fruitful because it offers a window into different visions of the present and future. Having examined sociotechnical imaginaries, in the following two sections, I discuss the construction of 'other' and monsters, and nature.

'Other' and Monsters

The construction of 'other' is related to the 'norms' of 'self' and society where difference is not always acceptable. This unacceptability and the representation of 'other' is always connected to the representation of 'self' (Wright 2020). The recognition of being different and the acceptance of difference is made possible through repression in the 'self'. The construction of 'other' means discrediting and disowning what is viewed as being different (Wood 2020). As Zuleyma Tang Halpin (1989, 286) argues, 'the "other" by definition, is the opposite of the "self", and therefore comes to be regarded as intrinsically of lesser value'. The relationship between 'self' and 'other' is hierarchical and is used to justify and sustain existing power relationships. This can be achieved because the familiar and similar to 'self' is considered good, whilst strange and evil is viewed as 'other' (Wright 2020).

'Other' is also bound to the idea of monstrosity (Wright 2020). To be a monster is to be 'other'. A monster exists because it occurs through an act of being named. Just like 'other', it is a social construct. As Jeffrey Cohen (2020) argues, the monstrous only exists because it is socially constructed. However, the construct of a monster is powerful. If a monstrous body can be classified, then it can become 'other'. The problem arises when a monstrous body cannot be easily constructed as 'other', therefore undermining the existing structures of 'self' and 'other' (Wright 2020). The threat from the power of monsters exists because of their wretchedness, their ability to shock, and their potential for horror (Dixon 2008).

Whilst I have provided an outline of what 'other' and monstrous means, the concept of 'other' is important when considering animals. This is because animals are already viewed as 'other' (Scholtmeijer 1995). Carol Adams (2018, 104) argues that 'through the human/other dialectic "human" de-facto represents Euro-American (human) maleness and "other" represents that which white maleness negates: other races, sexes, or species'. Animals can be constructed as 'other' through the use of 'innocuous phrases such as "food-producing unit", "protein harvester", "converting machine", "crops" and "biomachines"' (Adams 2015, 27). In part, this is because the relationship between animals and 'otherness' is yet to be disrupted (Adams 2018). Until this disruption occurs, these types of phrases will continue to be used. Having discussed the construction of 'other' and monsters, I now move on to the construction of nature.

Nature

The discourse of nature is important because it belongs to science, personal discussions, religion, recreation, poetry, and painting (Cook 2004). Nature is entangled with social life (Irwin 2001), and as a discursive construction, nature is powerful (Haraway 2020). Nature can be thought of as a 'figure, construction, artefact, movement, displacement' (Haraway 2020, 461). There are complex and sometimes conflicting discourses surrounding nature (Soper

2010). Anders Hansen has identified a number of constructions of nature, and these are as follows:

- Nature as good, pure, nourishing, nurturing, balanced, and harmonious
- Nature as vulnerable or threatened
- Nature as imperfect
- Nature as powerful, not to be messed or tinkered with
- Nature as a challenge
  Adapted from Hansen (2006, 813-14).

The richness of the meaning of the word nature, along with its different meanings makes it a powerful construct. These alternative constructs of nature show there are likely to be different opinions about nature.

Nature is an important sociotechnical imaginary when considering genetic modification. As genes occurring naturally are artificially amended by scientists, understandings of nature become bound up with science and scientific progress (Wall 1999). However, instead of considering how well nature is known scientifically, the focus should be on how scientists interact with nature (Bird 1987). As Lynda Birke (1995) argues, in the Judeo-Christian tradition, humans are dominant over nature. Therefore, nature is there for humans to manipulate and use. Science is also about objectivity and the production of facts by standing outside of nature (Birke 1995; Halpin 1989). Scientists can conduct experiments objectively because they stand outside of nature.

However, humans standing outside of nature is problematic. Alan Irwin and Mike Michael express this as follows:

> [if] we wish to treat seriously people's sense of belonging to particular places, and their lived mutualistic relationships with particular bodies, animals and environments, then we will need to consider carefully how such bodies, animals and environments might act within assemblages. (2003, 143)

It is necessary to understand the relationships and interactions between humans, animals and environments. Acting within assemblages allows '"We"-who-are-not-one-and-the-same-but-are-in-this-convergence-together' (Braidotti 2019, 182) to come together in unforeseen collaborations and associations. This also helps move away from the argument that nature is only protected because present and future generations of humans rely on its survival (Vance 1995). As this section illustrates, nature is a powerful construct. In the final section, I discuss previous research.

Previous Research

Research concerning news coverage of animals has tended to focus on animal welfare (Buddle and Bray 2019; Freeman 2009; Freeman et al. 2011). Emily Buddle and Heather Bray's (2019) study focused on the framing of farm animal welfare in Australian newspapers. They identified two dominant frames. Firstly, governments and farm animal production industries could not be trusted to ensure good animal welfare. Secondly, consumers could assist in improving farm animal welfare through ethical consumption practices. Carrie Freeman (2009) examined US

news coverage of farmed animals from 2000 to the end of 2003. She found that animal sentience was disregarded and news coverage amplified industry use over animal protection. Freeman et al. (2011) argue for the inclusion of animals' voices in news coverage. They argue this is required because news coverage should be obliged to inform citizens of how actions are impacting both humans and animals. This would enable choices to be made which are fair and responsible. These studies of news coverage of farmed animals illustrate how food has always been 'more-than-food' (Goodman 2016, 258). There is a need to consider how food, especially 'meat', is produced.

There have been numerous studies on the news coverage and reporting by journalists of GM food and crops in the UK and from around the world (Augoustinos et al. 2010; Bauer 2002; Cook et al. 2006; Flipse and Osseweijer 2012; Hornig-Priest and Ten-Eyck 2003; Maeseele 2015; Marks et al. 2007). Since the publication of some of these studies, digital spaces have become more prevalent. Facebook, Twitter, Instagram, blogs and websites have become more established in the food media landscape (Goodman and Jaworska 2020). Below the line comments, 'industry parlance for the comment, and debate spaces opened up underneath news articles and blogs' (Graham and Wright 2015, 319), are enabling audience members to participate in news making activities.

To my knowledge, no research has been conducted which examines news coverage or the associated below the line comments in respect of genetically modified animals. This research aims to address this gap and sets out to answer the question: Which sociotechnical imaginaries concerning genetically modified animals are present in UK online news articles and the associated below the line comments? To answer this question, a qualitative study was undertaken using discourse analysis to analyse UK online news articles and the associated below the line comments.

Methods

The methods presented here are part of a larger research project (Price 2018) conducted from September 2014 to September 2018.

Data Collection

A qualitative study was undertaken which included online news articles and the associated below the line comments from UK online news organisations. The news organisations included in the sample were *The Guardian*; *The Telegraph*; *The Times*; *The Daily Mail*; and *The Mirror*. These also included the Sunday editions. The sample included what have traditionally been seen as the broadsheets (*The Guardian*; *The Telegraph*; and *The Times*), and the tabloids (*The Daily Mail* and *The Mirror*). The news organisations included in the sample were chosen because of their diversity of content. The broadsheets generally are assumed to provide more in-depth content, whilst the tabloids tend to be more concise and simplistic. The sampling time frame ran from 1 January 2015 until 31 December 2015, enabling a sufficient data set to be collected. The overall sample gathered seventy-eight articles and 9,279 below the line comments. The sample of subset data concerning GM animals consisted of seven articles and one hundred and fifty-two below the line comments.

An important consideration which has to be taken into account with this study, is that those who post comments may be those who are particularly interested in the subject of GM animals. The views of those commenting are seen as being representative for this study and may not be characteristic of the population as a whole. However, this data is first hand from the audience who are interested in commenting about GM animals. Their views, feelings, understandings, and beliefs are revealed in the comments they post.

Data Analysis

Whilst there are many types of discourse analysis, the version used in this study is that developed by James Gee (2011). By conducting discourse analysis, questions are effectively asked of the text being examined. According to Gee (2011), there are seven different building tasks used in the construction of language whenever we speak or write and for each, it is possible to ask a discourse analysis question. These seven building tasks are significance; practices (activities); identities; relationships; politics; connections; and sign systems and knowledge. The seven building tasks are fundamentally interlinked with each other (Gee 2011).

In respect of selecting samples to analyse, a strategy Norman Fairclough (1992) proposes is to focus on those elements of the discourse where there is an indication and evidence that something is amiss and is going wrong such as misunderstandings. He also suggests focusing on areas of discourse which are pivotal, indicate something which is vital, or are puzzling. These suggestions were followed and those extracts which best represented a pattern of 'other', 'monster' or 'nature' in the subset data were selected. These three patterns were chosen as they were the most interesting. The questions described above for Gee's (2011) seven building tasks were then applied to the text extracts. An example of how the seven building tasks and the related discourse analysis questions were applied to the data are available in Price (2018).

In the findings which follow, any spelling mistakes or grammatical errors are left unchanged in the extracts taken from the news articles and below the line comments. It is acknowledged that readers of this article may have different interpretations of the data that are presented here.

Results and Discussion

'Other' and Monsters

The first sociotechnical imaginaries are of 'other' and monsters. These two imaginaries are described together because they are interrelated.

News Articles

The first extract comes from a news article which describes research being undertaken by the Roslin Institute, University of Edinburgh. Pigs were genetically modified to be resistant to the disease, African Swine Fever.

> On an isolated farm outside Edinburgh, pigs grunt eagerly as their food arrives. The barn has a typical farmyard whiff, and a litter of tiny piglets, born just hours earlier, lie with trotters outstretched and eyes sealed, as helpless as any newborns. Only the occasional

> fluorescent snout or trotter reveals that the building is home to one of the world's most advanced genetic modification projects.
>
> 'Could these piglets become Britain's first commercially viable GM animals?' (Hannah Devlin, *The Guardian*, 23 June 2015).

This is the introduction to the news article. The first two sentences describe a scene which would be expected in a farm setting. The journalist describes an evocative image which enables the reader to visualise the scene. The journalist first constructs the pigs as 'normal' animals. The following sentence, which describes the fluorescent snout or trotter, positions the pigs as 'other'. As animals are characterised by their unique physical and behavioural traits (Orland 2004), a fluorescent snout or trotter does not fit with the usual construction of a pig breed. The pig's fluorescent snout acquired through genetic modification makes it 'other'.

The construction of 'other' can also be seen in the next two extracts which focus on 'Green Sheep'. The two extracts are from different news articles but describe the same event. A genetically modified lamb which was used for research purposes at a research institute in France, had been allowed to enter the food chain.

> In what could have been the plot of a science fiction film, Emeraude and Rubis were reportedly part of a programme called Green Sheep launched in 2009, aimed at carrying out experiments on mammals for 'therapeutic research'. The jellyfish protein was reportedly introduced into the sheep to make their skin transparent and enable researchers to 'visualise and study heart transplants'.
>
> 'Lamb with jellyfish gene "may have been deliberately sent to abattoir"' (Kim Willsher, *The Guardian*, 23 June 2015).
>
> Rubis was the fruit of Inra's so-called 'green sheep' programme launched in 2009 to produce lambs genetically modified to contain a green fluorescent protein originating from a jellyfish. The proteins make the skin transparent and give off a greenish glow when exposed to certain ultraviolet light. Typically, they are used to monitor the activity of altered genes, and in this case to monitor transplants for heart disease.
>
> 'Genetically modified "jellyfish lamb" accidentally hits French dinner plates' (Henry Samuel, *The Telegraph*, 23 June 2015).

Both journalists describe the sheep as being part of the 'Green Sheep' programme. There are a number of ways in which the sheep are defined as 'other' by the journalists. By describing the colour as green, the sheep are constructed as 'other'. Sheep can be black, brown, white, grey or fawn (British Coloured Sheep Breeders Association 2020). The journalists also claim the sheep are 'other' by framing their use as animals used in research for heart transplants. These are not 'normal' sheep because their skin glows green under ultraviolet light in order to be used for scientific research purposes. The monstrous 'other' is also depicted here due to the sheep containing a protein originating from an unrelated species, the jellyfish. This is because monsters can cross categories or overlap species groups (Lorimer and Driessen 2013). Monsters are 'present as freak, or grotesque […] the irregular, the anomalous and the aberrant as manifest in bodily, mental and moral deformities' (Dixon 2008, 681). It is bodily deformities which are present in 'Green Sheep'.

Below the line comments also contained sociotechnical imaginaries of 'other' and monsters.

Below the Line Comments

The first comment was in response to the news article in *The Guardian* concerning the genetically modified lamb entering the food chain.

> It's nothing to do with GM food. The jellyfish protein is a fluorescent protein that's used as a marker - it glows green when it's exposed to UV/blue light. Sheep cells are being used to test a new medical procedure. The protein (GFP) is used to monitor the progress of the experiment. The meat from the lamb would contain a minuscule fraction of a percent of the "jellyfish" protein. To all intents and purposes it's the same as normal lamb meat and would not harm anyone eating it.
>
> Comment relating to the article, 'Lamb with jellyfish gene "may have been deliberately sent to abattoir"' (Willsher 2015).

In this extract, the commenter constructs the sheep as 'other'. As with the article, it is the colour which makes the difference, as well as the sheep being used for scientific research. Whilst the commenter claims there are differences between the 'Green Sheep' and normal sheep, these are downplayed. This is achieved through the reference to eating lamb and how there is no difference between 'Green Sheep' and normal sheep.

Whilst the monstrous is still visible here, with the mention of 'jellyfish protein', the commenter does not appear to be disgusted by the idea. Often it is the monster's lack of fit which provides repulsion, horror, disgust, and even wonder (Dixon 2008). This comment raises interesting questions. What happens when we accept the genetic manipulation of animals? What happens when we accept monstrous animals?

Non-traditional forms of science communication in the form of science fiction, can be found in the sociotechnical imaginaries of 'other' and monsters. Stories containing monsters can convey moral truths, enabling the audience to reject or embrace these moral truths, or to be inspired by them (Asma 2020). Inspiration taken from the *Frankenstein* story is illustrated in the below the line comments which follow, and these were in response to the news article concerning the pigs genetically modified to be resistant to African Swine Fever.

> Frankenpig in summer or winter; Frankenpig for lunch or dinner.
>
> Comment relating to the article, 'Could these piglets become Britain's first commercially viable GM animals?' (Devlin 2015).
>
> Frankenpig. Is anything safe from Dr. Frankenstein?
>
> Comment relating to the article, 'Could these piglets become Britain's first commercially viable GM animals?' (Devlin 2015).

Although both of these commenters make short statements, they are telling as they illustrate how cultural references are drawn upon in order to make sense of scientific issues. Both commenters claim the pigs in the news story are 'Frankenpigs'. The pigs are constructed as 'other' through the use of the Frankenstein metaphor.

Frankenstein is an important science fiction story, written by Mary Shelley, and first published in 1818. In the story, Frankenstein creates a monster from body parts and brings him to life using electricity. As these comments illustrate, the imagery of *Frankenstein* is still heavily drawn upon. Frankenpigs are monsters. Jon Turney provides a useful summary:

> […] we are never going to be rid of Frankenstein, even if we want to be. The story is too deeply embedded in our culture now not to leave its traces or raise echoes whenever we discuss our attitude to science and scientists. And as the products of biological manipulation become ubiquitous, there is every reason for the grip of the story to strengthen. (1998, 221)

For these commenters, genetically modified animals are analogous to Frankenstein's monster. The story of *Frankenstein* is 'one of scientific hubris, a quest for knowledge without consideration of human and social consequences, a disregard for individuals and their feelings' (Cook 2004, 98). There is the possibility that unforeseen problematic physical conditions in animals may arise from genetic modification. This idea is conveyed by the commenters.

Nature and Science

The sociotechnical imaginaries of nature in relation to genetically modified animals can be seen in the extracts which follow. The first part of this section examines the news articles.

News Articles

This extract is from a news article describing the research undertaken by the Roslin Institute, University of Edinburgh, in which pigs were modified to be resistant to the disease, African Swine Fever. The extract is from *The Times*.

> 'We need these animals to deliver something that could be a product,' he said. 'If these pigs show resilience, we will go the regulators. The limitations are no longer technical, they're legal.'
>
> 'Cloned little piggy heads to market' (Oliver Moody, *The Times*, 25 June 2015a).

This is a quote by Professor Bruce Whitelaw from the University of Edinburgh's Roslin Institute. The quote constructs the pigs as being in control of what is achieved with the experiment, with the onus of the experiment performing well placed on them. Although the discussion has moved on to the natural, the idea of 'otherness' still appears here. When animals are subjected to scientific experiments they are viewed as being 'other' (Adams 2018; Birke 1995; Halpin 1989). As Halpin (1989, 292) argues, the 'self versus other and the subject versus object dualities dictate that research animals will be regarded as lower (inferior) forms of life towards which the scientist need not feel any compassion or respect'. Nature can be manipulated because it is 'other'.

With the claim being made that the limitations are no longer technical, this indicates that the scientist constructs nature as something which can be overcome and conquered. Domesticated animals such as pigs, cattle, sheep and horses are biological beings manipulated through breeding by humans to serve humans (Russell 2004). With genetic modification, the process of obtaining the perfect breed is accelerated (Haraway 2018). However, an important caveat suggested by Susan Schrepfer (2004, 262), is that organisms 'have their own agendas, their own genetic options, and their own limitations. They are self-replicating'. We have to remember that humans are unable to completely control an organism. Nature cannot be completely overcome.

The manipulation of nature is also seen in the next extract which is from a news article which describes the research being undertaken with genetically modified cattle. Cattle were modified with a gene from a nematode worm in order to make the meat from the animals higher in omega-3 fatty acids.

> Genetically modified cattle whose beef is rich in omega-3 fatty acids more commonly found in fish have been created by scientists in China.
>
> The calves are the latest breakthrough in the controversial field of 'designer' livestock, as geneticists scramble for ways to boost the nutritional value of meat and improve public health.
>
> 'Scientists create GM cows high in fish oil' (Oliver Moody, *The Times*, 12 May 2015b).

In the article, the journalist constructs the cattle as one which has crossed boundaries with another species. This boundary crossing could never occur naturally and is only made possible by the work of scientists. For Donna Haraway (2018, 58), we should be asking what 'new beings, for whom, and out of whom' are being produced with genetic modification. This question is important for democracy, social and environmental justice, the environment, and agriculture surrounding new scientific developments in food production. With genetic modification, animals, plants and seeds become part of the bio-genetic economy, with companies able to profit from life itself (Braidotti 2019). Essentially, nature is exploited for profit.

The use of the term 'designer' livestock by the journalist indicates that nature can be improved by scientists. Genes which are the sources of biological diversity in technobiopower, are causing policymakers, venture capitalists, scientists and activists to scrabble and challenge for their control (Haraway 2018). Controlling genes means not only controlling the natural genetic diversity, but also the technology to create new beings. In this extract, the journalist states 'geneticists scramble'. This gives an urgency for the need for genetically modified animals.

The journalist also constructs the improvement of the quality of meat as being important for human health. Because the importance of meat-eating has been promoted by the agricultural industry, citizens often consider this aspect of their diet important for their own and their families' lives (Adams 2018; de Bakker and Dagevos 2012; Luke 1995). In this extract, genetic modification is presented as a technological solution to improving public health.

Environmental problems are also presented as being solvable through genetic modification. This is illustrated in the following extract which is also from the news article describing the research being undertaken with genetically modified cattle.

> In 2011 a Canadian project to breed an 'enviropig', a pig spliced with bacterial and mouse DNA that could digest phosphorus and therefore reduce the environmental damage of pig farming, collapsed after a suspicious reception from US regulators.
>
> 'Scientists create GM cows high in fish oil' (Moody 2015b).

In this extract, the journalist describes the reasoning behind the development of 'enviropig'. The coming together of three very different organisms is explained by the journalist to show genetic modification solving environmental problems. The answer to solving environmental damage caused by pig farming is not to think about farming in a different way, or even to stop

rearing pigs, instead a technological solution is developed. The manipulation of nature is the answer to solving the degradation of nature. Here, the degradation of nature is due to how animals are farmed. Factory farming or intensive production brings the factory automated assembly line to the farm, and is how most meat and dairy products are produced. It is more cost effective and profitable than producing food on a small, non-intensive farm. Over the past few decades, factory farming has increased whilst traditional, small, non-intensive farms have disappeared (Rowlands 2002; Standing 2019). Industrialisation becomes as much a biological process as a mechanical process (Russell 2004). Genetically modifying pigs further advances biological industrialisation because changes can be made at the cellular or subcellular level.

The final section examines how an animal, part of nature, is turned into the edible. This is the focus in the Below the Line Comments section.

Below the Line Comments

This comment was in response to the news article in *The Guardian* concerning the pigs genetically modified to be resistant to the disease, African Swine Fever.

> For all you meat eaters, bon apetit. nothing like glow in the dark frankenmeat to get the salivary glands pumpin'. as a vegetarian, i find the entire meat and slaughter industry an immoral hellhole. this makes me even more happy that i have abandoned the flesh plates for a nice, healthy does of organic greens...
>
> Comment relating to the article, 'Could these piglets become Britain's first commercially viable GM animals?' (Devlin 2015).

This commenter claims that the genetic modification of animals adds to the immorality of meat eating. Here, the use of the word 'meat' takes away the contact with the animal. When we talk about eating a product such as a burger, we say we are eating meat, not that we are eating a dead animal (Adams 2018).

There are different types of 'nature' at play in this comment. Firstly, with the commenter stating they 'have abandoned the flesh plates' there is the sense that eating meat is not natural. This ties in with why nature is considered 'good'. Guy Cook (2004, 103) argues that 'good' is founded on the 'perception of natural processes (in the sense of those which occur without human intervention) as predominantly life-giving and healing, reliable, and independent of human error and malice'. By eating animals, life is taken away, therefore going against nature (Adams 2018; Vance 1995). However, the suffering of farm animals is mostly invisible. Consumers of meat are not aware of how animals are reared in intensive production or how they are slaughtered and butchered (Adams 2015, 2018). Once animals are butchered, then there is a move away from nature. This is achieved through invisibility (Adams 2018). For Karen Morgan and Matthew Cole (2011, 118), the 'sterile supermarket packaging of dismembered animals deflects attention from whole animals, and euphemisms such as 'pork' or 'beef' rather than 'pig's flesh' or 'cow's flesh' are tactics which serve to conceal the origins of the meat being consumed'. Once life is taken away, nature no longer exists.

Secondly, the use of the term 'Frankenmeat' by the commenter draws attention to genetic modification being un-natural. Discussing dairy cows, Barbara Orland (2004, 184) explains that 'today's high-yielding cow came into being within a new culture of competition,

standardisation, performance control, selection, and predictability, forcing farmers and new institutions like breeding organisations to search for methods and technologies to improve milk yields'. Genetic modification of animals is an extension of these breeding practices. Bigger and better animals can be produced. However, these so-called improvements show how animals are treated as machines in modern, intensive production systems (Luke 1995).

This comment, though, illustrates a change. By stating they 'find the entire meat and slaughter industry an immoral hellhole', the commenter is making farm animals more visible. Animals and nature start to become less exploitable once visible. When people feel for animals, the 'self' versus 'other' duality breaks down and the interrelatedness between humans and animals exists (Halpin 1989). Boundaries between humans and animals are challenged.

Conclusion

This study set out to answer the question: Which sociotechnical imaginaries concerning genetically modified animals are present in UK online news articles and the associated below the line comments? In answering this question, the sociotechnical imaginaries of 'other' and monsters, along with nature, were identified.

The findings presented in this article are representative of this study only. The sociotechnical imaginaries present in the news articles depict genetically modified animals as 'other' in comparison to those bred through selective breeding (the conventional process). The news articles describe pigs with fluorescent snouts or trotters, and 'Green Sheep'. It is only through genetic modification that animals such as these can be brought into existence. These results would not be achieved through conventional breeding techniques. Genetic modification amplifies 'otherness'. The crossing of different species using genetic techniques also places animals into the category of monsters. Monstrosity also features in the below the line comments. Here, the sociotechnical imaginaries draw on the concept of 'other' along with Frankensteinian imagery. Animals are usually seen as 'having no individuality, no significant life-plan, no preferences, and, ultimately, no real concerns' (Vance 1995, 168). This renders animals as invisible. The construction of genetically modified animals as 'other' removes the veil of invisibility. Difference makes genetically modified animals noteworthy.

Nature also features in the sociotechnical imaginaries in the news articles. Journalists present genetic modification as overcoming nature, as well as scientists designing nature. Genetic modification is also presented as a scientific solution for environmental problems. The sociotechnical imaginary in the final comment focuses on turning nature into the edible, and the act of eating meat. Once animals are butchered and are turned into meat, there is a move away from nature. This is achieved through invisibility (Adams 2018).

The final comment illustrates that animals can be made more visible. Removing invisibility means boundaries can begin to be broken down. Challenging boundaries can lead to better understandings. If the 'social, the natural, the scientific, the technological, the human, the non-human – are seen to be fluid and contextually constituted rather than predetermined' (Irwin 2001, 178), this opens up the potential for more diverse approaches of imaginings. This gives rise to creative potential (Jasanoff 2015b) and could enable a reimagined relationship between humans and animals.

Sociotechnical imaginaries enable individuals to make sense of what is happening in the world around them. As stated in the Methods section, the views of those commenting are seen as being representative for this study and may not be characteristic of the population as a whole. Neither do I wish to claim that the comments posted reflect the opinions of the audience as a whole. It is important to note that those who posted comments may be particularly interested in the subject of genetically modified food or animals. Interviewing those who comment would provide reflections on the motivations for posting content about genetically modified animals. In order to understand how journalists write these articles and the approaches they take in obtaining stories, it would be necessary to interview them. This research could also potentially ascertain how journalists decide to portray genetically modified animals in news stories.

As I have shown, sociotechnical imaginaries act as a 'form of intensely political narration, reminding both observers and observed that the seen reality is not the only one about which we can dream' (Jasanoff 2015b, 340). In this article, depictions of 'other', monsters and manipulated nature are all part of the construction of imaginaries of genetically modified animals. Where animals are usually invisible, here sociotechnical imaginaries bring them to the fore.

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