The Online Genetically Modified Food Debate: Scientific Expertise and Alternative Knowledges

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Declaration

The thesis is my own work and has not been submitted for a degree at any other university.

The following articles have been submitted during the period of study for this PhD:

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Book review of *What's So Controversial about Genetically Modified Food?*, *Graduate Journal of Food Studies,* Vol. 5, no. 1 (2018).

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Abstract

Using UK online news articles and below the line comments, this thesis assesses the construction of claims of scientific authority, credibility and trust, together with the contestation and disputation of these claims in connection with online news coverage and audience reception of the genetically modified (GM) food debate.

The sample includes 73 online news articles and 9,279 below the line comments from 5 UK news organisations, commencing 1 January 2015 until 31 October 2015. A qualitative data analysis is conducted, combining two approaches. Firstly, a grounded theory approach as advocated by Charmaz (2014), employing the techniques of coding and memo writing. Secondly, a sociological discourse analysis drawing on theoretical concerns including expertise (Dewey, 2016; Giddens, 1991; Lippmann, 2008; Nichols, 2017), journalism (Schudson, 2008b), and risk (Beck, 1992, 1995; Douglas, 1992) to connect the findings of this study to those of theoretical relevance.

Analysis of the articles reveals the contested place of scientific knowledge in the GM food debate within and between the state, non-governmental organisations (NGOs), citizens and consumers. Narratives in the articles surrounding the development of GM crops and use of science in decision making processes, illustrate the legitimacy of science. Where there is uncertainty surrounding the science of genetic modification, calls are made for further research. This is often to ascertain whose science is legitimate, e.g. the state (funded by Research Councils) or NGOs, and demonstrates the pluralistic nature of science. Below the line comments contest scientific expertise in respect of GM foods, and dispute its status as a scientific issue. Here, emphasis is on the different types of knowledges that are used rather than solely a scientific rubric. Commenters draw upon their knowledge gained from previous food scares, e.g. the BSE crisis and Horsemeat Scandal, notably how the state and food industry acknowledged and managed these incidents.

Chapter 1: Introduction

In this introduction, I outline some of the key concepts associated with the genetically modified (GM) food debate. Before this, I highlight two pertinent points made by Murcott. Firstly, in order to approach 'GM food sociologically, an exceptionally broad, numerous and intricately interrelated set of substantive arenas and concerns will need to be encompassed', and secondly, in the future there needs to be collaboration between 'rural sociology, the sociology of scientific knowledge (SSK), the sociologies business and commerce, of mass media, of occupations, of consumption, of social movements and of policy and politics' (Murcott, 1999: 1). This illustrates the complicated nature of the GM debate and how this needs to be considered using a broad approach. This thesis draws on different literature including risk, journalism, media, and expertise, and brings together the sometimes separated fields of media and risk research (Tulloch and Zinn, 2011).

The chapter begins by considering Food Systems as this describes some of the actors visible in the GM food debate, and I then proceed in providing a brief history of GM food and crops. This provides the context for the subsequent chapters. I then present the thesis summary, research questions and order of discussion.

Food Systems

Everyone needs food. It is an intimate part of everyday life, and as well as being a biological necessity, it is also a social phenomenon. Food is a means of bringing people together, whether this be family, friends, or work colleagues. According to Lang and Heasman (2015: 3, emphasis in original), the following are fundamental characteristics of food which need to be taken into account:

- *health*: the relationships between diet, disease, nutrition and public health;
- *business*: the way food is produced and handled, from farm inputs to consumption;
- *consumer culture*: how, why and where people consume food;
- *society*: how food is framed by values, norms, roles and social divisions;
- *the environment*: the use and misuse of land, sea and other natural resources when producing food; and
- *food governance*: how the food economy is regulated and how food policy choices are made and implemented.

These aspects might coalesce into a ‘food system’. They were in evidence in The Global Environmental Change and Food Systems (GECAFS) project organised by the University of Oxford, and which ran from 2001 until 2011. This examined how food security could be achieved without further damaging ecosystems, and the framework they produced is shown in Figure 1.1. The figure highlights the activities and outcomes which are associated with food systems including producing food; consuming food; social welfare; food security; and environmental welfare. Ericksen et al. (2010) explain that food systems activities are governed by the connections between human and biogeophysical environments. These connections are shown on the framework in Figure 1.2 as the drivers. These drivers include any factor, actor or policy framework which shapes or pushes the food system, either internally or externally.

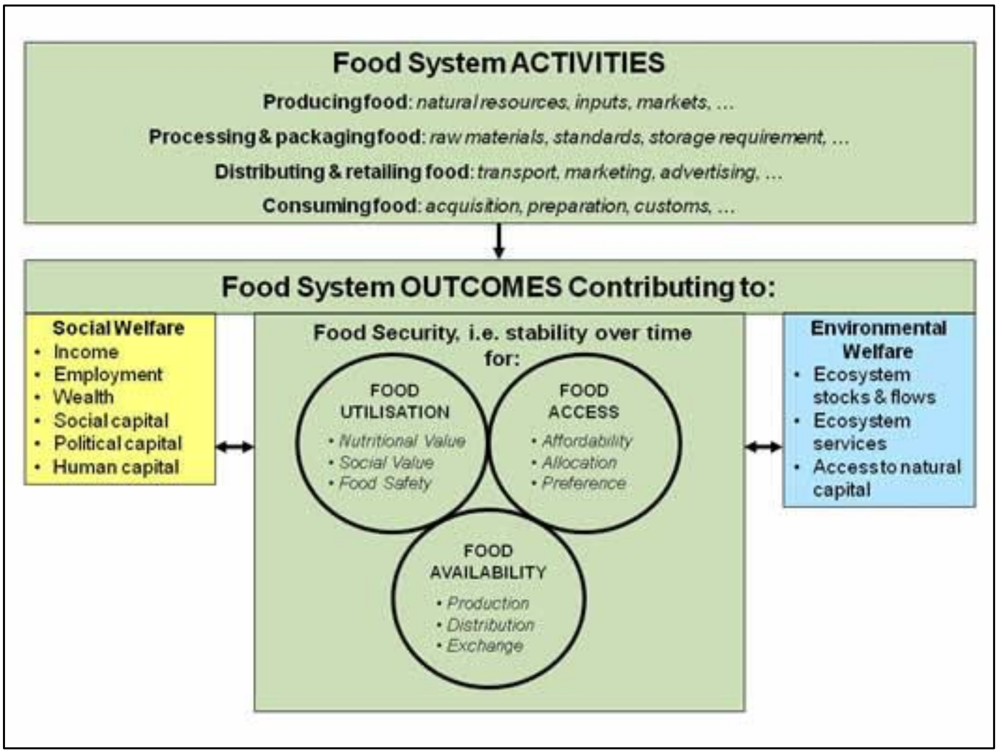

Figure 1.1 The activities and outcomes associated with food systems (Ericksen et al., 2010: 28).

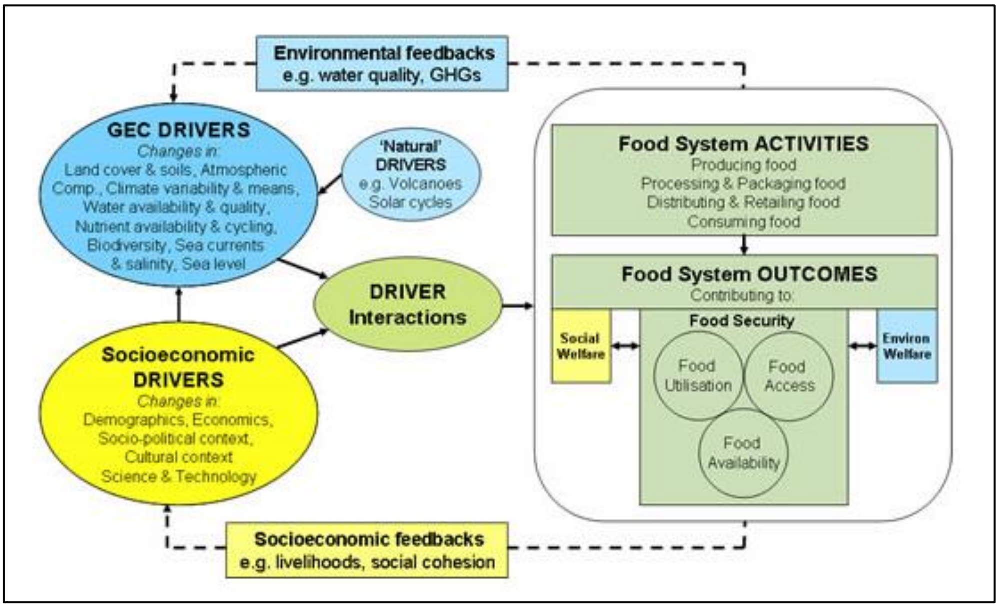

Figure 1.2 The drivers associated with food systems (Ericksen et al., 2010: 28).

Figure 1.3 illustrates the inputs and flows through the food system. In addition to the inputs, the food system is also shaped by a number of factors. The left hand side of Figure 1.3 depicts the levels of *governance* which can influence the food system including from international organisations, regional bodies, national governments, and local governments. The right hand side highlights the social interventions from other industries such as research and development, and the consciousness industries including media and advertising. The bottom of the diagram shows the outputs and therefore, the consequences of the food system. Although Figure 1.3 is helpful in explaining the food system, it also reveals that it is extremely complex.

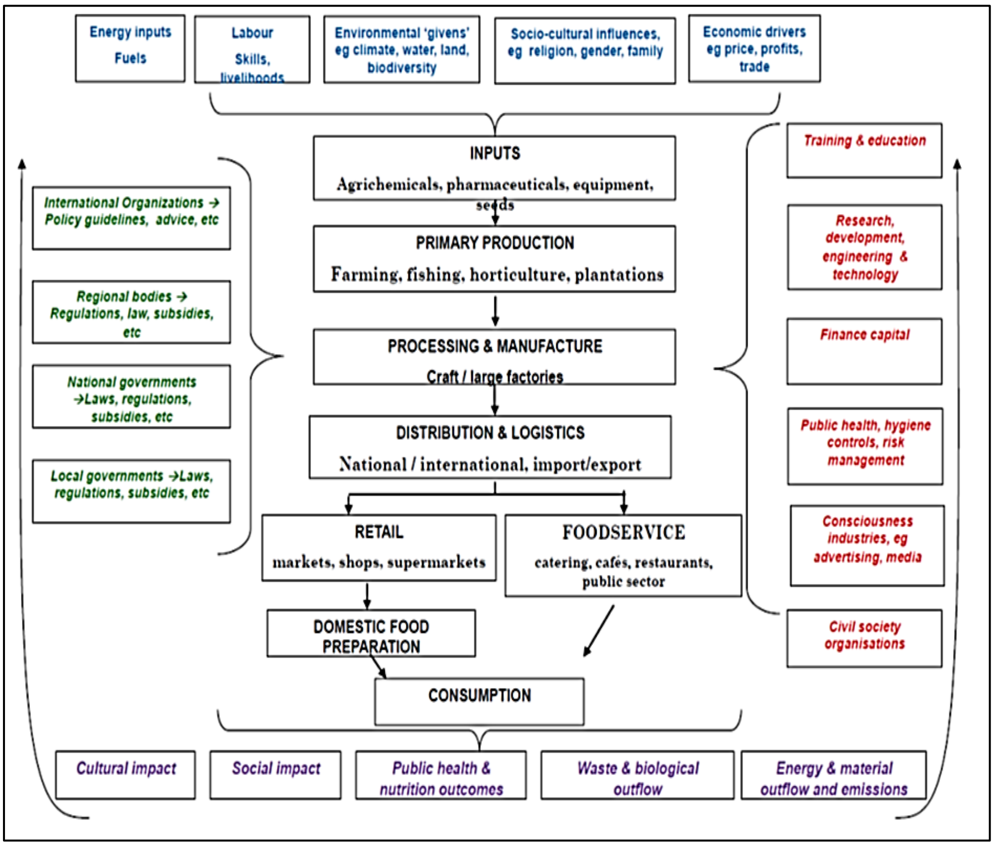

Figure 1.3 The inputs and flows through the food system (Lang and Heasman, 2015: 23).

An argument which Lang (1999: 169) puts forward, is that ‘food systems are the outcome of policy and political choices. Food is contested territory. There are conflicts of analysis and interest between diverse groups and sectors’. The different actors which are associated with GM crops and foods in the UK are evident in Figure 1.3, and these are: agrichemical (biotechnology) companies; universities and research institutes; the European Parliament; the UK Parliament; regional bodies (Scottish Government, Welsh Assembly); farmers; retailers; food services (catering and restaurants); NGOs; consciousness industries (PR, media, advertising); and consumers. Additionally, the diagram also highlights the significance of food governance to the operation of the food system. According to Liverman and Kapadia (2010: 20), ‘governance can be defined as the systems of rules, authority and institutions that coordinate, manage or steer society. Governance is more than the formal functions of government but also includes markets, traditions and networks, and non-state actors such as firms and civil society’. Food systems are not static and the relative significance of different actors within the system may change. In 2018, corporations who are producers, processers and retailers of food, play a more important and influential role. Therefore, because corporate interests are so important in the food system, governments no longer play a central role in decision making (Lang and Heasman, 2015). As of 2018, the key functions of governments in relation to food, are to negotiate trade agreements and to determine standards (Lang and Heasman, 2015; Lang and Barling, 2012; Liverman and Kapadia, 2010). However, Lang (2003) argues this has created a duality. Whilst the government implement regulations, the food supply chain, particularly food retailers, are employing their own system of self-regulation. This duality ‘has compounded policy incoherence, because it fails to address a central feature of food policy, its inter-connectedness’ (Lang, 2003: 562). The connection between this duality of regulation is trust.

According to Lang (1999), UK food policies have been inclined to favour production interests as opposed to consumer and citizen interests. However, public confidence has been weakened following various controversies.

These have included salmonella in eggs (1988), the crisis surrounding bovine spongiform encephalopathy (BSE) in cattle and the link to variant CJD in humans during the 1990s, and more recently, the horsemeat scandal (2013). With the BSE crisis, Shaw (2002) contends the public believed there was a failure in risk protection by the Government, the scientific community and the food industry. Food systems can create trouble in the distinctions between individuals and their biological needs or appetites and social contexts, i.e. between the individual and the social. As food selection and intake are part of individual decision making, this means individuals experience a sense of anxiety about what to eat (Fischler, 1980). This leads on to an important point raised by Murcott (1999: 1), whereby ‘attention is centred on knowing and knowledges’ in respect of a sociology of food. In the food system highlighted in Figure 1.3, this can be a number of actors.

The impact of food governance by environmental groups and consumer groups is increasing, and they are focussing on issues such as environmental protection, food safety, locally sourced food, corporate power, disadvantaged communities, world hunger, fair trade, diet and health (Lang and Heasman, 2015; Liverman and Kapadia, 2010). The involvement of the consumer and environmental groups may help address some of the questions raised as to who is in a position to make informed decisions about food and accountability. Lang and Heasman (2015: 13) argue that ‘ultimately, the public must be engaged too, not least to tackle the unacceptable legacy of disease, ill health and environmental damage … but whether that, too, is integrated and coherent remains to be seen.’

Engaging citizens in debates about food might help to address some of these problems, although this may appear to be a challenge when corporate actors have so much power. This is part of a broader challenge of engaging citizens with science, which the case of genetically modified (GM) food exemplifies. In the next section, I provide a brief history of GM crops and food.

A Brief History of Genetically Modified Crops and Food

Genetic modification can be defined biologically as the insertion of genes into genomes using artificial techniques instead of natural crossing and recombination. It is artificial in the sense that it cannot occur without human intervention. It enables strict control of the genetic changes made to an organism enabling the incorporation of 'new genes from one species into a completely unrelated species through genetic engineering, optimising agricultural performance or facilitating the production of valuable pharmaceutical substances' (Phillips, 2008: 1).

Genetic modification has been used commercially in agriculture since the 1990s, and has met with widespread resistance since. In part, some of this controversy has arisen from the 'control over the intellectual property of seeds, the regulatory approval needed (especially in term of their environmental or human health impacts) in global markets and finally the corporate control over the GMOs and hence market power' (Lang and Heasman 2015: 205). Additionally, there have been competing claims in connection with the benefits and problems associated with genetic modification. The benefits can be described as follows:

- Increase in crop yields
- Environmental benefits through the reduction in chemical use
- The cultivation of crops able to withstand environmental stresses such as floods, pests and drought
- Improvement in nutritional qualities of foods
- Improved taste, appearance and texture of foods

Adapted from Lang and Heasman (2015: 205).

Alternatively, the problems can be described as follows:

- Plants with undesirable effects, e.g. may become invasive species
- Unintended gene flows from GM plants into other crops and wild relatives
- GM plants modified to be toxic may cause harm to biodiversity

Adapted from Lang and Heasman (2015: 205).

During 1995, a genetically modified tomato paste was sold in the United Kingdom (UK) by the supermarket chains Safeway and Sainsbury's, and was one of the first GM food products to be put on sale in shops. The tomatoes were grown, processed into a puree and canned in California before transportation to the UK. The product sold at 29p for 170g, whilst the non-GM equivalent sold at the same price for 140g. The GM product outsold its non-GM equivalent by 2:1 (Burke, 2012). There have only ever been two GM crops approved for commercial cultivation in the European Union (EU). The first is a modified starch composition potato which was withdrawn because the biotechnology company, BASF, had concerns about the regulation of GM crops and food in the EU. The second is *Bacillus thuringiensis* (Bt) insect-resistant maize (Moses, 2012). As of September 2018, no GM crops are being grown commercially in the UK (UK Government, 2018). Nevertheless, every year, the EU imports at least 70% of its livestock feed which is derived from GM crops, mostly in the form of soya beans (Baulcombe et al., 2014). EU regulations mean that meat, milk and eggs from animals fed on GM animal feed do not have to be labelled, although any other food products containing GM ingredients do have to be clearly labelled (Food Standards Agency, 2018).

One of the most used claims for the introduction of GM crops is the reduced reliance on the use of pesticides, insecticides and herbicides which are used extensively in conventional agriculture. Additionally, advocates of genetic modification often draw attention to the health benefits which can be conferred from GM crops. Cook (2004) describes the issue with GM golden rice. This rice has been modified to help address the problem of Vitamin A deficiency. This deficiency is often found in populations where rice is the staple diet, and particularly affects children. Beta-carotene which converts to Vitamin A in the body, is lost from rice during the milling and polishing processes. This beta-carotene is located in the husks and leaves which are removed during processing. However, GM golden rice has been modified with the introduction of a gene from a daffodil. This ensures that beta-carotene is produced in the de-husked grain and can still be absorbed by the body when eaten. Nevertheless, there is a counter-argument to GM golden rice. Opponents believe the crop is not an efficient source of beta-carotene as it may not be in the form which can be easily absorbed in the body. Dietary supplements are the more efficient form of moving people out of Vitamin A deficiency. In the rice eating communities in Africa and Southeast Asia where there is extensive Vitamin A deficiency, a vegetable called Bathua used to be eaten which was the traditional source of Vitamin A. The irony is that this plant has been eradicated in these places through the use of herbicides, as it is deemed to be a weed in the rice fields.

Another GM crop is Rainbow papaya and Lang (2016) provides an informative overview of the development of this fruit. This papaya has been modified to be resistant to ringspot virus which affected Hawaiian papaya production by 50% in the 1990s. As a result, 75% of the island's crop are now the Rainbow papaya. Although this crop is important to Hawaiian farmers, it is insignificant on a global scale. These speciality crops are insignificant to biotechnology companies such as Monsanto or DuPont, as profits lie with developing the commodity crops such as maize and soya. Whilst GM golden rice and GM Rainbow papaya indicate advancements, the apparent radical promise of GM food is yet to be fulfilled.

June 1998 saw the publication of a letter by Prince Charles in the *Daily Telegraph* in which he raised doubts about the safety of GM foods and questioned its expansion (Howarth, 2012). This was followed by a television documentary in August 1998 which included preliminary research by Dr A. Pusztai. He claimed rats fed on GM potatoes suffered from reduced immunity and stunted growth (Burke, 2012; Howarth 2012). Lang (2016: 105) describes the research:

> The research involved feeding two sets of rats a protein (lectin). He fed one set of rats using potatoes that were genetically modified to produce more lectin; he fed the other set potatoes that had lectin added by non-GM methods. According to the findings, the rats which fed on GM potatoes suffered a number of harmful effects on growth, organ development and immune responses; the other group of rats did not suffer the same ill effects. Dr Pusztai speculated that the GM device used to carry the new gene into the potatoes might be the source of the problem.

The claims of harm were more strongly voiced in the spring of 1999, although scientists from other institutions along with the Royal Society, strenuously criticised the experiments and analysis. Media coverage of these events spiralled and the 'tabloids had a field day and delighted in fanning the flames of public anxiety' (Burke, 2012: 33). As media coverage intensified, consumers starting boycotting GM foods. The UK supermarket chains Safeway and Sainsbury's stopped selling GM tomato puree (Burke, 2012), work and school canteens banned GM foods, and GM crop fields were damaged by activists (Howarth, 2012). According to Howarth (2012), media campaigning did not stop until the Government responded to public concerns in a manner which was satisfactory to the media. This included the then Prime Minister, Tony Blair, apologising and acknowledging there was no clear evidence available recognising the risks, benefits, harm or safety of GM crops and food.

Following this, the UK Government conducted the public consultation of *GM Nation?* during the summer of 2003. For Barbagallo and Nelson (2005), the purpose of this debate was to determine whether GM crops should be commercially grown in the UK by enabling the public to participate in the discussion. In addition to the public strand of the debate, there were also official expert forms of consultation in the economic and scientific strands.

The economic strand provided an assessment of the costs and benefits of GM crops, whilst the science strand reviewed all available research concerning genetic modification. As Irwin (2009) explains, the economic and science strands fed into the decision making process, whilst the opinions and viewpoints from the public strand were considered but effectively ignored. He also states that one particular criticism of the debate was it came too late as GM crops were already close to coming to market. Furthermore, Burke (2012), who was present at some meetings, describes how the pro-GM and anti-GM groups talked past each other so no agreement could be reached. Additionally, he explains how a second attempt of this type of debate was made by the UK Government in 2009. The panel consisted of scientists, social scientists and members of environmental NGOs, but once again, no consensus was reached so the project ceased in 2010. As these examples and controversies highlight, GM food has been a controversial subject for many years and this is continuing to be the case (Augoustinos et al., 2010; Cook et al., 2006; Maeseele, 2013).

How have we moved from a situation where GM tomatoes were willingly purchased in 1995 by consumers, to only one GM crop being approved by the EU for commercial cultivation, 20 years later? The promises of GM appear to have been rejected. So what went wrong? Having introduced some of the key background controversies associated with the thesis, the next section provides a summary of the thesis and introduces my research questions.

Thesis Summary, Research Questions and Order of Discussion

Thesis Summary

This work has been informed by a longstanding interest in public engagement with science and the relationship between science and society. It specifically looks at the construction of the GM debate in the articles and below the line comments on UK news organisation websites.

Whilst research has been conducted into the use of language in articles in printed newspapers in connection with the GM food debate (Augoustinos et al., 2010; Cook et al., 2006), this research looks at the construction of the debate in the digital realm. This thesis examines not only the content of the articles but also the reception of these, by investigating the associated below the line comments. In the past, reception studies have been conducted by using either interviews or focus groups (Shaw, 2002). This research analyses the claims made in the debate using actual comments.

The study focuses on different actors in the debate including scientists, the UK Parliament Science and Technology Select Committee, the Scottish Government, Non-Governmental Organisations (NGOs), and citizens and consumers. By focusing on these different actors it is possible to examine the construction of scientific expertise in both the articles and the comments. Additionally, the different ways in which scientific expertise is assessed and critiqued in the articles and by commenters is also examined.

By examining the construction of scientific expertise in the online articles and comments, it is possible to see how this is used and rejected by various actors. This is achieved by analysing the claims made by scientists, in producing scientific facts in relation to the development of GM crops. These scientific facts can then be used or dismissed by other organisations, and this aspect is considered by examining the claims made by the Science and

Technology Select Committee, the Scottish Government, Non-Governmental Organisations (NGOs), citizens and consumers. The thesis broadens the literature as it takes into account how expertise is constructed and dismissed in an online setting, through the claims-making activities of various actors.

According to Hansen (2010), much of the focus of research on news coverage of environmental issues, has related to revealing the key sources quoted or discussed, the major themes which are evident, the accuracy and balance/bias in the coverage, and the amount of coverage. These are all important aspects of the analysis of news coverage and do appear in this thesis. Hansen (2010: 105) also argues that 'perhaps more obvious and conspicuous – dimensions of news coverage, the deeper-lying and perhaps taken-for-granted assumptions, myths and ideologies which form both the basis and contexts for 'what is or can be said' about certain problems or issues' have tended to be ignored. The thesis also takes cultural assumptions into consideration. Cultural scripts or narratives can assist in articulating perspectives, understandings, conventions, world views, and assumptions. In his book about genetic modification and biotechnology, Turney (1998: 6) explains the power of scripts and narratives:

> Scripts of various kinds, from behavioural to emotional, are crucial to the operation of memory, and help us to navigate through a wide range of possible social and cultural encounters. Once a script has been laid down, a single cue can evoke an entire story, as an interpretive frame or context for what is being discussed. In this sense, the Frankenstein script has become one of the most important in our culture's discussion of science and technology. To activate it, all you need is the word: Frankenstein.

In addition to understanding GM food as a scientific construction in news coverage, the thesis also examines it from the perspective of a food issue. Although there has been much research into various food scares concerning risk, there has been little attention to food consumption and its relationship to public engagement with science. In this respect, Blue (2010: 148) contends that the definition of public engagement with science needs to be extended to ‘include everyday consumer practices such as shopping and eating’. As Michael (1998) argues, science can be thought of as a ‘consumable’ when it is applied to everyday life, as scientific knowledge can be used to inform decisions about purchasing particular products. This is especially true with food, as consumers have to negotiate risk every time they decide what to eat. Where consumers are concerned about the safety of a product, rather than making a direct challenge to the organisation involved, they are more likely to alter their consumption habits (Blue, 2010). In this regard, they may purchase a completely different product. Additionally, when thinking about food, consideration also needs to be given to the influence of the media. As well as news coverage of food, celebrity chefs have their own television programmes, recipe books and Twitter accounts. There are many ways food is celebrated and refuted in the media (see Rousseau, 2012), in addition to the many sources of information consumers have access to. As Rousseau (2012: xiii) argues when thinking about food in the media, we need to consider the ‘representations of food and eating, and the politics of media interference into how we feed ourselves and into how we think about feeding ourselves, particularly as media both generate and shift existing sites of authority and expertise. It is about the intersections (and, often enough, the gulfs) between the real and the represented when it comes to food’.

Research Questions

The thesis answers three substantive research questions.

1) How are claims of scientific authority, credibility and trust, constructed in connection with GM food in the online articles and comments?

This research question emerges from the discussion concerning risk and science in the media. It is concerned with how scientific knowledges and claims are shaped. Additionally, scientific knowledge is considered as a legitimate form of understanding as it is produced by experts in specific fields. As a consequence, in connection with decisions surrounding risk, this is often determined using scientific evidence.

2) How are claims of scientific authority, credibility and trust, disputed and contested in connection with GM food in the online articles and comments?

This research question also arises from the discussion concerning risk and science in the media. Scientific knowledge is not always agreed upon, and at times this can lead to polarisation. Furthermore, knowledge is often assumed to reside with experts, and as a result there is a presumed superiority between experts and lay people. However, consumers have experienced previous food scares, and they have understandings and experiences from these. Therefore, there are often struggles and conflicts over legitimacy of knowledge.

3) How are the different key actors constructed in terms of their authority, credibility and trust, in the online articles and comments concerning GM food?

This research question emerges from the discussion concerning the food system. Many actors are visible in the food system (Figure 1.3), and to a varying degree, GM food relates to them all. This ranges from the producers, right through to the consumers. Previous food scares, especially BSE, created anxieties, and various actors responded to these in different ways. As a result, trust in the food system has been undermined. Furthermore, actors in the food system use the media in order to communicate their message about food, as well as finding themselves the topic of conversation. Here, issues of authority, credibility and trust can be produced and altered.

Order of Discussion

Chapter 2 and Chapter 3 begin the process of setting the broader theoretical context for this discussion. Chapter 2 outlines the literature surrounding facts and values associated with science. In addition, it summarises the arguments concerning both risk and expertise. The focus then shifts in Chapter 3 to review the literature concerning the media dimension of the thesis. This examines the role of news in society along with digital journalism, the norms of journalism, and how these norms affect science reporting. Arguments are also put forward in respect of the function expertise plays in the media, along with risk reporting and science in the media. The final section of this chapter reviews the previous work conducted in connection with GM foods in the media.

Chapter 4 explains the methodological rationale and the way in which the theoretical context discussed in Chapters 2 and 3 is operationalised. It describes how quality can be attained in qualitative research. The chapter then focuses on the sampling strategy, the use of documents and the data analysis used in this research.

Chapter 5 is the first analytic chapter. This examines the expertise of scientists and the claims which they make. In addition, it also examines how scientific facts concerning GM find their way into news coverage through public relations (PR) strategies. This chapter explores the production of scientific evidence by scientists and the authority, trust and credibility which surrounds it. This assists in addressing Research Question 1. Additionally, the authority, credibility and trust of scientists are examined and this helps with answering Research Question 3.

Chapter 6 examines how the facts generated by scientists are used by those in political authority in the claims which they make. The first section of the chapter focuses on the UK Parliament Science and Technology Committee. This examines the renaming of GM foods and the Precautionary Principle. The second section of the chapter focuses on the Scottish Government and also examines the Precautionary Principle. This chapter explores the use and dismissal of scientific evidence by those in political authority and assists in answering Research Question 2. Additionally, it examines the authority and trust surrounding the UK Parliament Science and Technology Committee and the Scottish Government, and this helps address Research Question 3.

Chapter 7 examines the expertise of non-governmental organisations (NGOs) and consumers. The first section of the chapter focuses on the NGOs and their use of scientific evidence in claims-making. The second part of the chapter examines consumers. In this section, the extent to which scientific evidence is deferred to is examined, along with expertise of consumers. This chapter explores the contested nature of scientific evidence, and whose scientific research should be used when addressing problems. In this respect it answers Research Questions 1 and 2. Additionally, it examines whether NGOs and consumers are constructed as legitimate claims makers, and this helps answer Research Question 3.

Chapter 8 is my concluding chapter. This briefly recaps the key findings in relation to the research questions, and considers the significance of the thesis in addressing these. The limitations of the study are discussed and future areas of research are suggested. The next chapter begins the process of setting the broader theoretical context for the thesis.

Chapter 2: Literature Review

Science and Society: Science, Consciousness of Risk, and Expertise

Introduction

The relationship between science and society is not straightforward. What exists is a set of complex interfaces and intersections. In order to understand these connections, there is a need to examine the concepts of facts, values, expertise, and risk and how these relate to one another as well as to science and society.

Firstly, though, it is worthwhile considering why science is conducted. In one sense, science can be thought of as operating in a cycle. A problem exists and experiments are carried out in order to achieve a solution. Once one is found, the science can be implemented and the problem in existence is solved. However, there are unforeseen consequences, and the new scientific solution creates a different problem. Again, science is deployed to solve this latest problem. This continues in a self-perpetuating motion. In this respect, risks are created by science and have to be solved by science (Irwin, 2001).

Before moving on, it is worth noting that some of the discussions which follow in this and the forthcoming chapters, draw upon the work of Dewey (2016) and Lippmann (2008). Both were originally writing in the early to mid, 20th century. However, much of this is still relevant today. Both come from the starting position of an increasingly complex society and the emergence of mass media. The 'Dewey-Lippmann' debate was largely around the role of journalism in democracies in the early to mid, 20th century. This interchange was never really a 'debate' as it does not appear Lippmann was ever in dialogue with Dewey. However, Dewey's *The Public and Its Problems* was in discussion with Lippmann (Schudson, 2008a).

Lippmann's argument is that citizens are overloaded with information and presented with journalistic inaccuracies. No individual citizen has the time or the ability to become an expert in all issues they are presented with. As citizens have to rely heavily on news stories to form opinions, their knowledge is limited to what is presented as news by journalists. It is not possible to achieve an informed and active citizenry. As such, only experts with specialist expertise are able to make judgements about issues. In contrast, Dewey argues that citizens are able to engage and make informed decisions about issues. 'Publics' are individuals who respond to particular issues and form interested groups. This results in many 'publics'. However, not all individuals need to be a member of every public. By being actively engaged, citizens are able to influence and direct the work of experts. If problems arise, citizens are also able to hold experts to account. The 'Dewey-Lippmann' debate also defines the 'public'. For Lippmann the 'public' is 'everyone', whilst for Dewey the 'public' are 'individuals who belong to certain groups'.

This chapter will explore the complex interfaces and intersections between science and society. Science can be regarded as producing the 'facts' which solve problems. However, 'values', the important beliefs and ideals which are shared by society concerning what is good or bad, or desirable and undesirable, are often disregarded by scientists, and there is an assumption that science should be value free (Collins and Evans, 2017; Douglas, 2009). The chapter will consider this fact-value distinction and why it exists. It will also examine the argument that values can and should exist in science. The chapter will then focus on considering the risks generated by science. It will examine what a risk is considered to be, and who has the right to determine this. This will consider if this should be 'science' alone, i.e. the professional experts and the institutions they inhabit, or whether citizens should also be allowed to voice their opinions. Following on from this, the role of expertise will be examined. This will explore the definition of who is considered to be an expert and why it is believed there is a need for expertise in society. It will also reflect on the specific role of scientists as experts, along with the responsibility which can be given to citizens in respect of scientific expertise. The first section discusses values and beliefs as these terms appear frequently throughout the thesis.

Values and Beliefs

Values are important to both individuals and society. Adler (1956: 272) explains that:

> the discussion of values is made difficult by pronounced differences in what the term "value" means to different people. Concepts of value can, however, be reduced to about four basic types: (A) Values are considered as absolutes, existing in the mind of God as eternal ideas, as independent validities, etc. (B) Values are considered as being in the object, material or non-material. (C) Values are seen as located in man, originating in his biological needs or in his mind. Man by himself or man in the aggregate, variously referred to as group, society, culture, state, class, is seen as "holding" values. (D) Values are equated with actions. There are, in addition, some mixed types.

Values are significant because they enable individuals and society to make choices. Individuals are confronted with an array of decisions they need to make. By basing their courses of action on values, they are able to substantiate the choices and decisions taken. Values 'fine-tune the regulation of action within established ways of life' (Swidler, 1986: 282). The choices individuals make are often based on preferences from previous experiences and conversations. Wildavsky (1987: 5) argues that 'people discover their preferences by evaluating how their past choices have strengthened or weakened (and their future choices might strengthen or weaken) their way of life. Put plainly, people decide for or against existing authority'. Individuals are able to strengthen, reject or modify relations of power and authority. Additionally, 'a basic reason people are able to develop so many preferences is that they actually do not have to work all that hard. A few positive and negative associations go a long way' (Wildavsky, 1987: 8). Individuals become invested in their perspectives, mainly because of the reliance placed upon them to guide actions and manage experiences. Individuals may also hold a number of different values and beliefs. Although an individual may *say* they are going to carry out a particular task, but actually *do* the complete opposite, both behaviours represent that individual's values. The individual may be inconsistent in their approach but they adhere to their beliefs (Adler, 1956). Values are also part of 'the common-sense culture in which everyone lives. Children are taught to have "values". Grownups usually know if something is a big priority in their lives or not' (Wuthnow, 2008: 339). Priorities also mean that individuals can hold different and alternative values. A person's values will influence the choices they make and therefore, a particular situation may provoke completely different responses from two individuals (Swidler, 1986).

The values and beliefs of individuals are also important to society. It is values and beliefs which help organise society (Dake, 1991). According to Mary Douglas (1982: 3) 'beliefs are held because and insofar as they can be legitimated within a general structure of plausibility for the society that the believers have together constructed'. The other important factor to values held in society is that of culture. According to Swidler (1986: 273), 'culture consists of such symbolic vehicles of meaning, including beliefs, ritual practices, art forms, and ceremonies, as well as informal cultural practices such as language, gossip, stories, and rituals of daily life'. Individuals draw on these meanings in order to negotiate the society they are living in and to make choices. For individuals making 'important decisions, these choices are simultaneously choices of culture – shared values legitimating different patterns of social practices' (Wildavsky, 1987: 5). It is the shared meanings, values and beliefs which shape society. Having defined values and beliefs, the next section provides a very brief history of science before describing the facts and values associated with science.

A Very Brief History of Science, and the concept of Facts and Values in relation to Science

Before considering the facts and values associated with science, it is valuable to reflect on what science actually is and how this has developed over time. Defining the term science is not straightforward. This is highlighted by Fara (2009: xvi) who argues that 'pinning science down is difficult. One obvious if irritating definition is to say 'Science is what scientists do,' but even that circular description limps as the word 'scientist' wasn't invented until 1833'. As Carolan (2006: 663) argues 'after centuries of philosophical debate about what science is, we still lack a shared definition of the term. Some fields of science, for example, are highly experimental (e.g., high-energy particle physics); others almost entirely observational (e.g., astronomy) or based on complex modelling (e.g., meteorology)'. Additionally, Wynne (1991: 112) claims 'there is no clear consensus even among scientists themselves as to what is "science" or "scientific knowledge" in any specific context'. The term science can be viewed as an overarching term which describes the many disciplines it encompasses. Looking back at the history of science enables us to see how this has developed. According to Fara (2009: 228) subjects such as 'astronomy, optics, mechanics – stemmed directly from mediaeval university syllabuses: although they slowly changed over the centuries, their roots can be clearly seen stretching back over time'. In addition to these sciences were the emergence of chemistry and biology which originated from more everyday practices. As Fara (2009: 228) argues, the origins of chemistry 'lay not in abstruse scholarly studies, but in everyday practices such as alchemy, medicine, and skilled crafts. Similarly, the word 'biology' was only invented in the early nineteenth century, but the new speciality inherited a good deal of accurate knowledge from herbalists, merchants, and collectors (women as well as men)'. Fara (2009) also explains how the term scientist first appeared. In 1833, the British Association for the Advancement of Science (BAAS) held its third annual meeting, and here, the delegates decided they required a designation which described the diverse interests. William Whewell, a Cambridge mathematical astronomer, suggested the name scientist. However, Fara states the term was not fully accepted until the early twentieth century. This was because 'far more was at stake than the word itself. The new label signalled changes in class, money, and status – long term social transformations that the privileged classes found hard to accept … gradually, science became a paid profession open to many, rather than an all-absorbing but expensive occupation for the leisured classes' (Fara, 2009: 228). In essence, science had been accessible only to privileged gentleman who did not need to earn their living and who considered themselves as part of an elite group. With the opening up of science into a paid profession of scientists and laboratory assistants, science ceased to be the preserve of the elite.

The founding of modern science is often accredited to Francis Bacon who authored *Novum Organum* (*The New Organon*) in 1620. In the book *Novum Organum*, Bacon laid out the method which could be used to produce new knowledge, and this was the experiment (Poovey, 1998). 'Bacon set out an experimental agenda, insisting that the laws of nature could only be uncovered through collecting and organising massive amounts of data … Bacon favoured an inductive, bottom-up approach – inferring explanations from observations untainted by theoretical preconceptions' (Fara, 2009: 158).

The Royal Society in London was founded in 1660 by Robert Boyle (a chemist), Robert Hooke (an experimenter who used both mathematical and optical instruments), and Christopher Wren (the architect). Francis Bacon was the ideological figurehead of the Royal Society, and the observations the Fellows conducted were based on the foundations laid down by him (Fara, 2009). However, there is wide agreement that Robert Boyle is a founder of the experimental world that modern day scientists operate in (Shapin and Schaffer, 1985). Experiments were conducted through the use of scientific instruments. These early scientific instruments were divided into optical, mathematical and philosophical categories and consisted of those used for 'weighing food, surveying land, navigating by the stars, assessing precious metals, telling the time, preparing herbal remedies' (Fara, 2009: 158).

According to Shapin and Schaffer (1985: 22), Robert Boyle believed knowledge was 'generated through experiment and that the foundations of such knowledge were to be constituted by experimentally produced matters of fact'. Boyle sought agreement by generating facts through the use of experiments. As Poovey (1998: 100) argues, the experiment 'conformed to rules, it theoretically counteracted the tendencies simply to project the mind's internal order onto the external world and to discover about nature what one already knew about the self'. This was in contrast to René Descartes, the French philosopher, who favoured the approach of knowing the conviction of his own mind and making discoveries about the natural world based on this knowledge (Fara, 2009).

The modern fact, Poovey (1998: 96) argues 'could be represented either as mere data, gathered at random, or as data gathered in the light of a social or theoretical context that made them seem worth gathering'. Facts in this respect can be viewed as two concepts depending on the argument which is to be made. According to Poovey (1998: 96), commenters may take the approach used by Bacon whereby 'fact collection is separate from and prior to interpretation and theory, whereas others argue, as G. Robertson did in 1838, that facts cannot exist – in the sense of being meaningful – unless they speak to some relation, which is always implicitly theoretical'. For Bacon, facts were unconnected to theory, whilst G. Robertson held the contrasting view, in that facts could only exist if there was an association with theory. When theoretical disagreements arose around new and emerging science, Bacon's view of the separation between fact and theory was used, especially by the Royal Society, so as to keep scientific knowledge away from controversy (Poovey, 1998).

According to Shapin and Schaffer (1985), an experiment could not generate a fact if it was only witnessed by one person. In order for a fact to be generated, the experiment had to be observed by a number of people. The

Royal Society insisted that experiments took place ‘in the presence of reliable witnesses: collective witnessing made the production of truth a public act, and if numerous individuals observed the same experiment at the same time (or replicated it elsewhere and later), then collective witnessing would convert self-serving disputes into mutually accepted knowledge’ (Poovey, 1998: 113). These witnesses were likely to be gentlemen. Fara (2009) explains that although the Society was allegedly democratic, in reality it was elitist, with less privileged men rarely becoming Fellows, and with women banned from the meeting rooms until the twentieth century. Poovey (1998: 111) argues that it is important to note the

> ‘specific emphasis that members of the Royal Society gave to the facts they produced that necessitated the invocation of civility. Because they argued that facts were separable from both theory and method in order to decrease the likelihood of civil dispute, the experimentalists had to invoke some other rule-bound practice so as to stabilize facts – to place what counted as a fact beyond dispute and, by doing so, to make it meaningful.

The production of facts has always been an integral part of science and continues to be so. Latour (1987) explains how creating facts in modern science is a collective process as opposed to an activity carried out in isolation. Each new scientific research paper builds on the claims of those which have gone before. As each new paper is published the fact becomes more established. As Latour (1987: 42) explains, ‘every new paper getting into the fray pushes it one step further, adding its little force to the force of the already established fact, rather than reversing the trend’. It is collective fact building that creates authority and expertise.

In order to operate, science requires political support, a supply of money, and labour. In this respect, it is just like any other social activity. However, whilst science can bring about many benefits such as controlling disease, increasing food production, producing energy, along with many other technological developments which are of benefit to humanity, new threats have been created with the potential to be disastrous and catastrophic. Some of these dangers bring about scientific controversies as the benefits are seen to be outweighed by the potential harm which may occur. However, as Hicks (2017) argues, in respect of some scientific controversies such as with the Measles, Mumps and Rubella (MMR) vaccination and climate change, these are not always actually about science per se but instead concern disagreements over the establishment of the 'facts' of a particular phenomenon. In this respect, science acts as a substitute for other issues, such as the role of expertise, risk, and the environment. Science enables these other issues to be brought to the fore of the conversation, and can act as a proxy in political debates.

Due to the relationship between science and society, Durant (1998: 74) argues the 'public and political cultures need a greater appreciation of what science can and cannot be called upon to do'. Such an appreciation could lead to a better understanding of the role science could play in society. Collins and Evans (2017) argue that if the public are only exposed to the results of science as opposed to the complexity attached to it (in the form of the processes required to obtain results), at some point there will be a public reaction if science is not seen to be solving problems. Additionally, the public in complex democracies, should not be viewed as passive receivers of scientific information, but should also be considered as participating in the legitimisation of science (Turner, 2001).

The extension of authority in science is considered by Collins and Evans (2017: 20) in their term of elective modernism and this is defined as taking 'science to be a matter of moral choice: the word 'elective' implies choice; the word 'modernism' has to do with science'. The scientific approach is used by institutions in order to make progress, and this stands alongside 'the state' and 'capitalism' as key conceptual underpinnings of the 'modern' world. They contend that whilst democratic institutions recognise science as being important in the decision making process, it should also be acknowledged that it should not be scientists alone who make decisions. Decision making should encompass policymakers and citizens too, so that all can make a decision on the use of science. Here, the emphasis lies with the values of science as opposed to scientific knowledge. This is in contrast to the current situation according to Irwin (2001: 117, emphasis in original), who believes ‘regulatory institutions characteristically present a *technical* rationale for their decisions. Governmental and other institutions, therefore, do not simply receive (or respond to) scientific advice but play an important role in defining *what counts as ‘good science’ within particular decision-making contexts* – an active, and sometimes contested, process’. In this regard, it is science which is attributed the decisive role in making judgements, and it is those who are able to access the knowledge and understand it, who are able to use it to make decisions. However, Thompson (1993) claims it is impossible to separate facts and values in policy making processes. He goes on to explain how the ‘linear progression, from the facts (the ‘hard-science’ definition of the problem) down into the values (the ‘softer’ politically and culturally impregnated steps by which policy options are generated, selected and implemented)’ is no longer acceptable because the ‘soft, value-sodden stages are actually driving the supposedly hard starting-point. Values and facts are always intertwined’ (Thompson, 1993: 670).

Before moving on, it is worth considering what is ‘good science’? According to Bird (2014: 169), ‘graduate students in science learn that “good science” means quality research – accurate, reliable, reproducible research that can be relied on to serve as a solid foundation upon which other researchers can build’. She goes on to explain how good science is expected by the scientific community. It is an unwritten but accepted agreement, which all scientists are required to adhere to.

‘Facts’ are an important concern with science. Science is often viewed as providing facts about the lines of enquiry being pursued. However, as Grove-White (1998) argues, science is not just fact based, it is shaped by and can be inspired by society. This is alluded to further by Dewey (2016: 62), who was writing in the early to mid, 20th century, whereby ‘the difference between facts which are what they are independent of human desire and endeavour and facts which are to some extent what they are because of human interest and purpose, and which alter with alteration in the latter, cannot be got rid of by any methodology'. At present, when appeals are made to science to solve problems, these are often on the understanding these are based on facts. In this sense, the 'more sincerely we appeal to facts, the greater is the importance of the distinction between facts which condition human activity and facts which are conditioned by human activity' (Dewey, 2016: 62). The reliance on facts though, as opposed to also considering social values, can give rise to scientific controversies as well as creating an uneasy relationship between science and society. In order to address this, Collins and Evans (2017: 22, emphasis in original) believe 'it is *scientific values* that are going to be said to be central to our culture not *scientific facts and outcomes*'. This is required in order to open up the debate to enable society to help determine what science they would like to see conducted. This can be achieved Collins and Evans (2017) believe, provided there are institutions involved in public decision making processes which foster and develop both scientific and democratic values.

In his book, *Politics of Nature*, Latour (2004) describes how he believes there are weaknesses with the concepts of facts and values. He states the use of the word 'fact' signifies the end product of a period of scientific work. Once a piece of work is validated it becomes a fact. Using the word 'fact' hides all of the work which has to be conducted in order for it to reach that stage. In all stages of scientific work, once an element is validated it becomes a fact. This means the use of the word fact is necessary for 'sketches, prototypes, trials, rejects, and waste products' (Latour, 2004: 96). Latour also has another issue with the idea of the use of the word fact because it does not allow the importance of theory to be emphasised. An 'isolated fact always remains meaningless as long as one does not know of what theory it is the example, the manifestation, the prototype, or the expression' (Latour, 2004: 96). For Latour, 'values' also depend on 'facts'. An important weakness of the term 'value' is that it is determined by the definition of 'fact'. Once science has established the facts, then values can be used to convey important concerns, needs, and wants. Latour uses the example of cloning to illustrate how the establishment of facts is required in order for values to be implemented. ‘Once the cloning of sheep and mice has become a fact of nature, one can, for example, raise the “grave ethical question” whether or not mammals, including humans, should be cloned’ (Latour, 2004: 97). By establishing it is possible to clone an animal, it is then possible to ask whether it is ethical to do so. For Latour (2004: 100), ‘facts define the work of the sciences as poorly as values define the task of morality’.

This section considered the definition of science and also provided the historical context of science. It also considered the origins of the scientific fact along with the values associated with science. The next section will discuss Public Understanding of Science and Public Engagement with Science.

Public Understanding of Science and Public Engagement with Science

In their 1987 article, Thomas and Durant put forward nine arguments for promoting the Public Understanding of Science (Thomas and Durant, 1987). Their first argument is that promotion is of benefit to science. If the public understand the methods, processes, and products of scientific research, they will be more accepting of it. A better understanding of science would also help the public in having realistic expectations of what science can achieve. Their second argument concerns the benefit to national economies. Nations whose citizens possess a high level of scientific understanding will train and develop future generations of scientists. Additionally, consumer demand for science and technology products depends on a certain level of scientific understanding. Their third argument relates to the benefits to national power and influence. Citizens who possess scientific understanding belong to nations who champion science. Science education enables countries to remain intellectual leaders in the world. Their fourth argument relates to benefits to individuals. Knowledgeable citizens are able to navigate their way through society. Citizens have better job opportunities, they can make informed decisions about diet, health-care, and personal safety. The fifth argument relates to benefits to democratic government. Citizens have genuine and legitimate interests and concerns when science is conducted for the public good. Therefore, they have a right to shape the science policy-making process. However, if citizens are influencing science policy, there is a requirement that they understand science and scientific processes. The sixth argument is that science benefits society as a whole. In order for this to be effective, science needs to be accepted in society. If citizens do not understand science properly, they may respond with either fear or glorification of scientific developments. The seventh argument is that science provides intellectual benefits. Science is important to intellectual culture, and in order to take part, a person needs to be educated. If intellectual culture is promoted, then there is also a need for the promotion of public understanding of science. The eighth argument put forward is that science has aesthetic benefits. Life without science, the arts and literature is much less worth living. The final argument is that science brings moral benefits. The norms and values associated with science are of a higher order and if these are transferred into wider society, these advance human civilisation.

In the light of these arguments put forward by Thomas and Durant (1987), scientists were charged with informing and persuading citizens of the value of science. The assumption was that citizens did not have sufficient scientific knowledge or did not know enough about how science operated in order to support science (Stilgoe and Wilsdon, 2009). This assumption is at the heart of what has become known as the 'deficit model', and is how the public understanding of science perspective came into being. Irwin (2009: 7) describes the deficit model as

> the assumption on the part of institutions and their science communicators that the public is ignorant about science – but that it (for this is a singular presentation of 'the public') would accept science readily if it only knew more (with 'science' similarly being

> singular rather than plural or heterogeneous). The deficit perspective suggests one-way communication with a passive audience soaking up 'the facts'.

The assumptions on which the public understanding of science model were based were intended to disrupt the relationship between science and citizens. The intention for 'the public' to have a greater comprehension of science was widely regarded as advantageous by the scientific community and Government agencies in the UK.

In his article in 1991, Brian Wynne was already stating problems which were becoming evident with the public understanding of science model (Wynne, 1991). The public understanding of science model meant both 'the public' and the level of understanding or ignorance about science had to be generalised. However, this approach did not work. Science means different things to individual citizens depending on the situation they find themselves in. As scientists cannot reach a consensus as to what science is, it is not surprising that citizens face the same dilemma. Wynne's research found that 'public uptake (or not) of science is not based upon *intellectual capability* as much as social-institutional factors having to do with social access, trust, and negotiation as opposed to imposed authority. When these motivational factors are positive, people show a remarkable capability to assimilate and use science or other knowledge derived (inter alia) from science' (Wynne, 1991: 116, emphasis in original). Citizens could be educated about science, but they were unlikely to accept this if they did not trust the institution. Wynne (1991: 114) also found that 'people do not use, assimilate, or experience science separate from other elements of knowledge, judgment, or advice'. Individuals often draw on existing knowledge obtained from previous encounters with a particular situation. This relates to a further point made by Wynne (1991: 116, emphasis in original), in that 'public nonreceptivity to scientific information is often based on judgment that it is not *useful* or does not match public or personal experience'. Citizens may be dismissive of scientific developments if they run counter to their previous experiences.

The assumption to ‘know science was to love science’ was directly undermined by certain events (Stilgoe and Wilsdon, 2009: 19). During the 1990s, problems arose with the relationship between science and society. This started with the BSE crisis, and continued with GM crops, risks surrounding mobile phones, and concerns about the measles, mumps and rubella (MMR) vaccination. The ‘people’s relationship with science was far more active and sceptical than previously thought. People wanted to be able to ask questions of science and have their voices heard’ (Stilgoe and Wilsdon, 2009: 20). There were calls for an alternative approach to the deficit model. The approach proposed was ‘public engagement with science’ and this method called for a dialogue between scientists and society. Science should be questioned by society and there should be broader engagement with other experts, stakeholders and citizens. Irwin (2015: 25) argues that at the ‘core of what has come to be defined as ‘public engagement’ there is generally an attempt to ‘broaden’ discussion, to identify new issues and to consult groups which might not otherwise be heard’. There are now multiple publics, and public engagement with science has become more sophisticated.

According to Stilgoe and Wilsdon (2009: 29), ‘public engagement provides a lens through which policy-makers can see issues differently, focusing on contexts, uncertainties, alternatives and local concerns’. Jasanoff (2003: 239) contends ‘what is lacking is not just knowledge to fill the gaps, but also processes and methods to elicit what the public wants, and to use what is already known’. In the case of GM foods, there can be a number of responses. For example, some citizens perceive the manipulation of genes as unethical, whilst others recognise genetic modification as a means of addressing food security. If citizens are actively engaged with the development of a new area of science or a particular technology, it can be shaped to consider their values and beliefs. Obviously, this takes into account more than risk, but this type of conversation between science and society enables progress to occur in a more informed manner. According to Jasanoff (2003: 226), the ‘wider public responsibilities of science, as well as changes in modes of knowledge-making, demand new forms of public justification'. This may be ethics in genetic technologies or precaution in environmental assessments. As advances in science and technology are made, we should query, voice reservations, and highlight doubts, and in this respect 'the questions we should ask of almost every human enterprise that intends to alter society: what is the purpose; who will be hurt; who benefits; and how can we know?' (Jasanoff, 2003: 240).

In order for public engagement with science to be successful, it has to be part of routine practice. Different forms of engagement may be required at different points of the research process. (Stilgoe and Wilsdon, 2009). However, 'the more public engagement is practised, the clearer becomes the tangle of institutional motivations behind it' (Stilgoe et. al, 2014: 6). Stakeholders may wish to engage citizens for a variety of reasons including gaining support for a predetermined approach or for considering new procedures and policies.

As public engagement with science opens up to more diverse perspectives, the development of science and technology should become more socially beneficial. If public engagement starts at the beginning of a new scientific development, there may be a reduction in public controversy and opposition as citizens are more likely to trust institutions (Sturgis, 2014). Irwin (2015) contends that hopefully, by listening to citizens' views, research is more reactive, there is increased accountability, and research is more relevant to citizens. However, the 'ability of deliberation to yield substantively *better* decisions will only be delivered when, at a minimum, all potentially affected interests are voluntarily represented and the views expressed by participants are treated equally and with respect by all' (Sturgis, 2014: 39, emphasis in original). This should enable better quality decisions to be made.

Irwin (2015) argues that policymakers often encounter difficulties with public engagement, as citizens views are often so broad and diverse, they do not remain within an institutionally designed framework. Citizens wish to discuss the issues that are important to them. However, very little is known about how enthusiastic citizens are about public engagement with science activities compared to those institutions who wish to conduct these exercises (Sturgis, 2014). It can be demanding for individuals taking part in public engagement with science activities as it requires a high level of effort and motivation. Citizens have to 'monitor sources of scientific information, judge between them, keep up with shifting scientific understandings, distinguish consensus from isolated scientific opinion, and decide how expert knowledge needs qualifying for use in *their* particular situation' (Wynne 1991: 117, emphasis in original). This is how broad and diverse views are generated.

Public engagement with science can continue moving forward in the future. For this to occur, Jasanoff (2014: 23) suggests three proposals. Firstly, public engagement with science 'should promote a more robust conception of *publics* – not treating them as natural collectives (e.g., housewives or teenage women) but as dynamically constituted by changes in social contexts'. Secondly, instead of understanding or engagement with science, better terminology would be representation of science. Thirdly, there should be an expansion in focus from 'science pure and simple to *science (and technology) in society*'. In addition to these three propositions, Irwin (2015) proposes six principles for improving public engagement with science. These are:

1) Public engagement with science needs to be seen as a challenge, disturbance or provocation to scientific governance and not simply an extension to it. Taken for granted assumptions should be opened up to fresh scrutiny and instead of fixed visions of the future, these should be opened up to multiple possibilities.
2) For public engagement to have real meaning, it cannot be solely controlled by government institutions. Public engagement must be open to the public(s) to construct and define in a plurality of imaginative ways.

3) As much attention should be paid to the citizenship dimensions of public engagement as to the technical aspects. Words like 'democracy', 'justice' and 'choice' should be brought explicitly into public engagement exercises from the beginning.
4) Public engagement cannot simply be defined as a local or national concern. The role of 'the global' within 'local' discussions cannot simply be dismissed as an institutional inconvenience since the political boundaries are not drawn in this way.
5) Public engagement with science only makes sense in the wider context of socio-technical innovation. There is a need to be realistic about what is and is not open for change and also what can be achieved by 'engagement' rather than other, perhaps more direct forms of political action.
6) Public engagement with science should have the central purpose of acknowledging and exploring multiple socio-technical futures and their relationship to public experiences of the present (adapted from Irwin, 2015: 30-31).

This section discussed Public Understanding of Science and its evolvement into Public Engagement with Science. It has described how these imperatives were designed to enhance and improve the relationship between science and society. Public engagement with science has the potential to open up discussions about the purposes and politics of science. This can assist with the broader debate about the public value of science. The next section will consider the association of risk with science and how risks are connected to scientific developments. This is an area of focus due to the uncertainties which can be associated with the construction of scientific facts and scientific developments. It is these uncertainties which can create risks.

The Connection between Science and the Consciousness of Risk

Risks concern both real and imagined problems. They become real because of the claims made by those who are concerned about the issue. These claims are assembled, presented, and contested (Irwin, 2001). As risks are socially constructed, ‘their existence takes the form of (scientific and alternative scientific) knowledge’ but are also ‘products of struggles and conflicts over definitions within the context of specific relations of definitional power’ (Beck, 2009: 30). According to Beck (2009: 33), the key figure in the sociological analysis of risk, the significance of these struggles over knowledge can be viewed as follows:

> ‘relations of definition’ also rest on control over the ‘means of definition’, in other words, over scientific and legal rules. Here, too, there are ‘owners of the means of definition’ – namely, scientists and judges – and citizens ‘bereft of the means of definition’, who have the dependent status of ‘laypersons’ and are subjected to the power of definition and decision of experts and judges who decide on behalf of all which conflicting ‘definitions of risk’, and which liability and compensation claims derived from them, are recognised and which are not.

This shows how knowledge is perceived to belong to those in a position of authority. Beck (2009: 33) goes on to argue how there is ‘a clear hierarchy of knowledge. It lays down the superiority of the expert vis-à-vis the layperson. This presupposes that knowledge and non-knowing can be distinguished, so that in cases of doubt the monopoly over what constitutes knowledge resides with the experts’. Decisions about risk, are therefore primarily made by those who are considered to have expertise. Risks are determined by experts through the application of techniques of probability and cost-benefit analysis which are impersonal and focused only on mathematical certainties (Jasanoff, 2003).

As Jasanoff (2003: 224) argues, risk 'is part of the modern human condition, woven into the very fabric of progress'. Risk determination remains with mathematical calculations conducted by experts, because biases, misjudgements, misunderstandings, and errors are believed to be associated with *citizens* as opposed to *experts* (Beck, 2009). Citizens are assumed to be poorly informed and have to be educated in order to understand risks. Mary Douglas (1992) argues that risk is the probability of an event occurring combined with the importance of the gains and losses that will be made. These gains and losses may be to citizens, the environment, or industry depending on the context and who in particular is considering the risk. A gain for industry, for example, may be a loss for citizens or the environment. As Hornig (1993: 107) states, 'risks are socially constructed; they are interpreted (whether by lay publics or by the scientific elite) in a particular social and cultural context'. This also makes risk a political issue. The argument put forward by Beck (1998: 19), perceives risk as 'a powerful uncontrollable 'actor'' which plays an important role in challenging the dominance of science in society. This is a further reason why there is a need for a greater involvement of society with science. However, this is not straightforward and this is illustrated by Beck (1998: 18), who argues there are four key points which have to be addressed:

1. Who is to determine the harmfulness of products or the danger of risks? Is the responsibility with those who generate those risks, with those who benefit from them, or with public agencies?
2. What kind of knowledge or non-knowledge about the causes, dimensions, actors, etc., is involved? To whom does that 'proof' have to be submitted?
3. What is to count as sufficient proof in a world in which we necessarily deal with contested knowledge and probabilities?
4. If there are dangers and damages, who is to decide on compensation for the afflicted and on appropriate forms of future control and regulation?

The above points not only highlight questions which need to be raised concerning science and its associated risks, but they also illuminate the difficulties associated with who should determine how risks are addressed. Alternative sources of authority such as those citizens with direct experiences of situations, are able to inform policymakers. In the case of GM crops, a farmer may not have the same understanding as a scientist, but they have knowledge about growing crops. Alternative forms of knowledge, such as with the farmer, should be used in conjunction with science when making decisions. In the case of risks, the coming together of the two processes, with both science and society being given the authority, could help decide which risks are worth taking for the benefits to be gained. These questions of authority and who has the right to speak about science will be discussed in the Results chapters which follow.

Irwin (2001) argues that originally science was advocated for improving lives and offering solutions to problems, however, science is now increasingly being used to solve situations created by science. This is further alluded to by Beck (1992: 163, emphasis in original):

> Science is involved in the origin and deepening of risk situations in civilisation and a corresponding threefold crisis consciousness. Not only does the industrial utilisation of scientific results create problems; science also provides the means – the categories and the cognitive equipment – to recognise and present the problems *as* problems at all, or just not to do so. Finally, science also provides the prerequisites for 'overcoming' the threats for which it is responsible itself.

Beck (1992: 158) also argues that 'scientific civilisation has entered a stage in which it no longer merely scientizes nature, people and society, but increasingly itself, its own products, effects and mistakes. Science is no longer concerned with 'liberation' from pre-existing dependencies, but with the definition and distribution of errors and risks which are produced by itself’. Unless risks are acknowledged scientifically, they do not exist and therefore cannot be avoided or prevented. Ethics, opinions, values, and protest, which could all demonstrate the existence of a risk are discounted because of the dominance of science. In some instances, by the automatic default to science, there may appear to be no risk in existence. Science has created risks both for humans and to the environment but these risks have to be recognised by science in order to be documented as a risk (Beck, 1995).

Attention now turns away from Beck, to the work of Mary Douglas in respect of risk. Viewing risk from a scientific perspective, Douglas and Wildavsky (1982a: 3) argue that ‘science simultaneously can increase the gap between what is known and what is desirable to know’. This is achieved through knowledge production. However, this depends on what research questions are asked and this is addressed by Douglas and Wildavsky (1982a: 63) as follows:

> Scientists disagree on whether there are problems, what solution to propose, and if intervention will make things better or worse. One scientist thinks of Mother Nature as merely secreting a healthy amount of dirt and another thinks of her being forced to ingest lethal pollutants. No wonder the ordinary lay person has difficulty in following the argument, and no wonder the scientists have difficulty presenting themselves in public.

Whilst scientists disagree about what constitutes a risk, citizens do not views risks in the same way as experts. Citizens believe ‘anger, hope, and fear are part of most risky situations. No one takes a decision that involves costs without consulting neighbours, family, work friends. These are the support group that will help if things go wrong. However, they tend to give conflicting advice’ (Douglas, 1992: 12). Whilst experts are determining risks purely through science, citizens are also drawing on both individual and collective beliefs and values. Additionally, Douglas (1992: 6) argues that ‘danger is defined to protect the public good and the incidence of blame is a by-product of arrangements for persuading fellow members to contribute to it'. A danger that is seen as being common to society provides 'a handle to manipulate, the threat of community-wide pollution is a weapon for mutual coercion' (Douglas, 1992: 6).

As already highlighted, dangers often emerge from technologies developed by science to improve safety. Douglas and Wildavsky (1982a) believe these new scientific developments draw attention to the issue of responsibility of ensuring risks are controlled. As such, governments are expected to protect citizens by regulating risks. This is currently achieved by conducting risk assessments and these 'would be easier in a society so settled and so certain of its values that its processes for discovering the facts and making political decisions would be judged fully adequate. That would be a trusting world, but it is not the one in which we live' (Douglas and Wildavsky, 1982a: 67). They also argue there is a distinction between risks which individuals are willing to choose to undertake and those which individuals believe are imposed on them. Taking part in a dangerous sport or overeating are risks undertaken through individual choice. However, polluted air or eating food containing carcinogens are risks which individuals are exposed to unwillingly. These risks are those which individuals have no control over and have no choice as to whether they wish to be subjected to them or not.

Citizens face many risks, however, some of these risks are ignored, whilst others become a focus of attention. Values and beliefs play a role in this decision making practice by individuals and by society. One person may find a risk acceptable, whilst another person may not. Because of this, the acceptability of risk should be determined not only by science, but also by the values and beliefs of individuals and society. As individuals we are faced with a vast array of information which we have to make sense of. Douglas and Wildavsky (1982b: 50) argue that because 'an individual cannot look in all directions at once, social life demands organization of bias. People order their universe through social bias. By bringing these biases out into the open, we will understand which policy differences can be reconciled and which cannot'. In doing so, this enables us to choose which risks we should focus our attention on. This leads on to a further point put forward by Douglas and Wildavsky (1982b), in that common values are also attributable to common fears. As an individual it is not possible to determine all possible risks. Therefore, at times, the role of risk determination is subsumed by society. It is important that societal aspects are reflected upon and considered, as if they are not, risks may be rejected by society if they are addressed by science alone.

Wilkinson (2001) has reviewed the arguments put forward by Douglas in connection with risk. He believes that for Douglas, the prominence of science in Western cultures means that when talking about personal anxieties and fears, people are likely to use a risk vocabulary. One of the points Wilkinson (2001: 97) raises is that for Douglas, when considering risk and future planning, this should be considered not 'as a product of the extent to which expert risk analysis makes us more aware of the potentially hazardous uncertainties of our future but, rather, as a popular means of alerting others to the seriousness of our expressed anxieties by underlining them with the authority of science'. As such, science is used to emphasise the notion of a risk which exists. This leads on to the public perception of risks, where for Douglas, we appreciate 'public disputes on risk as not so much to do with disagreements over the accuracy of 'objective' calculations of future possibilities but, rather, as a reflection of the cultural dispositions of different groups to entrust themselves to a ('theological') perspective on nature and society which conforms to their prior experiences of social solidarity' (Wilkinson, 2001: 105). This 'risk consciousness' is for Douglas, concerned with 'the extent to which this serves to shore up our convictions as to how we should live and what we should do in order to maintain our preferred way of life' (Wilkinson, 2001: 104). The final point which Wilkinson (2001) draws attention to, is how Douglas views blame being apportioned to those who are deemed as being responsible for causing threats to the way lives are led. Those who cause risks such as scientists are viewed as scapegoats, and therefore, they are to blame. Additionally, this enables people to persuade themselves that their point of view concerning risk is the correct one.

In addition to reviewing the arguments put forward by Douglas, Wilkinson (2001) also examines those made by Beck. According to Wilkinson (2001: 103), Beck believes that when we think about risk 'we are understood to acquire an amplified sense of doubt with regard to our personal ability to live in safety. The social significance of 'risk consciousness' resides in its capacity to make us anxiously preoccupied with maximising our powers of control over the course of our destiny'. Here, the concern is with how citizens can live their lives in safety and away from dangers. According to Wilkinson (2001), Beck believes that if the public have an increased understanding of risk, then there are more likely to be public debates about the ethics of science and the introduction of new technologies.

These two reviews by Wilkinson, highlight the differences in the theoretical points of view put forward by Beck and Douglas. Wilkinson (2001: 107) draws attention to these differences and believes 'Beck's 'risk society' thesis is inspired by the view that Western civilisation is faced with the very real threat of 'self-annihilation', Douglas' cultural anthropology is generally understood to cast doubt upon such an apocalyptic scenario'. For Douglas, the emphasis is on the extent to which debates concerning risk are a substitute for other social concerns. In part, this is due to the collapse of community and the growth of individualism. Wilkinson (2001) also addresses the point that whilst Beck emphasises the cause of anxiety being due to the knowledge of risk, Douglas is more concerned with the connections between risk, anxiety and coping and the consequences which arise from these associations.

Beck (1992, 1995) argues that whilst science has an important role to play, it cannot be relied upon to provide solutions to problems. In connection with environmental issues, science often creates more problems as opposed to solving them. Therefore, discussions surrounding science and expertise become key concerns. 'Risks are not unproblematically real: they are constructed, not least by expert systems which must recognise cases, collate statistics, develop accounts of causal mechanisms and, finally, 'identify' the risk' (Irwin and Michael, 2003: 76). Furthermore, each risk brings with it, its own uncertainties and values. As a result, experts are no longer automatically trusted by publics to decide whether a risk is acceptable (Irwin and Michael, 2003).

Douglas and Wildavsky are also known for their work on contamination. They argue that ‘pollution, defilement, contagion, or impurity implies some harmful interference with natural processes. It assumes something about normality because it implies an abnormal intrusion of foreign elements, mixing, or destruction’ (Douglas and Wildavsky, 1982a: 36). What is considered natural and normal can be challenged when a new technology is introduced. Risks which were once considered normal are revised in order to take account of the contamination which has occurred. Those who have carried out the contamination become the focus of blame. However, blame very much depends on whether citizens believe a risk is occurring. If enough citizens are committed morally to protecting something from becoming contaminated, then they will focus the blame on those they believe are creating the contamination (Douglas and Wildavsky, 1982a).

Spencer Weart (1988) writes about the public fear surrounding nuclear technology. This relates to the idea of contamination, and could equally apply to the science of genetic modification. The ‘interference with nature’ by the associated nuclear technology was unpredictable and had the potential to be destructive. As Weart (1988: 188) explains:

> The concept of contamination had an important social dimension. Some anthropologists noted that the disgust and fear associated with taboos would fasten especially on a person who was “out of place” in the accepted social structure … it was common to call that sort of person a witch. … a witch was someone who could prevent the conception of babies or bring an unseasonable storm, someone who above all violated the proper scheme of things, perverting the community and nature itself.

He then goes on to describe how scientists can be perceived as causing contamination:

> Much the same was said of nuclear bombs and the men who made them. Scientists and nuclear officials made particularly apt targets for suspicions about the disruption of childbirth, the weather and so on, for at least some of that sounded plausible. Equally important, there was a long tradition of accusing science and technology of violating the order of things – which came close to saying that they brought pollution (Weart, 1988: 188).

Considering the arguments put forward by Douglas and Wildavsky (1982a) and Weart (1988), it is possible to imagine scientists being blamed for the contamination of plants through genetic modification. The natural is being tampered with.

In this section, the association between science and ‘risk consciousness’ has been considered, with particular attention being paid to the arguments put forward by Beck and Douglas. The differences between their arguments have also been highlighted. The idea of contamination and pollution has also been discussed. The topic of expertise has been introduced, and the following section discusses this in more detail. This next section will consider the definition of expertise and how expertise relates to the issue of trust by citizens.

What is Expertise?

Expertise is concerned with specialisation in the field of knowledge and in the production of knowledge. Giddens (1991: 18) argues that expert systems ‘are not confined to areas of technological expertise. They extend to social relations themselves and to the intimacies of the self. The doctor, counsellor and therapist are as central to the expert systems of modernity as the scientist, technician or engineer’. I would also argue that a journalist should be added to this list of experts. According to Schudson (2008b), an expert is a person whose specialised knowledge is seen as genuine and which is acknowledged as such by society. In some instances, this includes not only the knowledge but also the associated skills. He also defines an expert as a person who is aware of different arguments pertinent to their specialised knowledge. Nichols (2017) perceives an expert as a person who understands a subject in depth, and who we will turn to if we require educating about that subject, or advice. As such, work conducted by experts play an important role in decision making processes. However, according to Dewey (2016: 225), who was writing in the early to mid, 20th century, this is not about the determining and implementation of policies,

> but in discovering and making known the facts upon which the former depend. They are technical experts in the sense that scientific investigators and artists manifest *expertise*. It is not necessary that the many should have the knowledge and skill to carry on the needed investigations; what is required is that they have the ability to judge of the bearing of the knowledge supplied by others upon common concerns.

This argument put forward by Dewey, illustrates how the experimental method in science is not the only route to authoritative knowledge.

Expertise is also related to trust. Expert systems according to Giddens (1991: 19) depend on trust which ‘presumes a leap to commitment, a quality of ‘faith’ which is irreducible’ and furthermore, ‘trust brackets the limited technical knowledge which most people possess about coded information which routinely affects their lives’. Trust allows people to go about their daily lives, mainly because everyone is effectively a lay person in virtually all social activities. As experts all have their own specialised knowledge, the accumulation of this as a whole allows us to trust that society will function. Of course, there are times when trust in experts is withdrawn, and people draw on their own knowledge to make decisions.

Giddens (1991) argues that the knowledge which is associated with expertise is in effect available to everyone providing they have the energy, time and resources to attain it. However, the most anyone can ever hope to achieve is to be an expert in one small, particular area. This narrow focus of expertise though, also gives rise to the problem of unexpected and unintentional consequences. Solving these difficulties means developing expertise further and therefore, a cycle emerges. Expertise can be defined as a knowledge which is relied upon by others and can be recognised by education, experience, peer support and talent. Although each one indicates expertise, it is the combination of them which provides an indication on who can be trusted (Nichols, 2017).

Whilst experts and expertise are valued by society, it is equally possible that expert knowledge can be rejected. Turner (2001) argues because expertise is justified by legitimisation, it is also possible for this to work in reverse, and for the legitimacy of expertise to be retracted. The opinions of those considered to be experts can be disregarded. This is in part connected to the relationship between citizens and experts. Nichols (2017: 222, emphasis in original) argues that citizens misunderstand experts and their role in five ways and these are:

> First, experts are not puppeteers. They cannot control when leaders take their advice. …
> Second, experts cannot control how leaders implement their advice. …
> Third, no single expert guides a policy from conception through execution, a reality that the public often finds bewildering and frustrating. …
> Fourth, experts cannot control how *much* of their advice leaders will take. Experts can offer advice, but often political leaders will often hear only the parts they want to hear – specifically, the parts that will be popular with their respective constituencies. …
> Finally, experts can only offer alternatives. They cannot, however, make choices about *values.*

These misunderstandings can lead to a breakdown in the reliance of experts by citizens. However, this can be seen as a fault on both the part of citizens and experts. Nichols (2017) argues that it is possible for citizens to believe they know enough information to make their own informed decisions, as well as being disinclined to understand issues which are problematic. Experts become reluctant to talk to citizens, and instead, experts promote their own resolutions in decision making processes as well as only connecting with their colleagues. He also raises the point that citizens may not wholly adopt the advice from an expert, and if the desired results are not achieved, the expert is likely to be blamed because someone has to be culpable. Nichols (2017: 230, emphasis in original) goes on to argue that if the public have ‘no idea about the substance of an issue, and will vote based on who they *like* rather than what they *want*, it is difficult to put too much blame on policymakers and their expert advisers for being confused themselves’. As Nichols illustrates, there are different factors which influence what information citizens wish to consider as well as who they would like to pay attention to. However, policymakers have to continue to make decisions even if citizens no longer wish to listen to them. These decisions still have an impact on citizens no matter how informed or ignorant they wish to be. Nichols (2017) also argues that experts can advise the public on difficulties and problems which may arise, however, it is for the public to decide whether to act on the information or disregard it.

This complicated relationship between citizens and experts is also based on how experts are perceived as well as how their role is understood. Firstly, it needs to be established who is an expert. This is explained by Lippmann (2008: 183) who was writing in the early to mid, 20th century, whereby

> the choice of the expert, though a good deal easier than the choice of truth, is still too difficult and often impracticable. The experts themselves are not in the least certain who among them is the most expert. And at that, the expert, even when we can identify him, is, likely as not, too busy to be consulted, or impossible to get at. But

> there are people whom we can identify easily enough because they are the people who are at the head of affairs.

Therefore, experts are perceived as those who have the authority to talk about and discuss particular subjects and issues. Secondly, as Nichols (2017: 5) highlights, an expert who makes a claim of expertise will find the public complaining that this is nothing more than 'fallacious "appeals to authority", sure signs of dreadful "elitism", and an obvious effort to use credentials to stifle the dialogue required by a "real" democracy'. If citizens are not able to talk to experts, tensions can be created especially when expertise does not benefit all in society. In these circumstances, citizens are likely to reject expertise. Fundamentally, Nichols (2017: 5) argues the 'death of expertise is not just a rejection of existing knowledge. It is fundamentally a rejection of science and dispassionate rationality, which are the foundations of modern civilisation'. Latour also sees expertise disappearing from view. 'The idea of the expert is a remnant from the trickle-down model of scientific production; he or she is a person in charge of mediating between the knowledge producers, on the one hand, and the rest of the society in charge of values and goals, on the other' (Latour, 2011: 13). As a result of the rejection of expertise, citizens are now only using respected knowledge as and when they wish to.

The decline in the confidence of expertise is a concern for science and scientists. This point is made by Durant (1998: 74) who argues 'science is important. For all its imperfections, scientific knowledge is an enormously valuable asset. In order to take advantage of this asset, however, we depend on public confidence in science and scientists as credible sources of ideas and information in their appropriate areas of expertise'. A similar argument is made by Heather Douglas (2009: 3) who states 'without reliable knowledge about the natural world, however, we would be unable to achieve the agreed upon goals of a public policy decision. … Any implementation of our policy would fail to achieve its stated goals. Science is essential to policymaking if we want our policies concerning the natural world to work'. Whether they are in a policy advisory role or not, scientists do tend to hold a position of authority in society, and this also applies to the claims they make about their work in journals, at conferences, or in the media (Douglas, 2009).

However, specialist expertise is challenging for citizens to access. Part of this is connected with the use of training in science. As Dewey (2016) explains, science is a language that is acquired through the use of training. Scientific language is studied with a particular purpose and use in mind, and each area of science has its own subtleties in its use of language. This scientific training enables those who undertake it to obtain specialist expertise in their particular area of science. The scientist is aware they are carrying out science through the use of particular methods, however, citizens have to accept the conclusions which are reached. This is due to the fact that scientific training excludes non-scientists and therefore the knowledge and expertise that would otherwise be available to them. The difference between experts and non-experts means citizens are unable to access the realm of science. Whilst engaging the public with science is advantageous, citizens will never be able to become scientific experts unless they undertake scientific training. Nevertheless, citizens should be able to determine the authority and expertise assigned to scientists. Citizens would be better able to do this if there were more democratic engagement between themselves and scientists and this would also enable citizens to hold scientists to account (Collins and Evans, 2017).

This section considered the definition of expertise and how expertise relates to the issue of trust by citizens. It illustrates how a lack of trust in experts can lead to citizens rejecting their claims and expertise. For the point of the discussion here, this means the rejection of the scientific claims which form the basis of the arguments concerning risk. The section also considered the specific expertise of scientists. Specialist training is required to be undertaken in order to become a scientist. As such, it is those who understand scientific language that are able to become experts. Therefore, non-experts are expected to accept the conclusions made by scientists. In terms of the risks associated with science, it will be scientists who act as experts and who will decide if legislation can be passed to allow scientific developments to proceed.

Chapter Conclusion

This chapter has reviewed the literature in connection with the interfaces and interconnections between science and society. In particular, this has focused on the facts and values associated with science, risk, and expertise. The next chapter considers the relationship between media and science.

Chapter 3: Literature Review

Science and Society: Journalism and Science News

Introduction

This chapter will consider different aspects of the media in its relationship with science. Firstly, it will examine what are deemed to be the norms of journalism. These will consider the values which are assumed to underpin journalism such as balance and objectivity. The focus then turns to the changing landscape of journalism and the interactive nature of digital journalism. These sections examine how the rise of digital platforms are impacting the traditional role of journalism. Following on from this, attention turns to claims-making. This section describes how actors state their claims, and how claims are assembled. The chapter then considers how the norms of journalism interact with science reporting. It reflects on how scientific research has to undergo translation by journalists in order for citizens to comprehend the scientific news story. The next section of the chapter considers the relationship between the media, risk and science. This examines how risks associated with scientific developments are reported in news articles. The final section of this chapter describes the previous research conducted in respect of GM food in the media.

The Norms of Journalism: Objectivity and Balance

Before discussing the norms of journalism, it is worth reflecting on the definition of journalism per se and the role it plays in news production. Journalism can be described as a set of practices, and Malik and Shapiro (2017) propose five points which they believe define journalism and these can be described as follows:

1) Independence – those with an interest in the journalistic content being reported should not drive how it is conveyed.
2) Accuracy – the work needs to display a degree of rigour and an objective of being truthful
3) Current and recent – past events should only be used to provide context
4) Original presentation – the work needs to present material which involves creative thinking or research instead of reproducing the work of others
5) Public edification – information needs to be available to a wide audience

The traditional newspapers have often been regarded as primary agenda setters, as they are able to operate in the medium to long term. They have 'the power to set the dominant political agenda, as elaborated over weeks, months and years, in editorials, columns and other forms of pro-active, opinionated journalism, amounting to extended narratives of unity and division, success and failure, rise and fall' and are able to establish 'the dominant interpretative frameworks within which ongoing political events' are understood (McNair, 2000: 30). Even with an increase in abundance of media platforms available to citizens, the agenda setting function of news organisations continues to exist (Djerf-Pierre and Shehata, 2017). An early statement made by Bernard Cohen which is still relevant today, explains how 'the press may not be successful much of the time in telling people what to think, but it is stunningly successful in telling its readers what to think *about*' (Cohen, 1963: 13, emphasis in original).

Items which appear on the news agenda are often those which news organisations believe will appeal to citizens. According to Henderson et al. (2014), media organisations respond to what publics appear to be interested in, and will likely respond to. Journalists have to make judgements when selecting news stories. Maras (2013: 14) contends this 'judgement refers not only to how stories are handled, and deemed newsworthy, but also to the way some events or facts are deemed to fall inside or outside of the category of 'news'. Judgement relates, then, to how news journalists construct their 'news net', and navigate the web of facts, and gossip'. Certain scares, be these environmental, health, or food, may not attract the attention of journalists, and this may in part be due to uncertain and contested science surrounding specific topics (Howarth, 2013). However, this is not the case with GM food, even though there is a degree of uncertainty with the science surrounding the cultivation of crops and the impact on the environment. At times, ‘news exists not because there is a significant risk, but because there is some triggering event such as an explosion, or an injury, or fight between government officials and their charges, or conflict among stakeholders’ (Miller and Riechert, 2000: 48). This last element has certainly been in evidence with GM foods. Journalism is not always exclusively concerned with transmitting ‘facts’. For some journalists, there is a desire to craft interesting news stories – those which are engaging and entertaining, as well as informative (Schudson, 2008b). It is these stories which are assumed to draw the audience in.

Just as facts and values exist in science, they also emerge in the course of journalistic activity. News according to Lippmann (2008: 282) can be described as follows:

> The hypothesis which seems to me the most fertile, is that news and truth are not the same thing, and must be clearly distinguished. The function of news is to signalise an event, the function of truth is to bring to light the hidden facts, to set them in relation with each other, and make a picture of reality on which men can act. Only at those points, where social conditions take recognisable and measurable shape, do the body of truth and the body of news coincide.

Journalistic facts are created with different assumptions to scientific facts. Journalism requires facts to be separated from values or facts to be separated from opinions. By doing so, we are able to know the truth (Maras, 2013). As facts are assumed to be related to direct experiences, they are perceived to be unpolluted by values. ‘‘Facticity’ is the name we can give to this problem of drawing a distinction between facts and the world. Put simply, facticity describes a test, or set of conditions, through which experiences, information, statements, become facts’ (Maras, 2013: 95).

These facts are then reported as news, in the form of a story. A news story is a collection of facts which have been ‘accumulated, validated, verified’, interwoven with sources and shared understandings (Maras, 2013: 75). Although it is mentioned above that journalistic facts are created differently to scientific facts, there are some similarities. Tuchman claims the professionalism of journalism is based on the idea of the professional methods used by scientists to ascertain scientific facts. ‘Just as scientists discovered the facts about nature by using normatively established objective methods, so, too, the news media and the news professionals would use their methods to reveal social reality to the news consumer’ (Tuchman, 1978: 160).

News events can be reported even if there is no truth to what is contained in the news story. As Maras (2013) explains, journalists have to decide whether they report the truth as they find it or as they see it. Journalists also have to ascertain if information is truthful or factual. In the case of official statements, journalists have to decide if these are to be believed and can just be relayed in the news story, or if these facts need to be contested.

To carry out the reporting of facts, the professional norms of journalism requires journalists to perform the task of providing information to citizens via the journalistic model and its conventions (Schudson, 2008b). As it is in science, one of these norms is objectivity. The basic definition of the different aspects of objectivity are ‘values, process and language’ (Maras, 2013: 8). How this objectivity norm works in practice is best described by Schudson (2001: 150) who states, the

> ‘objectivity norm guides journalists to separate facts from values and to report only the facts. Objective reporting is supposed to be cool, rather than emotional, in tone. Objective reporting takes pains to represent fairly each leading side in a political controversy. According to the objectivity norm, the journalist’s job consists of reporting something called ‘news’ without commenting on it, slanting it, or shaping its formulation in any way’.

Maras (2013) argues that the process of objectivity can be achieved by the organisation of the news article in a typical format, using evidence and quoting sources, and through the use of perspectives which may be balanced or conflicting. Objectivity is 'often articulated in a cluster of terms such as impartiality, neutrality, accuracy, fairness, honesty, commitment to the truth, depersonalisation and balance' (Maras, 2013: 8). In respect of language, Maras (2013) argues that there are two definitions of this. Firstly, the use of language creates a notion of trust and authority in the journalist and this can arise from the what, who and when included in the article. Secondly, the use of language sees journalists only reporting stories as opposed to creating them.

Balance is a further norm of journalism. According to Kitzinger (1999), the use of balance by journalists means that erroneous views and accounts sometimes appear in news articles. This is due to the fact that actors with differing opinions are always presented in articles. By doing so, this enables the audience to hear the alternate perspectives that exist. However, by providing balance in a news story, a journalist may harm the truth by trying to create the feeling of fairness by allowing both sides to have their say (Maras, 2013). Nevertheless, Schudson (2008b) argues that the range of opinions expressed in the news can be constrained by journalists themselves through their use of official sources, the professional norms of journalism, and the opinions of those for whom they are writing the news.

This section began by reflecting on the definition of journalism. It then considered the journalistic norms of objectivity and balance. These norms shape the news articles and affect how they convey their messages. However, with the development of digital journalism, amendments are appearing to news production and consumption. The landscape of journalism is changing. This is the focus of the next section.

The Changing Landscape of Journalism: Traditional News Production and the Intervention of Digital Platforms

According to Maras (2013), discussions concerning journalism often focus on before and after the introduction of the internet and digital technologies, and this places an emphasis on the power of technology to implement change. However, he goes on to argue how this does not identify the cultural and historical perspectives of journalistic practice. Schudson (2008b: 12) contends there are six functions which journalism has frequently claimed in democratic societies, in different combinations and with different emphases, and these are:

1) information: the news media can provide fair and full information so citizens can make sound political choices;
2) investigation: the news media can investigate concentrated sources of power, particularly governmental power;
3) analysis: the news media can provide coherent frameworks of interpretation to help citizens comprehend a complex world;
4) social empathy: journalism can tell people about others in their society and their world so that they can come to appreciate the viewpoints and lives of other people, especially those less advantaged than themselves;
5) public forum: journalism can provide a forum for dialogue among citizens and serve as a common carrier of the perspectives of varied groups in society;
6) mobilisation: the news media can serve as advocates for particular political programs and perspectives and mobilise people to act in support of these programs.

Whilst these six functions still exist, the establishment of the internet and digital technologies have granted citizens the capability to mobilise to a greater extent. This is discussed in more detail later in this section.

Although the boundaries of professional journalism have been relatively stable, the different forms of obtaining online news have now made these more porous (Jukes, 2018). When writing online, journalists have ‘to make decisions as to which media format or formats best convey a certain story (multimediality), consider options for the public to respond, interact or even customize certain stories (interactivity), and think about ways to connect the story to other stories, archives, resources and so forth through hyperlinks (hypertextuality). This is the ‘ideal–typical’ form of online journalism, as professed by an increasing number of professionals and academics worldwide’ (Deuze, 2003: 206). Even when writing online, journalists adhere to their professional norms. However, there are challenges to these professional norms.

Fake news has been increasing ‘with targeted attempts to manipulate public opinion and to earn “clickbait” advertising revenue. In addition, fake news has been used as a term of abuse by those (often politicians) who do not agree with what the media are reporting’ (Jukes, 2018: 1031). McNair (2017: 1318) defines this culture as ‘post-factuality’ and what the Oxford English Dictionary (2018) describes as post-truth. The definition of post-truth is an adjective ‘relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief’ (Oxford English Dictionary, 2018). Citizens are left deciding who to believe and have to determine who is telling the truth. Digital media has also transformed the news media marketplace. McNair (2017: 1327) argues that some of the online ‘organisations are cultural parasites, merely aggregating the content of other organisations. Others produce “clickbait” of various types – listicles and celebrity gossip of dubious provenance; others still blend advertorials and native advertising with original material’. For those news organisations which have traditionally followed the norm of objectivity, by continuing to do so, their reputation is enhanced when compared to the less reputable brands associated with news. ‘The contemporary crisis of objectivity can be rooted in the capacity of the globalised public sphere – digitised, networked, relatively uncensorable and rapidly evolving as it is – to disseminate information which is difficult to verify in short time frames, but ever-more difficult for competitive and, indeed, objective news media to ignore or dismiss' (McNair, 2017: 1328). However, as stated above, established news organisations are continuing to follow the norm of objectivity. In a study conducted by Jukes (2018), he examined the submissions made to a UK Parliamentary Inquiry into fake news. He found that some news organisations had refocused on traditional values and boundaries to counter fake news. The BBC reiterated the importance of objectivity and impartiality in its news reporting, whilst ITV news emphasised its reputation for accurate, impartial reporting and transparency in its news sourcing. ITN who supplies news to ITV, Channel 4 and Channel 5, ensure quality journalism and fact checking. For Reuters, objectivity, accuracy and a lack of bias were important values. As Jukes (2018: 1036) states, 'it comes as no surprise that when faced with disruption, aggressive competition and financial pressures, journalists at established news organisations such as the BBC, Reuters and the Press Association should fall back on tried and trusted values that had served the news industry well for the first 150 odd years of its existence'. Although there is a decline in faith in objectivity and trust in journalism, by placing an emphasis on the practices and principles associated with the professional norms of journalism, established news organisations are able to distinguish themselves from the multitude of other news outlets that are available through digital media. 'Objectivity will continue to be a key pathway to the mobilisation of trust in journalism, but in the post-factual world where powerful sources brazenly assert the Truth of their demonstrably untruthful versions of events, objectivity must include a determination to challenge "authoritative" sources as never before' (McNair, 2017: 1331).

It can be argued that the professional norms of journalism become more important as reality becomes more complex. The vast amount of information individuals have to navigate requires an awareness of discerning what is true. Journalists perform a gatekeeping role by deciding what information should be passed on to the audience. With news stories, it is journalists who determine if information is accurate, substantiated, and is important for citizens to be aware of (Vos and Thomas, 2018). However, gatekeeping has been through turbulent times. As Vos and Thomas (2018: 14) argue:

> ‘Throughout this twenty-first century discourse, three periods emerge: one at the turn of the century where a gatekeeping role enjoyed some normative traction, a period of intense criticism from roughly 2005 to 2010 (with less intense criticism before and after), and a final period of renewed willingness to consider the virtues of the gatekeeping role. This final period was mostly in 2016 and 2017 and emerged as a defence, particularly of the editorial oversight version of the gatekeeping role, in light of concern about a post-truth age. Here, gatekeeping as a kind of democratic duty has regained some urgency’.

Whilst gatekeeping has received some renewed importance, Wallace (2018) argues that gatekeeping is altering. Although journalists still play a major role, this is increasingly being conducted by other actors. He proposes that gatekeeping should be thought of as a model which contains journalists, individual amateurs, strategic professionals and algorithms. Algorithms are included in this model because although as yet they rarely create news items, algorithms select information, publish and disseminate it. As Wallace (2018: 278) states ‘gatekeeping in contemporary media ecologies bears more resemblance to an open city with local, individually managed centres than a centralised city with walled gates’.

The news presented to citizens are not straightforward pieces of writing by journalists. In respect of the actual news article, Schudson (2008b) argues that although journalists create their own stories, these are derived not just from their own resources but from those which are provided for them such as press conferences, press releases and scheduled interviews. These news stories are also shaped by news values and the pressures of commercial production. Whilst news is driven by events or focuses on conflicts, those people which feature in the coverage are either well known, or are from certain occupations (Steele, 1995). However, this means that voices can be excluded from news coverage and those who dissent are unlikely to appear. As Schudson (2008b: 53) argues, ‘the mainstream journalist writing for a standard news institution is likely to be ignorant of, or, if informed, dismissive of opinions outside the fold’. From this description, a news article can be seen as a construction of an event with people who feature in the coverage, details, and the inclusion of quotes, all chosen by the journalist.

Due to the sheer volume of platforms available to citizens such as the online platforms of traditional news organisations, Facebook, and Twitter, there is a wide variety of choice for obtaining news. In respect of news organisations, Amend and Secko (2012) contend that journalists need their stories to capture the readers’ attention, and those stories which have a human interest angle or which are controversial are those which are likely to attract the most attention. Lippmann (2008: 183) argues that ‘except on a few subjects where our own knowledge is great, we cannot choose between true and false accounts. So we choose between trustworthy and untrustworthy reporters’. As these points illustrate, citizens are having to make many choices about the news which they select, as there are so many competing organisations vying for the click of the mouse or the swipe of the finger. Not only are there trustworthy and untrustworthy reporters, but also the opinions of the non-expert bloggers, tweeters and also those who post on Facebook. Nonetheless, news organisations are aware of these issues. Mike Wilson was appointed the editor of the Dallas Morning News in 2015. He addresses the changing face of journalism and what readers would like to see in an interview with Benjamin Mullin on 7 July 2015.

> I think what we need to throw out are some old notions of what our readers need. We just have to be more responsive to what the audience wants. I think the tradition in newspapers has been that we have set the agenda and we’ve told readers what we think they want to know. I think we need to come down off of that mountain a little

> bit and ask people, involve people in the conversation a little bit more (Poynter, 2017).

Along with the greater availability of news, Nichols (2017) argues how citizens now have the ability to interact with it. For example, this comes in the form of below the line comments, Twitter and Facebook. Digital media is allowing participation in both news production and consumption. However, there is also the potential for the spread of misinformation. It is these new media platforms such as Twitter and Facebook which will enable publics in their attempts to impact democracy. Keane (2011: 5) argues that 'a whole new mental effort is required to make sense of how democracies are being shaped and re-shaped by the new tools and rhetoric of communication – and why our thinking about democracy must also change'. Additionally, the use of new media platforms by citizens, journalists and media organisations is highlighting how the journalistic conventions of authority, truth-seeking, reputation, objectivity and professionalism are having to be reconsidered (Maras, 2013). There are three important points concerning the era of 24/7 news and online journalism, and these are as follows:

> 1) On-line and citizen journalism may not in itself represent a challenge to objectivity. New techniques of reporting and platforms for publishing can (and are being) incorporated into established news models, which are themselves adapting to a 24-hour news cycle.
> 2) New media are providing new channels for 'monitory democracy'.
> 3) The admittedly very broad area of blogging and citizen media is challenging and changing the very informational foundation of objectivity as a method for knowing and presenting reality. Adapted from Maras (2013: 191-193).

Before moving on, it is worth pausing to consider the term 'monitory democracy' in point 2. The institutions concerned with monitory democracy are defined by Keane (2011: 6) as 'courts, human rights networks, professional organisations, integrity bodies, civic initiatives, bloggers and other web-based monitors' and by acting on behalf of citizens they are able to challenge 'elite monopolies of power by stirring up the sense that power monopolised by a few can be dangerous, that people and their representatives must rein in their power so that citizens can shape and re-shape their lives as equals'.

The new media platforms and the internet have allowed the public forum and the mobilising aspects of journalism to develop. If citizens wish to respond to a news article, they no longer have to write a letter to the editor, instead they can immediately post their own comment. Furthermore, the new journalistic voices (mainly bloggers) and their forums (blogs, wikis, news aggregators) are enabling those voices to be heard which have previously been excluded. Some of these blogs are hosted on Popular Science Blogs, Sciblogs, and until August 2018, The Guardian's Science Blog Network. Here they are acting as a 'monitory democracy'. Keane (2011: 14) claims 'people at various points on the earth witness the powers of governmental and non-governmental organisations being publicly named, monitored, praised, challenged, and condemned, in defiance of the old tyrannies of time and space and publicly unaccountable power' and this is made possible by the new media platforms. These global publics are able to offer a voice for responsibility, authority and representation. However, these global publics are not linked to governments nor are they part of the establishment of countries (Keane, 2011). Due to the global reach of news, it is possible for the powerful to be named and shamed. Schudson (2008b: 3) puts forward an argument concerning the role of journalism in democracies:

> Scholars, journalists, and citizens alike should learn to recognize the ways that institutions can help as well as hinder democratic government. We should learn to take seriously the benefits of representative democracy. We should learn that specialised knowledge (in experts) and concentrated power (in politicians or judges) are necessary ingredients in democracy and that the

> democratic task is to control the specialists rather than eliminate specialised knowledge.

This section considered the role news coverage plays in society. It highlights how in a changing world of journalism, the audience expects to be kept constantly updated. In an era of fake news and post-truth, objectivity in journalism is becoming more important. Through the use of platforms such as Facebook and Twitter, news can be shared, but this also means there are a greater number of gatekeepers. This leads on to the next section which describes the interaction and engagement with producers and consumers of digital content.

The Interactive Nature of Digital Journalism and Digital Consumption

When considering the interactive nature of digital journalism and digital consumption, it is useful to take into account how the 'multimedia site of a typical large news organisation serves as a hub for the latest news and feature coverage with a view to further distribution via cross-platform channels and social networks. It includes blogs and live blogs, digital-only videos and newscasts, podcasts, and photo galleries' (Malik and Shapiro, 2017: 17). By its very nature, digital journalism requires a level of interaction, and there is a two-way relationship between producers and consumers. According to Malik and Shapiro (2017: 21, emphasis in original), digital journalism comes into existence 'when the author-audience *relationship* becomes more interactive and engaged and when a work's completeness or limitation becomes a question or challenge, rather than a fact. On the other hand, at that same moment of birth, the *impact* of a work becomes permanent enough to achieve lasting impact, for good or ill'. They also believe accuracy should now be viewed as work in progress as audience members can highlight any errors. This un-siloed nature of news allows the audience to access information which reinforces their opinions and attitudes. However, Malik and Shapiro (2017: 21, emphasis in original) do offer the alternative view in that '*longevity* and *ubiquity* of digital news products may result in misinformation, as news reports proliferate without either context and beyond reach of corrections. This is further complicated by the fact that news websites have been found to dedicate more time and resources to propagating questionable claims than verifying or debunking them'.

Digital news consumption enables those with access to devices such as computers, tablets and smartphones to access news whenever it is convenient. Westlund (2017: 211) argues how citizens may 'develop habits of truly engaging with news through their mobile devices, both in terms of cognitive efforts through *reading* or *watching*, as well as active participation through social media (*liking, commenting, sharing, recommending, and voting*)'. This is further alluded to by Ksiazek and Peer (2017) who perceive digital journalism as a combination of traditional journalism with user-generated content and user-user interactions. The user-generated content relates for example to comments posted by users. It is a user interacting with the producer and content of a specific piece such as a news article, and is a basic form of feedback (Ksiazek et al., 2016). User-user interactions relate to those posting comments in response to one another. Two or more users interact with one another and this creates conversations and dialogues between them (Ksiazek et al., 2016). Both forms of engagement demonstrate individuals reacting to the content presented to them. 'Making the decision to publicly contribute your reaction or opinion in response to the story indicates an individual that is more invested, aware, and attentive—in other words, more engaged—with the content' as opposed to one who only reads the story (Ksiazek et al., 2016: 505). Comments provide a means of allowing the audience to participate in a discussion about current events as well as offering competing headlines and interpretations to the news article (Ksiazek, 2018). Each comment is 'anchored in somebody's present in the sense that it signifies a more or less immediate reaction to the reading of an article and/or preceding comments to this article' (Bødker, 2017: 60). Therefore, comments provide an opportunity for engagement and self-expression. The interactive nature of online news can potentially enable participants to engage in dialogue and discussion in an accessible and visible manner. Comments may be supported, challenged or ignored. As Loosen and Schmidt (2017) contend, traditional reporting can be enhanced by user comments, with those posting able to question the perspective of the journalist, provide their own opinion, and ask questions. Comments provide readers with alternative and diverse perspectives from commenters who could be anywhere in the world. These views can often be opposite to those which appear as the official consensus provided by experts in the news articles (Turner, 2013). This can be a problem with expert knowledge. Responsible journalists explain expert knowledge in terms in which the news reading audience can understand. By doing so, expert knowledge is made accessible, and legitimate claims are distinguished from those which are false. In contrast, the comments section 'which is open to anyone, has no filters, and allows false and misleading attacks on experts and assertions of fact that conflict with expert knowledge' (Turner, 2013: 162). There is also a blurring of the boundary between production and consumption. Loosen and Schmidt (2017: 357) argue that digital journalism has 'introduced a conversational mode into the journalism-audience relationship by providing communication channels and spaces that afford direct interaction, whether dialogue- or conflict-oriented'. This illustrates how different perspectives on news events can be received by online media users simply by viewing various news organisation websites or by reading people's opinions in the comments.

One consideration to be taken into account is that digital journalism and digital consumption are still evolving, and so too are the definitions. Malik and Shapiro (2017: 22) propose that 'digital journalism may be recognised by the presence of *some combination* of interactive engagement, author-audience collaboration, contingent publication, resilient impact, and global reach'. However, digital journalism and digital consumption can be considered disruptive compared to the traditional media forms such as print and broadcast. The interactive nature provides a site for implementing struggles over meanings. Whilst news organisations have always informed the audience of what is new, commenters are also able to do this now, along with contesting the ideas presented by journalists.

A final point to note is the relationship between digital technologies and science. The internet and platforms such as below the line comments, blogs, Facebook, and Twitter have enabled a more apparently diffuse conversation about science. As a result, these platforms perform a role in dispersing trust and authority in relation to scientific expertise. ‘They provide a forum in which issues that matter to people, but which pass the mainstream media by, can be kept alive. They also create a space in which ideas can grow and participants can acquire the confidence to step outside their comfort zone to campaign and complain’ (Henderson, 2012: 120). Media needs to be considered ‘both as technologies including infrastructures *and* as processes of sense-making, if we want to understand how today’s social worlds come into being’ (Couldry and Hepp, 2017: 5, emphasis in original). In order to make sense of, and understand scientific issues, individuals will draw upon a bank of cultural descriptions, meanings, metaphors and images (Hansen, 2009). Being online enables those with similar interests to find one another and enables them to spread the message they wish to promote. Additionally, these platforms are able to provide a collective public voice, and this appears to be becoming more powerful (Henderson, 2012). As Stilgoe et al. (2014) argue, these types of activities are not formal engagement processes but are ones which should not be ignored or discounted. Research into online communities may provide useful insights into science and the values held by interested publics. A further point stated by Stilgoe et al. (2014: 8), is that we should think of the public ‘less as a pre-existing entity and more as a space within which publics selectively form around technoscientific objects and matters of concern’. This appears to be especially relevant with online communities. Jasanoff (2014: 24) contends that ‘people in the twenty-first century certainly need to understand many basics of science, but what they need to understand more urgently is when to accept scientific consensus, when to trust experts, and when to assert values that seem contrary to those held by scientists’.

This section considered the definition of journalism and how this relates to the digital landscape. Digital journalism and consumption enables interaction to take place, with the audience participating by posting comments, and sharing on Twitter for example. However, this interactive nature enables the audience to be exposed to a range of viewpoints and opinions. The focus now turns to claims-making on online news websites.

Claims-Making and Online News Websites

The issues which make it onto a news organisation's agenda often do so because these matters are considered problematic. Many journalists like reporting conflicts because it provides the opportunity for making the powerful uncomfortable (Schudson, 2008b). The practice of journalism as it currently operates, is one which rhetorically at least 'offends powerful groups, speaks truth to power, and provides access for a diversity of opinion' (Schudson, 2008b: 54). In terms of conflicts, Spector and Kitsuse (1973: 146, emphasis in original) define social problems as '*the activities of groups making assertions of grievances and claims to organisations, agencies, and institutions about some putative conditions*'. The use of putative is to 'emphasise that any given claim or complaint is about a condition *alleged* to exist, rather than about a condition whose existence we, as sociologists, are willing to verify or certify. That is, in focusing attention on the claims-making process, we set aside the question of whether those claims are true or false' (Spector and Kitsuse, 2001: 76, emphasis in original). The important point to note in this statement is that of an *alleged* condition. It is the alleged conditions which are the focus of attention with social problems. The emergence of a social problem depends on defining a putative situation or condition as a problem, and removing, altering or improving that situation or condition. From Spector and Kitsuse's definition emerged the terms, claims, claims-maker, and claims-making (Best, 2002). Social problems became relevant *only* if they are subject to claims-making.

It is the claims-makers who create and promote claims. ‘Claims-makers tend to be interested parties – individuals who stand to gain something if their claims are successful – but not all claims-makers have similar interests’ (Best, 2009a: 103). There are a number of types of claims-maker. These include:

1) Victims – these are people who feel mistreated, angry, or wronged. They wish to vent their grievances and may wish to seek compensation.
2) Activists – these people tend to be inspired and motivated by ideology and join causes they believe in.
3) Specialists – claims-makers can hire specialist people who conduct public relations and fundraising activities. They have the skills and experience to conduct claims-making activities.
4) Professionals – these are experts such as scientists, solicitors, and doctors who have the authority to speak about their respective discipline. When a professional is successful in their claims-making, they can potentially increase their power, status and wealth.
5) Pressure groups – these groups often influence government decisions. However, their claims may not always be visible as they frequently approach policymakers in private.
6) Officials – these are people in government positions. Their claims either protect their current standing on a social problem, or they seek to extend their influence. Some of their claims-making activities are conducted to achieve maximum publicity (adapted from Best, 2009a: 103-104).

Claims-making is always a form of interaction between one party and another about what is believed to be a social problem. Even if those who make the claim do not receive satisfaction, they possess the right to make their claim heard. According to Spector and Kitsuse (2001: 78), the ‘activity of making claims, complaints, or demands for change is the core of what we call social problems activities. Definitions of conditions as social problems are constructed by members of a society who attempt to call attention to situations they find repugnant and who try to mobilise the institutions to do something about them'. It is claims-makers who choose to emphasise certain aspects of a social condition. However, claims-makers do not just draw attention to social conditions. 'Claims-makers shape our sense of just what the problem is. Any social condition is a potential subject for claims-making, or rather for several kinds of claims-making. Each social condition can be constructed as many different social problems' (Best, 2009b: 8). All who participate in claims-making activities contribute to defining social problems.

Best (2009b) argues that claims-makers attempt to *persuade* their audience of a particular social problem and the solution they believe will solve that problem. The success of claims-makers depends on whether their claims persuade their audience. When there is a debate about a particular social problem, rival claims-makers will offer different characterisations about the debate, and the audience will need to decide who to believe. At times, the audience may be indifferent to the claims being made by the claims-makers.

Claims-makers convey their claims using *language* they believe is persuasive and which they consider their audience to find persuasive. 'Claims-makers may have occasion to address the converted – individuals belonging to or allied with their movement. At the other extreme, some audiences are resolutely hostile; a claims-maker may assume that they cannot be moved, regardless of how they are addressed. In between are the audiences deemed persuadable, those who might respond to the right appeal' (Best, 1987: 115). If the correct language is used by claims-makers, claims-making is likely to be successful.

From the perspective of this thesis, an important point is made by Hannigan (1995: 2) who argues, 'from a sociological point of view, the chief task here is to understand why certain conditions come to be perceived as problematic and how those who register this 'claim' command political attention in their quest to do something'. As already stated, there can be great diversity in the ensemble of claims-makers who promote a particular social problem. For this thesis, GM crops and foods can be viewed as a scientific, environmental or a health problem. Claims-makers may include scientists, governments, citizens, members of the environmental movement, farmers, and the food industry. In order for this type of problem to be successfully constructed by the individual or organisation making the claim, Hannigan (1995: 55) contends there are six factors which are required:

> 1) Scientific authority for and validation of claims.
> 2) Existence of 'popularisers' who can bridge environmentalism and science.
> 3) Media attention in which the problem is 'framed' as novel and important.
> 4) Dramatization of the problem in symbolic and visual terms.
> 5) Economic incentives for taking positive action.
> 6) Emergence of an institutional sponsor who can ensure both legitimacy and continuity.

Using an example of acid rain, Irwin (2001: 21, emphasis in original) describes how these six factors are used in order for claims making to be successful:

> *Assembling the claim* involved the scientific community but also Swedish government officials and articles in the press. All of these were important in building public awareness and, crucially, distinguishing acid rain from wider air pollution problems. *Presenting the claim* involved 'framing' the environmental problem in 'dramatic, even apocalyptic' terms – a process helped by the phrase 'acid rain' itself, but also images of 'dying' lakes and forests. Such a claim was then vigorously *contested*, since the evidence was partial and circumstantial rather than conclusive.

Hansen (2010) makes a convincing argument concerning the media in general. He contends it is the one arena where publics can discover what is occurring in the other important arenas of science, parliament and the courts. Without it, there would be a lack of information. 'While the traditional press still functions as the primary gatekeeper of public discourse, the Web has provided individuals with the opportunity to circulate information and opinion to worldwide audiences so quickly that journalists and politicians have, at times, been forced to react to those claims' (Maratea, 2008: 144). Innovations in communication technologies such as online comments, Twitter, Facebook, and blogs, have enabled an increase in the ease and speed in which ideas can spread. Claims can travel further and faster than ever before. Where some claims makers may have only been able to have their claims heard locally, these new technological innovations now enable these to be heard both nationally and globally (Best, 2015). These technologies also make 'it possible to mobilise support—through the ability to reach sympathizers, policy makers, and members of the press simultaneously—and gain mainstream media attention faster than is possible using more traditional claims-making methods' (Maratea, 2008: 144).

In respect of this thesis, online news organisations can be viewed as a 'key public arena, in which the voices, definitions, and claims of claims-makers (notably representatives of government, public authorities, formal political institutions, professional communities and associations, pressure groups, etc.) are put on public display and compete with each other for legitimacy' (Hansen, 2010: 39). However, the immediacy of engagement by citizens with online news stories should not be underestimated. Below the line comments enable users to 'not only comment on news …but they can point out inaccuracies and bring additional expertise and context to the stories' and in this respect 'the relationship between digital publishers and consumers is two-way' (Malik and Shapiro, 2017: 19). Therefore, below the line commenters should also be added to the list of claims-makers. Through the professional activities of the online news organisations, news making performs a role in constructing and framing both problems and the claims-makers. However, as the claims-makers have a voice if they are quoted in news articles, both they and news professionals can 'draw attention to particular interpretations through *selection* (e.g. our attention is drawn to some aspects while others, not selected, are kept out of view) and *salience or emphasis*, which promotes particular definitions/interpretations/understandings rather than others' (Hansen, 2010: 32, emphasis in original). The claims-makers in this thesis include some of the actors appearing in Figure 1.3 in Chapter 1.

This section has considered how problems come into existence once someone has made a claim and drawn attention to it. It has described how claims are made, as well as discussing how claims-making occurs in an online news setting. Attention now turns to the norms of journalism surrounding science news.

The Norms of Journalism: Objectivity and Balance in Relation to Science News

Science is afforded credibility by its examination from external sources, such as that which occurs with news coverage (Murcott and Williams, 2012). However, as McInerney et al. (2004) contend, citizens are restricted to news coverage that is the interpretation of scientific research made by journalists. As a result, citizens are only ever given a restricted overview of the research being carried out. Additionally, more complex pieces of scientific research require an increased level of translation by journalists so that it is interesting and understandable for readers (Hansen, 1994). According to McInerney et al. (2004), the scientist's original research becomes subjected to interpretation by the journalist who is writing for an audience with different interests and levels of education. In turn, the audience uses their own cultural background to interpret the meaning of the news article. These aspects mean the complexity of science sometimes gets lost in translation. However, translation is not only conducted by journalists. Weingart (1998) argues that when addressing journalists, scientists ensure results become less complicated, along with ensuring these are remarkable. Indeed, scientists may be encouraged to do so by the press and impact offices of universities and research institutions. For journalists writing about science, Maras (2013: 63) contends that the news article becomes ‘a form of professional communication, where journalists adapt information from one source (say a government report) to another (the reader)’. Dunwoody (1992: 98) also explains that ‘journalists will always behave differently from scientists. A good thing too. To lose the writer’s interest in detail or the ability to build rich tapestries from conversations with one or two individuals would doom us all to media accounts that are both dry and un-compelling’.

Murcott and Williams (2012) claim how the storytelling nature of the media, whether this be print or broadcast, can conflict with the manner in which science operates. Science is continually revised as more research and experiments are conducted. They also argue how a journalist writing a good story has to ensure it has a beginning, a middle and an end and this can be difficult when science still has questions to ask. According to Nerlich (2013), reporting science is just as concerned with telling a story as is it in revealing the facts. Scientific news stories have to entice people to read them in order to engage and entertain. The role of this storytelling falls to scientists, journalists and public relations staff. Suitable science stories can be difficult for journalists to obtain, because often routine science is not deemed to be newsworthy as it does not have the spectacle that will generate attention-grabbing headlines. However, scientific events which are valued by journalists are those which enable them to illustrate how science impacts on daily life (Allan, 2009).

Murcott and Williams (2012) argue that the most important person to convince a story is worth publishing is the editor, as they are the gatekeeper to the audience. If they are not convinced, the story is not going to be published. This then leads on to why a science story should be published. It has to have importance and be of significance. An editor may overrule a journalist on scientific stories even if the editor has less experience and knowledge than the journalist (Amend and Secko, 2012).

According to Fahy and Nisbet (2011: 790), science journalists cover 'critically the scientific community itself, new scientific findings, challenges to scientific knowledge, science policy claims and, indeed, science journalism itself'. In recent years, science journalism in particular has been declining. The number of specialist science journalists has been decreasing and much of the science news is now written by non-specialist journalists (Murcott and Williams, 2012). This is due to a number of major news organisations making cuts to staffing levels in science journalism. In addition to this, Murcott and Williams (2012) also raise two further points. Firstly, they argue that a large percentage of science news reaches journalists from the public relations (PR) departments of organisations which are highly resourced and professional. These organisations include biotechnology, pharmaceutical and energy industries, along with universities, research councils, government departments, pressure groups, charities and specialist science publications. These press releases can be easily reproduced into a news article by a non-specialist journalist. Secondly, as the obtaining of science news is outsourced to PR departments, science becomes more difficult in being held to account by journalists. The power has shifted from journalists obtaining news stories, to the PR departments releasing items they wish to see covered by the press.

Journalists also believe scientific research is of good quality if it has been published in a respected peer reviewed journal or presented at conferences. It is therefore of a reliable standard to appear in a news article and there is no need to question it (Weitkamp and Eidsvaag, 2014; Conrad, 1999). However, Nichols (2017) illustrates how believing all that is published in scientific journals can be troublesome for journalists. He describes how a journalist called John Bohannon posed as a scientist named Johannes Bohannon, and submitted a paper to a journal which was duly accepted and published on how chocolate is good for you. The journalist wanted to illustrate how news headlines concerning diets could be influenced by bad science. This also demonstrates the fallibility of the peer review process of academic papers. Smith (2006) describes how the BMJ conducted studies, whereby errors were incorporated into papers to ascertain if peer reviewers detected them. None of the reviewers spotted all of the errors, and some reviewers did not detect any. This illustrates how peer review can be quite poor at uncovering flaws or even fraud in academic papers. The situation with the reviewers is also similar to the production of truth by journalists. When journalists are unable to confirm the truth of the facts presented to them, they will often present ‘both sides of the story’ in a news article. It then becomes the responsibility of the reader to determine which ‘fact’ is correct (Tuchman, 1978). By presenting alternatives, journalists are able to release themselves from ascertaining the truth surrounding ‘facts’.

Science can be viewed as being distorted when the journalistic norms of balance are applied, and therefore, the minority view of science can receive more credibility and authority. An example provided by Murcott and Williams (2012) is the representation of the MMR (measles, mumps and rubella vaccine) and the link to autism that was given in a statement by Andrew Wakefield. A large number of researchers in the area disputed any link, and only a small minority accepted there was a link between the vaccine and autism. The balance given in the news coverage showed both sides of the argument as having equal claims to expertise and evidence, when this was not actually the reality of the situation. The Andrew Wakefield case also played out further. Godlee et al. (2011) describe the events which unfolded. The research paper which reported the link between autism and the MMR vaccination was published in the journal, the *Lancet* in 1998. It was authored by Andrew Wakefield and twelve others. At the time, Andrew Wakefield was working at the Royal Free Hospital and Medical School in London. When the scare surrounding the vaccination escalated, the journalist, Brian Deer, began investigating the research paper in 2004. Deer found evidence of misrepresentation and falsification. The General Medical Council discussed the paper and specifically focused on whether the research was ethical. They found him guilty of wrongdoing and he was stripped of his academic and clinical credentials. The research paper was finally retracted from the Lancet twelve years after it was initially published. What is telling in this situation is once again the fallibility of peer review. It took a journalist to uncover the misrepresentation in this research paper. These issues should have been discovered during the peer review process. Although the unbalanced news coverage may have given the views of Andrew Wakefield traction initially, it was investigative journalism which revealed the extent of the wrongdoing.

News values also play a role in news coverage. According to Allan (2009), news values are determined by individual journalists and their assumptions on whether a story is news worthy. These are filtered for example, through their professional training, the commercial pressures of the newsroom and editorial positions. He also claims that news values are constantly changing due to the specific nature of the circumstances being reported. In their study into the media coverage of BSE and salmonella in eggs, Macintyre et al. (1998: 236) found there were five news values, and these were 'scientific advances, divisions among experts, matters of state, division in the government and government suppression'. In respect of the salmonella study, these news values involved the resignation of a Government Minister; suspicions that the true extent of infection in poultry was suppressed by Government; and disagreements amongst experts and apparent conflicts of interests between the Department for Health, the Ministry of Agriculture, Fisheries and Food (now DEFRA), and the egg industry.

In respect of science stories, Conrad (1999) argues that the journalistic norms of balance and objectivity are used when a story is controversial. He argues this is most evident when a journalist presents the implications of research as opposed to the actual science. However, the problem with balance which concerns Murcott and Williams (2012), is the idea that the inclusion of balance in a story by a journalist may inadvertently distort the views of scientists or the scientific research which is being conducted. The use of quotes by scientists is also a way in which legitimacy can be added to news stories by journalists. For Conrad (1999) there are three pertinent points:

1) The use of a quote by a scientist is one way of legitimising the scientific research being conducted and the benefits this will confer.

2) The naming of a scientist and the institution they are associated with are significant aspects to a science story. These two details are important in distinguishing the person as an expert.
3) Including quotes by scientists can serve three purposes. Firstly, they may be used to assist with the angle the journalist has taken with the framing of the story, or they may provide credence. Secondly, if two scientists have differing opinions, the quotes illustrate the opposing viewpoints. Thirdly, these help set the context, provide balance, and convey the benefits or consequences of the research.

A study by Allan et al. (2010), found that scientists are developing a greater understanding concerning the importance of news coverage in determining how the public perceive science. This awareness has led to scientists being aware of the need for managing public trust through the representation of science in news coverage. An important point is made by Anderson et al. (2012), who state public opinion is influenced by the portrayal of science in the media and this may impact on which institutional actors are considered trustworthy. Maras (2013: 62) argues 'it is intellectuals that have the greatest access to facts, and that the journalists and experts are educators of the audience. In effect, what is handed down is a dialogue between experts on facts to audiences, leaving audiences on the outer. A conversation with the public falls by the wayside'. Audiences are left on the outside because news articles only pass on facts from experts. There is no dialogue between experts and citizens.

Whilst an academic expert is well versed in the literature of their particular field and has carried out a substantial amount of research, journalists view experts as those who are knowledgeable about real world situations. According to Steele (1995), the view of expertise by a journalist is very different from the definition of an academic expert. The experts chosen by journalists can have political or biased perceptions and these are not always highlighted by the news organisations (Steele, 1995). Therefore, this aspect can be hidden from the audience. Journalists use experts because experts 'provide opinions, and, in so doing, detach the reporter from any values or conclusions implicit in the story' (Steele, 1995: 801). Schudson (2008b) believes the use of official sources allows the agenda to be set by those in authority and this limits public discussion. However, he goes on to say that if journalists provide a wide range of views, ideas and beliefs, then citizens can consider these alternatives. In addition, Steele (1995) argues that the criteria used by journalists to select experts, affects the journalistic norms of objectivity and balance. This often involves journalists attempting to pair experts together who have opposing views in order to achieve balance in news coverage. However, the extent to which this is achieved depends on factors such as how narrowly focused news coverage is. Additionally, the use of experts with controversial opinions can be used to improve ratings. This is because the profile of news stories can be raised if they are more newsworthy and likely to attract attention.

Journalists also use experts to provide news stories with authority and legitimacy. Experts are often asked to describe the actors, explain policies, and predict what may occur in relation to a particular news story. In certain news articles, journalists will use both experts and non-experts. Allan (2002: 95) claims 'the media process certain voices as being self-evidently 'expert' or 'authoritative' while simultaneously framing others as lacking 'credibility''. Indeed, this juxtaposing automatically gives experts more credence as they are seen as having a full understanding of the issue. The inclusion of the institution of which they are associated with also increases the expert's authority. In contrast, the non-expert immediately lacks the credentials which signify authority. Therefore, the validity of any statements made by the non-expert may be viewed by the audience as being less significant than those made by the expert.

Objectivity and balance, and the use of experts in controversial science is not something new for environmental journalists. As Fahy (2018: 856) contends, 'since the specialism was formed in the 1960s, environmental journalists have reported on science and policy issues where facts are contested, where facts and values are entwined, where expertise is challenged, where credibility is crucial, where uncertainty is manufactured, where audiences seek out information that conforms to their existing beliefs, and where issues involve deep ideological division'. Fahy (2018) goes on to explain how environmental journalism has already addressed some of the problems arising with journalism in a 'post-truth' age (see earlier in this chapter for a definition of this term). Firstly, since the 1960s, environmental journalists have tended to favour advocacy journalism as opposed to objective journalism. Advocacy journalism presents the news from a particular point of view, is motivated by a social or political agenda, and does not separate fact from values. Secondly, environmental journalism has addressed the issue of balance. Many journalists no longer apply balance to their news stories, instead favouring the use of weight-of-evidence reporting (see below for an explanation of this). Thirdly, environmental journalists have to decide on how to report controversial issues. Scientists who examine controversial issues from different disciplines, all produce valid scientific facts. Therefore, scientific evidence can be used to support a variety of positions on a problematic issue. A final point made by Fahy (2018: 860) is that 'other journalists can learn from environmental reporters who reassessed objectivity as they moved to weight-of-evidence reporting, broke the binary between objective and advocacy journalism, and reported on public controversies that involved evolving scientific evidence, deep political division, and fractious public debate'.

Weight-of-evidence reporting requires journalists to provide the audience with contrasting points of view and to report these accurately. However, the journalist also has to determine the majority consensus in respect of evidence and report that to audiences (Dunwoody, 2005). As Dunwoody and Kohl (2017: 341) describe, 'a weight-of-evidence narrative offers audience members the array of existing truth claims about an issue but then, importantly, makes clear how experts are distributed across those claims', however, the 'effect's success relies on audiences' willingness to trust expert claims'.

As well as the change in reporting outlined above by Fahy (2018), the rise in digital platforms is impacting the work of the remaining science journalists. According to Fahy and Nisbet (2011), the traditional functions and practices of science journalists are changing and are now:

1) Shifting from a transmission view
2) Becoming critics and cartographers
3) Reporting the process of science
4) Adopting dialogical journalism
5) Co-opting the blog movement (adapted from Fahy and Nisbet, 2011: 784-786).

Dunwoody (2008: 23) adds to this argument, and she states that producing stories for news organisations online has changed a science journalist's working environment in a number of ways:

- The channel requires not only strong narrative skills, but also equally strong visual ones; science journalists must become increasingly multimedia in nature;
- The speed of the internet will make timeliness an ever greater priority in the news business; quick turnarounds do not nurture storytellers but, instead, require journalists who relish the 'signaling' capability of the business;
- The reliability and validity of science stories will come under increasing scrutiny as readers exercise their ability to seek out multiple narratives about the same topic.

These points all have implications for science journalists. The hourly production cycles for online news do not align with the time periods required for the production of scientific knowledge. Science journalists are required to produce news stories which include only elements of the process of scientific developments, and they have to hope their readers are able to piece these together to form an overall picture (Dunwoody, 2008).

Following the shift to digital platforms, scientists, activists, and citizens can now actively contribute to news. This means ‘online science news and content has the potential to be highly participatory, social, and collaborative’ (Fahy and Nisbet, 2011: 782). However, science journalists are no longer privileged purveyors of scientific findings and developments. Also, citizens are not necessarily listening to experts, and as was described in Chapter 2, there is a decline in the trust in expertise. Nichols (2017) believes citizens remain ignorant and uniformed about what is happening in the world, along with rejecting news and the opinions of experts because of the availability of too much news. The abundance of different judgements, views, and beliefs, is challenging for citizens to comprehend. It is easier for citizens to disconnect from what is happening in the world as opposed to attempting to understand it.

The section considered how science is reported in news articles. It explained how journalists enable science stories to be accessible to a wide audience. However, in doing so, the scientific facts which are described in Chapter 2 can be distorted. The use of scientific experts can add legitimacy to stories. This section described how the work of science journalists is changing in respect of objectivity and balance, as well as with the rise of digital platforms. The section also focused on how journalists select the experts which appear in news articles, along with the reasons for doing so. Experts provide balance to news stories along with credibility. The inclusion of an institution’s name increases the authority of an expert. However, as the next section will show, those stories which involve risk also include many other stakeholders, as well as scientists.

Risk and Science in News Coverage

Disagreements between stakeholders have often been connected to risks associated with GM food. There are stakeholders who have concerns about the harm caused to the environment such as loss of biodiversity, whilst others worry about the dangers of consuming GM food. According to Tulloch and Zinn (2011: 3) the 'decision makers' perspective of risk communication originally followed an instrumental view of the media, as a tool to deliver the right knowledge, via expert interpretation of the world, to the public, assuming that public opinion about risk is mainly influenced by the quality of news coverage'. They also argue that from this perspective, news organisations can be criticised for overstating and exaggerating risks.

Although Beck's work on the risk society (1992) is important, criticisms have been levelled at his writings concerning media in the risk society. Cottle (1998: 6) argues that Beck's views on the media are at times 'uneven, underdeveloped and contradictory' and his thoughts 'remain scattered across his writings and often appear to play a metaphorical role'. According to Tulloch and Zinn (2011), they believe there are three limitations associated with Beck's *Risk Society* theories in connection with the media. These are outlined below:

1) The media is presented as being homogenous and the theorising does not account for the numerous levels, inconsistencies and disagreements in existence.

2) Little is written on the practices used by media in the construction of risks. Furthermore, there is no acknowledgement that 'risk' may have different meanings, depending on who is using the term.

3) The historical changes associated with journalism and media, and the impact this has had on the reporting of risk, is not adequately acknowledged.

However, Beck does raise some pertinent points and these are discussed further. Beck (1992: 23) argues that risks can 'be changed, magnified, dramatized or minimised within knowledge, and to that extent they are particularly *open to social definition and construction*. Hence the mass media and the scientific and legal professions in charge of defining risks become key social and political positions'. Risks and scientific knowledge usually appear in news coverage when these risks are likely to impact citizens or a controversy arises. The attention drawn to these possible threats allow citizens to become aware of issues (McInerney et al., 2004). In terms of a controversial science, the scientific discourse 'rarely if ever remains the dominant discourse for very long, but is soon competing with a wide array of different discourses: economic, legal, political, moral and so on' (Hansen, 2016: 765).

According to Beck (1995), it is the media which allows risks to be highlighted to citizens. Without this mechanism, institutions could conceal hazards which they do not wish the public to know about. He also argues that reporting risk is an attraction for journalists because there is the potential for headline news to be produced that will attract readers' attention. Therefore, whilst news articles highlight risk to the audience, there is an underlying motive of attracting an increase in readership by news organisations.

The weaknesses described above in connection with risk and the media, have been acknowledged by Beck. He writes that whilst he has written about 'the key significance of the mass media in the risk society' this has been 'only with bold theories', and he goes on to explain how 'this is clearly not sufficient given the significance of the subject and is to be attributed to my limitations alone' (Beck, 2000: xiv). He writes about his understanding of the media and explains the following:

> First, risks are usually uncovered not within, but outside the institutions that bear responsibility in the economy, science and

> politics. Second, the mass media play a decisive role in this, with their portrayal of conflicting definitions of risk, that is, their representation, or construction, of risks and uncertainties. As the uncovering of risks and uncertainties usually involves complex arguments, and because risks are not perceptible by the senses in everyday life, the public eye of the media takes on a key significance in the risk society (Beck, 2000: xiii).

As a result of the critiques surrounding the lack of media attention to the risk society and Beck's own acknowledgement of weaknesses, these have been considered in respect of this thesis. Whilst his work is drawn upon in respect of risk, this is supported with literature from media scholars such as Allan (2002, 2009), Maras (2013) and Schudson (2008b). This I believe addresses any shortcomings which may have resulted from using Beck's work in isolation.

It is worth considering Beck was writing the above at a time when the plethora of digital platforms did not exist, and the internet was still in its infancy. Nevertheless, Tulloch and Zinn (2011) argue how those theorising risk often consider the media to be homogenous, and disregard the different entities it consists of. These range from the traditional, including broadcast (television and radio) and print newspapers, through to the Internet, with search engines, online editions of news organisations, platforms such as Facebook and Twitter, blogs, and YouTube. These various forms of digital media can be related to an important point raised by Beck (2000: xiv), in that 'the risk society can be grasped theoretically, empirically and politically only if one starts from the premise that it is always also a knowledge, media and information society at the same time —or, often enough as well, a society of non-knowledge and disinformation'. This is especially pertinent in an era of 'fake news' and 'alternative facts', which can be accessed from any number of outlets. The relationship between risk and the media is further alluded to by Tulloch and Zinn (2011: 1), who contend how 'attempts to bring these two 'risk and media' fields together have been only sporadic'. Additionally, they also argue that research would benefit from understanding how grand theories are grounded ‘in everyday processes of news production rules and meaning-making practices’ (Tulloch and Zinn, 2011: 13).

With risk reporting, Allan et al. (2010) argue that news coverage often involves different sources because of the various stakeholders involved in an issue. They believe scientists are one of the key stakeholders to determine risk, and therefore, they are able to influence the agenda and the debate. As discussed previously about the decline of expertise, the response to risk reporting is a problem associated with the rejection of scientific expertise. Grove-White (1998: 50) argues that the ‘mounting reliance of everyone in modern society on the judgements of ‘experts’ is paralleled by the growing ability of many of us, reinforced by modern media, to deconstruct political reassurance couched as scientific or technical ‘fact’’.

By reporting risks, there is a requirement on the part of journalists to interpret risks so the audience understands. This is especially true with scientific perspectives of risk as the use of scientific terminology could make risks appear incomprehensible to the reader (Allan, 2002). He also argues that often journalists will write news accounts which show risks remaining uncertain until further scientific research is conducted. In this respect, it is science which will resolve risks even if it is science which created them. This type of reporting not only illustrates how important science is deemed to be to society but also the reliance placed on it.

This section examined how the risks associated with scientific developments are reported in news articles. Risks and scientific knowledge often appear in news articles when a controversy arises. Citizens are also likely to turn to news coverage to understand the issues when controversial situations arise. The controversial nature of GM foods has meant previous work has been conducted into media coverage of this issue. In the final section, previous research involving the coverage of GM food in the media is discussed.

Previous Research of the Coverage of Genetic Modification in Newspapers

Various studies of the coverage of genetic modification in newspapers have been conducted. Bauer (2002) examined newspaper coverage of biotechnology in the UK from 1973 to 1999 using cultivation analysis. The results can be briefly described as follows. During the 1990s, the British publics' salience of biotechnology increased, and there was the emergence of the RED-GREEN contrast in biotechnology. This separated biomedical applications from food applications, and red was viewed as positive, whilst green was seen as negative. The UK elite press cultivated this contrasting representation of biotechnology, and helped shape public opinion. Controversies surrounding GM foods and crops, and cloning in the mid-1990s put green (food applications) into a negative light and red (biomedical applications) into a positive light. Negative items and events received more news coverage and public attention than those which were positive. In the case of GM crops and foods, the negative representations were food safety and environmental impacts.

Flipse and Osseweijer (2012) examined newspaper coverage in the English written press from January 1998 to December 2004 in respect of three case studies. These case studies were Monarch butterflies and GM corn, GM potatoes, and StarLink corn. The three cases studies were analysed to determine how they fit with the Down's issue attention cycle. The results can be briefly described as follows. There was a large increase in the number of news articles about the Monarch butterfly and GM corn in the period the initial journal article by John Losey was published. A gradual decrease of news articles was observed until a minimum was reached three years later. In respect of the GM potatoes, there was an increase in attention around February 1999, followed by a gradual decrease in news articles. In respect of the StarLink corn, there was an immediate media response when the Genetically Engineered Food Alert (GEFA) released a report in 2000. A gradual decrease in news articles was observed and when scientific evidence was released, media coverage was already at a minimum. What was common with all three cases, was the event generated increased media attention, which then gradually decreased to a minimum over the course of several years. A year after the first decline in media attention, scientific data emerged which either substantiated or invalidated the claims made by journalists which initially generated the media hype.

In their study, Marks et al. (2007) examined newspaper coverage in The Times, The Sunday Times (UK) and the Washington Post (USA), in respect of medical and food applications of biotechnology. The sampling time frame was 1990 to 2001, and in total, 750 news articles were obtained for medical applications of biotechnology, and 1,251 news articles for food applications of biotechnology. Content analysis was used to analyse the data. The results can be briefly described as follows. Newspaper coverage distinguished between the different applications of biotechnology. In both countries, medical applications were portrayed more favourably than food applications. Following the cloning of Dolly the sheep in 1997, news coverage followed the debate about human cloning, but this was more contentious in the USA than in the UK. News coverage relating to StarLink corn, Monarch butterflies, and GM canola were negatively framed. Information on possible risks and negative events such as a decline of Monarch butterflies, drove the framing of certain issues. However, the cloning of Dolly the sheep was framed more negatively in the USA than it was in the UK.

Hornig-Priest and Ten-Eyck (2003) examined newspaper coverage of biotechnology from fourteen European countries, Canada and the USA. Content analysis was used to analyse the framing of the news articles. Hornig-Priest and Ten-Eyck (2003: 31) state:

> Eight frames were developed to help categorize the articles. These included 1) progress – includes discussions of how the technology is an extension of science or a debate over its efficiency and effectiveness, 2) economic – which includes discussions of financial

> developments around new drugs and crops, 3) ethical – encompasses concerns with the role of humans in developing new species, the role of the church in these debates, and so forth, 4) Pandora's Box – arguments that if this kind of technology is released into the environment it will only bring evil, 5) runaway technology – contentions that if this technology is started humans will not be able to stop or control it, 6) nature/nurture – concerns with designer babies and other species of animals and plants, 7) public accountability – if something goes wrong, who will be responsible?, and 8) globalization – questions regarding dependency of some nations on those nations where the technology is being developed.

The results of the study can be briefly described as follows. In eleven of the sixteen countries, the progressive frame was the most commonly used. This was followed by the public accountability frame and then the economic prospects frame. Although the progressive frame was the most commonly used, it was not equal across issues. In Europe, 60% of articles concerning medical issues used the progressive frame whilst 30% of agriculture and food articles used this frame. In Canada, 63% of medical articles used the progressive frame, and 36% of agriculture and food articles used this frame. In the USA, 64.5% of medical articles used the progressive frame whilst 50.6% of agriculture and food articles used this frame. In all of the countries, medical applications of biotechnology were framed as progressive more often than agriculture and food applications. In Europe, 11% of agriculture and food articles used the Pandora’s Box frame whilst 3% of medical articles used this frame. 4% of agriculture and food articles used the runaway frame whilst 3% of medical articles used this frame. In Canada, the runaway frame was not used in any medical articles, but was used in 3% of articles for agriculture and food. The Pandora’s Box frame was used in 3% of medical articles and 15% for agriculture and food articles. In the USA, the runaway frame was used in 2% of medical articles, and in 9% of articles for agriculture and food. The Pandora’s Box frame was used in 3% of medical articles and 8% for agriculture and food articles.

Vicsek (2013) examined the newspaper coverage of GM crops and foods in four daily newspapers in Hungary from 1 May 2007 to 31 October 2009. Both quantitative and qualitative analyses were conducted. The quantitative analysis established the articles as belonging to 1) a PRO-GM frame category, 2) an ANTI-GM frame category, 3) both frames category (where neither frame was dominant), 4) neither frame was present. A qualitative frame analysis was also conducted. The results can be briefly described as follows. In respect of the quantitative analysis, of the 196 articles, 107 employed the ANTI-GM frame, 27 employed the PRO-GM frame, 43 employed both frames, and 19 had neither frame. The qualitative analysis examined in greater detail, aspects of the ANTI-GM frame and PRO-GM frame.

In respect of the ANTI-GM frame the results were as follows:

- GM crops were risky and disadvantageous.
- Actors responsible for introducing GM crops were agricultural biotechnology companies, the World Trade Organisation, the USA, and the European Commission.
- Research into the safety of GM crops and foods should be conducted by independent researchers who were not financed or influenced by the GM lobby.
- The Hungarian public were against GM foods because of a lack of adequate research, and the unknown long term consequences to human health and the environment.
- Benefits to be gained by agricultural biotechnology companies were framed negatively.
- Genetic modification of food represented the negative status of the globalised, modern world.
- Images included in the articles depicted damaged crops, protest actions, or experts, activists, politicians, and celebrities who were opposed to the introduction of GM crops and foods.

- Research results which did not find any risks associated with the introduction of GM crops and foods were biased and under the influence of the GM lobby.

In respect of the PRO-GM frame the results were as follows:

- Regulatory and policy obstacles stood in the way of scientific advancement.
- Biotechnology scientists should be allowed to conduct research into GM crops. Regulations should allow GM crops to be cultivated and sold more extensively.
- Genetic modification should be allowed as it could produce more food combatting hunger, contribute to curing certain illnesses, and crops resistant to disease, drought, or insects, could be bred providing higher yields and profits.
- Benefits to be gained by farmers and consumers were framed positively.
- Genetic modification was narrowly defined as a controversial procedure which was allowed in some countries but not in others.
- Images included in the articles depicted crops and pictures of scientists with test tubes, and images of scientists who promoted GM crops.
- Research which emphasised risks was seen as inadequate or not of a high enough research standard. Research which was positive about GM crops was seen as being of international standard and the results were accepted.

The study conducted by Maeseele (2015) examined the newspaper coverage of agricultural biotechnology in five Belgian newspapers from 1 January 1998 to 31 December 2007. Five case studies were analysed using critical discourse analysis. The results can be briefly described as follows. The first case study examined new approvals and new applications from January

1998 to June 1998. GM products were constructed as a scientific matter. The science of genetic modification was reliable and consensual, and government, industry, and university scientists defined science and how it operated. Individuals from institutions with recognised authority legitimated knowledge claims, and the implicit scientific certainty associated with genetic modification underpinned policy decision making. The second case study examined the Swiss referendum in June 1998. The authority of scientists and the institutions they worked for were legitimised by their use of facts, their positions of importance, and the role they played in economic prosperity. Opponents to genetic modification had no credentials, and there was a homogeneous public who were constructed as ignorant and easily manipulated by the opponents. The third case study was of The Pusztai Affair during August 1998. De Standaard and De Morgan both stated his work was the first to show GM foods could cause health problems. Both news organisations provided balance in the stories by using sources who reaffirmed the safety of GM foods. De Standaard and De Morgan also ran stories which focused only on Dr Pusztai and delegitimising his research. The fourth case study was of The Pusztai Affair during February 1999. The De Morgan news articles mobilised public concerns by concentrating on the uncertainties surrounding environmental, health and socio-economic risks. De Standaard chose to focus on 'sound science' by highlighting Pusztai's research as flawed. By doing this, Pusztai and his research were once again delegitimised. The fifth case studied examined the moratorium of the approval of GM crops in June 1999. De Morgan focused on the precautionary principle. The reporting was driven by values relating to social and global responsibility, and promoted sustainable development. De Standaard instead concentrated on free trade. The EU were constructed as standing in isolation by implementing the moratorium. This was based on political considerations as opposed to science.

In their study, Augoustinos et al. (2010) examined the newspaper coverage of GM foods over a 3 month period from 12 January 2004 until 11 April 2004 of six UK newspapers. They used critical discourse analysis to examine: negative constructions of GM crops and food; positive constructions of GM crops and food; widespread public opposition to GM crops and foods; the government; the science of GM farming; and biotechnology companies (adapted from Augoustinos et al., 2010: 102-109). The results for these six sections can be briefly described as follows. They found the negative constructions were associated with potential risks to public health and the environment. The positive constructions emphasized the potential of GM crops to alleviate hunger and food shortages in developing countries. However, criticisms were also evident which challenged this argument. The public were constructed as being opposed to the cultivation of GM crops, with statistics from the *GM Nation?* debate frequently used in the articles to reinforce the claims made. The government were constructed as being determined to proceed with the introduction of GM crops despite the public opposition. The press represented scientific evidence supporting the commercial growing of GM maize as inconclusive and problematic. Biotechnology companies were depicted as a powerful industry and a lobby group, who were able to apply political pressure not only on the government but also on the UK.

Cook et al. (2006) examined the newspaper coverage of GM foods from January 2003 until July 2003 of four UK newspapers. They also used critical discourse analysis. In contrast to Augoustinos et al. (2010) who examined the articles for the positive and negative constructions of GM food and crops and the key actors and stakeholders, Cook et al. (2006) studied the whole article. Their results can be briefly described as follows. The Times contained some pro-GM stories, but these were in the form of the public needing to be educated about science. There was little discussion of the political, cultural or historical aspects of the debate. The Guardian printed anti-GM articles and these contained the social and political contexts of the GM debate as well as highlighting the economic interests of those who funded GM technology. They also examined the use of some emotive words that were used by the newspapers. These included ‘scaremongering, hostile, irrational, lurid, feverish, evangelical, immoral, unscientific, ignorant, emotional and anti-science’ (Cook et al., 2006: 13). Whereas Augoustinos et al. (2010) did not carry out interviews to establish wider opinions, Cook et al. (2006) used both interviews and focus groups to solicit views. Participants for the interviews were people involved in the communication and assessment of matters relating to GM food technology. These included scientists, members of non-governmental organisations, a journalist and a politician. Those interviewees who were pro-GM saw the public as ignorant and not able to make informed decisions about the debate. Anti-GM interviewees saw wider contexts to the debate including social and political aspects. Finally, six focus groups were recruited to establish the views of the public. Most of the focus groups participants did not trust the scientists carrying out genetic modification, politicians or government departments such as the Department for Environment, Food and Rural Affairs. The biotechnology companies were viewed as only being interested in achieving profits. What was also interesting was that this study took place during the time of the *GM Nation?* debate in 2003. Whilst the interviewees were aware of this event taking place, participants in the focus groups were not.

Howarth (2012) examined four interventions concerning GM crops and foods, and the subsequent newspaper coverage in the UK. These were the interventions made by Prince Charles and Dr A Pusztai, the launch of newspaper campaigns, and the counter-attacks made by Tony Blair. Four newspapers were used in the study and these were The Daily Mail, the Daily Express, the Independent on Sunday, and the Mirror. 4000 articles were retrieved in the sampling time frame from 1998 to 2000, so the sample was restricted to editorials only. These news articles were analysed using discourse analysis. The results can be briefly described as follows. In June 1998, a letter by Prince Charles was published in the Daily Telegraph. The Daily Mail and The Daily Express stated the intervention was morally correct as Prince Charles was expressing the opinion the vast majority of citizens held about the introduction of GM crops and foods, and the speed this was occurring. Two months later, the research of Dr Pusztai appeared on television, and this claimed mice fed GM potatoes had suffered from reduced immunity and reduced growth. All four newspapers portrayed Pusztai as a scientist whose research had led him to question the

Government's certainty of the safety of GM foods, whose moral doubts questioned whether it was correct to allow citizens to consume GM foods, and his preference to avoid eating GM foods was made impossible due to inadequate labelling laws. The discourse revealed scientific uncertainty, moral doubt and consumer disempowerment. Science was no longer seen as authoritative and objective. In respect of the newspaper campaigns, The Daily Express launched their campaign in July 1998, with the other newspapers following. The agenda was threefold. Firstly, a revelatory agenda so that consumers were aware of the hidden dangers of GM crops and foods. Secondly, an educative agenda to address gaps in consumer awareness about the lack of choice in eating GM foods. Thirdly, an advocacy agenda calling for a change in policy in respect of a moratorium on the commercial cultivation of GM crops, and comprehensive labelling of GM foods. After the launch of the fourth newspaper campaign, the intervention by the then Prime Minister, Tony Blair, occurred. He launched a counter-attack in a news article in the Daily Telegraph. He accused the media of scaremongering, and that scientific facts were being turned into fiction. This misrepresentation of facts meant citizens were subjected to increased uncertainty. Blair also dismissed claims that the Government were putting citizens at risk, as the sale of GM foods and the cultivation of GM crops were only able to proceed once they had been tested and verified by independent scientists.

This final section has described the previous research which has been conducted concerning coverage of GM foods in newspapers. These studies used a range of methods to analyse data including cultivation analysis, case studies, the Downs issue attention cycle, content analysis, frame analysis, and discourse analysis. These different approaches and the reasons for not using these in this research (except discourse analysis) are discussed in Chapter 8 in the Learning from Practical Experience section.

Chapter Conclusion

This chapter has reviewed the literature in connection with the interfaces and interconnections between science and society. In particular, this has focused on the relationship between media and science. Previous research in connection with the coverage of GM food in newspapers has also been discussed.

In the chapters which follow, the lines of enquiry described in Chapters 2 and 3 will be explored empirically in connection with the online news articles and below the line comments relating to GM foods and crops. Chapter 5 will consider scientists and scientific progress; Chapter 6 will examine scientific expertise and political authority; and Chapter 7 will consider the expertise of non-governmental organisations and consumers. The next chapter will outline the methodology used in the empirical research.

Chapter 4: Methods

Introduction

This chapter discusses the methodological choices used to address the research questions outlined in Chapter 1. The chapter also outlines how the concepts discussed in the preceding discussion have been transformed into this empirical project. However, before discussing the approaches taken in the study, I first consider how quality can be assured in qualitative research. I then move on to describe the study, and I start with the sampling strategy. The discussion then proceeds to the qualitative data analysis which combined the use of two methods. Firstly, the use of a grounded theory approach as advocated by Charmaz (2014), which employs the techniques of coding and memo writing. Secondly, a discourse analysis drawing on theoretical concerns including expertise (Dewey, 2016; Giddens, 1991; Lippmann, 2008; Nichols, 2017), journalism (Maras, 2013; Schudson, 2008b), and risk (Beck, 1992, 1995; Douglas, 1992). This enabled connections to be drawn between the preliminary grounded theory results and the important theoretical concepts. The use of Computer Aided Qualitative Data Analysis Software (CAQDAS) in the study is also described, and the chapter concludes with a discussion of the use of the combination of a Grounded Theory approach and a Discourse Analysis in answering the research questions. Figure 4.1 provides a visual representation of the research process.

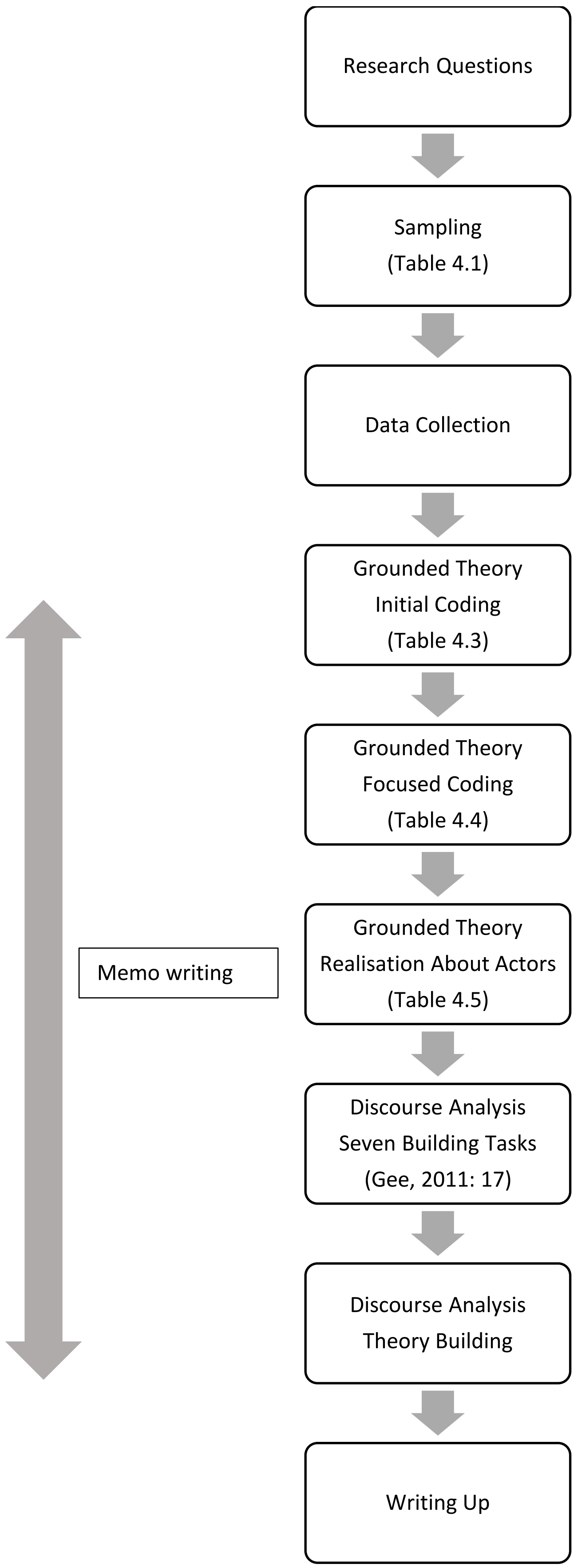

Figure 4.1 Visual representation of the research process

Quality in Qualitative Research

As Welsh (2002) and Crawford et al. (2000) argue, it is important that qualitative research and data analysis are conducted thoroughly and with transparency. According to Welsh (2002: 4), ‘qualitative data analysis has been regarded as akin to “impression analysis” because of the lack of detail and scrutiny on how the analysis process itself is carried out’. As Gaskell and Bauer (2000: 343) claim, ‘sampling, reliability and validity have served quantitative research well, but are just not appropriate for the evaluation of qualitative inquiry’. They therefore suggest guidelines which can be applied to qualitative research, and these include triangulation, reflexivity, transparency and procedural clarity. These will be explored below. Gaskell and Bauer (2000: 349) also contend that whilst these guidelines can help direct the research design, analysis and reporting of a project, they also serve to highlight ‘what any critical reviewer may ask of a piece of research, and a reminder to the researcher that appropriate steps have been taken to provide the necessary reassurance’. In addition, the use of CAQDAS allows for greater transparency. As Welsh (2002: 4) argues, ‘one of the main benefits of the advent of software in this area is that the practice of qualitative data analysis has been open to debate’. This is because software enables the process to be more organised, explicit and visible. The study addresses these quality criteria which are discussed in more detail below, as well as using NVivo to assist with transparency.

Triangulation

The use of more than one method to collect or analyse data can be viewed as method triangulation (Thomas, 2013). This approach was used in this study by combining grounded theory and discourse analysis, and the amalgamation of these methods are discussed later in this chapter. Analysing data using several approaches is advantageous. The different viewpoints enable confidence in findings or the conviction to reject an explanation (Thomas, 2013). According to Kushner and Morrow (2003: 32), the combining of different approaches such as grounded theory and discourse analysis enables ‘an effective means of bringing out the strengths and dealing with the limitations of each perspective. The benefits of this interplay derive simultaneously from a triangulation that is mutually corrective and synergistic’.

Reflexivity

According to Gaskell and Bauer (2000: 362), reflexivity is the approach in which ‘researchers should reflect upon their own practice’. Whilst being aware of the social construction of both the news articles and comments, I am also aware that I place my own interpretation on both the grounded theory and the discourse analysis. This position is made clear by Charmaz (2014: 17) who claims that in relation to grounded theory, ‘neither data nor theories are discovered either as given in the data or the analysis. Rather, we are part of the world we study, the data we collect, and the analyses we produce’. What I bring to the study also influences what I see. I am making assumptions about what is real, I have been educated and I possess knowledge. These are all factors which could influence the analysis of the data collected. Grounded theory enables us to produce an interpretation of the world as opposed to the exact depiction of it. This is the position I take in respect of both the grounded theory and the discourse analysis. As Charmaz (2014: 17, emphasis in original) argues, we ‘*construct* our grounded theories through our past and present involvements and interactions with people, perspectives, and research practices’. Reflexivity enables scrutiny of the research design, experience, analysis, writing, and decisions taken during the whole research process.

Transparency and Procedural Clarity

As Gaskell and Bauer (2000: 346) contend, ‘good documentation, transparency and clarity of procedures of data elicitation and data analysis are an essential part of quality research work’. In respect of this study, this was achieved through the use of CAQDAS, in the form of NVivo. For

Welsh (2002) and Gaskell and Bauer (2000), the use of CAQDAS enables a transparent and accurate data analysis procedure. By using NVivo in this study, I was able to periodically check the codes for the grounded theory, and if necessary, amend them. This ensured a strong foundation for commencing the discourse analysis. A final point which is made by Gaskell and Bauer (2000) is that the transparency of qualitative research can be ascertained for example, by a comprehensive description of the selection of materials, the method of data collection and an explanation of coding. This has been achieved with this chapter.

Sampling

The sample included what have traditionally been seen as the broadsheets (e.g. The Times), and tabloids (e.g. The Daily Mail). Table 4.1 lists each news organisation included in the sample, together with the number of articles and below the line comments associated with each one. The news organisations included in the sample were chosen because of their diversity of content. The broadsheets (see Table 4.2) generally are assumed to provide more in depth content, whilst the tabloids (see Table 4.2) tend to be more concise and simplistic.

News Organisation	Number of Articles (*n* = 73)	Number of Comments (*n* = 9,279)
The Guardian and The Observer	20	5508
The Telegraph and The Sunday Telegraph	14	1819
The Times and The Sunday Times	18	202
The Daily Mail and The Mail on Sunday	19	1750
The Mirror	2	0

Table 4.1 The number of articles and comments included in the sample for each news organisation (weekday and Sunday editions).

News Organisation	Category
The Guardian	Broadsheet
The Telegraph	Broadsheet
The Times	Broadsheet
The Daily Mail	Tabloid
The Mirror	Tabloid

Table 4.2 The news organisations and the associated category of newspaper type.

Having considered the news organisations included in the sample, the discussion now moves to the sample size and the sampling time frame.

The sampling time frame ran from 1 January 2015 until 31 October 2015, enabling a sufficient data set to be collected. It also enabled me to follow the journalistic constructions of GM food along with the comments for a period of almost a year. The sample gathered 73 articles and 9,279 comments from British online news organisations. The first articles in the sample focused on the legislation passed by the European Union to allow individual countries to decide if they wished to cultivate GM crops. It then continued throughout the following months with the last articles centring on the development of GM tomatoes.

Initially, I considered searching for the news articles by using the search function on the individual news websites. The search terms *GM food* and *genetically modified food* would have been used. However, I did not feel this was an effective approach for searching for the articles. This was because I could not tell if I was locating all of the articles which fitted within my sampling time frame. The news articles returned were those which were relevant to the key words, but this made the dates wide ranging. There was no option to select dates on the news websites' search functions.

I tried an alternative approach, and used Google Advanced Search to locate the news articles. Google Search was used by Dyjack et al. (2013), to locate news articles for their study of *Public Health Implications of Animals in Retail Food Outlets*, so this appeared an appropriate method to use. *GM food* and *genetically modified food* were both used as key word search terms. These were searched for using the 'all these words' option. The website address for each news organisation was put in the 'site or domain' option. The past year (from 1 January 2015) was selected for the 'last update' option. Once all this information was completed, the searches were conducted. However, searching for the articles in this way meant each news article had to be individually checked. This was to ensure it fit within the sampling time frame. In total, 104 articles were returned in the search. The articles were also screened for relevance. Some articles which appeared in the search were not appropriate for this project. These included articles concerning business news in connection with companies such as Monsanto and Bayer. Therefore, these were omitted, and the total number of articles relevant to the project was 73. In respect of the comments, those used in the study were those which were associated with the articles. Therefore, these did not have to be searched for separately. The number of comments included in the sample was dependent on the number of audience members who decided to post a comment. Audience members visiting The Guardian website appeared to be more prolific at commenting than those who visited other news organisation websites (see Table 4.1).

Overall, it was difficult to ascertain information about those who were commenting, such as age, gender, and occupation. The majority of those commenting used pseudonyms such as ‘Radical Rodent’ and ‘SteB1’. These pseudonyms enabled those commenting to do so anonymously. In this respect, there have been studies which have investigated the use of anonymity in the online comments sections of news organisations. Hille and Bakker (2014) conducted a study examining the differences in comments between the Facebook fan pages of Dutch news websites, and the comments sections of those same news websites. They found the comments on the Facebook pages were more civil and they believed this was because of the visibility to the user’s social network of friends and family. However, because of the anonymity associated with the news websites comments, these users provided more detailed comments and did debate between one another. At times though, these discussions became uncivil and this was attributed to anonymity. The role of anonymity was further alluded to by Rowe (2015) in his study on the posting of users comments on the Facebook page of *The Washington Post* compared to the comments section of *The Washington Post* website. He found there was a greater amount of civility between those using the Facebook comments as opposed to those interacting on the news website comment section. A further point is made by Hlavach and Freivogel (2011) about suppression of information, and they claim that whilst anonymity enables those posting comments to conceal their identity, this denies readers an important piece of information. Readers lose the ability to determine if the commenter is reliable, along with their motives. In my research, at times, commenters did include further information in the comments they posted. Some would state their occupation, as well as explaining why they considered they had the authority to speak about the topic. Where this information was available, it is included in the Results chapters. This I believe, is important information to include, because it provides context to the comments. It also indicates the basis of claims to authority and expertise depending on which occupations are revealed by the commenters.

On certain occasions, those posting comments would provide a link to other websites. For example, these could be to journal articles or blog posts. Each one of these was individually checked. Where the link still worked, the following details were noted: 1) the website name; 2) the URL (website address) of the link which was posted; 3) the date I accessed the website; 4) brief details of the website page you were taken too when using the link. These details were documented because those reading the comments could potentially be using the links and accessing the websites. For those links which were broken, it was not possible to access the websites. Therefore, it was not possible to ascertain what information readers could possibly be accessing.

The news articles and the comments which formed the data set, were collected and then saved into NVivo. This occurred once the time period for posting comments was closed. A full discussion on the use of NVivo follows later in the chapter.

When I first started this research, the intention was to also include data collection from Twitter, and to use tweets in the analysis. Twitter was used in the data collection, and in total, I gathered 7871 tweets. These were also coded. The majority of these tweets only stated the news article headline and provided some hashtags. As such, I did not find these very helpful in answering my research questions. This became apparent when conducting the discourse analysis. I therefore decided against including them in the research.

Documents

The news articles and the associated below the line comments are the data chosen to address the research questions, and are deemed to be extant documents. Extant documents are those which the researcher does not have any involvement with in their construction. As such, they include ‘public records, government reports, organisational documents, mass media images and texts, charts and diagrams, literature, autobiographies, personal correspondence, internet discussions and earlier qualitative materials from data banks’ (Charmaz, 2014: 48). However, as addressed by a study conducted by Boero (2007: 43), which examined news articles into obesity, articles can be considered as ‘social constructions and not as social facts. Thus, these articles represent the media construction of an epidemic, and not objective information on science or medicine’. This is how I consider the news articles in this study. Some are constructions of GM food as a *scientific* issue, whilst others are that of a *food* issue. The significance of this distinction will be discussed in detail in the Results chapters.

A further aspect which informed the analysis, is the influence of the news industry on the messages the audience receive about scientific issues. In respect of news organisations, because as ‘dominant and elite voices in the public conversation about a social problem these media sources are important sites of reality construction’ (Bogard, 2001: 431), they are important sources of trustworthy information for the audience. However, whilst this influence should be acknowledged, it is important to remember that the audience may not necessarily think about and consider the issues in the same way (see Cohen (1963), Chapter 3). An important consideration which has to be taken into account in respect of this study, is that those who post comments may be those who are particularly interested in the subject of GM foods. In this respect, the views of those commenting are seen as being representative for this study and may not characteristic of the population as a whole.

In addition to the news articles written by journalists, the audience are also able to view the opinions of others through the provision of the comments section by the news organisation. This provides a platform for those who wish to speak. By including the comments, it is not just the principal voices of the news organisations who comprise the sample. Charmaz (2014) contends that a mixture of documents indicates the context for the analysis being conducted (in this research it is the articles and comments). An understanding of the actors and issues involved in the production of documents can help provide a perspective of the situation being investigated.

Analysing the comments provides an approach for understanding the reception of the articles concerning GM foods by audience members. The data for reception analysis is often collected using methods such as interviewing, observation or focus groups. In contrast to these approaches, where participants have to be recruited and who often have to recall information, this study uses the actual responses of commenters. Therefore, this data is first hand from the audience who are interested in commenting about GM foods. Their views, feelings, understandings, and beliefs are revealed in the comments they post.

Data Analysis

Charmaz (2014) argues that other approaches to qualitative data analysis can be used in conjunction with grounded theory approaches. This study uses a combination of grounded theory and discourse analysis. Both of these approaches are discussed in greater detail below, and I begin with grounded theory.

Grounded Theory

The first part of the analysis for this study comprised the use of grounded theory and is an approach advocated by Charmaz (2014). Originally developed by Glaser and Strauss (1967), the use of this method enables theory to be derived from the data. According to Charmaz (2014: 1), grounded theory commences with 'inductive data, invokes iterative strategies of going back and forth between data and analysis, uses comparative methods, and keeps you interacting and involved with your data and emerging analysis'. Charmaz (2014: 16) goes on to argue that the process of conducting grounded theory should be considered as a set of guidelines as opposed to 'methodological rules, recipes, and requirements'. Therefore, I have followed these guidelines and have not used all the phases of grounded theory. I have applied the various stages of coding and memo writing to the data, and these are discussed in greater detail in a later section of this chapter. The final stage of conventional grounded theory which develops mid-level theory was excluded from this study, and instead, discourse analysis was used. This was due to critiques which have been raised concerning the use of grounded theory.

The criticisms made by Conrad (1990) are in connection with the coding and how this can fracture the data. In effect, as coded extracts are removed from the data they can become out of context. Therefore, the perspective the data originally represented as a whole ceases to exist. Coded extracts can also be viewed as being detached from the person who created the data. In respect of the limitations of grounded theory, Kushner and Morrow (2003: 36) argue how these occur 'at the levels of metatheory, empirical analysis, and normative implications'. Furthermore, Kelle (2000) argues that both grounded theory and computer aided qualitative analysis can overemphasise coding, leading to other forms of textual analysis to be disregarded. Therefore, detailed analyses such as those afforded by discourse analysis can be absent. However, this is overcome in this study as discourse analysis is also conducted, and this is discussed later in this chapter. Firstly, I explain the coding of the data in the study using the grounded theory approach.

Coding

Summarised below are the three steps which Charmaz (2014) outlines when conducting coding. The first step in data analysis is to carry out the initial coding. Charmaz (2014:117) argues these codes are ‘provisional, comparative, and grounded in the data’ and by being provisional the objective is to ‘remain open to other analytic possibilities and create codes that best fit the data’. This step is achieved by carrying out line by line coding. By questioning the data, these initial codes can assist in developing categories and making comparisons. Stage two is focused coding and involves studying and assessing the initial codes. By doing so, initial codes and data can be assessed and this enables those codes with the greater analytic strength to be identified. According to Charmaz (2014: 141) this process enables those codes to be identified which have more ‘theoretical reach, direction, and centrality’ and which can form the basis of the emerging analysis. The third and final stage of the process concerns memo writing. Memos enable you to ‘catch your thoughts, capture the comparisons and connections you make, and crystalize questions and directions for you to pursue’ as well as providing ‘a space to become actively engaged in your materials, to develop your ideas, to fine-tune your subsequent data-gathering, and to engage in critical reflexivity’ (Charmaz, 2014: 162).

In some grounded theory approaches such as that developed by Strauss and Corbin (1990), a third stage of coding is included in the process. This is axial coding and this enables data to be reconstructed into a coherent whole by connecting categories to subcategories. Charmaz (2014) does not include this in her grounded theory approach as she believes it makes the method unwieldly. I have used Stages One and Two as a guide for the framework to conduct my analysis, and this is now explained. Firstly though, the coding in this study was carried out using Computer Aided Qualitative Data Analysis Software (CAQDAS) and this is discussed in detail in a later section of this chapter.

The initial coding stage started with the raw data which were the articles and comments. I worked through these line by line and generated the codes as I went along. These initial codes were just used as labels and no theoretical interpretation was placed upon them. Table 4.3 provides a summary of the initial codes that I developed during my analysis. An explanation of these codes and an example for each one is included in Appendix A.

Initial Codes	Number
View of nature	110
Scientific progress (good)	447
Scientific progress (risk)	197
Scientific evidence	293
Failed Science	152
Risk (individual)	37
Risk (social) – Fear	182
Risk (social) – Labelling	156
Risk (social) – Morality or Ethics	229
Risk (social) – Poison/Contamination	160
Risk (social) – Trust	127
Risk (social) – Uncertainty	315
Risk (environment) – Fear	183
Risk (environment) – Morality or Ethics	115
Risk (environment) – Poison/Contamination	114
Risk (environment) – Trust	20
Risk (environment) – Uncertainty	100
Risk (time)	5
Power (over science)	480
Power (over food supply)	1869
Natural/un-natural	522
Food security	156
Sustainability (GM needed)	156
Sustainability (GM not needed)	120
Edible/inedible	24

Table 4.3 The initial codes and the number of these from my data.

Having conducted the initial coding, I then moved onto the focused coding. This enabled me to examine the codes in greater detail which were more conducive to my analysis. The focused codes are included in Table 4.4. These focused codes enabled me to explore the data, so that I could produce an analysis which was richer, interesting, and provided more insights.

Focused Codes	**Focused Codes**
Scientific progress (good)	Scientific evidence
Risk (social) – Morality or Ethics	Risk (social) – Trust
Risk (social) – Uncertainty	Risk (social) – Fear
Risk (social) – Poison/Contamination	Risk (environment) – Morality or Ethics

Table 4.4 The focused codes from my data.

As I conducted the initial and focused coding, I also wrote memos. I used this approach mainly as a form of keeping notes about items which I considered were important. For example, these included thoughts I had about the data or the codes, ideas which could potentially be developed, or any assumptions I believed I was making. Some of these memos were analytical whilst others were just used to note down ideas as I thought about them.

When I was about to move onto the discourse analysis, I looked at the data and realised there was another important layer which had not been considered. This was identifying which actor was speaking or being spoken about. This was an important consideration because of thinking about who has expertise and authority to speak about issues. For example, I needed to identify whether a scientist was quoted in an article, or whether a scientist was speaking in the comments. This was a pivotal moment in the analysis, as I felt I was able to start making sense of the data. As I had already completed the focused coding by this stage, the actors are those which appear in these. I made the decision not to examine the actors in the initial codes as I did not believe this was going to be of any benefit to the analysis. The actors which appeared in the focused codes are included in Table 4.5. I noted the actors manually and without the aid of computer software. This was due to the stage I was at with my analysis, as I only considered this when I was about to commence the discourse analysis.

Actors	**Number of Times Coded**
Scientists	295
European Union and European Parliament	53
UK Parliament's Science and Technology Select Committee	27
Scottish Government	33
Food Companies and Supermarkets	34
Non-Governmental Organisations	47
Citizens/Consumers	144

Table 4.5 The actors which appeared in the focused codes, including the number of times these actors were coded.

Computer Aided Qualitative Data Analysis Software (CAQDAS)

The software NVivo was used to organise and code the data. Firstly, an important point needs to be made here in respect of this study and saving the data in NVivo. The web pages containing the articles and the comments were downloaded into NVivo using Ncapture for NVivo. However, the webpage had to be captured and saved twice. This enabled the webpage to be saved so that the article and the comments could be coded separately. If this was not done, it was not possible to establish whether the coded text was from the article or a comment. A further issue was that if there were more than one page of comments, each page had to be separately captured and saved into NVivo. Fortunately, these two issues were identified before data collection commenced. As I was using NVivo to work through my data collection procedures, these difficulties were established then. Therefore, this enabled me to determine measures which I could use to address these problems.

Although there were complications which needed to be solved, the use of NVivo was still appropriate in this study. As Welsh (2002) argues, CAQDAS is often believed to be founded on a grounded theory approach to data analysis. As such, software development has been highly influenced by grounded theory. Kelle (2000: 294) contends 'it is not surprising that developers of software that supports qualitative analysis who are in search of a methodological underpinning usually draw on the methodology of grounded theory as one of the best known and most explicit approaches of qualitative analysis'. However, there have been warnings about the use of computer software in data analysis because of the possibility of distancing the researcher from their data. Furthermore, because of the software being based on a grounded theory approach, this could force researchers to analyse their data in this way. These points were addressed in this study by combining grounded theory and discourse analysis, and the amalgamation of these methods are discussed later in this chapter. As these issues have been attended to, any disadvantages are outweighed by the advantages as these include increased productivity, transparency, reliability and rigour (Kelle, 2000).

Using Memos to Identify Conceptual Categories

Charmaz (2014) defines categorising as selecting focused codes which have a significance to the data, or selecting themes and patterns from several codes and transforming these into an analytic idea. Categories can explain ideas, processes or events. To begin, Charmaz (2014: 189) advocates that you should 'assess which codes best represent what you see happening in your data. In a memo, raise them to conceptual categories for your developing analytic framework – give them conceptual definition and analytical treatment in narrative form in your memo'. This allows data to be synthesised.

Memo writing is described by Charmaz (2014) as a method to enable researchers to stop and consider ideas and thoughts about codes and any developing categories. Time can be devoted to thinking about ideas concerning the data, codes or analysis. It is also possible to write memos throughout the research process in order to develop lines of enquiry. Charmaz (2014: 171) argues there is no particular definition of a memo but it can be used for any of the following:

- Define each code or category by its analytic properties
- Spell out and detail processes subsumed by the codes or categories
- Make comparisons between data and data, data and codes, codes and codes, codes and categories, categories and categories
- Bring raw data into the memo
- Provide sufficient empirical evidence to support your definitions of the category and analytic claims about it
- Offer conjectures to check in the field setting(s)
- Sort and order codes and categories
- Identify gaps in the analysis
- Interrogate a code or category by asking questions of it

Charmaz (2014: 190) goes on to explain that when codes become categories, memos contain statements which:

- Define the category
- Explicate the properties of the category
- Specify the conditions under which the category arises, is maintained, and changes
- Describe the consequences
- Show how this category relates to other categories

As categories become further developed, memos should be written ‘to detail comparisons between them. These memos help you to tease out distinctions that sharpen your treatment of the material. Such memos also aid you to weigh and locate your categories in relation to each other. Through memo-writing, you distinguish between major and minor categories and delineate how they are related' (Charmaz, 2014: 182). The analysis is developed and shaped through memo writing. Memos can be 'partial, preliminary, and provisional' and can remain private and only to be seen by the writer (Charmaz, 2014: 181). This enables data to be analysed without writing for an audience. When writing memos we need to consider where the codes, categories, and the data these include are guiding us. As Hallberg (2006) explains, memo writing should be conducted throughout the entire analytic process. These memos should be used for noting down ideas, making connections and associations between codes, data, categories and theories, and for reflecting on the research process. Charmaz (2014: 183) contends that memo writing enables you to 'construct fresh ideas, create new concepts, and find novel relationships' as well as demonstrating 'connections between categories (e.g. empirical events and social structures, larger groups and the individual, espoused beliefs and actions)'.

Memo writing enables constant comparisons to be made with the data. There is the potential to identify and develop a key category that may otherwise be overlooked. Charmaz (2014: 342) describes the constant comparison method, as a 'method of analysis that generates successively more abstract concepts and theories through inductive processes of comparing data with data, data with code, code with code, code with category, category with category, and category with concept. In the last stages of analysis, researchers compare their major categories with those in relevant scholarly literatures'. Constant comparison is useful for examining differences, connections, discrepancies, and similarities in the data, codes, and categories (Hallberg, 2006). Through the process of memo writing, categories begin to emerge from the data. As Hallberg (2006: 143) explains, 'every category must earn its way into the analysis, i.e. it must be grounded in the data rather than being generated from the researcher's hypotheses and preconceptions'.

Discourse Analysis

The preliminary results obtained from the coding process indicated potential connections between the data and social theory. This is alluded to by Jørgensen and Phillips (2002), who argue this approach enables alternative types of knowledge to be used, which facilitates a greater understanding of the situation being examined, and it is a practice which is welcomed. This is expanded upon by Phillips (2000), who contends that sociological theories can act as prompts for the discourse analysis and therefore, provoke questioning of the data which is of greater relevance to the study. This approach enabled me to search the literature for theoretical concepts and broader social trends which were relevant to the data. These included for example, risk (Beck, 1992, Beck, 1995, Giddens, 1991), and contamination (Douglas and Wildavsky, 1982a). To ensure clarity in the above description, it is the coding of the data which led me to the important theoretical concepts used in the project. I then assessed and interpreted the claims obtained in the literature by examining their relevance to the interpretation of my data. I conducted this aspect of the data analysis through the use of discourse analysis. This was carried out manually without the use of a computer package.

The starting point with discourse analysis is the notion that reality is accessed through the use of language. Language contributes to constructing reality. 'Language is a 'machine' that generates, and as a result constitutes, the social world. This also extends to the constitution of social identities and social relations. It means that *changes* in discourse are a means by which the social world is changed. Struggles at the discursive level take part in changing, as well as in reproducing, the social reality' (Jørgensen and Phillips, 2002: 9, emphasis in original). Discourse assists in producing knowledge, identities, and social relations which aids the construction of the social world. The use of language in the production and consumption of texts also helps shape social practice (Jørgensen and Phillips, 2002).

According to Gill (2000: 173), discourse analysis is based on the epistemological position of what can be called ‘social constructionism, constructivism or simply constructionism’ and as such she argues the key perspectives of discourse analysis are:

> 1) a critical stance towards taken-for-granted knowledge, and a scepticism towards the view that our observations of the world un-problematically yield its true nature to us
> 2) a recognition that the ways in which we commonly understand the world are historically and culturally specific and relative
> 3) a conviction that knowledge is socially constructed – that is, that our current ways of understanding the world are determined not by the nature of the world itself, but by social processes
> 4) a commitment to exploring the ways that knowledges – the social construction of people, phenomena or problems – are linked to actions/ practices

When conducting discourse analysis, the researcher ‘has to work with what has actually been said or written, exploring patterns in and across the statements and identifying the social consequences of different discursive representations of reality’ (Jørgensen and Phillips, 2002: 21). According to Gill (2000) there are many types of discourse analysis and the version used in this study is that developed by Gee (2011). He argues there are two forms of discourse analysis, one descriptive and one critical. The descriptive form assesses the use of language in order to comprehend it, whilst in contrast, the critical form not only examines the use of language, but also aims to address the world about the analysis conducted. In this sense, Gee (2011: 9) argues how he believes ‘all discourse analysis needs to be critical, not because discourse analysts are or need to be political, but because language itself is … political’. An additional point which Gee (2011:12) makes in respect of the purpose of discourse analysis, is that if this proceeds beyond description, it can ‘contribute, in terms of understanding and intervention, to important issues and problems in some area that interests and motivates us as global citizens’. This is a view which is taken in respect of this study and is concerned with the struggle between different knowledge claims, and the processes of claims-making. The struggle between different discourses provide alternative understandings of the GM food debate. ‘Different discourses put forward different knowledge claims including claims relating to the attribution of responsibility’ (Jørgensen and Phillips, 2002: 167). Furthermore, different identities are constructed for speakers, depending on their use of language in discourse.

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 are listed below (adapted from Gee, 2011: 17):

1) Significance: How is this piece of text used to make certain things significant or not and in what ways?
2) Practices (Activities): What practice (activity) or practices (activities) is this piece of text being used to enact (i.e., get others to recognise as going on)?
3) Identities: What identity or identities is this piece of text being used to enact (i.e., get others to recognise as operative)? What identity or identities is this piece of text attributing to others and how does this help the speaker or writer enact his or her own identity?
4) Relationships: What sort of relationship or relationships is this piece of text seeking to enact with others (present or not?)
5) Politics (the distribution of social goods): What perspective on social goods is this piece of text communicating (i.e., what is being communicated as to what is taken to be “normal”, “right”, “good”, “correct”, “proper”, “appropriate”, “valuable”, “the way things are”, “the way things ought to be”, “high status or low status”, “like me or not like me”, and so forth)?

6) Connections: How does this piece of text connect or disconnect things; how does it make one thing relevant or irrelevant to another?
7) Sign Systems and Knowledge: How does this piece of text privilege or dis-privilege specific sign systems (e.g., Spanish vs. English, technical language vs. everyday language, words vs. images, words vs. equations, etc.) or different ways of knowing and believing or claims to knowledge and belief (e.g., science vs. the Humanities, science vs. "common sense", biology vs. "creation science")?

Having described the discourse analysis approach, I now explain how I used this for my study. Once I completed the focused coding for the grounded theory, I was ready to conduct the discourse analysis. In respect of selecting samples to analyse, Fairclough (1992: 230) argues that 'the answer is broadly that samples should be carefully selected on the basis of a preliminary survey of the corpus … so that they yield as much insight as possible into the contribution of discourse to the social practice under scrutiny'. One strategy 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. He also suggests focusing on areas of discourse which are pivotal, indicate something which is vital, or are puzzling. I followed these suggestions, and also selected those extracts which best represented a pattern in the data. The questions described above for the seven building tasks were applied to the text extracts which had been previously coded. The following is an example of how I applied these seven building tasks and the related discourse analysis questions to my own data. The extract relates to the risk (environment) – morality or ethics code.

Just one more diktat from the EU that puts profit for the Plutocrats before the wellbeing of the People. The Jury is still out on the subject of GM foods but once allowed, it will be just another case of trying to put the genie back into the bottle if it is found to cause harm. It will be impossible to stop the spread of GM seeds migrating to other fields where they are not wanted. Whatever the pitfalls or merits of the situation, we cannot allow it to happen until the issue is resolved. To try to do so afterwards will be too late.

Extract 1 Comment from the article 'EU set to allow controversial genetically modified crops to be grown in the UK' (The Daily Mail, 13 January 2015a).

1) Significance

The commenter believes new regulations from the EU are aimed to enable businesses to achieve profits instead of protecting citizens from GM foods. In their opinion, this should not be allowed to occur until there is a consensus about GM foods not causing harm to the environment. If GM foods were released into the environment before agreement was made about their safety, then damage may occur which cannot be corrected. In this respect, the safety of citizens is related to the environment. By harming the environment, citizens are also vulnerable, and this exposure to risk is being caused by financial pursuits by businesses.

2) Practices (Activities)

The commenter is drawing attention to the regulations being implemented by the EU in connection with GM foods, in an inflammatory way. They do this with the use of the phrase 'Plutocrats before the wellbeing of the People'. The regulations will impact both businesses and citizens. From the perspective of business, this will be viewed positively, whilst for citizens, there may be negative effects. There is also an element of the contested nature of science with the use of the phrase 'put the genie back into the bottle', and the commenter believes this is associated with causing unnecessary risks.

3) Identities

The actors visible in this comment are the EU, business, and citizens. Here, the commenter constructs the EU as favouring businesses. The welfare of citizens is secondary.

4) Relationships

Here, the commenter presents a favourable relationship between the EU and businesses which comes at the expense of citizens and the environment. There is also a connection between the environment and citizens. By allowing GM crops to be grown, the seeds could spread throughout the environment, and may not be able to be halted. This could have a negative impact on citizens because of damage to the environment.

5) Politics

The commenter illustrates the authority of the EU by describing the introduction of regulations. This piece of EU legislation is viewed as favouring business because it enables them to achieve greater profits. This is viewed as improper by the commenter. The commenter also believes legislation should be protecting citizens and the environment from risk, as opposed to exposing them to it.

6) Connections

As already stated, there are connections between the EU, business, citizens and the environment. These connections are due to the legislation being implemented owing to the growing of GM crops.

7) Sign Systems and Knowledge

'Another case of trying to put the genie back into the bottle if it is found to cause harm'. With this sentence, the commenter refers back to what they believe are other instances whereby science has been viewed as creating difficulties. Once problems are established, they may not be able to be reversed. The commenter can relate GM foods to previous risks created by science.

The seven building tasks are fundamentally interlinked with each other (Gee, 2011). Many of the same words and phrases can be used to address the building tasks and answer the related discourse analysis questions. He also argues that if the building tasks or discourse analysis questions are not relevant to a particular piece of data, this is not an issue. There is flexibility in this approach.

A further point is made by Gee which is of particular help in connection with analysing the comments. In discourse 'we can speak as experts – as doctors, lawyers, anime aficionados, or carpenters – or as "everyday people"' (Gee, 2011: 2). With this study, some of those who post comments do state their occupation, an example being a molecular biologist. Therefore, the levels of knowledge and understanding which are apparent in the comments are due to the person who is commenting. An appreciation of this argument made by Gee is of particular help in this study. However, as I have explained earlier in this chapter, it is not always possible to ascertain information about those commenting. Therefore, a commenter's occupation could only be considered if it was explicitly stated in the comment. Having outlined both the grounded theory and discourse analysis approaches, the reasoning for these choices are discussed in the next section.

The Combination of a Grounded Theory approach and a Discourse Analysis

Both the ground theory approach advocated by Charmaz (2014) and the discourse analysis promoted by Gee (2011) follow social constructionist principles. By imagining the two phases of analysis as separate but complementary, potential conflicts between the two approaches could be overcome.

The grounded theory constructionist approach taken by Charmaz (2008: 402) is based on the following assumptions:

> (1) Reality is multiple, processual, and constructed—but constructed under particular conditions; (2) the research process emerges from interaction; (3) it takes into account the researcher's positionality, as well as that of the research participants; (4) the researcher and researched co-construct the data—data are a product of the research process, not simply observed objects of it. Researchers are part of the research situation, and their positions, privileges, perspectives, and interactions affect it.

In addition to these four assumptions, Charmaz (2008) also advocates the following four principles: 1) the research process should be viewed as a social construction; 2) the choices made about research and the directions it takes should be analysed; 3) during the research process, methodological and analytic strategies should be managed; 4) an adequate amount of data should be collected to enable the researcher to ascertain the constructed nature of the world. Both the assumptions and the principles consider the constructed nature of the world, along with the constructions of the researched and the researcher. These considerations are important for me because I am aware I am part of the research process. I assign the parameters to the data collected, and I place my own interpretation on both the grounded theory and the discourse analysis. Therefore, it is impossible for me to be detached from the research process.

Following on from this, in terms of the discourse analysis, Gill (2000: 175) argues that 'we deal with the world in terms of constructions, not in a somehow 'direct' or unmediated way; in a very real sense, texts of various kinds construct our world'.

As both the grounded theory and discourse analysis used in this study were based on social constructionist principles, they were easily combined to form a complementary method to conduct the analysis. As Kushner and

Morrow (2003) argue, the use of a combination of grounded theory and other theoretical perspectives enables the strengths of each to be used whilst also addressing the limitations of each. This point is also addressed by Charmaz (2014: 16), in that 'grounded theory methods can complement other approaches to qualitative data analysis, rather than stand in opposition to them'. The combining of grounded theory and discourse analysis was an approach used by Gough (2007) in his study of the newspaper representations of men, food and health, and Hanson et al. (2016) in their study of the newspaper coverage of medical research in rheumatoid arthritis. Both argue their analysis was strengthened by the amalgamation of the two methods.

Chapter Conclusion

This chapter has discussed the sampling and analytical procedure for this study, along with a rationale for the choice of research methods. It has explained in detail the sampling strategy, along with the approach of a combination of grounded theory and discourse analysis in the data analysis. The assurance of quality in qualitative research has also been discussed. I now begin my analysis and start addressing my research questions. Any spelling mistakes or grammatical errors are left unchanged in the extracts taken from the articles and comments. The following chapter examines the construction of news articles and comments in respect of the production of scientific facts by scientists in connection with GM foods.

Chapter 5

The Online GM Food Debate: News Production and the Narratives of Scientific Expertise

Introduction

Scientists construct new experiments by building their facts on the knowledge of those who have previously created developments. However, this is not always straightforward. Latour (1987: 131) argues that the 'problem of the builder of 'fact' is the same as that of the builder of 'objects': how to convince others, how to control their behaviour, how to gather sufficient resources in one place, how to have the claim or the object spread out in time and space'. This illustrates how scientific progress and scientific developments occur through various factors which interact with one another. An argument put forward by Jasanoff (1990: 12) is that 'scientific "facts" are, for the most part, socially constructed. We regard a particular factual claim as true not because it accurately reflects what is out there in nature, but because it has been certified as true by those who are considered competent to pass upon the truth and falsity of that kind of claim'. However, she goes on to state that 'players with different stakes in technical controversies arrive at different constructions of scientific reality' (Jasanoff, 1990: 13). As some aspects of science are funded by Research Councils in the UK (i.e. the State), this means that scientists are answerable for the developments they make. Jasanoff (1992) argues that policy decisions made by governments are often supported by scientific facts. The science conducted to produce these scientific facts often requires funding by citizens through their taxes. Reporting the results of scientific experiments through news channels is a means in which scientists can show citizens how their funding is being spent. However, as well as scientific facts being constructed, this is also true for journalistic accounts. Neither are therefore a direct representation of reality.

I begin the chapter by examining the production of science news especially through the use of press releases. As a result of using press releases, news coverage is becoming increasingly standardised. This section describes the use of press releases by journalists and how these press releases are impacting the work of journalists. It is a useful starting point to describe the work of journalists, as it is this work which appears throughout the thesis, in the extracts taken from the news articles. As described in Chapter 3, responsible journalists ensure expert knowledge is made accessible to the news reading audience. Legitimate claims are separated from those which are false.

Following the section on journalists and their work, the discussion moves on to describe the comments posted by two scientists. It is their work as scientists which enable them to claim scientific expertise and provides them with authority. The focus then moves to discuss the work of scientists in the form of scientific progress. Following this, the discussion focuses on who gains from scientific progress, and whether these gains are acceptable. The final section describes acceptability in terms of the moral and ethical implications of a GM lamb.

The Production of News Concerning GM Foods

There have been a number of changes occurring with science journalism. In a report produced by Williams and Clifford (2009) concerning science journalism, they noted how the number of science journalists had risen between 1989 and 2005, but the numbers had since declined. The report which was authored in 2009, also stated how journalists believed their workload had increased in the previous five years (since 2004). This was attributed to many journalists having to produce content for news organisations for both online and print editions. As part of the response to this, journalists were increasingly relying on the use of press releases, and are continuing to do so in 2018. The following section examines the use of press releases.

Press Releases

Press releases from science departments in universities and research institutes are increasingly being found in news articles. Couldry (2012: 102) contends that as the ‘resources available for media production are remorselessly cut, other forms of over-accessing become important: the over-accessing of the public relations efforts of institutional actors who are outside, but close to, the media’. As a result, the narratives from these institutions easily enter news discourse. In the two extracts which follow, the research of scientists working on GM tomatoes are disseminated to the audience. As will be seen, both are very similar and the reasons for this will be discussed following the extracts.

Professor Cathie Martin, from, the John Innes Centre in Norwich, said: 'Our study provides a general tool for producing valuable phenylpropanoid compounds on an industrial scale in plants, and potentially production of other products derived from aromatic amino acids.

'Our work will be of interest to different research areas including fundamental research on plants, plant/microbe engineering, medicinal plant natural products, as well as diet and health research.'

The key to turning tomatoes into natural medicine factories is a protein called AtMYB12, found in the garden weed thale cress. Introducing the protein to tomatoes acted like opening a tap to boost levels of phenylpropanoids, a family of organic compounds that give rise to a wide range of plant chemicals. Genes encoding specific enzymes were added to switch on production resveratrol or genistein, the researchers reported in the journal Nature Communications. They believe the same technique could be used to manufacture other compounds that form the basis of many medicines. Tomatoes are a high-yield crop, with up to 500 tonnes of the fruit per hectare being harvested in some countries, and cheap to grow. The scientists hope they will provide a more cost-effective way of producing valuable plant compounds than synthesising them artificially or extracting tiny amounts from natural sources such as grapes and soybeans.

Co-author Dr Yang Zhang, also from the John Innes Centre, said: 'Medicinal plants with high value are often difficult to grow and manage, and need very long cultivation times to produce the desired compounds.

'Our research provides a fantastic platform to quickly produce these valuable medicinal compounds in tomatoes. Target compounds could be purified directly from tomato juice.

'We believe our design idea could also be applied to other compounds such as terpenoids and alkaloids, which are the major groups of medicinal compounds from plants.'

Extract 1 From the article 'Researchers grow supertomatoes containing same amount of cancer-beating chemical as 50 glasses of red wine' (The Daily Mail, 26 October 2015b).

Supercharged GM tomatoes packed with natural chemicals that combat illnesses like heart disease, cancer, diabetes and Alzheimer's disease could soon be on the menu.

British scientists are experimenting with a range of genetically engineered tomatoes.

One contains 50 times the amount of the antioxidant resveratrol as a bottle of wine.

Resveratrol, which is found in red grapes and also peanuts and berries, is believed to protect the heart and circulatory system and lower cholesterol.

Another tomato produced the same amount of genistein - a soybean compound that may help prevent breast cancer - as 2.5 kilograms of tofu.

The key to turning tomatoes into natural medicine factories is a protein called AtMYB12, found in the garden weed thale cress.

Introducing the protein to tomatoes boosted levels of phenylpropanoids, a family of organic compounds that increases a range of plant chemicals.

Genes encoding specific enzymes were added to switch on production resveratrol or genistein, the researchers reported in the journal Nature Communications.

The scientists hope tomatoes will provide a more cost-effective way of producing valuable plant chemicals than synthesising them artificially or extracting tiny amounts from natural sources such as grapes and soybeans.

Professor Cathie Martin, from the John Innes Centre in Norwich, said: "Our work will be of interest to different research areas including fundamental research on plants, plant/microbe engineering, medicinal plant natural products, as well as diet and health research." Co-author Dr Yang Zhang added: "Medicinal plants with high value are often difficult to grow and manage, and need very long cultivation times to produce the desired compounds "Our research provides a fantastic platform to quickly produce these valuable medicinal compounds in tomatoes."

Extract 2 From the article ‘British scientists create supercharged GM tomatoes that could help beat cancer, diabetes and Alzheimer's disease’ (The Mirror, 26 October 2015).

Both Extracts 1 and 2 which appear in The Daily Mail and The Mirror, draw heavily on a press release (Appendix B). This was circulated by the John Innes Centre on 26 October 2015. What can be seen in both of these extracts is that although they are both from different news organisations, they are virtually identical. The journalists from both news organisations have used the press release to write the news article, and the quotes given by Professor Cathie Martin and Dr Yang Zhang are those provided in the press release. The use of repeated information such as this has been described as ‘churnalism’ (Murcott and Williams, 2012; Davies 2009). Public relation practitioners are often responsible for the production of these press releases.

In the report compiled by Williams and Clifford (2009), they found an unease had been created following the losses of science journalists at UK news organisations. This had been felt at all outlets, regardless of whether directly affected by job losses. Additionally, their findings suggested science journalists did not believe they had been specifically targeted in connection with job losses. The specific issues put forward included a reduction in the number of journalists due to the rise of different platforms on the internet, a reduction in audience numbers, and a decline in advertising revenues. According to Murcott and Williams (2012), journalists are having to adapt now they are working in an increasingly online world. They often have to produce alternative forms of their stories for the different platforms news can now be found on. This is another impact on their time, and also means they are less likely to source original stories. With journalists having less time, the use of public relations (PR) in science news has become influential over the last couple of decades. As a result, PR departments are becoming instrumental in setting the news agenda. Rather than sourcing, framing and writing stories, journalists are now being forced into reproducing what has already been written by PR professionals. The table below illustrates the prevalence of the use of press releases by journalists in their writing of the news articles included in this study.

News Organisation	News Article	Organisation Issuing the Press Release	Title of the Press Release
The Daily Mail (26 February 2015c)	Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops	UK Parliament (2015)	EU Regulation on GM Organisms not ‘fit for purpose’
The Daily Mail (25 March 2015d)	Could 'super spuds' soon be on the menu? Scientists are close to developing a GM potato that's healthier and cheaper	The Sainsbury Laboratory (2015)	GM Potatoes: Food for Thought
The Daily Mail (13 January 2015a)	EU set to allow controversial genetically modified crops to be grown in the UK	European Parliament (2015)	New Legislation to allow EU Member States to restrict or ban the cultivation of crops containing Genetically Modified Organisms

The Daily Mail (22 April 2015e)	GM food is natural: 'Foreign DNA' in sweet potatoes suggests plants genetically modify themselves	Ghent University (2015)	Sweet Potato naturally expresses Agrobacterium genes
The Daily Mail (26 June 2015f)	Taxpayer-funded trial of GM wheat designed to beat bugs and cut need for insecticides ends in a £3million failure	1) Rothamsted Research (2015) 2) GeneWatch UK (2015)	1) Scientists disappointed at results from GM Wheat field trial 2) GM Wheat trial failure highlights poor GM success rate, need to invest in other R and D
The Daily Mail (13 February 2015g)	Obama administration approves world's first browning-resistant apple as biotech food wars heat up again	United States Department of Agriculture (USDA) (2015)	USDA Announces Deregulation of Non-Browning Apples
The Daily Mail (4 March 2015h)	Senior academic condemns 'deluded' supporters of GM food as being 'anti-	Beyond GM (2015)	Jane Goodall teams with US lawyer to expose Government and scientific fraud over GM food

	science' and ignoring evidence of dangers		
The Guardian (14 February 2015a)	Canadian company's genetically modified apples win US approval	United States Department of Agriculture (USDA) (2015)	USDA Announces Deregulation of Non-Browning Apples
The Guardian (25 June 2015b)	GM wheat no more pest-resistant than ordinary crops, trial shows	1) Rothamsted Research (2015) 2) GeneWatch UK (2015)	1) Scientists disappointed at results from GM Wheat field trial 2) GM Wheat trial failure highlights poor GM success rate, need to invest in other R and D
The Guardian (23 June 2015c)	Lamb with jellyfish gene 'may have been deliberately sent to abattoir'	French National Institute for Agricultural Research (INRA) (2015)	INRA reports to the legal authorities that it sold an animal bred in the context of a research programme
The Guardian (9 August 2015d)	Scotland to issue formal ban on genetically modified crops	Scottish Government (2015)	GM crop ban

The Guardian (26 February 2015e)	UK should be given power to regulate GM crops, MPs say	UK Parliament (2015)	EU Regulation on GM Organisms not 'fit for purpose'
The Telegraph (25 March 2015a)	A blight-resistant potato could become a reality	The Sainsbury Laboratory (2015)	GM Potatoes: Food for Thought
The Telegraph (27 June 2015b)	Anti-GM protesters don't understand how science works	1) Rothamsted Research (2015) 2) GeneWatch UK (2015)	1) Scientists disappointed at results from GM Wheat field trial 2) GM Wheat trial failure highlights poor GM success rate, need to invest in other R and D
The Telegraph (26 February 2015c)	Britain must take back powers from Europe to allow GM crops, say MPs	UK Parliament (2015)	EU Regulation on GM Organisms not 'fit for purpose'
The Telegraph (13 January 2015d)	Genetically modified crops could be planted in England this year	European Parliament (2015)	New Legislation to allow EU Member States to restrict or ban the cultivation of crops containing Genetically

			Modified Organisms
The Telegraph (23 June 2015e)	Genetically modified 'jellyfish lamb' accidentally hits French dinner plates	French National Institute for Agricultural Research (INRA) (2015)	INRA reports to the legal authorities that it sold an animal bred in the context of a research programme
The Telegraph (21 February 2015f)	Owen Paterson: 'The Green Blob' is threatening lives in Africa	Genetic Literacy Project (2015)	Owen Paterson: Anti-GMO stance of Green Blob, Greenpeace condemn poor to starvation, death
The Telegraph (25 June 2015g)	'Pointless' £3m GM wheat trial fails	1) Rothamsted Research (2015) 2) GeneWatch UK (2015)	1) Scientists disappointed at results from GM Wheat field trial 2) GM Wheat trial failure highlights poor GM success rate, need to invest in other R and D
The Telegraph (25 September 2015h)	SNP's GM crop ban risks backfiring, experts warn	The Royal Society of Edinburgh (RSE) (2015)	RSE Calls for a Rational GM Debate

The Times (10 August 2015a)	Farmers' union attacks move to ban GM crops	Scottish Government (2015)	GM crop ban
The Times (26 June 2015b)	GM 'whiffy wheat' fails to deter aphids	1) Rothamsted Research (2015) 2) GeneWatch UK (2015)	1) Scientists disappointed at results from GM Wheat field trial 2) GM Wheat trial failure highlights poor GM success rate, need to invest in other R and D
The Times (26 February 2015c)	GM crops 'need a rebrand', say MPs	UK Parliament (2015)	EU Regulation on GM Organisms not 'fit for purpose'
The Times (24 February 2015d)	GM protesters 'condemning millions to hunger'	Genetic Literacy Project (2015)	Owen Paterson: Anti-GMO stance of Green Blob, Greenpeace condemn poor to starvation, death
The Times (9 August 2015e)	Scots farmers' backlash over GM crops ban	Scottish Government (2015)	GM crop ban

Table 5.1 The news articles which included information from a press release, the organisation issuing the press release, and the title of the press release.

As Table 5.1 shows, all of the news organisations included in the sample used press releases at some point. The news articles listed in Table 5.1 are those where it has been possible to identify the use of a press release. Those news organisations covering the same story used the same press release. All of the news organisations with the exception of The Mirror, reported the failure of a GM Wheat trial at Rothamsted Research. All of these news organisations used press releases from both Rothamsted Research and GeneWatch UK. The release of a report by the UK Parliament's Science and Technology Select Committee was also reported by all of the news organisations with the exception of The Mirror. The press release issued by the UK Parliament was used in all of the news articles covering this story. As this illustrates, little variation is on offer to the audience and shows churnalism is occurring.

Churnalism enables a greater number of science stories to be published, especially those which are uncritical. As Murcott and Williams (2012: 159) argue, ''churnalism' fills pages and air time, and supplies the biggest output for small limited resource input. It also might suit research institutes rather well to have their positive results reported with minimal potentially awkward questions asked'. Churnalism results in journalists no longer performing many aspects of their profession. Rather than advising their readers of the news which they have researched, journalists have become passive receivers of information from PR departments, whether this be fact or fiction, important or insignificant (Davies, 2009). 'The journalists claim that its influence is mainly as an agenda-setter, providing initial ideas for stories and a starting point for later journalistic work. Nevertheless, it also often facilitates 'cut-and-paste' shortcuts, which mean that news stories are increasingly similar to institutional press releases, so-called 'low-hanging fruit'' (Murcott and Williams, 2012: 156). Journalists and news editors used to decide on which stories to pursue and the angle which would be taken when writing them. The judgements which these people used to make have now been handed over to the PR departments of organisations. 'The structure of corporate news has converted journalists from active news-gatherers to passive processors of material – only 12% of which could be shown to be free of the mark of wire agencies and PR consultants' (Davies, 2009: 113). As Conrad (1999) explains, press releases often used to form the basis of a news article and whilst it may have impacted on what became news, it was not a copy and paste exercise. He also explains that whilst there were suggestions of which experts to interview, most science journalists often decided to trace their own experts to include in a news article.

Due to the changes outlined above, journalists who do not have the time to research their own news stories are increasingly relying on the information provided for them by the PR industry. The angle of the story and the information contained in the press release is often to meet an organisation's political or commercial interests. As a result of this, the journalist involved could be publishing distorted facts and untruths (Davies, 2009). However, whilst PR can produce work which is framed to meet certain requirements, is distorted, or promoting untruths, the PR industry is not completely to blame. With the increase of press releases being used in news stories, there are instances when a press release is left unchecked. It proceeds to enter the public domain in a news article exactly as it was written by the PR staff. Göpfert (2008) argues that the growing influence of PR in the news coverage of science, results in bias which supports science PR. This PR weakens journalism because of the material that can be written straight into a news story. It is tailor made news copy. The journalistic strategy of objectivity is unable to be implemented. Objectivity plays an important role for professional journalists. According to Maras (2013: 24), best practice for journalism recommends the 'reporter presents the facts, preferably covering all sides of the issue, allowing the reader to decide' and this enables us to think of objectivity in 'progressive ethical terms such as virtue, standards and excellence'. It is not only scientific establishments such as universities and research institutes which issue press releases concerning GM crops and foods, but also other institutions such as the Scottish Government, and the European Parliament. The three extracts which follow (Extracts 3, 4, and 5) are from three different news articles. All of these contain excerpts or quotes by Richard Lochhead, from the press release issued by the Scottish Government (2015).

"There is no evidence of significant demand for GM products by Scottish consumers and I am concerned that allowing GM crops to be grown in Scotland would damage our clean and green brand, thereby gambling with the future of our £14bn food and drink sector," he said.
"The Scottish government has long-standing concerns about GM crops – concerns that are shared by other European countries and consumers, and which should not be dismissed lightly," he added. "I firmly believe that GM policy in Scotland should be guided by what's best for our economy and our own agricultural sector rather than the priorities of others."

Extract 3 From the article 'Scotland to issue formal ban on genetically modified crops' (The Guardian, 9 August 2015d).

However, Mr Lochhead said: "There is no evidence of significant demand for GM products by Scottish consumers and I am concerned that allowing GM crops to be grown in Scotland would damage our clean and green brand, thereby gambling with the future of our £14 billion food and drink sector. I have heard from food and drink producers in other countries that are ditching GM because of a consumer backlash."

Extract 4 From the article 'Farmers' union attacks move to ban GM crops' (The Times, 10 August 2015a).

Richard Lochhead, the rural affairs minister, has revealed plans to opt out of European consents for cultivating GM crops, including a variety of maize that has already been approved by the EU and six other GM crops that are awaiting authorisation.

Extract 5 From the article 'Scots farmers' backlash over GM crops ban' (The Times, 9 August 2015e).

Just as with Extracts 1 and 2, the quotes in Extracts 3 and 4 are taken directly from the press release. Extract 5 is also virtually identical to the press release with very little editing carried out. Extracts 3 and 4 also show the use of quotes from press releases. All of these extracts illustrate the prevalence of the use of press releases in the news coverage of GM crops and food.

One other aspect related to press releases is peer reviewed journal articles. Once research articles have undergone the peer review process and are published, press releases are often issued to draw attention to those considered important. These research articles often form the basis of news stories, and through the issue of press releases, the scientific community is able to influence and manage awareness of certain scientific issues to news organisations (Göpfert, 2008). In order to be completely successful, journalists need to be persuaded to only concentrate on the information and angles presented in the press release (Davies, 2009). Weitkamp and Eidsvaag (2014) and Conrad (1999) argue that journalists may consider research to be of good quality if it has been published in a peer reviewed journal or presented at a conference. The journal, Nature Communications is mentioned in both The Daily Mail and The Mirror articles in Extracts 1 and 2. As described in Chapter 3, journalists strive through objectivity to present social reality to the audience. This is achieved through presenting facts fairly and by balancing opinions. The work of journalists and their professionalism is challenged now through the use of press releases. In the case of scientific research, if a press release is used, the audience will only be presented with the information the university or research institute issue. Objectivity is undermined. The Daily Mail's (2015e) news article, 'GM food is natural: 'Foreign DNA' in sweet potatoes suggests plants genetically modify themselves', was also based on a press release issued by Ghent University. The research had been published in the journal, Proceedings of the National Academy of Sciences of the United States of America (PNAS), and the press release was issued by Ghent University to draw attention to this.

In respect of scientists appearing in the news, Weitkamp and Eidsvaag (2014) argue that UK scientists understand the role of news organisations in disseminating research. As a result, scientists are unlikely to be criticised by their colleagues for appearing in news articles. A greater emphasis is also placed on science communication in the UK as opposed to other European countries. Furthermore, Weitkamp and Eidsvaag (2014: 880) contend:

> It would seem, then, that scientific institutions (e.g. universities, scientific societies and publishers) are mobilising support for their scientists to help them engage with the media. Scientists are complicit in this process, though not necessarily proactive in seeking coverage; working with press officers and the media is, perhaps, another task added to their primary occupation. Journalists appear to make fairly uncritical use of the materials produced by scientific institutions, appearing to trust media materials from these sources and to use them with limited additional verification.

As Extracts 1 to 5 illustrate, news articles are similar to press releases with little editing being carried out. This relates to the research carried out by Weitkamp and Eidsvaag (2014), into the reporting of superfoods by news organisations. They also found that quotes used in news articles, were taken directly from a press release. Due to similarities in Extracts 1 and 2 to the press release, the public relations practitioner responsible for the press release from the John Innes Centre, has been able to play a role in the framing of both news articles. As Jackson and Moloney (2016) argue, this enables the organisation to obtain positive coverage and relay the key points they wish to make.

Journalists also aim to provide balance in stories (see Chapter 3). This means that with a controversial issue, a number of points of view should be highlighted in a news article. However, this is not evident in Extracts 1 and 2. The only actors visible in both extracts are scientists who conducted the research. In the study carried out by Ten Eyck and Deseran (2001) which examined food irradiation, a food activist described how they were continually used as a source once they had been quoted in a news article. The food activist saw this as a way of news coverage becoming standardised. This can be seen in Extracts 1 and 2. Both report the story in exactly the same way because of the use of the press release.

According to Murcott and Williams (2012), the standardisation of news coverage is leading to UK news organisations offering similar content, with little variation on offer for consumers. Additionally, they also believe that the growth of science PR and the science communication sector, could have serious consequences in the role science news plays in holding science to account. With PR professionals able to play a greater role in what is reported, and therefore becoming more influential, science journalists are likely to become uncritical in their coverage due to this shift in power. Although there has always been an element of translation by science journalists, this aspect of their role now seems to have become a copyist of the PR departments. As described in Chapter 3, Lippmann (2008) put forward the argument that citizens cannot choose between accounts which are true or false because of the lack of knowledge. Instead, citizens have to rely on trustworthy or untrustworthy reporters. This appears to be altering with the increased reliance on the use of press releases. Citizens are now having to rely on trustworthy journalists and trustworthy PR professionals.

In addition to the use of press releases from scientific institutions and universities, journalists rely on experts to act as spokespeople. This is illustrated in the extracts which follow. All of the news organisations with the exception of The Mirror, reported the failure of a GM Wheat trial at Rothamsted Research.

> Rothamsted researcher Dr Toby Bruce said: ‘In science, we never expect to get confirmation of every hypothesis. Often it is the negative results and unexpected surprises that end up making big advances - penicillin was discovered by accident, for example.

Extract 6 From the article ‘Taxpayer-funded trial of GM wheat designed to beat bugs and cut need for insecticides ends in a £3 million failure’ (The Daily Mail, 26 June 2015f).

> The director of GeneWatch, Dr Helen Wallace, said: ‘We must now recognise that GM has had its chance and failed to deliver.
> ‘We must move on to an agricultural system that does work and produces safe food that consumers want and that doesn’t damage the environment. Our research systems need to now move away from their stubborn obsession with GM and instead provide what the public wants and the environment needs.’

Extract 7 From the article ‘Taxpayer-funded trial of GM wheat designed to beat bugs and cut need for insecticides ends in a £3 million failure’ (The Daily Mail, 26 June 2015f).

> John Pickett, who led the Rothamsted trial, agreed that how the pheromone is released may be crucial to protect the plants. “We now know that in order to repel natural aphid populations in the field, we may need to alter the timing of release of the alarm signal from the plant to mimic more closely that by the aphid, which is a burst of release in response to a threat rather than continuous,” he said.

Extract 8 From the article ‘GM wheat no more pest-resistant than ordinary crops, trial shows’ (The Guardian, 25 June 2015b).

Helen Wallace at the campaigning group, GeneWatch, argued that the field study was a waste of taxpayer's money. "With GM crops, it's always jam tomorrow and never jam today," she said.

Extract 9 From the article 'GM wheat no more pest-resistant than ordinary crops, trial shows' (The Guardian, 25 June 2015b).

Extracts 6 and 7 are from The Daily Mail and Extracts 8 and 9 are from The Guardian. Both have used quotes from the press release issued by Rothamsted Research and the press release issued by GeneWatch. This enabled the journalist to provide balance in the news story. Although a negative result was achieved in the research, the quotes included in the news articles from those conducting the research at Rothamsted are still positive and optimistic. The research surrounding the GM Wheat trial is constructed as making scientific progress even though it did not work as anticipated. Balance is provided by the use of quotes from Dr Helen Wallace from GeneWatch. Both of her quotes used in the news articles describe the research concerning genetically modified crops negatively. The research is constructed as a scientific development which is rejected by citizens, is a waste of taxpayers' money, and is harmful to the environment.

Conrad (1999) makes the following observations about the inclusion of quotes by experts in news articles. Quotes can be used in a story to provide the scientific context or background. They may also be used to frame an article from a certain perspective or to provide credibility. The use of quotes from experts in this way, explains why new findings are important for science or to highlight why the discovery is newsworthy. With controversial science, quotes from experts with opposing views provide a juxtaposition in the story. The journalistic norms of balance can be attained by using these conflicting quotes. If there is some uncertainty or scepticism surrounding a new finding, a quote may be used to illustrate this to the reader. Quotes can also be used to develop a point a journalist wishes to put forward in a story, along with providing structure. Furthermore, those quotes likely to be included in an article, are ones which are clear and concise.

In addition to these points, Conrad (1999) goes on to explain how readers of a news article only know of those experts which are quoted or named. The views of these quoted experts may be representative of other scientists, or they may have contradictory opinions. 'Quotes are places in the story where "experts" directly present their viewpoints in their own words. Although quotes are selected by the journalists, they are uttered by the experts and can have a significant impact on how the news is written and read', however, 'lay people and especially the "affected" are rarely quoted' even if they have experience or a stake in the issues involved in the scientific research (Conrad, 1999: 300).

As has already been seen, and will be seen throughout this chapter, and Chapters 6 and 7, press releases and quotes are routinely used by journalists in the coverage of GM food. In respect of this particular chapter, the experts who appear in the news articles are scientists from scientific research institutions and universities. However, by offering below the line comments, news organisations are enabling greater participation from the audience. This is the focus of the next section.

The Use of Below the Line Comments by Scientists

Comments may play a part in offering alternate opinions, as well as potentially disrupting the standardisation of news coverage which is described above. Whilst the reader may be presented with a cacophony of jumbled and decontextualized messages in the below the line comments, those who may previously have been without a voice are now able to express their beliefs. For example, as organisations and social movements communicate with their audiences, they construct collective identities and meanings. They can potentially become 'powerful 'voices from below', communicating shared values and representing identities, values and visions' (Tufte, 2017: 102). This can also apply to individuals. 'Whose voice is heard … that of a community, a group, an NGO, a government or a donor? Power, policy and participation go hand in hand' (Tufte, 2017: 36). New media platforms enable greater participation. Content can potentially be produced by those who were restricted in the past, and different types of knowledges are able to be communicated. Those considered to have lay knowledge as opposed to expertise, are able to express their opinions. These aspects will be seen in this chapter and in Chapters 6 and 7.

The four extracts in this section all emerged from the analysis as being associated with the code of scientific evidence. Scientific facts or the peer review process are important to these commenters. The following two extracts are comments relating to the article entitled 'Anti-GM protesters don't understand how science works' (The Telegraph, 27 June 2015b). This article describes how a GM wheat trial carried out by scientists at Rothamsted Research had failed. The wheat had been modified so that it smelt like mint in order to repel aphids. The modification worked in the laboratory, but failed when tested outdoors. The article explains this is how science operates. If an experiment fails, it is amended and the trials begin again. The journalist also states that some members of the public do not understand how science operates. As will be seen, the comments do not convey the same information as the news article. The next three extracts (Extracts 10, 11, and 12) are comments posted by two scientists. This information was ascertained from either the information obtained from accessing the hyper-link in their comment, or from them actually stating they were a scientist.

So many myths about GE crops on the web. This can help: https://www.geneticliteracyproject.org/2014/10/28/not-all-science-is-created-equal-the-genetically-engineered-crops-story/ I am 100% responsible for the content so lets discuss the content.

Extract 10 Comment relating to the article 'Anti-GM protesters don't understand how science works' (The Telegraph, 27 June 2015b).

The grammatical error is made by the commenter in this extract. This commenter is a scientist in the Biology Department, at Vancouver Island University. He posted a link to the Genetic Literacy Project (2016). This link takes the reader to a post authored by the commenter. This lists the different myths he believes are associated with GM crops and foods. These are: GM crops and food are not tested; GM crops threaten the environment; GM crops do not increase yields; and GM crops threaten organic agriculture. Information is provided for all of these which attempt to dismiss these myths. The commenter appears to believe that this piece will help the audience understand genetically modified crops. This resonates with Beck (1992) who argues that scientists decide what they feel is acceptable to the population, and Williams and Clifford (2009: 12), who state 'scientists and other science communicators have tended to see the news media as little more than a "transportation system" whose primary role is to disseminate information about science, health, or the environment to an expectant public waiting to be educated'. Those views which do not match the scientists are disregarded and are often viewed as unreasonable. As this extract shows, this does not appear to be the case as the commenter is willing to engage in conversation. This commenter also posted Extract 11.

The level of pre-market testing for GE crops is 10-50 times that of non-GE crops. Can you think of any tests not already done in the evaluation process for all GE crops that you would like to see added? http://www.efsa.europa.eu/en/efsajournal/pub/2150

Extract 11 Comment relating to the article ‘Anti-GM protesters don't understand how science works’ (The Telegraph, 27 June 2015b).

The commenter describes the level of testing carried out on GM crops and provides a link to the European Food Safety Authority (EFSA, (2016)). The document describes the guidance for risk assessment which was outlined by the Scientific Panel on Genetically Modified Organisms (EFSA GMO Panel). It outlines how the EFSA make risks assessments on GM plants and derived food and feed. The commenter appears to direct the audience to this link and asks for them to consider any additional tests which should be added to those outlined in the EFSA document. Here, this commenter appears to be provoking audience reflection on the acceptability of GM crops.

Continuing with the theme of what is acceptable, this is further illustrated in the following two extracts which came from an article entitled ‘Greenpeace is failing to be 'honest' about GM crops, former EU scientific adviser says’ (The Telegraph, 3 February 2015i). This article was about how Professor Anne Glover, the former EU Chief Scientific Adviser believed certain NGOs such as Greenpeace were ignoring the scientific evidence about GM crops. She believed that if there was a reappointment to her old position, that person would most likely hold the same opinions as herself in respect of GM crops.

Am I not familiar with GM science? Well, I am a molecular biologist, but accepting my own limitations and that I might just be a mediocre one, I adopted the views of The Royal Society, the US National academy of sciences, the American Association for the Advancement of Science (the biggest scientific society in the world) and the European Food and Safety Authority. ALL of them reporting that GM crops are safe for humans and the environment
https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2009/4294967719.pdf
http://www.aaas.org/news/aaas-board-directors-legally-mandating-gm-food-labels-could-%E2%80%9Cmislead-and-falsely-alarm
http://www.efsa.europa.eu/en/efsajournal/pub/3355
Journal Impact Factors are extremely important for academics, that's what give us promotions (i.e. salary raises). The only reason for publishing in lower impact factor journals is failing to make it into the good ones. One of the reasons for failing is if your "hard data" is rubbish. And let's face it, whatever credible data that GMOs are unsafe in general would make it into Nature straight away because it would be extremely important.

Extract 12 Comment relating to the article 'Greenpeace is failing to be 'honest' about GM crops, former EU scientific adviser says' (The Telegraph, 3 February 2015i).

In this comment, the person states they are a molecular biologist. They are an advocate for GM crops and state they take the view of the organisations listed in the comment. They provide a link to each of the three organisations and these are described below.

The first link is to a report by The Royal Society entitled *Reaping the Benefits* (2009). It describes how food security could be addressed presently and in the future. The report examines different approaches to sustainable food production and states that no techniques or technologies should be ruled out. This applies to GM crops and organic food production.

The second link is to a statement released by the American Association for the Advancement of Science (2012). This statement advises readers that the organisation believes GM foods to be of no greater risk than those produced from crops bred by conventional means. The organisation was opposed to labelling of products containing GM, because they believed this may incorrectly inform consumers and allow them to believe there was a risk attached to them.

The third and final link is to the European Food Safety Authority Journal (2013). It explains the risk assessment carried out on a GM soybean developed by Monsanto. The risk assessment concluded there were no risks to human and animal health or the environment, and it was as safe as the conventional plant.

The commenter discusses journal impact factors and if GM foods were dangerous, the research would automatically be published in *Nature* due to the importance. In this way, the science is speaking for itself. Latour (1987: 73) describes this as the 'answer is easy: by letting the things and persons represented say for themselves the same thing that the representatives claimed they wanted to say. Of course, this never happens since they are designated because, by definition, such direct communication is impossible. Such a situation however may be convincingly staged'. This means that the scientists are speaking on behalf of the experiment which has been carried out. The experiment cannot talk, but the scientists acting on behalf of the experiment can act as its 'spokespeople'. The scientists can do this by publishing their research. If research is published in a journal such as *Nature*, other scientists should be able to conduct the experiment to ascertain if they achieve the same results. If the research has been conducted correctly and the same process is followed, identical results should be achieved in an experiment carried out by a different scientist.

In this comment, links are provided to the organisations listed above who all appear to be in favour of GM crops and food. This aligns with the argument of Beck-Gernsheim (1996: 148) whereby the 'advocates of genetic engineering attack with the argument 'For the sake of health'; the critics on the other hand proclaim 'For the sake of nature'. A very visible polarisation of viewpoints has taken place, one that splits the established parties and groups, splits the academic world and not least the natural sciences also'. In the case of the comment above, these organisations would be advocates of genetic modification of food.

As previously stated, the three preceding extracts were all posted by scientists. All of these as commenters draw on their expertise as scientists and the use of facts (see Chapter 2) in order to establish their authority. A different viewpoint can be seen in the comment which follows and is a response to the commenter who posted Extract 12. This extract also relates to the code of scientific evidence and refers to the peer review process.

You are not replying on the basis of data and scientific argument. If you don't like data showing toxic effects of GM crops on animals, then do some more rigorous experiments. Don't just cite journal impact factors, especially in light of the unscientific behaviour of Nature journal regarding 'inconvenient' findings, which by the way were later confirmed as correct by further research: http://www.spinwatch.org/index.php/issues/science/item/164-smelling-a-corporate-rat Also this is relevant: http://www.gmwatch.org/latest-listing/1-news-items/5077-2-journals-to-review-editorial-policies I see you prefer appeals to authority rather than hard data. In that case maybe you might be interested in these scientific organisations which say either that GM isn't safe or that there are doubts so GMOs should be labeled. http://beyond-gm.org/who-says-gmos-are-safe-and-who-says-theyre-not/

Extract 13 Comment relating to the article 'Greenpeace is failing to be 'honest' about GM crops, former EU scientific adviser says' (The Telegraph, 3 February 2015i).

The spelling mistake of 'labeled' is made by the commenter in this extract. It should be 'labelled'. This commenter in their response to the comment in Extract 12, provides links to organisations which are opposed to genetic modification. They provide a link to three organisations.

The first link is to Spinwatch (2018) and according to their website:

> Spinwatch investigates the way that the public relations (PR) industry and corporate and government propaganda distort public debate and undermine democracy. The PR and lobbying industry in the UK is the second biggest in the world, worth £7.5 billion. As the go-to organisation for information on this field, we routinely track PR and lobbying firms and corporate front groups, exposing their spin and deception.

This link is to a post which explains how a study carried out by Professor Gilles-Eric Seralini has been attacked by scientists, scientific organisations and regulators. It describes how quotes dismissing the study were provided by the Science Media Centre in London, and these were for journalists to use in news articles. There were also calls for the study to be retracted from the journal it had been published in, which was Food and Chemical Toxicology (Spinwatch, 2012).

The second link is to GMWatch (2018) and according to their website:

> GMWatch provides the public with the latest news and comment on genetically modified (GMO) foods and crops.
>
> GMWatch is an independent organisation that seeks to counter the enormous corporate political power and propaganda of the GMO industry and its supporters. It does this through its website, email lists, Powerbase portal, LobbyWatch, social media (Twitter and Facebook), and other outreach and campaigning activities. GMWatch was founded in 1998 by Jonathan Matthews and its managing editors are Jonathan Matthews and Claire Robinson.

This link is to a post about how the journals, *Science* and *Nature*, are to review their editorial policies following complaints that researchers had not disclosed financial interests. An example given in the piece described a letter that had been published in the journal, *Nature Biotechnology,* and an editorial which had been published in *Science*. The plant science centre responsible for these two items had been partially funded by Monsanto, and this was not disclosed in either the letter or the editorial (GMWatch, 2003).

The third link is to Beyond GM (2018) and according to their website:

> Beyond GM is a new independent initiative set up by experienced campaigners and journalists. Its goal is to raise the level of the debate on genetically modified organisms (GMOs) in the UK and elsewhere, at both the local and national level. Its activities aim to broaden the discussion about GMOs beyond the abstract, and often impenetrable, scientific and academic arena and out into the public arena.
> The campaign aims to bring some vitality back into GM campaigning by working with the strengths, talent and commitment of real people all over the UK and bringing their views to the fore.
>
> But it also has a serious purpose. For two decades the idea of GMOs has been ‘sold’ to the public as a way to ‘fix’ the food system. The truth is GM crops and foods were conceived at a time when many still believed that industrial farming was the answer to all our problems. Today they are little more than a crutch, used to prop up some of the worst, most damaging and most outdated aspects of a broken food system. If anyone tells you that GM crops are the answer to the problems of food insecurity, environmental degradation, and world hunger it’s a sure sign that they have failed to understand the true nature of these very serious problems.

This link is to a post which provides a list of organisations who have been quoted in the past as stating GM foods are safe. The position of these organisations are described as to their stance on GM foods. According to this document, some of these organisations did not appear to support GM foods, and these included the American Association for the Advancement of Science, the European Commission, the World Health Organisation, and the British Medical Association (Beyond GM, 2014). Beck (1992) argues that the criticism of science is becoming more open, and scientists will have to become accustomed to having their imperfections of their work exposed. By rejecting their expertise (see Chapter 2), this commenter appears to challenge the authority of both the previous commenter who wrote Extract 12 and those organisations listed in that extract.

The commenter also illustrates the complexity surrounding science when a development becomes controversial because of the competing claims being made. As Irwin (2001: 86) argues, 'whilst it may be helpful at times to view science as characterised by a particular world-view and approach, it seems more generally appropriate and productive to consider scientific differences as well as similarities. Thus, occupational and disciplinary divisions between scientists may produce substantial variations in terms of the scientific accounts offered'. Therefore, depending on their discipline, scientists may identify different problems which require solving, or alternatively, they may arrive at different solutions for the same problem. By its very nature, science can raise more questions than it answers.

This section has described the use of the below the line comments by scientists. It has also illustrated the appeals to scientific authority and scientific evidence by those commenting. The next section explores the narratives concerning gains from scientific progress.

Who Gains from Scientific Progress?

The next pattern to emerge with the discourse analysis was with that of who gains from scientific progress? This relates to the comments section. Extract 14 is associated with the risk (environment) morality or ethics code and Extract 15 relates to the risk (social) morality or ethics code. These extracts are comments which are concerned with who could gain from the development of GM crops and foods, and whether these gains are morally or ethically acceptable to both society and the environment.

The complexity of science and its interconnectedness with the environment is explained further in the following extract. This is a comment from the article entitled ‘UK should be given power to regulate GM crops, MPs say’ (The Guardian, 26 February 2015e). This article was about a report which had been released by the UK Parliament Science and Technology Committee.

> This is the science - the nature and health of topsoil - which should be getting a far higher profile. So far most of the research is being done by small private companies eg Nutri-tech solutions and academic bodies promoting agroecology and related sciences. Do the plant scientists who work for biotech companies have any idea of the essential qualities of the soil and the incredibly complex systems which give rise to it? The problem lies largely with the almost extreme degree of specialisation - an in-depth knowledge of genetics allows for little room for the study of the complex ecologies which will be affected by transgenic cross-fertilisation. And the horrifying effects of such toxic chemicals as glyphosate on the absolutely vital mycorrhizal fungi in the soil are being revealed daily

Extract 14 Comment relating to the article ‘UK should be given power to regulate GM crops, MPs say’ (The Guardian, 26 February 2015e).

This comment highlights the complexities involved with science and how scientists can only remark on their particular area of work. Scientists producing facts about genetic modification in plants will not be able to produce facts relating to soil science. These facts are created by scientists in laboratories and are proved via the instruments used in their creation. Latour (2004: 95) argues that

> we now know how to identify a whole gamut of stages where facts are uncertain, warm, cold, light, heavy, hard, supple, matters of concern that are defined precisely because they do not conceal the researchers who are in the process of fabricating them, the laboratories necessary for their production, the instruments that ensure their validation, the sometimes heated polemics to which they give rise – in short, everything that makes it possible to articulate propositions.

These points raised by Latour, can be seen in the extract in relation to the uncertainty of facts. Some areas of science may create more risks than others. In this extract, the risks to the environment from GM crops are alluded to, along with how it is morally wrong for plant scientists to say these crops are safe. Plant scientists are only able to address with any certainty, the facts they produce, and they would have to leave any questions unanswered about how GM plants impact the soil. This means these facts remain uncertain. As I noted in Chapter 2, Dewey (2016) explains how scientific language is used for a particular purpose, and each area of science has its own subtleties in the use of this language. Scientists can only be experts in their particular specialism. The commenter draws attention to how a scientist with an in depth knowledge of genetics would not understand ecology and ecosystems. As they use terminology such as ‘transgenic cross-fertilisation’ and ‘mycorrhizal fungi’, this is a person who has a high level of expertise. There is a use of technical words as opposed to those which are the everyday.

Being able to make their own claims enables commenters to define their own understandings, knowledges and interests. Comments allow an opinion to be expressed, and in this instance, a commenter who appears to express a high level of expertise is able to offer their viewpoint. The comment also explains a point made by Mythen (2010: 55), in that interactive discussion ‘can potentially serve to improve the quality of information circulating about risk incidents’. The commenter believes we need to be looking after the environment and especially the soil. They consider the importance of soil science and the need for more research to be carried out in this particular scientific discipline. The commenter draws attention to those who are currently conducting research into soil science such as ‘Nutri-tech Solutions’.

> The research is not under threat however as I said in my earlier posting these scientists who are lobbying for GM simply want to be taken on by the US GM companies, probably because they think there will be daft money being paid in salary terms.
>
> So far as being shown to be safe, I would not trust a US GM company to tell me today's Tuesday without checking my calendar. It is not going to come as any surprise, after we learn from some leaked documents telling us of some horror results from GM trials, that GM are telling everyone who'll listen, "Lessons will be learnt".

Extract 15 Comment relating to the article ‘Science bodies urge Scottish government to rethink GM crops ban’ (The Guardian, 18 August 2015f).

There are two significant ideas put forward by this commenter concerning research into GM crops and the moral and ethical risks surrounding it. Firstly, the scientists who are lobbying for GM are those who wish to be employed by the large biotechnology companies. This is the only reason a scientist would lobby for GM crops and food. Attention is drawn to this by the use of the phrase ‘daft money being paid in salary terms’. Secondly, GM crops are not safe due to the large biotechnology companies. Here, the phrase ‘I would not trust a US GM company to tell me today’s Tuesday without checking my calendar’ is used. The commenter suggests that scientists who wish to see GM crops implemented, are only doing so because they believe they will be employed by the American agri-business companies. In this extract, scientists are perceived as using their expertise where they are most likely to gain financially from it. As Lang (2016: 94) states, ‘researchers who make positive remarks about biotechnology are accused of being corporate shills with vested interests in the success of agribusiness firms'. Integral to the belief and trust in science by citizens, is the notion that scientific studies are neutral and free of conflicts of interest. Any attempt by scientists to advance their personal agendas, whether actual or perceived, will undermine the credibility of science. In this extract, scientific integrity is under threat from scientists concerned about money.

Here, the commenter also raises doubts about the reasons why scientists would wish to promote GM crops. Beck (1997) argues that doubt enables the limits and mistakes of all scientific progress to be illuminated including those aspects which are considered to be certain. In this instance, this commenter appears to doubt the reasoning of the scientists and why they wish to promote the growing of GM crops. Here, the only reason scientists would wish to promote genetic modification is for employment with the agricultural biotechnology companies. Grove-White (1996) argues that doubts and concerns surrounding the patenting of biotechnology include those based on political, legal and ethical grounds, where commercial or social advantages are concerned. Here, any commercial gains would be made by the agricultural biotechnology companies through scientific promotion.

Both of these comments questioned the use of genetic modification in food. As scientists are trained in one particular area of science, this is the only specialised knowledge they have. As a consequence of this specialised knowledge, the plant scientists cannot be certain of the harm GM crops may cause the soil. Therefore, it is morally wrong for plant scientists to say GM crops are safe. As the notion of science is perceived to be neutral and free of conflicts of interest, the credibility of science may potentially be undermined by scientists who work for the agricultural biotechnology companies. These scientists are understood as only being concerned about money, as opposed to the research they are conducting.

The theme continues with the moral and ethical implications associated with scientists working on research into GM foods in the next section. The focus is on a genetically modified animal, a lamb called Rubis.

Genetically Modified Lamb and the Moral and Ethical Implications

The next pattern to emerge with the discourse analysis was concerned with genetically modified lamb and its release into the human food chain. This relates to the news articles and the comments. All of the extracts in this section relate to the risk (social) morality or ethics code. This section examines how the expertise of scientists and a scientific research institution can be undermined by a particular event, and the moral and ethical implications of this. In this specific instance, a lamb was genetically modified with a jellyfish gene to be used in medical research to study heart transplants. It was sent to an abattoir and was sold for human consumption. A press release (Appendix C) was issued by the National Institute for Agronomic Research (INRA) in connection with this incident.

The following extract came from an article entitled ‘Lamb with jellyfish gene 'may have been deliberately sent to abattoir'’ (The Guardian, 23 June 2015c).

> A lamb born with a jellyfish gene was mistakenly sold for human consumption and probably ended up on someone’s plate, French authorities have said. A dispute between researchers at a highly respected national institute may have been the cause of the animal being deliberately sent to the abattoir last year. Police have now been called in and an inquiry launched into how the lamb could have been passed as fit for human consumption.

Extract 16 From the article ‘Lamb with jellyfish gene 'may have been deliberately sent to abattoir'’ (The Guardian, 23 June 2015c).

In this extract, the journalist focuses on a genetically modified lamb being sent to an abattoir. This is made significant by the journalist through their use of the word ‘deliberately’, which indicates to the reader that the incident was planned and knowingly conducted. It was premeditated. As opinion about GM food in France is not favourable and no GM crops are cultivated or GM animals produced (Library of Congress, 2018), this is something which should not have happened. This illustrates scientists as disreputable and who cannot be trusted with handling research. There is also an element here of science being above other forms of authority, such as legal, moral and ethical. In this instance, a risk appears to have been created when there was no need for this to occur. The press release from INRA (Appendix C) states that the sale of any genetically modified organism breaches the French Environment Code. However, an employee allowed a sale to occur which they went on to conceal. The press release goes on to describe how the lamb was of a low risk to human health and the environment. As Beck (2009: 188) contends 'risk defines a social relation, a relation between at least two people: the decision-maker who takes the risk and who thereby triggers consequences for others, who cannot, or can only with difficulty, defend themselves'. Here, the protocol to prevent harm to consumers is broken by a scientist, by allowing the lamb to be sent to slaughter with those intended for human consumption. The breaking of these rules by the scientist showed a disregard for the safety of consumers.

The journalist notes how researchers from a 'highly respected national institute' allowed this incident to occur. This exemplifies how risks can be generated by organisations whose work is usually considered extremely worthwhile. The scientist brought the authority of the research institution into doubt through inappropriate actions. This resonates with the argument of Beck (1995: 88) whereby 'liabilities, legal claims, the principles of calculations, legitimations, 'explode' socially upon contact with reality. Admission of the danger coincides with the admission that everybody who has been right until now, including all the institutions, was mistaken and has therefore failed'.

A number of actors are made visible by the journalist and these comprise consumers, French authorities, researchers from the national institute, the abattoir, and the police. This demonstrates to the reader the importance of the incident due to the involvement of the French authorities and the police. By using the phrases the ‘Police have been called in’ and an ‘inquiry launched’, the journalist is indicating to the reader that the incident is being investigated to establish how it occurred. Beck (1995) describes how disclosing a danger means that those who have argued against the risk have to concede and acknowledge its existence, and this also includes institutions. This can be seen as a failure. Here, the National Institute for Agronomic Research has to admit that a lamb entered the food chain and this appears to be the fault of one of its scientists.

As well as an article appearing in The Guardian concerning the GM lamb, an article was also published in The Telegraph. The following extract is from The Telegraph article.

> While Rubis was a class 1 GMO, in other words containing a gene posing "no or negligible risk" to humans, Gérard Pascal, a former Inra biochemist, told Le Parisien its introduction into the human food chain was “intolerable”.
> “Beyond the ethical issues, one cannot put foodstuffs into the market that haven’t been the subject of deep research. Until they’ve been studied, one cannot assess the risk,” he said.

Extract 17 From the article ‘Genetically modified 'jellyfish lamb' accidentally hits French dinner plates’ (The Telegraph, 23 June 2015e).

In this extract, the journalist includes a quote from Gérard Pascal, a former biochemist at the research institute. This is significant because it is a former employee who is concerned about the GM lamb entering the food chain. The use of the word ‘intolerable’ indicates the extent he believes it should not have happened. By including this source, the journalist is indicating to the reader how an ex-employee of the institution perceives the situation. Gérard Pascal then goes on to explain how the situation is ethically improper as well as addressing the issue of safety. As Irwin (2001: 79) claims, ‘sophisticated calculations of risk must always depend upon social and institutional judgements as to the likelihood that safety procedures will actually be followed' and 'the judgements of scientific experts are premised upon what is effectively a social assessment of how the risks involved will be managed and whether officially sanctioned procedures and practices will actually be observed'. Gérard Pascal makes the claim that a foodstuff should only enter the food chain after it has been properly tested and shown to be safe. This juxtaposes with the 'no or negligible risk' which is also stated in the extract and illustrates objective reporting on the part of the journalist.

These two preceding extracts focus on the unacceptability of the lamb having been sent to slaughter and deemed to be fit for human consumption. This unacceptability emanates from the research institute. The sale of the GM lamb into the food chain by an employee, undermines the credibility and integrity of research conducted at the research institute. This is evident from the quotes used by the journalists. This unacceptability is also addressed by a commenter in the extract which follows.

> The really worrying thing here is not so much the specific GM activity. It is the ease with which an experimental organism could be disposed of, the ease with which it could be hidden and moved without separate identification and very tightly scrutinised supervision. We are told this lamb was 'safe' - they would say that - but such unsupervised dispersal, aka vanishing, could also be implemented in less benign situations, for example when the lab wished to dispose of more troublesome outcomes. My main caution against GM is precisely this - the fact that we do not know enough about the outcomes, and more specifically, the fact that we cannot trust those conducting these experiments. Neither their processes, as here, nor their statements, possibly also as here.

Extract 18 Comment relating to the article 'Lamb with jellyfish gene 'may have been deliberately sent to abattoir'' (The Guardian, 23 June 2015c).

In this extract, the key message the commenter is trying to communicate is their concern about the lamb being sent to an abattoir and the research institute not being aware of this. Here, the ethical implications of the GM lamb being sent to slaughter are entwined with issues of trust. The commenter expresses their own opinion because of the use of 'my' but they also use 'we'. This suggests the commenter is attempting to make this situation into an issue everyone should be concerned about. Although the lamb is supposed to be 'safe', the commenter suggests that if a lamb can be lost in a situation such as this, it can happen again if an experiment goes wrong. The commenter appears to be less concerned about the genetic modification of food than they are with the integrity and credibility of scientists and the institutions they work for. In part, this is related to trust.

The commenter suggests scientists cannot be trusted with research concerning genetic modification after this incident. The argument the commenter constructs illustrates a rejection of scientific expertise (see Giddens (1991); Nichols (2017); Turner (2001), Chapter 2). The ease in which the lamb is disposed reveals inadequacies in safety procedures in the research process. Beck (1997: 155) argues that 'expectations and values are changing accordingly. That which today appears to be a ghastly horror story from the laboratory of some mad scientist in the movies will cease to be so spectacular once enjoyed and experienced. Like so many other things, it will go its own way, frightening at first, then beneficial and perhaps again frightening at the thought of losing the benefit'. In this respect, the comment resonates with part of Beck's statement in that a scientist involved with the lamb incident, appears to be like a mad scientist in a film[1]. The disposal of the lamb is like the first stage, which is frightening. However, the commenter does not view these developments with the lamb as something which could be beneficial. In this case, the disposal of the lamb exemplifies a way in which other experiments carried out by scientists could be disposed of. This in itself is a worrying development for the commenter.

[1] See Chapter 7 for a discussion concerning the use of science fiction in framing the news articles and below the line comments.

Chapter Conclusion

The chapter started by examining press releases. In this respect, narratives from press releases are increasingly being found in news articles. As a result, news stories are becoming increasingly standardised and there is a growth in the amount of churnalism which is occurring. In part, this is due to changes in the way journalists are working and gathering information for news stories. PR departments are now playing a greater role in what becomes science news, as well as how this news is framed. The below the line comments draw attention to how standardised news coverage can become disrupted. Here, the audience are presented with a wider range of views, as well as the ability to express their own opinion. Some of these comments demonstrate how commenters use links to direct the audience to other websites. Scientists also post commentary in the comments section, and are able to assert their authority and expertise by linking to content they have produced. This reaffirms the authority of science.

The articles also describe how scientific facts are produced by those who have the expertise and authority to do so. Journalists use scientists as sources in the news articles and this provides legitimacy.

Commenters also draw attention to who they believe stands to gain from scientific progress, and whether this is morally and ethically acceptable. As scientists are specialists in one particular area of science, they may not understand the consequences of the research they are conducting. Commenters also believe that science should be neutral and free of conflicts of interest, and this is integral to the belief in science.

The GM lamb being deliberately sent for slaughter indicates how science can be above other forms of authority such as legal, moral and ethical. The articles also illustrate how the misjudgement of a scientist can potentially impact the reputation of the research institution they work for. However, the institution was shown as attempting to investigate this error, and could therefore be seen as putting the reputation of the research institution before the scientist. The arguments put forward in the articles illustrate this as morally correct.

Those commenting about the incident with the lamb, describe how they believe scientists should not be trusted with the disposal of materials used in experiments. The incident with the lamb revealed to one commenter, how easily results of experiments can be hidden if unintended consequences occur.

In the next chapter, I will examine how the authority of the UK Parliament's Science and Technology Select Committee, and the Scottish Government are described and discussed in the articles and comments.

Chapter 6

The Online GM Food Debate: Narratives of Scientific Expertise and Political Authority

Introduction

Scientific facts are interpreted by political decision makers when informing policy. In addition to this, political decision makers inevitably have to decide whether the science that is created requires regulation. The political judgements made on determining the risks surrounding science can lead to controversy. Related to controversy, is improved access to information due to the greater availability of the internet (see Chapter 3). This enables greater ease for information to be obtained, and therefore, facilitates an opportunity for beliefs to be contested. Consequently, 'science policy-makers must recognise this diversity of perspectives and proceed in the face of it' (Hornig Priest, 2009: 233). Lang and Heasman (2015) argue that the media are eager to cover food policy issues, especially when these are controversial. This is related to who is attempting to have their voice heard in the milieu of policy making. Contentious issues relate to the immense power in the food system (see Chapter 1), which is greatly interconnected on regional, national and global scales (Lang, 2003). Such interconnections position trust as one of the key components of food policy and as such, food safety is widely reported by news organisations.

In this chapter, I examine the articles and comments concerning the decisions made by the UK Parliament's Science and Technology Select Committee and the Scottish Government. Firstly, I analyse the articles in connection with the Science and Technology Select Committee's call to amend the terminology of GM food, together with the responses of commenters to this. Next, the focus remains on articles about the Science and Technology Select Committee, but attention is turned to the analysis of the articles in connection with the use of the 'precautionary principle', along with how commenters respond to this. Finally, I analyse the articles in connection with the use of the precautionary principle by the Scottish Government, together with the reactions of commenters. Throughout this chapter the emphasis is on the tension between science and values. In addition, the legitimacy of science is also questioned. As will be seen, in part, this is related to the definition of science, and how science can answer a particular problem in different ways.

UK Parliament Science and Technology Select Committee

This section examines the online news articles in connection with the authority at the level of the UK Parliament. The UK Parliament's Science and Technology Select Committee appear in the news coverage as one of the key actors of the GM food debate during 2015. This is principally due to their report which was published on 26 February 2015 entitled, *Science and Technology Committee – Fifth Report; Advanced genetic techniques for crop improvement: regulation, risk and precaution* (House of Commons Science and Technology Committee, 2015). The coverage of this report resonates with the argument put forward by Ten Eyck and Williment (2004), in that institutions and organisations require the media in order to inform citizens of the latest developments. Similarly, Nelkin (1987) argues that the consequences of scientific knowledge often have media appeal. Coverage of the release of the report appeared in The Guardian, The Telegraph, The Times and The Daily Mail. However, the construction of the articles were different in these different newspapers, with journalists choosing to cover a variety of issues. The two issues analysed here, are the wish by MPs to rename GM crops and foods, and the use of the precautionary principle. These two issues appeared as patterns when conducting the discourse analysis.

As a starting point, Figure 6.1 explains the role of the UK Parliament Science and Technology Select Committee and emphasises the importance placed upon the use of scientific evidence in policy and decision making.

The extracts that follow examine how the Science and Technology Select Committee's report is framed in regards of the position taken in respect of GM crops.

Commons Select Committee

Role - Science and Technology Committee

The Science and Technology Committee exists to ensure that Government policy and decision-making are based on good scientific and engineering advice and evidence

The Science and Technology Committee is unusual amongst departmental select committees in that it scrutinises the Government Office for Science (GO-Science), which is a "semi-autonomous organisation" based within the Department for Business, Energy and Industrial Strategy.

GO-Science "supports the Government Chief Scientific Adviser and works to ensure that Government policy and decision-making is underpinned by robust scientific evidence". The committee therefore has a similarly broad remit and can examine the activities of departments where they have implications for, or made use of, science, engineering, technology and research.

Figure 6.1 The role of the Science and Technology Select Committee (UK Parliament, 2018a).

The Renaming of GM Foods – News Articles

The first pattern to emerge with the discourse analysis is the recommendation of the Science and Technology Select Committee to rename GM foods, and this relates to the news articles. Extracts 1 and 2 are associated with the risk (social) morality or ethics code, and Extract 3 is associated with the risk (social) fear code.

Coverage of the Science and Technology Select Committee Report appeared in The Times and The Daily Mail. These report how politicians on the committee appear to be recommending the renaming of genetically modified food to make it more acceptable to consumers. With food being a sensitive issue for citizens (see Chapter 1), any renaming could potentially be controversial.

As will be seen in the analysis, scientific knowledge is viewed as being superior to any other knowledge, and this provides legitimacy to political decisions. The following two extracts are from an article entitled ‘GM crops ‘need a rebrand’, say MPs’ (The Times, 26 February 2015c).

> Ministers must stop using the term “GM” when referring to genetically modified crops because it has negative connotations and encourages public hostility to the technology, a committee of MPs has said.
> The government has failed to educate the public about the benefits of modifying plant genes, the report by the science and technology committee said. It acknowledged that the government has been vocal in its support for genetic modification but said that ministers “must do more to influence the narrative”.

Extract 1 From the article ‘GM crops ‘need a rebrand’, say MPs’ (The Times, 26 February 2015c).

In this extract, the journalist focuses on the report released by the Science and Technology Select Committee. The journalist describes how the report states that whilst the Government has supported genetic modification, ministers must be more proactive in their endorsements, enabling the public to have a more positive opinion of the technology. The key message from the journalist is that ministers must use alternative terminology and be more proactive in their approach to educating citizens. Currently, ministers are failing and are creating opposition to the technology instead. This message brings the moral and ethical debate to the fore (see Douglas (1992), Chapter 2). The journalist is making the reader aware, that the Science and Technology Select Committee wish to see citizens educated about GM crops and foods. As ministers need to ‘“influence the narrative”’, the journalist identifies the ministers as having the authority and power to persuade citizens to accept GM foods. The use of quotation marks around '"influence the narrative"' also removes the journalist's voice from the article. As Tuchman (1978) explains, using quotations of other people's opinions provides supporting evidence for the facts being presented. 'Journalists typically seek out experts to provide contextual knowledge, legitimate the journalists' own interpretations of phenomena, increase the credibility of the narrative and deliver information on knowledge-intensive topics' (Saikkonen, 2017: 2). The judicious use of quotation marks by the journalist, ensures readers are aware that it is the report which is calling for the narrative to be influenced as opposed to the journalist. The use of a quote by the journalist also adds legitimacy to the news story (see Conrad, 1999, Chapter 3).

The news media do not start with the agenda of how citizens feel about a subject (see Chapter 3 for the discussion of news agendas). In respect of this article, the focus of the public is addressed by a counter-claim. This is addressed in the following extract.

> The committee recommends that the government "initiate a reframing of the public conversation" by "moving away from the overly simple notion of 'GM' in its own communications".
> Peter Melchett, policy director at the Soil Association, which opposes GM crops, said the MPs' call for the term "GM" not to be used was "probably the most ridiculous recommendation to come out of any select committee in this entire parliament.
> "This has already been attempted once before and failed — when the name was changed from genetic engineering to genetic modification, and if anything this made it more unpopular. It's insulting to the British public to suggest they can be fooled that easily."

Extract 2 From the article 'GM crops 'need a rebrand', say MPs' (The Times, 26 February 2015c).

This extract is from the same article as Extract 1. It emerged from the analysis as being associated with the risk (social) morality or ethics code, because of the suggestion of the name change from genetic modification. The journalist provides balance to the news story because they include a response from Peter Melchett[2] of the Soil Association. This is also significant because it is a counter-claim. In Chapter 3, I described how Fahy (2018) believed a change had occurred with balance in reporting. Some journalists were no longer applying balance in their news stories, but were instead using weight-of-evidence reporting. This does not appear to be the case here, as balance appears to be applied by the journalist. Extract 1 and Extract 2 are both from the same news article and show the different views of the actors involved.

The key message is contained within the quote from Peter Melchett, and he suggests how the British public may consider the name change. He alludes to the fact of a previous name change from genetic engineering to genetic modification, and how this made little difference to the perception of GM foods by citizens[3]. This also implies that previous experiences are drawn upon, even by those who provide evidence to the Science and Technology Select Committee (see Wildavsky (1987), Chapter 2). Peter Melchett states this is 'insulting to the British public', and this suggests he believes citizens are not ignorant or uninformed about scientific issues.

The previous two extracts both describe morals and ethics relating to the renaming of GM crops because of the suggestion of reframing the conversation or influencing the narrative. The journalists are describing how the MPs on the Science and Technology Select Committee believe it is possible for citizens to be more accepting of GM foods by altering the conversation. The implication is that if citizens are educated about the

[2] Since collecting the data, Peter Melchett has passed away.
[3] I have attempted to establish when this occurred and how this was achieved. Unfortunately, it has not been possible to locate any information. Many of the documents on the UK Parliament website refer to genetic modification as opposed to genetic engineering, along with a combination of the use of both terms.

science, they will be accepting. This ties in with the deficit model and public understanding of science (see Chapter 2). Here, the credibility of the knowledge of citizens is questioned by the Science and Technology Select Committee because citizens are presented as being able to be persuaded by new terminology. This is apparent in the quotes in the extracts. This juxtaposes with the extract which includes the quote by Peter Melchett. He suggests the name change will not alter the opinion of citizens because he does not believe they are uninformed and ignorant about science.

The following extract is from an article entitled ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (Daily Mail, 26 February 2015c). The claims relate to the fear associated with renaming GM crops and food. This emerged from the analysis as being associated with the risk (social) fear code, because of the use of the term ‘lightning rod’.

> The term ‘GM food’ should be abandoned, say politicians who are calling for an extraordinary rebranding exercise.
> MPs on the science and technology select committee has demanded a ‘reframing of the public conversation’ about genetically modified food.
> In an inflammatory report today, it says the GM label has become a ‘lightning rod’ for fears about designer crops.

Extract 3 From the article ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (Daily Mail, 26 February 2015c).

In this extract, the journalist focuses on the report released by the Science and Technology Select Committee. The grammatical error with ‘MPs on the science and technology select committee has demanded’ is made by the journalist. The key message from the journalist is that there needs to be a different conversation with citizens about genetic modification. The phrase ‘lightning rod’ suggests to readers that the term GM has become a focus of attention and controversy, and is an issue of concern (see Douglas (1992), Chapter 2). By using this terminology, the journalist is able to quickly convey the message to the reader. In renaming GM crops, the MPs hope to reframe the public debate. This exemplifies a point made by Wynne (1996: 73), whereby science is 'like all other kinds of knowledge, thoroughly cultural, and the ways in which it conceals its own fundamental indeterminacies by subtly and tacitly building the cultural and institutional terms of its own validation'. The journalist goes on to call them designer crops which could potentially signify to the reader how the name could be changed.

This extract also illustrates the storytelling nature of science reporting. As Nerlich (2013) argues, reporting science is just as concerned with telling a story as is it in revealing the facts. Scientific news stories have to be engaging and entertaining if the audience is to read them. The use of language by the journalist such as 'extraordinary', 'inflammatory', 'lightning rod', and 'designer crops', sensationalises a Science and Technology Select Committee report. Rather than only providing the audience with facts, the journalist presents a dramatic narrative to engage the reader with a news story concerning a report. The next section focuses on how the renaming of GM foods is discussed in the comments section.

The Renaming of GM Foods – Comments

The pattern with the discourse analysis continues with the wish of the Science and Technology Select Committee to rename GM foods, but this is in connection with the comments. Extracts 4, 5, and 6 relate to the risk (social) trust code. These extracts examine how trust can be undermined when citizens believe they are being deceived and lied to.

As the analysis will show, commenters draw on their values and beliefs. The following three extracts are comments which were posted in response to 'Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops' (Daily Mail, 26 February 2015c). This article was discussed in the previous section.

> Let's have the names of these MP's on this select committee. If they see deceiving the voters is ok. then let us show them it's not ok, get rid of them in May. The US a leading Country in GM farming is reported as having second thoughts on their use. Just yesterday Hershey the famous US chocolate manufacturer have declared not to use GM ingredients in their products. These MP's are clearly 'FRIENDS' GM laboratories. Why are they afraid to label their products, If they are as safe as they say, no problem. Let me exercise my right of choice and not be lied to

Extract 4 Comment relating to the article 'Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops' (Daily Mail, 26 February 2015c).

The grammatical errors are made by the commenter in this extract. Firstly, it is possible to establish the names of the MPs sitting on the Science and Technology Select Committee. These are listed on the webpage for the Science and Technology Select Committee on the UK Parliament website (UK Parliament, 2018b). Requesting the names of the MPs on the comments section requires less effort on the part of the commenter than if they were to seek out this information directly. This commenter is calling out and asking other commenters to list the names of the MPs. By doing so, they are drawing attention to what they perceive as deception, as well as attempting to get other people involved. This relates to the argument made by Douglas (1992) (see Chapter 2), whereby blame is used to encourage other citizens to join the debate.

For this commenter, it appears MPs need to be trustworthy in order to serve in Parliament, and the commenter relates the matter of trust to the safety of GM products. If Hershey decides against using GM ingredients in its products then they cannot be safe. If GM ingredients are not safe, then MPs should not be allowing the introduction of GM crops. The only reason the commenter could see this happening is due to the relationship between scientists and MPs, and this enables the integrity of science and scientists to be questioned. Developments with GM crops are only allowed to occur when scientists are ‘friends’ with politicians. What is significant for this commenter is how they do not wish for citizens to be lied to, and that citizens should have a choice. The key words used by this commenter are ‘deceiving’ and ‘lied to’. Both these words indicate how the commenter perceives those with political authority are misleading citizens. Those with political authority are doing so for their own benefit. Collins (2014) argues there is an expectation by the public that science is carried out differently to business and politics. There is a belief that financial and political motivations will influence those working in business and politics, but this should not be the case with scientists and science. He goes on to state how the public appear concerned when scientists are found to have political or financial motives for carrying out or advising on research. If citizens believe they are being deceived by those in authority, it can potentially undermine expertise (see Nichols (2017), Chapter 2).

> In other words try and hide the truth. These foods are pure evil. When that is realised,those who promoted it no doubt will not be held to account!

Extract 5 Comment relating to the article ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (Daily Mail, 26 February 2015c).

The grammatical error is made by the commenter in this extract. In this extract, the commenter is focusing on how the truth is hidden. The comment is in response to the Daily Mail article, so this suggests those ‘who promoted it’ are politicians. However, the commenter is not explicit, so this could be scientists too. This commenter appears to believe politicians are promoting GM foods, whilst lying to the public at the same time. This illustrates a point made by Lewis et al. (2005), whereby the active agencies in the news are governments or industry, whilst citizens are not active, only reactive. In Extracts 4 and 5, the commenters' responses could be viewed as being reactive to the disclosure in the article of changing the name of GM crops. The reactive nature of the citizen could also be due to the view that only experts such as scientists are knowledgeable enough to make decisions, whilst citizens have poor judgement (Lewis et al., 2005). Citizens are not able to be active agents in science news. By using the comments section and expressing an opinion, this may be an opportunity for citizens to become active agents. However, those reading the comments may be presented with misleading information or falsehoods. Turner (2013: 162) argues that those audience members reading and posting comments may be sceptical about expert claims, and this can undermine 'the kind of deference to fact that is essential to democratic discussion, and forces the discussion of questions that are properly subject to expert knowledge into the fact-free arena of ranting, speculation, and ignorant assertion'. This can lead to conflicts with expert knowledge. The reactive view of citizens is further illustrated in the following extract.

So, in other words, just lie to the public. So you just know it is bad/harmful when they have to lie.

Extract 6 Comment relating to the article 'Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops' (Daily Mail, 26 February 2015c).

In this extract, the commenter focuses on how the truth is hidden, as with Extracts 4 and 5. If the truth is hidden, the commenter suggests this is because there is a problem with GM foods. They imply that because politicians believe it necessary to lie about the name of GM foods, they must be harmful. As this comment is a response to the Daily Mail article, 'lie to the public' appears to refer to the politicians lying to the public by changing the terminology from genetic modification. All three extracts (Extracts 4, 5, and 6) show the commenters as believing they have not been told the truth. This reflects the contested nature of the GM debate, especially with the provision of a platform which enables all of those who wish to speak, the opportunity to express their opinion. As I note in Chapter 2 and alluded to above, Turner (2013) explains how expert knowledge can be undermined by commentary. These three commenters all draw attention to lies and deception which they perceive to exist. Deception can undermine trust (see Giddens (1991), Chapter 2). This illustrates one aspect of why science becomes contested. In these examples, trust is an important issue. Another issue concerning disputes surrounding science is uncertainty. This uncertainty is sometimes dealt with by the application of the precautionary principle, and this is the focus of the next section.

The Precautionary Principle – News Articles

In order to deal with uncertain science surrounding issues such as GM crops, it is possible to apply what scientists and policy makers have established as the 'precautionary principle'. O'Riordan and Cameron (1994: 12) define the precautionary principle as a concept which 'takes its cue from changing social conceptions about the appropriate roles of science, economics, ethics, politics and the law in pro-active environmental protection and management', and it is a 'rather shambolic concept, muddled in policy advice and subject to whims of international diplomacy and the unpredictable public mood over the true cost of sustainable living'. The precautionary principle was first used in environmental policy decision making in the UK in the mid-1980s (Haigh, 1994), and there are six aspects to it, which are as follows:

> 1) Preventative anticipation;
> 2) Safeguarding of ecological space or environmental room for manoeuvre as a recognition that margins of tolerance should not even be approached, let alone breached;
> 3) Proportionality of response or cost-effectiveness of margins of error to show that the selected degree of constraint is not unduly costly;

4) Duty of care, or onus of proof on those who propose change;

5) Promoting the cause of intrinsic natural rights;

6) Paying for past ecological debt (adapted from O'Riordan and Cameron, 1994: 17).

Additionally the definition of the precautionary principle as applied by the European Union (EU) is shown in Figure 6.2. This is referred to in the extracts which appear in the subsequent sections.

The precautionary principle

The precautionary principle enables rapid response in the face of a possible danger to human, animal or plant health, or to protect the environment. In particular, where scientific data do not permit a complete evaluation of the risk, recourse to this principle may, for example, be used to stop distribution or order withdrawal from the market of products likely to be hazardous.

ACT

Communication from the Commission on the precautionary principle (COM(2000) 1 final of 2 February 2000)

SUMMARY

The precautionary principle is detailed in Article 191 of the Treaty on the Functioning of the European Union (EU). It aims at ensuring a higher level of environmental protection through preventative decision-taking in the case of risk. However, in practice, the scope of this principle is far wider and also covers consumer policy, European legislation concerning food and human, animal and plant health.

This Communication establishes **common guidelines** on the application of the precautionary principle.

The definition of the principle shall also have a positive impact at international level, so as to ensure an appropriate level of environmental and health protection in international negotiations. It has been recognised by various international agreements, notably in the Sanitary and Phytosanitary Agreement (SPS) concluded in the framework of the World Trade Organisation (WTO).

Figure 6.2 The definition of the Precautionary Principle (European Union, 2016).

One pattern to emerge with the discourse analysis is the acceptance of the precautionary principle by the Science and Technology Select Committee, and this relates to the news articles. Extracts 7 and 9 relate to the scientific evidence code, and Extract 8 is associated with the scientific progress (good) code. The following extract (Extract 7) is from an article entitled 'UK should be given power to regulate GM crops, MPs say' (The Guardian, 26 February 2015e). This extract discusses scientific evidence which demonstrates GM crops as safe.

A new report from the committee is damning of regulatory delays caused by the EU's consideration of GM under a 'precautionary principle' which obliges caution where scientific evidence is insufficient, inconclusive or uncertain.
"Opposition to genetically modified crops in many European countries is based on values and politics, not science," said Andrew Miller, the chair of the science and
technology committee. "The scientific evidence is clear that crops developed using genetic modification pose no more risk to humans, animals or the environment than equivalent crops developed using more 'conventional' techniques."

Extract 7 From the article 'UK should be given power to regulate GM crops, MPs say' (The Guardian, 26 February 2015e).

In this extract, the Science and Technology Select Committee are framed as not only being in opposition to the EU, but also suggests the EU make decisions uninformed by science. According to Andrew Miller, Chair of the Select Committee, the legitimate authority in decision making is science as opposed to values and beliefs. This use of science in decision making was emphasised in *The Public Understanding of Science* report, published by The Royal Society (1985). This explains 'there are few, if any, public issues, including unemployment, that do not have a scientific or technical component' (The Royal Society, 1985: 9). This underlines the importance of science in almost all aspects of social issues. The report then goes on to state 'science and technology therefore should be major considerations in public policy. Whether they actually are depends on how far ***(a)*** the decision-makers and their advisers, and ***(b)*** the public to whom they are ultimately responsible, understand the scientific and technological aspects of each issue and, more generally, the scope and limitations of scientific method'(The Royal Society, 1985: 9). This section of the report stresses the importance of scientific literacy of decision makers and citizens, in order for science to be used in policy. If decision makers and citizens are scientifically illiterate, the scope of the use of science is limited. If this is the case, it will be difficult for science to be the legitimate authority in decision making. The reasons for The Royal Society (1985: 10) wishing for citizens to be scientifically literate are as follows:

> In a democracy public opinion is a major influence in the decision-making process. It is therefore important that individual citizens, as well as the decision-makers, recognize and understand the scientific aspects of public issues. To decide between the competing claims of vocal interest groups concerned about controversial issues … the individual needs to know some of the factual background and to be able to assess the quality of the evidence being presented. Wider understanding of the scientific aspects of a given issue will not automatically lead to a consensus about the best answer, but it will at least lead to more informed, and therefore better, decision making.

If citizens and decisions makers are aware of the scientific facts, they are able to assess competing claims. This is similar to the argument made by Andrew Miller. However, for Andrew Miller, the competing claims are based on values and beliefs as opposed to science.

The narrative also shows the Science and Technology Select Committee as believing the use of the precautionary principle by the EU is unnecessary with GM crops. As the scientific evidence shows no difference between conventional crops and GM crops, the use of the precautionary principle should be abandoned. However, the narrative also shows the difference between the EU believing the science surrounding GM crops remains uncertain and inconclusive, whilst the Science and Technology Select Committee view it as clear and unequivocal. As a result, there appears to be divergence between the precautionary principle invoked by the EU, and the use of scientific evidence. Jasanoff (1990) contends that those involved in regulation attempt to influence the main issues by alternating between science to policy or policy to science. In this instance, the precautionary principle is the policy implemented by the EU, whilst the Science and

Technology Select Committee claim to base their recommendations on scientific evidence. 'In the context of regulation, by contrast, scientific "facts" serve as a bridge not to other facts but to policy decisions. They undergo no subsequent testing at the hands of scientists, so that their legitimacy depends exclusively on the manner of their production. Yet they must be robust enough to underpin decisions entailing significant social costs' (Jasanoff, 1992: 203).

Andrew Miller, the Chair of the Science and Technology Select Committee, is presented as emphasising how decisions about GM crops are based on values as opposed to science. Whittemore (1983: 31) argues that attempting to separate risk into 'fact and value is illusionary' and this implies this is an impossible task to achieve. In comparison, Douglas and Wildavsky (1982a: 64) claim that 'where values are closely compatible and where most facts are agreed upon, attention can be turned to investigating the remaining problems. When values diverge sharply, as in the controversies over risk, fewer facts are certified and disagreements arise over what used to be taken for granted'. In contrast to these arguments, Andrew Miller appears to be attempting to drive the decision making process for GM crops to be based on scientific evidence only, whilst values and beliefs are dismissed. There is a paradox to this, given that politics is underpinned by values and beliefs. However, given the value free ideal of science (see Chapter 2), it is not unsurprising there is a wish to exclude values and beliefs. Nevertheless, in science policy, it is impossible to separate values from scientific facts (Hunt, 1994; Jasanoff, 1990; Whittemore, 1983). Hunt (1994) argues that science cannot address the wider range of questions which are associated with values, and as such these need to be answered by a number of social actors.

As stated above, the scientific progress (good) code relates to Extract 8. This extract, along with Extract 9 are from an article entitled 'Britain must take back powers from Europe to allow GM crops, say MPs' (The Telegraph, 26 February 2015c).

The government's Science and Technology Committee said the EU regulatory regime for GM was 'not fit for purpose' and was based on the flawed assumption that techniques were inherently dangerous. In a report released on Thursday, MPs pointed out that GM versions of staple crops were already being grown around the world, increasing crop yields while cutting the need for pesticides.

Extract 8 From the article 'Britain must take back powers from Europe to allow GM crops, say MPs' (The Telegraph, 26 February 2015c).

In this extract, the journalist states how the Science and Technology Select Committee believe the EU uses the precautionary principle with GM crops because of the perceived dangers. For the Science and Technology Select Committee, there are only benefits to GM crops, and the journalist outlines these in the news article.

The journalist uses the phrases 'flawed assumption' and 'not fit for purpose' to describe the EU regulatory system as viewed by the Select Committee. This indicates that the regulations are not achieving what they are designed for. By applying the precautionary principle, the EU regulatory system means that European countries are missing out on the benefits which could be gained by cultivating GM crops. These benefits will be based on scientific evidence, due to the assumed importance of this for policymaking. Jasanoff (1990) contends that scientific claims are seen as true, because they are declared by those who are considered as proficient to do so. This extract focuses on the EU regulatory regime, and the journalist describes how the Science and Technology Select Committee view this regulatory regime as preventing scientific progress.

Also appearing in The Telegraph article is a counter-claim made by Peter Melchett from the Soil Association. Extract 9 emerged from the analysis as being associated with the scientific evidence code. It discusses scientific evidence which illustrates the harm GM crops can cause to the environment and wildlife. This concerns the evidence the Soil Association provided to the Science and Technology Select Committee for their report. Jasanoff (1990) makes the argument that whilst scientific claims are constructed, it is also possible for them to be deconstructed. She contends this deconstruction often occurs with major stakeholders rejecting and dismantling each other's claims.

> The association's policy director Peter Melchett also said: "In our evidence to the Committee, the Soil Association reminded them that the UK Government had spent millions of pounds of public money over five years, researching whether GM crops would be beneficial or damaging for British wildlife.
> "This research found that, overall, GM crops would have a negative impact on farmland, birds, wild flowers and other wildlife, something which the Committee, despite its emphasis on the importance of scientific evidence, fails to mention."

Extract 9 From the article 'Britain must take back powers from Europe to allow GM crops, say MPs' (The Telegraph, 26 February 2015c).

The construction and deconstruction of claims leads on to the argument made by Miller (1999: 1253), whereby 'the beliefs and statements of certain actors are a heady and varying combination of deception and perspectives which are functional for the interests of the powerful in science, politics and decision-making'. In this extract, the journalist provides a counter-claim by Peter Melchett, a representative of the Soil Association. This provides the news story with balance (see Chapter 3). The Science and Technology Select Committee only appear to perceive the benefits associated with cultivating GM crops. However, the Soil Association provided scientific evidence for the report which detailed the harms to wildlife, and according to Peter Melchett, this has been ignored. In this extract, the journalist makes the scientific evidence provided by the Soil Association significant. The evidence provided by the Soil Association appears to be dismissed even though the Science and Technology Select Committee places an emphasis on scientific evidence. The phrase used by Peter Melchett of 'fails to mention' draws attention to this issue. He believes the research the Government representatives conducted to establish how harmful GM crops are to wildlife is dismissed, because this research undermines the position the Science and Technology Select Committee now wish to take. By highlighting the scientific evidence about harm to wildlife, Peter Melchett is attempting to establish authority with this claim. Weingart (1999) argues that when science is contested through counter claims, with these becoming part of the dialogue surrounding a particular area, science can become problematic in ascertaining differences between objective and biased information. Here, the extract suggests that scientific evidence was presented to the Science and Technology Select Committee which emphasised both benefits and disadvantages of GM crop technology. The position taken by Peter Melchett in the extract, attempts to frame the Science and Technology Select Committee as being prepared to risk harm to wildlife even though they are aware it may occur. A point made by Hunt (1994) is that governments will react to uncertainty in science by declaring more research is required to enable the knowledge base to be increased. The aim is for the uncertainty to be resolved. She also contends that science is viewed as the acknowledged and legitimate basis for decisions to be made in the policy making process. Whittemore (1983) argues that even if more research is conducted, this will not succeed in attempting to circumvent social issues. Therefore, the truth for political purposes cannot be established by further research. There is a tension here as a result of the type of research which has been funded by the UK Government. It appears they funded research to establish whether GM crops can cause harm to wildlife, and is a further example of different scientific disciplines arriving at different answers to a problem (see discussions concerning Jasanoff and Irwin in Chapter 5). In the extract, the Science and Technology Select Committee are framed by Peter Melchett as selective in the scientific evidence they use, and therefore confirming their political position through the science they use. This is illustrated by the fact that Peter Melchett was reminding them of what other research has been conducted. This draws attention to a couple of points. Firstly, the misuse of science is often seen by environmental groups as occurring due to a lack of consideration of social values when considering uncertain and complicated science (Jasanoff, 1990). Secondly, science should not be viewed as ‘being produced in an isolated, privileged realm and trickling out to inform the rest of us about what is “true,” science is made throughout – bubbles up from many places within – historically constituted human culture (Martin, 1998: 40). Both of these points relate back to the issue of ethics surrounding wildlife.

As well as the narrative of the precautionary principle featuring in the articles, it is also a focus in the comments. The following section examines this aspect.

The Precautionary Principle - Comments

The pattern of non-acceptance of the precautionary principle by the Science and Technology Select Committee also appears in the comments section. This emerges due to commenters expressing their opinions about the Science and Technology Select Committee and the use of the precautionary principle. Extracts 10 and 11 relate to the risk (social) trust code. These comments are related to the Guardian article, ‘UK should be given power to regulate GM crops, MPs say’ (The Guardian, 26 February 2015e).

If the precautionary principle is no longer used by the Government following the recommendations made by the Science and Technology Select Committee, citizens would have to trust the correct decision is being made. There would have to be scientific certainty around the development of GM crops, that no harm would befall human health or the environment. Jasanoff (1992) states that in respect of policy making, citizens want science distinct from politics to inform judgments, because if there is a distinct boundary between science and political decisions, citizens can be confident about risk assessment. The following comment illustrates the issue of boundaries between science and politics. It is associated with the risk (social) trust code, and illustrates how the Government handling of a previous food scare has undermined trust.

> Opposition to genetically modified crops in many European countries is based on values and politics, not science," say Andrew Miller
> Exactly the same was said of opposition to having BSE infected cattle in the food-chain for eight years — indeed, the government continued to hammer the "no scientific proof" line long after the scientific consensus was that proof would certainly come in short order— until one day a minister had to stand up and say that there was now scientific proof. As a result, Britain has far more people dying of or carrying vCJD than the rest of the world all together.

Extract 10 Comment relating to the article 'UK should be given power to regulate GM crops, MPs say' (The Guardian, 26 February 2015e).

The spelling mistake of 'say' and the grammatical error in this comment are made by the commenter. This commenter starts the discussion by including a quotation by Andrew Miller, from the article, before relating this to BSE and the current situation with GM crops. The commenter describes how the scientific argument was put forward which showed no risk to human health from eating beef. The link to vCJD was later found, so scientific evidence then had to be used to explain the risks associated with eating beef. The use of scientific evidence is the reason this commenter believes so many British people contracted vCJD. They suggest that although an importance is placed on scientific evidence, this cannot guarantee that risks will not occur. To illustrate this point, the commenter relates the issue with GM crops to the previous food scare of BSE and vCJD. 'It is important to recognise that people judge whether or not they can use or *trust* expert knowledge partly by measuring it against elements of their own already-tested knowledge and direct experience' (Wynne, 1991: 115). In this instance, the commenter relates GM crops to the experience they believed occurred with BSE and illustrates the point made by Wynne.

Citizens attempt to trust politicians to tell them what is safe to eat. In respect of BSE, trust between politicians and citizens became broken once it was established there was a link between vCJD and infected cattle. There still appears to be a lack of trust for this commenter between politicians and citizens. A further point made by Wynne (1991: 118) in that ‘the judgement whether or not to show an interest in science therefore is a social one, tied to judgments of one’s own power (or powerlessness) to act in one’s social environment’, emphasises a reliance on politicians by citizens in respect of food. Firstly, food can only be prevented from entering the food chain if politicians have the scientific evidence to prove there is a problem. Secondly, in democracies, politicians are given the responsibility to ensure the safety of food. This is designed to protect citizens from other actors in the food system (including commercial food producers) whom might have competing interests. This is what this commenter appears to be alluding to. Following on from this, the next comment addresses the issue of trust from the point of view of the use of scientific evidence by politicians and scientists.

“Opposition to genetically modified crops in many European countries is based on values and politics, not science,” said Andrew Miller, the chair of the science and technology committee …
The arrogance is breath-taking. We have no science whatsoever that will determine for us what the unintended consequences are of interfering in something as complex as the food chain and the environment in this way.
I'm not concerned that these foods are toxic, of course we can avoid this. I AM concerned by the fact that we should know by now - we have the science - that it is inherently impossible to predict the behaviour of complex systems, and for some reason - whether narrowness of scientific discipline, simply asking the wrong questions, peer or commercial pressure, "scientists" are ignoring this fact.

Extract 11 Comment relating to the article ‘UK should be given power to regulate GM crops, MPs say’ (The Guardian, 26 February 2015e).

As with the previous extract, the commenter uses the quote by Andrew Miller, which is used in the article. The commenter uses this to start to describe how scientific evidence cannot determine what is safe. They explain that what is known about science is that it cannot be used to predict what will happen in complex situations, especially with the environment. The commenter believes scientists are not acknowledging how complex science is and are choosing to ignore this. The point made by Beck (2009) in Chapter 2, explains how specialist knowledge can only be held by those with expertise. Therefore, decisions about risk are principally made by those who are deemed to be experts. If a risk is not deemed to be in existence then it will not be acknowledged by experts. The commenter demonstrates the scientists being at fault due to their use of the word “scientists”. The commenter could also potentially be signifying how they doubt the credentials of the scientists, as inverted commas can also be used for this purpose. It is the complexity surrounding science which concerns this commenter, and they suggest there is an underlying motive for scientists to choose to ignore complexity, although they are not sure what this motive is.

The commenter states the ‘arrogance is breathtaking’ when describing the Science and Technology Select Committee. This suggests the commenter is surprised by the claims being made by the Science and Technology Select Committee, as these appear to be overstated and exaggerated. This is in agreement with Wynne (1991), who states that citizens may not respond to scientific knowledge if they disagree with what scientists are saying. If citizens do not accept scientific findings, they may be considered ignorant by scientists. However, considering Wynne’s argument, citizens may reflect on their own experiences, and prefer to consider these as opposed to accepting the scientific argument.

The commenter highlights how they see politicians as being uneducated in science and should therefore not be making decisions as to whether GM crops should be grown. This relates to a point made by Douglas and Wildavsky (1982a: 19) who argue that the ‘key word is control: who is to control whom in regard to which aspects of life?’ and this is a significant aspect of the GM debate. The commenter believes that due to how complicated the subject of genetic modification is, politicians will be unable to make a decision based on science alone. Douglas and Wildavsky (1982a) also argue that when determining the level of appropriate risk, both scientific and social aspects need to be taken into consideration. They continue with the point that if only a low level of risk is permitted, this has to be set at the level people find acceptable.

These two comments describe the undermining of trust by the Government following the handling of a previous food scare, and the issue of trust in relation to the application of science by scientists and politicians. Due to these issues, commenters suggest the continued use of the precautionary principle is acceptable. The view of these commenters is similar to the Scottish Government, and this is the focus of the next section.

Scottish Government

This section examines the authority at the level of the Scottish Government who were taking a different stance to the commercial growing of GM crops compared to the Science and Technology Select Committee. Through their devolved powers, the Scottish Government intended to prohibit the cultivation of GM crops and continue with the enforcement of the precautionary principle. For this reason, they were one of the key actors in the news coverage during 2015.

The Precautionary Principle – News Articles

The use of the precautionary principle by the Scottish Government appeared in the news articles, and this emerged as a pattern when conducting the discourse analysis. Extracts 12, 13, and 14, relate to the risk (environment) morality or ethics code, Extracts 15 and 16 are associated with the scientific evidence code, and Extracts 17 and 18 relate to the risk (social) uncertainty code.

Coverage of the ban on the cultivation of GM crops in Scotland appears in both The Guardian and The Times. The analysis begins with The Guardian and the following four extracts are from an article entitled ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015d). Extracts 12, 13, and 14 illustrate how the GM crop moratorium is morally and ethically correct for the Scottish Government to continue to implement in order to protect the environment.

Scottish ministers are planning to formally ban genetically modified crops from being grown in Scotland, widening a policy divide with the Conservative government in London. Ministers in Edinburgh are to apply to use recent EU powers that allow devolved administrations to opt out of a more relaxed regime, which is expected to increase commercial use of GM crops around the EU. The move will reinforce a long-standing moratorium on planting GM crops in Scotland and allow the Scottish National party to further distance itself from the UK government.

Extract 12 From the article ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015d).

The journalist describes how the formal ban of GM crops by the Scottish Government is widening the policy divide with the UK Government. The journalist explains this is allowed to occur due to the introduction of new regulations by the EU, which allows devolved administrations to make their own decisions about the introduction of GM crops. The policy divide is emphasised by the journalist with the phrase ‘further distance itself from the UK Government’. This political manoeuvring illustrates a point made by Douglas and Wildavsky (1982a: 65) who suggest the ‘moment there is a disagreement or controversy, that is to say, when someone says a risk is unacceptable, the question *ipso facto* becomes political’. The distancing by the Scottish Government is for political purposes, but it is the use of the precautionary principle which allows this to happen. Here, the argument concerning GM foods is used as part of a broader political dispute between the UK and Scotland. The truth or falsity of the scientific evidence and the claims are less significant than the political dispute. Dewey (2016: 197) argues

> the true purity of knowledge exists not when it is uncontaminated by contact with use and service. It is wholly a moral matter, an affair of honesty, impartiality and generous breadth of intent in search and communication. The adulteration of knowledge is due not to its use, but to vested bias and prejudice, to one-sidedness of outlook, to vanity, to conceit of possession and authority, to contempt or disregard of human concern in its use.

Here, both the UK Government and the Scottish Government use evidence which supports the argument they wish to make. The knowledge they use reinforces their authority in the stances they take in allowing the introduction of GM crops. As described by Hicks (2017) in Chapter 2, science can be used as a proxy in political debates.

Following on from this, the journalist outlines the reasoning behind the Scottish Government's decision in terms of the use of the precautionary principle.

> Richard Lochhead, Scotland's environment secretary, said he wanted to uphold the precautionary principle – that the potential risks to other crops and wildlife from GMOs outweighed the likely benefits of the technology – by banning the commercialisation of GM crops. "There is no evidence of significant demand for GM products by Scottish consumers and I am concerned that allowing GM crops to be grown in Scotland would damage our clean and green brand, thereby gambling with the future of our £14bn food and drink sector," Lockhead said.

Extract 13 From the article 'Scotland to issue formal ban on genetically modified crops' (The Guardian, 9 August 2015d).

In respect of the reporting of the precautionary principle, Clover (1994: 167) argues that 'if precaution is likely to get coverage, it is when it tackles the efficiency and wealth creating syndromes'. The Scottish Environment

Secretary, Richard Lochhead, is the representative in the article for the Scottish Government. In this extract, he is quoted as stating how there is little demand for GM crops by Scottish consumers and due to this, he believes that GM crops should be banned. This is as Jasanoff (1990: 15) argues, in that decision makers can 'formulate science policy decisions that cannot pass muster with qualified scientists'.

Here, by preventing the growing of GM crops, the image of the food and drink sector in Scotland will be protected. The journalist includes a quote by Richard Lochhead and this emphasises 'damage to our clean and green brand' if GM crops are grown. This implies the Scottish Government are trying to protect the reputation of the agricultural industry. Scottish agriculture will not be contaminated or polluted by the use of GM crops. The argument put forward by Douglas and Wildavsky (1982a) in respect of contamination is discussed in Chapter 2. The importance of the food and drink industry is also addressed in this quote in monetary terms. This is illustrated by 'what's best for our economy'. As well as protecting the environment and the agricultural industry, the Scottish Government will also protect the money which is generated by these concerns. Uncertainty is one of the main reasons why the precautionary principle is invoked, especially in connection with the environment. This protection element surrounding uncertainty is further highlighted in the following extract.

> "The Scottish government has long-standing concerns about GM crops – concerns that are shared by other European countries and consumers, and which should not be dismissed lightly," he added. "I firmly believe that GM policy in Scotland should be guided by what's best for our economy and our own agricultural sector rather than the priorities of others."

Extract 14 From the article 'Scotland to issue formal ban on genetically modified crops' (The Guardian, 9 August 2015d).

The journalist includes additional quotes by Richard Lochhead, the Scottish Environment Secretary. With the Scottish Government having concerns about the cultivation of GM crops like ‘other European countries and consumers’, this indicates the Scottish Government are not alone in the stance they wish to take. The viewpoints of these different actors correspond with one another in their opposition to GM crops. This suggests it is worthwhile for Scotland to continue with the ban. Richard Lochhead’s quote also implies the precautionary principle is what is needed to protect Scotland’s agricultural sector and their economy from outside influences. A GM policy should not be implemented so that it suits the requirements of others. The extract does not explicitly state who or what ‘priorities of others’ actually are, but illustrates how the Scottish Government wants to put its political goals before anyone else. This illustrates a point made by Kazancigil (1998), in that decision makers often feel disillusioned by scientific experts. Due to the nature of science, uncertainties often exist, and scientists are unable to provide concrete evidence which is desirable for decision makers. Here, the risks are seemingly outweighing the benefits and adherence to the precautionary principle appears advantageous. These three extracts illustrate how the Scottish Government believe it is ethically correct to protect the environment when there is uncertainty with science. This aligns with the argument put forward by Douglas (1992) which is described in Chapter 2.

In the same article, a quote is included by the Scottish Conservative spokesperson. Their opinion about the ban on cultivating GM crops is very different to that of the Scottish Government. They believe scientific evidence demonstrates GM crops are safe. This extract relates to the scientific evidence code.

Murdo Fraser, for the Scottish Conservatives, said there was no great pressure for commercial use of GMOs in Scotland but that the weight of scientific opinion was in favour of the technology.
“I think this decision puts superstition before science,’’ he said.
“There’s a very strong scientific consensus that GM foods could be hugely beneficial, increasing the volume of food for the world’s population.
“There are two specific issues here for Scotland: if the rest of the UK moves to encourage GM foods and Scotland doesn’t, our farmers will be at a competitive disadvantage, and secondly, a lot of our research institutes which are keen to pursue this technology will lose talent.”

Extract 15 From the article ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015d).

This extract illustrates how balance is applied to the news story, as it includes quotes by Murdo Fraser from the Scottish Conservatives. Whereas Richard Lochhead opposes the introduction of GM crops, Murdo Fraser wishes to see them introduced. The view of Murdo Fraser is the same as the Science and Technology Select Committee, which was discussed earlier in this chapter. Scientific progress is restricted because the Scottish Government is cautious. This leads to farmers being disadvantaged and research institutes losing scientific talent. The precautionary principle in Extract 13 (this chapter) is seen as protecting Scotland. Here, Murdo Fraser portrays it as stifling progress in Scotland because it puts ‘superstition before science’. This implies the beliefs about GM crops are irrational if they are not based on scientific evidence. For Murdo Fraser, decisions should be based on facts. Scientific facts are discussed in Chapter 2. Superstition is also connected to ignorance or fear, so this could potentially be signifying that lack of knowledge, or concerns about GM crops are put before science. However, this superstition appears to be the concerns about the environment that are raised by the Scottish Government. Scientific research has been carried out into the effects on GM crops on the environment, and this is discussed in Extract 9 in this chapter. Here, the scientific evidence concerning the environment is dismissed as superstition. This illustrates a point made by Weingart (1999), who contends that political actors will compete in order to obtain the latest research results from scientists. The use of science in the decision making process demonstrates a further point made by Weingart (1999: 158) whereby, 'the competition for the latest, and therefore supposedly most compelling, scientific knowledge drives the recruitment of expertise far beyond the realm of consensual knowledge right up to the research frontier where knowledge claims are uncertain, contested, and open to challenge'. These differences in opinion between the Scottish Government and Murdo Fraser, illustrate how scientific evidence can be viewed from alternate perspectives, and the same conclusion will not always be reached even in policy making situations.

A point addressed in this extract is how farmers will be at a disadvantage if they are not allowed to cultivate GM crops, as well as the loss of scientists from research institutes. This illustrates a point made by Gregory and Miller (1998: 101) whereby 'if a society depends on science and technology for its productivity – for its creation of wealth, products, food, and comfort – then that society also has to live with the side effects of science'. This suggests that Murdo Fraser is highlighting the issue that if Scotland dismisses scientific progress in respect of GM crops, then it has to expect a diminished standard of living.

Coverage of the Scottish ban was framed in a slightly different way by The Times. This highlights how scientists and farmers were not happy with the decision taken by the Scottish Government. The following extract is from an article entitled 'Scots farmers' backlash over GM crops ban' (The Times, 9 August 2015e), and relates to the scientific evidence code.

Lochhead said he wants to protect Scotland's "clean, green status" and expressed concern that growing GM crops could damage the country's £14bn food and drink sector.
However, the move is at odds with UK ministers who want farmers to have a choice about cultivating GM crops. Earlier this year, Liz Truss, the UK environment minister, said she believed GM technology "had a role to play in Britain".

Extract 16 From the article 'Scots farmers' backlash over GM crops ban' (The Times, 9 August 2015e).

In this extract, a difference in opinion is highlighted between the Scottish Government and the UK Government. The journalist states Richard Lochhead wishes to protect Scotland and its 'clean green status'. Balance is provided by the journalist, as the stance taken by Liz Truss is also described, and this is an opposing view. Here, the scientific evidence is seen in contrasting approaches. For the Scottish Government, the evidence appears to suggest a risk to the environment as well as the economy. In respect of the UK Government, the development of GM crops is suggested as being a positive development which will be of benefit to farmers. This illustrates a point made by Martin (1998) whereby science should not be seen as one thing but should be seen as many. It is a further example of different scientific disciplines arriving at different answers to a problem (see discussions concerning Jasanoff and Irwin in Chapter 5). According to Irwin (2001: 83), scientific activities are complex and include 'physical location, intellectual division of labour, forms of activity and disciplinary approach'. Direct experience can lead various actors to consider scientific evidence from differing perspectives, and therefore, this impacts on the judgements made. As the extract illustrates, when deciding on the implementation of cultivating GM crops, the Scottish Government are drawing upon beliefs and values, as well as pure scientific evidence.

A couple of weeks later, The Telegraph reported further on the Scottish GM crop ban. The extract below describes how a report by the Royal Society of Edinburgh (RSE) perceived the Scottish Government's GM crop ban. This came from the article 'SNP's GM crop ban risks backfiring, experts warn' (The Telegraph, 25 September 2015h). Extracts 17 and 18 relate to the risk (social) uncertainty code. These relate to the decisions concerning the ban or how the ban was implemented.

> But the RSE called for a "rational debate" on GM in contrast to the "emotive language" used by Richard Lochhead, the Rural Affairs Minister who announced the ban.
> The announcement is "likely to fuel negative public perceptions about GM and related technologies (and) assumes a degree of public hostility to GM that is not supported by recent public attitude surveys," the report said.
> It dismissed his claim the ban was needed to protect the environmentally- friendly reputation of Scottish produce, noting that the country's agriculture sector has become reliant on imports of nitrogen fertiliser, phosphate and high-protein animal feed from South America that are "far from clean and green".

Extract 17 From the article 'SNP's GM crop ban risks backfiring, experts warn' (The Telegraph, 25 September 2015h).

Here, the journalist describes a report which was released by the RSE. The journalist explains how the report calls for a 'rational debate' as the 'emotive language' used by Richard Lochhead could create hostility in citizens towards GM crops. The argument put forward by the RSE is similar to the one put forward by the Science and Technology Select Committee. Decisions about GM crops should be based on science as opposed to values. Mention is also made in the extract of the surveys conducted to ascertain public opinion. Wynne (1991) believes that generally science is held in high regard by citizens and this is reflected in surveys. However, indifference and dismissal of science often occurs when citizens encounter a specific aspect of science, particularly that which is controversial. From the reading of the extract, these surveys appear to have been positive towards the introduction of GM crops. The RSE consider the introduction of the GM crop ban as potentially influencing public opinion towards rejecting genetic modification. This suggests the implementation of the precautionary principle by the Scottish Government could potentially lead to citizens becoming ambivalent towards GM crops. As such, the reception by citizens will 'typically involve a judgement as to *who* is conveying a particular message and their perceived interest in this matter' (Irwin, 2001: 80, emphasis in original). With politicians being responsible for ensuring the safety of food (see Extract 10, this chapter), their enforcement of a crop ban may lead to citizens questioning the safety of GM foods.

The claims made by the RSE in their report and which are included in the article, show that if the Scottish Government wanted to be 'clean and green', there would be other factors they would need to address. Jasanoff (1990) argues that scientists view regulatory bodies as unqualified in determining whether science is sound. Here, the RSE would rather see decisions concerning the growing of GM crops based on the use of science as opposed to upholding the precautionary principle. An ironic critique of the perceived environmental excuse for not allowing the cultivation of GM crops is provided by the RSE. Agro-chemicals which include pesticides and fertilisers have already caused damage to ecosystems and biodiversity (Irwin, 2001). The Scottish agricultural industry is already reliant on these agro-chemicals, and the RSE claim these are already damaging the environmental image of Scotland. It is not possible for agriculture in Scotland to be unpolluted and free from contamination.

In the extract which follows, the RSE are framed as being disappointed with the decision made by the Scottish Government to ban GM crops.

> They said Scottish ministers had failed to consult Prof Heathwaite "despite her evident expertise in this area" and said it was "unfortunate" the decision was taken while the Scottish Government post of Chief Scientific Adviser was vacant.
> It noted that the position had been left unfilled since the start of the year and there are many vacancies on the Scottish Science Advisory Council, warning this could create the perception of an "anti-science attitude".

Extract 18 From the article 'SNP's GM crop ban risks backfiring, experts warn' (The Telegraph, 25 September 2015h).

Jasanoff (1987) argues that the regulation of risk by governments can lead to competition in the claims of authority amongst governments and science, especially over who should explain scientific results. Here, the RSE appear to believe this should be a person who has the authority and expertise to speak about the decision. As of 2018, Professor Heathwaite is based at Lancaster Environment Centre and is Professor of Land and Water Science. She also holds the position of Chief Scientific Adviser for Rural Affairs, Food and the Environment for the Scottish Government. The journalist describes how the RSE believes Scottish Ministers made the decision about GM crops whilst the Scottish Government role of Chief Scientific Adviser was vacant, and neither did they consult Professor Heathwaite. The RSE appear to be unhappy with the Scottish Government in terms of the lack of appointments to the Scottish Science Advisory Council, as well as to the post of Chief Scientific Adviser. Whilst the article concerns GM crops, this extract illustrates an alteration in focus by the RSE from GM crops to scientific advisers. This demonstrates a point made by Collins (2014: 131), in that 'it will be those with the power to enforce their ideas or those with the most media appeal who will make our truths, according to whatever set of interests they are pursuing'. Here, the RSE appear to be using the ban of cultivating GM crops to address their concerns with the lack of scientific advisers. The RSE construct the lack of scientific advisers to be a problem because they believe the Scottish Government will be viewed as being anti-science. The RSE advocate for decisions to be made based upon scientific evidence and they would wish to see all vacant positions filled on the advisory board. Here, the argument is constructed as the more voices which can push for science, the better. As 'scientific activity is ever more closely linked to generating economic, social and political benefits, so the pressure on scientists to 'perform', both in terms of generating income and in generating the 'right' advice, increases and with it the dangers inherent in politicization' (Nerlich, 2013: 46). The extract illustrates how the use of science in the construction of arguments can politicise science.

Extracts 17 and 18 focus on the arguments put forward by the RSE in connection with the Scottish Government's GM crop ban. These illustrate the uncertainty surrounding science, especially when applied in the political decision making process. Political decisions are also a focus in the comments section, and the following section examines this aspect.

The Precautionary Principle - Comments

The pattern of the acceptance of the precautionary principle by the Scottish Government also appeared in the comments section. This emerged due to commenters expressing their opinions about the Scottish Government and the use of the precautionary principle. Extract 19 is associated with the risk (social) morality or ethics code, and Extracts 20, 21, and 22 are related to the risk (social) uncertainty code. The following two comments (Extracts 19 and 20) relate to how commenters view the decision taken by the Scottish Government. These are in response to the article entitled 'Scotland to issue formal ban on genetically modified crops' (The Guardian, 9 August 2015d). In Extract 19, the commenter refers to the moral and ethical implications of introducing GM crops to Scotland.

Somehow Scotland is deemed to be "backward" because it fails to be fooled by the hype and the spin of the GMO industry? Who wants GMOs anyway? Has anybody ever asked for a GMO product in a supermarket? There is no market demand -- so it is perfectly sensible to try and keep Scotland free of GMOs. And just a reminder. There is still not a single epidemiological study showing that GMOs are safe to consume -- and many laboratory studies that suggest otherwise. In making this move, the Scottish Govt is properly applying the Precautionary Principle and seeking, at the same time, to gain a competitive advantage over England. It also has concerns about public heath. Bravo!

Extract 19 Comment relating to the article ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015d).

The spelling mistake of ‘public heath’ is made by the commenter in this extract. It should be ‘public health’. This commenter is calling out and asking other commenters about Scotland. They are attempting to get other people involved (see Douglas (1992), Chapter 2). The commenter questions whether Scotland is ‘backward’ if they do not cultivate GM crops. Scotland may appear ‘backward’ if England is progressing with scientific developments, but the commenter suggests that by considering safety aspects, Scotland will be in a better position. Consumers are not demanding GM food products in supermarkets so there is no need for them to be grown. It is better for Scotland to be free of GM crops if they are not wanted by consumers. As Abercrombie (1994: 54, emphasis in original) argues, ‘as consumers acquire skill and knowledge, so also do they acquire authority; they become *active* consumers able to assert their authority’. Additionally, people experience scientific knowledge ‘indirectly, as part of their concrete experience of and position in particular institutional processes’ (Wynne, 1991: 115). Therefore, the interests and values of citizens are also brought into play and bound together with science. The commenter goes on to suggest that if GM foods are unsafe, then it is correct for the Scottish Government to apply the precautionary principle. They state no epidemiological studies (epidemiology is the study of how often diseases occur in different groups of people and why), have found GM foods safe to consume, and laboratory studies have found them unsafe. Here, the commenter is focusing on the risk to human health.

The use of the phrase ‘hype and the spin’ indicates the commenter perceives GM foods to be subjected to propaganda and bias by those who stand to gain from their introduction. The use of the word ‘bravo’ by the commenter, suggest they are pleased with the stance being taken by the Scottish Government in the use of the precautionary principle.

The correct decision being made by the Scottish Government is further illustrated in Extract 20. This emerged from the risk (social) uncertainty code. It could also apply to the environment.

> Actually Mr. Fraser Scottish growers will be at an advantage as people look for non-GMO food. Science has an unfortunate history of following money in cases like this. Let's just let a few generations go by and see what happens. Then there's "Silent Spring" all over again. Why would we want the world's leading producer of poison in control of our food supply?

Extract 20 Comment relating to the article ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015d).

In this extract, the comment is addressed to Murdo Fraser of the Scottish Conservatives. The commenter suggests the Scottish Government are correct to apply the precautionary principle. As consumers do not wish to purchase GM foods, Scottish farmers are able to produce food that consumers are willing to buy. If GM crops were introduced into Scotland, risks could be created, but with Scotland applying the precautionary principle, this means risks can be avoided. This commenter alludes to the issue of trust in science. Here, it is science itself which the commenter perceives as being influenced by outside concerns due to the use of ‘following money’. Irwin (2001: 153) describes opponents of biotechnology and contends ‘criticism has also been made of the increased power and control such technologies give to industry – for example, with the patenting of life forms’. This commenter appears to be raising this criticism, especially in connection with controlling the food supply. The commenter also relates the control of the food supply to contamination (see Chapter 2 for a discussion concerning contamination).

The commenter also mentions *Silent Spring* which is the book authored by Rachel Carson in 1962. As Jasanoff (1990: 123) notes, *Silent Spring* is ‘a book that not only launched a new social movement but helped locate pesticides at the very heart of environmental politics. As the promise of bountiful harvests gave way to images of spring without birdsong, pesticides came to symbolise much of the late twentieth century’s ambivalence about using technology to master nature’. It was an early example of scientific controversy, explaining the risks associated with chemical usage, and also a significant moment in the de-legitimisation of science. The commenter draws a comparison of the issues raised in *Silent Spring* with GM crops.

The uncertainty surrounding GM crops is further illustrated by Extracts 21 and 22. These relate to the risk (social) uncertainty code. Both of these comments are in response to the article entitled ‘SNP's GM crop ban risks backfiring, experts warn’ (The Telegraph, 25 September 2015h).

> If only a very narrow view is taken of the science then that view should be ignored until the wider consequences are understood. I suspect that the RSE is taking a narrow view in the interests of some of its members. Apart from the RSE, it seems to be only the unionist supporting cabal which is shouting the loudest on the issue and only for short sighted political advantage.

Extract 21 Comment relating to the article ‘SNP's GM crop ban risks backfiring, experts warn’ (The Telegraph, 25 September 2015h).

In this extract, the commenter appears to believe that all scientific evidence should be taken into account. If there is only a limited amount of science available, this should not be acted upon until more information is available. Here, the commenter appears to wish to see the precautionary principle continuing to be implemented. In a study described by Wynne (1991), citizens were judicious in the science they were happy to accept, but could potentially question the end results and the interests concerned with research. In this instance, the commenter appears to believe both the RSE and the Scottish Government are raising the issue of science for their own particular interests. This relates to the argument made by Dewey which is explained in Extract 12 in this chapter. As with that extract, there is also a strong inter-UK nationalistic element. This was following the Scottish Independence Referendum in 2014, and the UK General Election in 2015, when the SNP won 56 out of 59 seats.

Authority also depends on trust in institutions. According to Wynne (1991), cynicism about a particular institution and the release of scientific information, may be as a result of associated interests which citizens believe to be in existence. He goes on to state these interests ‘may not be deliberately chosen by scientists but may nevertheless be structured into the knowledge, for example, via the questions it emphasises, the degree of standardisation it imposes, or the extent to which uncertainties are withheld (even for the best of reasons)’ (Wynne, 1991: 116). Therefore, this commenter may not be happy to accept the authority of the Scottish Government, or the RSE, in respect of the scientific advice they are asked to accept. This is further alluded to in the extract which follows.

> Follow the money. There are vested interests at work here and, as we see time after time, vested interests are generally not in the public interest. Let England go ahead on the GM crops issue and be the guinea pig (Q: will the English actually wear it?). Scotland can wait and see how that develops before even thinking about committing itself. The same with fracking. It seems that there are many EU countries who have banned the use of GM including France and Germany so why should Scotland endanger itself?

Extract 22 Comment relating to the article 'SNP's GM crop ban risks backfiring, experts warn' (The Telegraph, 25 September 2015h).

As with Extract 20 (this chapter), the commenter draws attention to the relationship between science and outside interests. They also make their argument in how they believe Scotland should wait before allowing GM crops to be cultivated. The commenter uses the term 'endanger' and this relates to the argument made by Douglas (1992) in Chapter 2. Once again, the commenter suggests the precautionary principle should be upheld whilst scientific developments occur. If England wish to grow GM crops, they should proceed with this action. The use of 'guinea pig' implies England could be used as an experimental site in the growing of GM crops. France and Germany have banned GM crops so it is acceptable for Scotland to do the same. Grundmann (2017: 28) contends that 'scientific knowledge operates under conditions that allow waiting, gaining of distance and overview'. However, waiting can create uncertainty, and this is a point addressed by the commenter. From the environmental perspective, Adam (1996) describes how science and technology cannot be removed from the environment, and as such, should not be seen as solely an input and output. There are environmental connections which are effected by the introduction of these new developments, and as a consequence, impact on social life. By waiting as the commenter suggests, the implications of the introduction of both GM crops and fracking to society and the environment can be ascertained. This commenter also suggests 'follow the money' as in Extract

20 (this chapter), and ‘vested interests’. As with that extract this implies there are organisations or people who stand to gain from the introduction of GM crops. This point was also discussed in Chapter 5.

Chapter Conclusion

This chapter has examined the authority of the UK Parliament Science and Technology Select Committee and the Scottish Government. These authorities decide on whether GM crops should be cultivated or GM foods should be imported. The online news organisations choose to report on events in their own particular styles. This is evident with the report issued by the Science and Technology Select Committee. The Times and The Daily Mail report on how MPs wish to rename genetic modification so these foods are more acceptable to consumers, whilst The Guardian and The Telegraph highlight the use of the precautionary principle.

Firstly, there is a call for GM crops to be renamed by the Science and Technology Select Committee. This is to allow the reframing of the debate to enable public discussion and to assist with public acceptance. MPs must be more proactive in their endorsements, and must do more to influence public feeling to enable GM crops and foods to be accepted. Influencing the public brings the moral and ethical debate to the fore. One journalist uses quotes by Peter Melchett who believes it is morally wrong to change the name of GM foods because it belittles citizens. Secondly, the articles illustrate how scientific facts are constructed by those who are seen as being proficient in doing so, and as such, these people are scientists. These facts contribute towards and construct scientific evidence as powerful and legitimate. However, scientific facts can also be contested. One journalist uses the term ‘lightning rod’ to draw attention to GM foods being controversial. Finally, the Science and Technology Select Committee did not wish to use the precautionary principle in deciding to allow the cultivation of GM crops. They wish to see individual countries using scientific evidence to inform decisions and regulations. This is in contrast to the Scottish Government, who still wish to proceed with using the precautionary principle as opposed to scientific evidence. By using this approach, the Scottish Government draw not only on science, but also values and beliefs. There is a strong inter-UK nationalistic element with the Scottish Government, who appear to use GM crops as a means of distancing itself from the UK Government.

In respect of the comments, firstly commenters often use their knowledge of previous, analogous science controversies such as the BSE crisis, and apply this knowledge to the situation with GM crops. The commenters do not always believe they or other citizens, are told the truth by politicians about the situation with GM crops and foods. Perceptions of lying and deception undermines trust. Secondly, commenters appear to believe that political and scientific decisions should be kept separate. Whilst political motivations are believed to occur in business and politics, this is not seen as appropriate for science. This relates to the suggestion of close relationships between regulators and the regulated, and who can be trusted. Finally, commenters view themselves and other citizens as being seen as ignorant by scientists, if they do not understand the science of genetic modification. However, if citizens disagree with scientists, they will not accept any scientific evidence presented to them, so this may pose difficult for political decision makers.

There are a number of key points raised in this chapter in respect of the articles. One view is that scientific knowledge is superior to any other knowledge in the political decision making process. Science and scientific expertise provide the legitimacy for political decisions. When scientific evidence is available, there should be no requirement for the precautionary principle.

A different view emerges from the comments. Commenters relate to the values and beliefs they hold about science, especially concerning vested interests. Associated with this, is the relationship between science and politics and how these should be separated from one another. However, commenters view politicians as being responsible for food safety. There is also a belief by commenters that when there is uncertainty, it is correct for the precautionary principle to be used.

In the next chapter, I will examine how the authority of non-governmental organisations and consumers are described and discussed in the articles and comments.

Chapter 7

The Online GM Food Debate: Non-Governmental Organisations, Consumers, and the Narratives of Expertise

Introduction

Within this chapter I analyse and discuss non-governmental organisations (NGOs) and people in their roles as consumers. This focuses on the claims each of them make and the extent they defer to science when discussing GM foods. NGOs are often concerned about the use of scientific evidence in decision making processes, whilst consumers are the end users of GM foods. It is consumers who are directly affected by policy decisions and scientific developments. Chapter 5 describes scientific developments with GM foods, and Chapter 6 discusses the use of science in political decision making with GM foods. Attention now turns to those who have concerns about the introduction of GM foods.

The environmental movement and natural food movement are unified through concern and anxiety. However, they are anxious about different issues. The environmental movement is concerned about how the Earth's resources are used and the exploitation of the planet. As well as environmental NGOs, some humanitarian NGOs fall under this umbrella where livelihoods are trying to be protected. The natural foods movement is troubled by industrialised agricultural processes. These concerns include the effects on the food chain and contamination of food. Reflecting on the scientific aspects of the GM debate, it is worth considering how scientific evidence is evaluated by NGOs and social movements. Durant (1998: 72) argues that a 'new, more sceptical attitude to science is all around us. It is apparent, for example, in the increasing confidence with which pressure groups such as Friends of the Earth and Greenpeace contest scientific evidence on environmental issues; and it is equally evident in the increasing assertiveness of the consumer movement'. Aspects of the environmental movement concerning both non-governmental organisations and consumers are apparent in both the online articles and the below the line comments. How these groups appear to use scientific evidence will be examined, and the discussion commences with the NGOs.

Non-Governmental Organisations (NGOs)

Greenpeace and the Use of Scientific Evidence

The first example to emerge with the discourse analysis is Greenpeace and their belief in the use of scientific evidence. This relates to the news articles and comments. Extracts 1 and 2 relate to the scientific evidence code, and Extract 3 is associated with the scientific progress (good) code. Extract 1 relates to the scientific evidence Greenpeace wish to see used by the EU in their decision making processes.

> "Greenpeace wants more and better scientific advice and evidence to be used by the Commission, which is why we have advocated strong, broadly-based, well-resourced, independent science advice with clarity about political judgements and clear processes. Ensuring that EU decision makers base their policy on the best available evidence in chemicals, pesticides and climate change is in the interests of all EU citizens and the environment."

Extract 1 From the article 'Greenpeace is failing to be 'honest' about GM crops, former EU scientific adviser says' (The Telegraph, 3 February 2015i).

This extract contains a direct quotation from a spokesperson of Greenpeace. Their name is not disclosed. Greenpeace indicate they want scientific evidence to be used in the decision making process concerning GM crops. This is constructed in terms of 'more and better scientific advice and evidence', 'strong, broadly-based, well-resourced, independent science advice', and 'best available evidence'. These three phrases suggest science and scientific evidence are important to Greenpeace when decisions are made about scientific developments. As described in Chapter 5, Extract 15, integral to the belief and trust in science is that it is free of conflicts of interest and impartial. According to Yearley (1991: 45), green activists 'may find themselves rather ambivalent about science: they are often critical of it but find they need it too'. If scientists are working towards a commonality, but with different definitions of what that is, there will be challenges. The issue of trust in scientific evidence is alluded to by Irwin and Michael (2003: 72):

> The arguments made by each side are not simply a means of presenting the 'facts', because … those 'facts' are always liable to problematisation and contestation by the other side … such arguments are about engendering trust: they are directed at lay constituencies partly as a way of persuading them of the trustworthiness of the speaker … and thus the truth of each spokesperson's 'facts'.

This raises the question of whether there really is 'good' or 'bad' science? Or does this depend on the definition of the problem you need science to answer? 'Good' or 'bad' science very much depends on the perspective of the person questioning it. The issue of trust in science is also raised in the comments.

The below the line comments indicate a lack of trust in the use of scientific evidence by Greenpeace. Additionally, Greenpeace appear to make judgements based on values as opposed to scientific facts. Extract 2 emerged from the scientific evidence code.

Mr Parr must accept that even when Greenpeace gets "more and better advice and evidence" they just ignore it if it doesn't suit their purposes. The organisation is now a liability to serious environmentalists and is just a home for sad cases who dream of becoming a hero by lashing themselves to a chimney.

Extract 2 Comment relating to the article 'Greenpeace accused of making false GM claims' (The Times, 4 February 2015f).

The use of scientific evidence by Greenpeace is discussed in the comments. As with the articles, this concerns Greenpeace only wishing to use the evidence which fits with their purpose. This commenter refers to Mr Parr, Greenpeace's UK Science Adviser, and his quote in the news article this comment relates to. The commenter suggests that even if Greenpeace had 'more and better advice and evidence', Greenpeace will still dismiss it. The commenter believes that Greenpeace will only use the scientific evidence they consider fits with the message they wish to convey. The discourse concerning campaigners scaling chimneys is also perhaps an indication of the media representation of Greenpeace in the past (Hansen, 2010). This relates to an argument put forward by Hier (2003: 12), in that 'most people are aware of global affairs through their engagement with the mass media, but this form of mediation is encountered as a distinct mode of experience, separate from immediate experience and the contextuality of the familiar'. The commenter appears to be drawing on the media messages they have experienced in the past. With the rise of digital platforms, citizens are now better able to seek out the type of information they prefer. As Schäfer (2017) contends, citizens may avoid science news or they may obtain news from organisations or sources which support and reinforce their existing beliefs.

The negativity towards Greenpeace is also explained in Extract 3, and this emerged from the scientific progress (good) code. This relates to the benefits of GM crops and how the commenter describes these benefits in relation to Greenpeace.

GM crops are about the only solution to solve the problem of starvation in many parts of the world, GM crops could be developed to withstand drought and many of the exotic plant diseases prevalent there, but do Greenpeace care about that? no, most of their members are simply “rent a mob” who have no understanding of life outside their tiny world.

Extract 3 Comment relating to the article ‘Greenpeace accused of making false GM claims’ (The Times, 4 February 2015f).

The grammatical error is made by the commenter in this extract. In this extract, the commenter suggests GM crops are the only solution to addressing food security, and for developing plants which can resist drought or diseases. GM crops could be used to help feed those who are starving, but Greenpeace is preventing this from happening. The commenter perceives members of Greenpeace having a restricted view of the world and suggests Greenpeace and its supporters do not care about food security issues. The commenter describes Greenpeace members as ‘rent a mob’ suggesting they are viewed by the commenter as people who are always protesting.

What both of the comments in Extracts 2 and 3 have in common, is that those posting them believe Greenpeace are not using scientific evidence in their approach to contesting the introduction of GM crops. Their narratives appear to be constructed in respect of Greenpeace adopting a value based approach as opposed to one based on facts (see Chapter 2). However, according to Keck and Sikkink (1999), during the 1980s, Greenpeace changed focus from running media events to obtaining scientific evidence to ensure their facts were correct. Nevertheless, they still use the media and this is explored in the following section.

NGOs Use of News Organisations

The next pattern to emerge with the discourse analysis is the use of news organisation websites by NGOs. Extracts 4 and 5 are associated with the scientific evidence code, and Extract 6 relates to the contamination code.

The NGOs not only appear as sources in the articles but one article is written by a representative from a charity. This is Dan Crossley who is the Executive Director of the Food Ethics Council. Part of their mission statement is ‘our particular contribution is to promote ethical considerations in relation to decisions about food and farming and to facilitate deliberative thinking and bold action for a fair food system’ (Food Ethics Council, 2017). Extracts 4 and 5 emerged from the analysis as being associated with the scientific evidence code. These extracts describe how Dan Crossley wishes to see the exchange of scientific ideas between scientists and citizens.

> The vested interests at play mean the evidence we see from the research community isn’t always objective. So instead of allowing “experts” to determine the best course of action, why not ask the public? We could demand independent, objective evidence and then introduce people’s panels to assess different options and determine the best course of action.

Extract 4 From the article ‘GM technology isn't good or evil - it's what we do with it that counts’ (The Guardian, 28 August 2015g).

This article was authored by Dan Crossley. He describes how scientific evidence should be value free but he believes it is not. It is the research community that apply values to the research because of ‘vested interests’. He relates this to how connections with industry sometimes means science is not as impartial as it should be. His agenda appears to be to promote the possible use of citizen juries when determining acceptable science, as he states ‘why not ask the public?’ and ‘introduce people’s panels to assess different options’. NGOs often operate to offer alternative viewpoints and knowledge. Not only do they provide information but they often offer witness statements from those people who have been affected by a particular problem (Keck and Sikkink, 1999). From the perspective of engaging the public, there is potential for a variety of positions to be considered, and plurality to be added to the debate. Authority in decision making could arise from both experts and citizens if citizen juries are conducted. When ‘individuals work together, to make decisions … they produce something like a collective result’ (Turner, 2013: 168). This approach could promote deliberation as well as a substantial output. However, Michael (1998) argues that citizens require a comprehension of science, along with trust in scientists from government, NGOs or industry, when evaluating a particular problem. This contradicts what Dan Crossley advocates, in that a level of scientific input is still required. Dan Crossley describes ‘independent, objective evidence’ and this echoes the calls made by Greenpeace. The NGOs appear to want scientific evidence which is value free. Rather than experts ‘determine the best course of action’, Dan Crossley would rather see the public ‘assess different options’ with scientific evidence. This would see the move towards public engagement with science (see Chapter 2).

As well as writing the article, Dan Crossley also posted in the comments section.

For me, the main issue though is whether we can ever get objective, independent evidence. Scientists still have important roles to play. I do think we should give the general public more credit though about their ability to understand complex issues and to critique them. Just look at Which?'s recent public dialogue on food system challenges and possible solutions for evidence of that.http://www.staticwhich.co.uk/documents/pdf/food-system-challenges---public-dialogue-on- food-system-challenges-and-possible-solutions-411910.pdf

Extract 5 Comment relating to the article 'GM technology isn't good or evil - it's what we do with it that counts' (The Guardian, 28 August 2015g).

Here, Dan Crossley once again states 'objective, independent evidence' so reaffirms the importance of this statement. The comment is reiterating the article and reinforcing the argument Dan Crossley has already made. The public can make informed decisions about scientific developments. He advocates that the public should be acknowledged for their abilities to deal with difficult situations when he refers to the *Which*? research. Turner (2013) argues that in respect of the climate change debate, there is some hostility towards citizens in respect of their ability to make informed decisions. There have been calls to ignore public opinion and democratic discussion, and instead, focus only on scientific evidence. The perspective described by Turner (2013) opposes Dan Crossley's claim of citizens being able to make informed choices. Dan Crossley's argument relates to public engagement with science which is described in Chapter 2. He would like to see a dialogue between science and society, and broader engagement between experts, stakeholders and citizens.

In this extract, the agency of the public is related to consumers. NGOs can play a role in suggesting to consumers possible problems associated with GM foods, be these either environment or health related. NGOs are also able to influence regulations imposed by governments because of the heightened awareness surrounding issues (Schurman and Munro, 2003). The link in the comment is to a combined *Which?* and *Government Office for Science* report in which Dan Crossley was a contributor. This link no longer works but the report is still accessible on the *Which?* website. The report examines the challenges which face the food system such as climate change and water use, and how consumers wish to see these addressed through the use of sustainable farming practices and the reduction of waste (Which? and the Government Office for Science, 2018).

A further NGO which appears in the comments section is GM Freeze. Here, NGOs are using the comments section to promote their advocacy work. GM Freeze (2018) 'consider and raise the profile of concerns about the impact of genetic modification. We inform, inspire, represent and support those who share our concerns. We campaign for a moratorium on GM food and farming in the UK. We oppose the patenting of genetic resources'. Liz O'Neill is the director, and she posted the following in the comments section. Extract 6 emerged from the analysis as being associated with the contamination code.

> The directive doesn't include any mandatory measures to prevent contamination within individual member states and there are no rules governing liability so if the Government wants to see GM grown in the UK they have to start by establishing measures that will protect our right to grow and eat GM free.

Extract 6 Comment relating to the article 'GM crops: what it will mean for you if British farmers get green light' (The Telegraph, 13 January 2015j).

The comment clarifies how the UK Government needs to implement rules which ensure those who choose not to grow GM crops are protected from those who do. Whilst the content of the comment itself does not relate directly to the discussion in this chapter, it is worth emphasising. By posting on an online news website this NGO is highlighting their opinion to the article directly. This could potentially ensure the message they wish to convey reaches a wide audience without anyone actively seeking out their viewpoint through an internet search. Using the comments section enables NGOs to communicate and connect with other activists in different physical locations, thereby extending the movement or campaign (Mann, 2018). By commenting, NGOs are able to frame the particular message they wish to get across to the audience. However, 'congruence with the experience, attitudes, culture and beliefs of the target public is essential if the frame is to mobilise action and therefore become motivational' (Mann, 2018: 174). Liz O'Neill's message here, is that GM crops cause contamination (see Chapter 2 for a discussion concerning contamination). If the Government wishes to introduce GM crops, they should also implement procedures which prevent non-GM crops from being contaminated by those which are GM. This message could potentially appeal to the section of the audience who opposes the introduction of GM crops. Commenting enables NGOs as well as citizens to participate in political communication surrounding the food system (Mann, 2018).

As Extracts 4, 5, and 6 illustrate, NGOs are prepared to become involved in the debate, be this through an article written for a news organisation, or the posting of below the line comments. As described in the discussion above, NGOs require media exposure in order to communicate their message to the audience. At one time, claims by NGOs would have needed to compete for attention and space, and have been successfully framed by a journalist in order for their message to be promoted in the news (Hansen, 2016). As this section illustrates, representatives from NGOs will use the comments sections to promote their own messages, and can frame what they wish to advocate exactly how they desire. Whilst NGOs take on activist roles, it is also possible for consumers to do so. The following section focuses on consumer expertise and the role consumers play in the food system. Gross (2014: 21) argues that 'any challenge to the food system is a form of activism, even at the level of individual choice and even if people don't consider themselves activists'.

Expertise of Consumers

Moving on from the NGOs, the chapter now examines how online articles and comments describe consumers and those who act as consumer activists. The final pattern to emerge with the discourse analysis is trust or distrust in the food industry. This relates to the news articles and the comments. All of the remaining extracts in this chapter are associated with the risk (social) trust code.

Murcott (1999) argues that when journalists write about food, a 'consumer of food' is produced who is both a representative of the food industry position as well as being associated with groups and organisations of a consumer movement. In part, this depends on which actors are visible. According to Warde (1994: 66) 'the term 'the consumer' signifies an undersocialised actor; it exaggerates the scope and capacity for individual action. In doing so, however, it authorises the view that consumers choose freely simply because they are not forced to purchase anything in particular'. Consumers operate in markets where they are assumed to be free to make choices without considering any social obligation or the burden of guilt. However, as Giddens (1991: 82) argues, 'to speak of a multiplicity of choices is not to suppose that all choices are open to everyone'. There are those in society who are not able to make choices about the food they eat. For example, those living in poverty will be restricted to purchasing food they can afford, even if this means that in reality they object to the way food is produced. The food a person may wish to eat, compared to what they can afford to eat, is very different.

Wilkins (2005) describes ‘food citizens’ as people considering the effects of their eating habits and then implementing necessary changes. Citizens are active members of communities and are influenced by morals and ethics in their decision making. In respect of a citizen considering their choice, they make an allowance for others, and therefore, have a greater sense of responsibility compared to consumers. In summary, ‘citizens feel responsible to others and demand that the state takes responsibility for the common good, consumers only feel responsible to themselves, request no support from others or from the state and accept the bad as well as the good consequences of their actions’ (Gabriel and Lang, 2015: 196).

In addition to consumers and citizens, people can also act in the capacity of consumer activists. Consumer activists are people and social movements who promote the values, rights, morals, and interests of either all or a selected group of consumers (Gabriel and Lang, 2015). Action can be taken by consumer activists through a range of activities, from their consumption and buying patterns to boycotting certain products. As will be revealed in the discussion which follows, there is an element of consumer activism revealed in both the online articles and the below the line comments.

Labelling and Trust

Food labelling is an important issue in consumer rights. A reflection of long established insecurity and uncertainty about food led to people reacting by demanding labelling that is informative and lists ingredients, along with ensuring food companies guarantee purity of food and quality in products (Fischler, 1988). Labelling provides information which enables consumers to make informed decisions about the products they purchase and the foods they wish to consume, and is concerned with consumer interests as opposed to science (Lang, 2016). The issue of trust and labelling was raised in the comments sections.

> All food carrying this frankenstein poison should be clearly labelled - I want a choice as to what I eat and I will NOT eat anything containing genetically modified plants, meat or anything else. This is another case of science being hijacked by commercial interests. Science is indeed losing its integrity.

Extract 7 Comment relating to the article ‘GM crop vote was just the beginning of Europe's biotech battle’ (The Guardian, 19 January 2015h).

The commenter does not use a capital letter in their use of the word Frankenstein. Here, the commenter frames their discussion in terms of GM foods being ‘frankenstein poison’. These foods are polluted and contaminated, and relates to the argument made by Douglas and Wildavsky (1982a) (see Chapter 2). The commenter expects anything which contains GM ingredients to be clearly labelled so as to avoid eating them. Fischler commented in 1988 that consumers knew little about the history, origin, or production of the food they were eating (Fischler, 1988). This point still stands today, in 2018. As consumers become further distanced from the food supply chain, they require information on food labels so they are aware of what ingredients their food contains. Food labels become compensation for, or replacement of, the knowledge which exists when growing your own food. In this comment, genetically modified food is seen as ‘frankenstein poison’ and by labelling food products which contain it, it can be avoided. For the commenter, labelling allows them the choice of what to eat. Lang and Heasman (2015: 239) claim that ‘food labelling and its effectiveness in consumer transactions are likely to continue to be contentious for as long as some critics argue that complex information on a label in tiny writing across dozens of purchased goods does not enable the consumer to deliver for him or herself a health-enhancing diet, and others argue that, without such information, the consumer remains in ignorance’. This commenter would rather see food labels on food products, so they can be informed about what they are consuming. For this commenter, food labelling would not be required if science was not involved in food production.

The commenter also describes how science is 'being hijacked' and 'losing its integrity'. For this commenter, the development of GM crops is damaging science as a discipline. The discussion leads on to their belief of science being controlled by corporate interests, which is leading to the manipulation of science. The science used in GM food production is not benefitting consumers, it is only benefitting 'commercial interests'. Consumer trust in science is undermined by *who* is perceived to be gaining from GM foods.

An example of trust between consumers and retailers is shown below and relates to an article concerning Domino's pizza.

> So Ive been eating Dr Frankenstein Pizza via dominos who have not bothered to tell us since Feb. Thats me never ordering again! One thing to bring in a change, but another to do so and dont tell anyone!!!

Extract 8 Comment relating to the article 'Now 'GM-free' Domino's is selling Frankenfood Pizzas: Takeaway chain among number of big names using modified foods' (The Daily Mail, 21 March 2015i).

The grammatical errors are made by the commenter in this extract. In this extract, the commenter is drawing the reader's attention to the issue of Domino's pizza not informing customers about the use of GM ingredients in their products. The key phrases in this extract are 'not bothered to tell us' and 'don't tell anyone'. This commenter appears to feel betrayed by Domino's pizza, and they describe how the company has been using GM ingredients but not advising customers. This is similar to the findings by Ibrahim and Howarth (2017) in their study of media coverage of the horsemeat scandal. They found media coverage portrayed retailers as betraying the public, which instigated a loss of trust between consumers and retailers. This was due to them selling products which contained horsemeat when these were labelled as beef. If posting comments makes 'visible some of the questionable production processes adopted by big food players so that consumers can choose *not* to buy their products', challenges can be made to the food system (Lewis, 2018: 197).

What is also in evidence in the previous two extracts is the use of the Frankenstein frame by the commenters. In respect of scientific or environmental developments, the scripts from literature, film or other popular culture which are drawn upon by journalists, tend to be those which are dystopian and scary as opposed to the utopian and optimistic (Hansen, 2010). One of the main genres which is used by journalists is science fiction. According to Huxford (2000: 190), partly this is due to a 'predilection to distrust science and the scientist, a fear of the loss of individuality, a narrative discourse that sets man and nature, and science and God in oppositional pairings, an atavistic impulse to glorify an earlier golden era; all these are themes buried deep within popular science fiction'. As a result, science fiction provides journalists with metaphors which they are able to use in the framing of their stories and which can be used as cues to assist the reader. Often these metaphors, as well as the stories themselves are able to illustrate to news audiences the concerns journalists have about a new technology. 'A science fiction frame that employed multiple images to cue a series of familiar, oppositional narratives proved an effective strategy in covering the clone crisis' (Huxford, 2000: 197). In instances such as these, journalists are attempting to assist the reader in understanding the unknown by referring to a familiar framing device. In doing so, the journalist does not attempt to provide an understanding of the science being discussed. Whilst journalists often employ this as a framing device, what is also evident in Extracts 7 and 8 is that commenters are also using science fiction frames in their comments.

One of the important science fiction stories is that of *Frankenstein*, 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. Initially, the monster is sensitive and kind, but finds himself rejected by everyone he meets. Infuriated, he becomes destructive and aggressive, and begins a journey of cruelty and violence. When Frankenstein refuses to create a female companion, the monster murders Frankenstein's wife and withdraws to the Arctic Ocean.

According to Cook (2004: 98), 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'. It draws upon the notion of a runaway science which is out of control. Huxford (2000) argues how the imagery surrounding the Frankenstein story enables a negative connotation to be applied to the narrative written by the journalist, and as a result, Frankenstein is often associated with negative science. In addition, Huxford (2000) identifies three further points in connection with the Frankenstein story and these are as follows:

1) The imagery exposes a distrust of scientists
2) The image highlights a concern with the use of genetics, and a fear of what genetically modified organisms may become in the future.
3) The fear of science itself which is the main theme in science fiction.

It is often these points which journalists use in the narratives of their articles. In Extract 7 (this chapter), the commenter also draws on these three points. Whilst journalists often use the term Frankenstein to frame news to indicate science as out of control, it is important to note this does not mean they believe an actual piece of scientific research should literally be understood as a Frankenstein project (Turney, 1998).

Two terms have been used by journalists to describe GM foods, these being 'Frankenfood' and 'Frankenstein foods'. The term 'Frankenfood' was coined by Paul Lewis, a professor in English at Boston College, America, to describe GM food (Lang, 2016), whilst 'Frankenstein foods' was first used by the Daily Mail on 28 January 1999 (Cook, 2004). This terminology has been used extensively in the past by news organisations who have campaigned against the introduction of GM crops, along with activist groups. Activist campaigns draw upon the ‘Frankenfood’ terminology because it often reflects consumer anxiety about the use of GM technology in food production and the defiance of nature by transferring genes from one species to another (Fitting, 2014). Frankenstein food implies a connection between the monster and GM crops due to the potential for them to escape into the wider countryside, cause damage, and become out of control. Cook (2004: 96) contends ‘the phrase has rebounded upon those who first used it, and is now deployed, quite effectively, to brand and dismiss the opposition’. Those who wish to implement the growing of GM crops, often use the terminology in a bid to undermine the arguments made by the activists.

The Frankenstein frame has been used in news stories concerning GM foods for many years (Augoustinos et al., 2010; Cook, 2004), and can now be observed in the comments sections. Extracts 7 and 8 both use the Frankenstein or ‘Frankenfood’ frame to describe GM foods. In Extracts 7 and 8, there is no mention of the word GM, only Frankenstein. In this respect, the word is used to denote GM, with the audience seemingly expected to understand. As the comments illustrate, the imagery of Frankenstein is still heavily drawn upon. Turney (1998: 221) provides a useful summary, who explains ‘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’ (Turney, 1998: 221). The ‘Frankenfood’ frame is also used by the journalist in Extract 9. This news story reports the removal of GM ingredients from Hershey’s products and begins the focus on consumer activists.

Consumers and Trust

This section describes those who have spoken out about GM foods, and also those who use the below the line comments section to express their opinion as to how they experience GM foods from a consumer perspective. The commonality are anxieties surrounding food and issues of trust with the food industry.

> The decision comes amid a growing backlash against 'Frankenfoods'. Critics of GMO (Genetically Modified Organisms) foods consider them environmentally suspect and a possible health threat.
> Hershey's joins other companies including General Mills, Unilever and Post Foods in responding to consumers' demand to remove GMO ingredients from products.

Extract 9 From the article ‘Hershey's pulls GMO ingredients from best-selling chocolate bars amid backlash against 'Frankenfoods'’ (The Daily Mail, 24 February 2015j).

Here, the journalist describes how consumer demand for the use of non-GM ingredients in food products is increasing. Those who oppose GM foods are concerned about risks to the environment and human health. In response to this growing consumer demand for non-GM ingredients, food companies such as Hershey, General Mills, Unilever, and Post Foods are removing GM ingredients from their products. The journalist explains how claims made by consumers enabled them to influence Hershey’s into removing genetically modified ingredients from their chocolates. Consumers are constructed as critics, and view GM foods as a risk to both the environment and to health. Wilkins (2005: 269) argues that consumers should have the right to access ‘safe unadulterated food or truthful product information’. The exchange of goods between suppliers, retailers and consumers encompasses responsibility, accountability and trust. (Jackson, 2015). As this extract states, Hershey’s amended the ingredients in the chocolate bars, and this signifies the importance of maintaining trust with consumers. Negative public perceptions of ingredients in food products often lead to food manufacturers finding alternatives. This was evident with foods containing high levels of hydrogenated oils which were found in items such as cookies, crisps, cereal and crackers (Howard, 2016). Consumers who complain are able to challenge powerful companies as they become a mobilising force. As Howard (2016: 69) contends, ‘the stereotype of consumers as unconscious dupes is challenged by these cases, showing that a vocal minority can trigger some positive changes, even if they do not significantly threaten corporate power’.

According to Schurman and Munro (2003), activists will organise consumer campaigns in an attempt to alter the market and signal to retailers and restaurant chains that certain products are undesirable to consumers. This is also an attempt to indicate to farmers, exporters and ultimately the biotechnology companies, that their products do not have a market. As described in Chapter 1, this happened with the GM tomato paste in 1999. The following extract demonstrates how food companies can be pressured by consumers.

Hershey's acted after tens of thousands of people urged the company to drop GMO ingredients on their Facebook page and through emails in a relentless campaign led by GMO Inside. But in a statement, John Roulac, co-chair of GMO Inside, said that Hershey's has further to go. 'Hershey's needs to take the next step and go non-GMO with all of its chocolates, and get third-party verification for non-GMO ingredients. This includes sourcing milk from cows not fed GMOs and agreeing to prohibit any synthetic biology ingredients, starting with vanilla,' he said.

Extract 10 From the article ‘Hershey's pulls GMO ingredients from best-selling chocolate bars amid backlash against 'Frankenfoods'’ (The Daily Mail, 24 February 2015j).

The journalist describes how Hershey’s listened to consumers and removed GM ingredients from their products. ‘Tens of thousands of people’ contacted Hershey’s, using Facebook and email following a campaign led by the activist group, GMO Inside. This reflects how pressure can be implemented by people against companies if there is a momentum. The consumers are portrayed in the article as being activists due to them emailing Hershey’s and using Facebook. However, the article highlights how the campaign was led by GMO Inside. This was considered in the article as being ‘relentless’. This draws attention to the fact that consumers may not have considered writing to Hershey’s if it was not for this activist group. Irwin and Michael discuss how trust in social movements are also forms of identification. They describe this in relation to Greenpeace:

> With regard to trust in Greenpeace, this can be recast in terms of an identification with either Greenpeace or the social movements of which it is putatively a part. … In consuming, say, the signs of Greenpeace (its media representations, its paraphernalia, its arguments), one simultaneously contributes to its cause and signals one’s identity – who one is (Irwin and Michael, 2003: 78).

If Irwin and Michael's argument is correct, by writing to Hershey, consumers are contributing to GMO Inside's cause. They are assisting in the advocacy work of this particular NGO. Consumers would also need to identify with the beliefs of GMO Inside, if they were to write to Hershey to complain about the use of GM ingredients.

This extract also uses a quote from the chairman of GMO Inside, to construct the argument that more needs to be done by Hershey's. This can be viewed from two differing angles. Firstly, Hershey's could be seen as a company which will change ingredients to appease consumers, but only to a certain limit. This being highlighted in the news article, draws the attention of readers to the fact that Hershey's is willing to make changes. It is one way of ensuring consumers are aware of what can be found in products. Secondly, attention is drawn to the agenda set by GMO Inside. As argued by Hilgartner and Bosk (1988) and Best (2009b), those actors who highlight a problem have a specific agenda in mind. The quote highlights the agenda of the activist group and what they still wish to achieve. In this instance, it is the further changing of ingredients. This quote could potentially solicit further action from consumers if they believe they have already achieved a win over Hershey's, and is aimed at mobilising consumers in order to achieve the aims of GMO Inside. If an NGO can raise the awareness of a particular issue with consumers, it can potentially shift the debate. 'Food boycotts and buycotts are potent strategies in political consumerism; increasingly, consumer-citizens turn to digital platforms to search for or share information about food products, as well as about food producers and their commitment to labour rights, ethical sourcing and sustainability' (Schneider et al., 2018: 7). The journalist describes how consumers used Facebook and emails demanding the removal of GM ingredients.

Consumers are better able to pressure the food industry since the advent of social media. Pepsi and Coca-Cola removed brominated vegetable oil from their drinks following the creation of an online petition from a teenager in Mississippi which collected hundreds of thousands of signatures. In a similar case, Kraft removed artificial yellow food dye from their macaroni and cheese (Howard, 2016). These instances illustrate how consumers can influence food companies. Trust between consumers and retailers is demonstrated in the extract which follows. This also relates to the issue of contamination and how this relates to trust.

> It is worth noting that there were no reports on Waitrose meats being contaminated. They are the only UK supermarket to not feed their animals GM feed, which has been linked to all kinds of health problems, not least due to the high levels of glyphosate herbicide on the crops, which are designed to tolerate it.

Extract 11 Comment relating to the article ‘Could these piglets become Britain's first commercially viable GM animals?’ (The Guardian, 23 June 2015i).

Here, the commenter describes how Waitrose is the only UK supermarket which insists on animals being fed non-GM feed. They view the Waitrose meats as not being ‘contaminated’. For the commenter, this means Waitrose meat is unpolluted and clean. As they are the ‘only supermarket’ who insist on animals being fed non-GM feed, remaining supermarkets are constructed as selling meat which is contaminated because the animals have consumed GM animal feed. The commenter believes this could be considered dangerous to human health. By highlighting contamination of food by genetic modification as a danger, it is possible to attribute blame (see Douglas (1992), Chapter 2). When citizens or consumers have something to blame, they can join around the cause they perceive as a danger, to try to prevent it from occurring. For many consumers, their notion and knowledge of risk is that which is experienced on a daily basis, as part of everyday life (Hier, 2003). A contaminated food item would disrupt the lived experience and potentially initiate anxiety (see Giddens (1991), Chapter 2). The relationship between trust and contamination is explained further in Extract 12.

WE are all at risk because cattle feed and the food industry are using these poisons and OUR entire food chain is contaminated. WE must stop it with OUR votes to get the corporate-owned-operatives out of OUR governments.

Extract 12 Comment relating to the article ‘Pesticides in paradise: Hawaii's spike in birth defects puts focus on GM crops’ (The Guardian, 23 August 2015j).

In this extract, the commenter uses the terms ‘we’ and ‘our’, and this describes citizens as a collective. They see the food system as being poisoned by corporate interests, and that everyone is at risk from this pollution. However, they also view governments as being influenced by corporate interests. Hier (2003: 13) argues that ‘individuals are shielded from a sense of blame and anxiety, not from trust relations embedded in expert systems, but from a sense of order or control achieved in the realm of everyday living’. Food is protected through the regulations imposed on those in the food industry (e.g. retailers, suppliers, farmers) by government agencies. In the UK, these agencies include the Department for Environment, Food and Rural Affairs (DEFRA) and the Food Standards Agency (FSA). The narrative in the comment indicates a lack of trust in the protection of the food system as it appears to be suffering abuse from members of the food industry. This relates to two points. Firstly, ‘when food’s taken-for-granted and life-sustaining properties are thrown into question, anxieties are inevitable and spread rapidly among the population deemed to be at risk’ and secondly, ‘food-related anxieties derive their intensity and disruptive power because of food’s intimate connections with our embodied experience and because of the everyday nature of food consumption’ (Jackson, 2015: 47). As these two points illustrate, issues of trust are important in the food system, in order for consumers to believe they are being protected from anything which may cause them harm.

Being protected from harm also relates to trust in the food system. Previous food scares and the handling of these can influence consumer trust in both science and the food system. The remaining extracts in this chapter are from commenters who refer back to the BSE crisis and the horsemeat scandal.

> Didn't the food industry learn anything from the horsemeat scandal?? We, the British public, do not like being lied to..... And we have lots of options on where we spend our cash....

Extract 13 Comment relating to the article 'Now 'GM-free' Domino's is selling Frankenfood Pizzas: Takeaway chain among number of big names using modified foods' (The Daily Mail, 21 March 2015i).

Using the statement 'We, the British public, do not like being lied to' suggests the commenter is speaking on behalf of British citizens and the collective view is that the food industry are not truthful about what is in food. The commenter believes the trust between consumers and the food industry was broken following the horsemeat scandal food scare. This illustrates how deception can undermine trust (see Giddens (1991), Chapter 2). The commenter also speaks in terms of being a British consumer when they talk about the choice in where to spend money. In the extract, the commenter focuses their attention on the food industry and suggests the industry is at fault for allowing GM ingredients to be found in food. This concurs with the study by Ibrahim and Howarth (2017), whereby their findings found supermarkets were a main focus of media criticism in the horsemeat scandal. The supply chain was not protected and was able to be undermined, leading to consumers being unaware of what they were eating. The commenter in this extract is similarly critical in the sense they do not believe this episode was learnt from. 'Consumer anxieties about food are intensified by specific *events* (such as 'food scares') where they form part of an underlying *condition*, perpetuating food-related anxieties even at times when there are no specific events to trigger particularly intense moments of anxiety' (Jackson, 2015: 47).

Consumers don't want gm crops. Scientific evidence to their benefits or safety is irrelevant if people don't want to risk eating them. Personally, after the BSE scandal, I don't see why consumers should be expected to want to eat anything created unnaturally by big agro-tech.

Extract 14 Comment relating to the article ‘Science bodies urge Scottish government to rethink GM crops ban’ (The Guardian, 18 August 2015f).

In this extract, the commenter refers to the BSE crisis and draws on their knowledge and experience from this previous food scare. The commenter believes that even if the scientific evidence proves GM crops and foods to be safe, this does not matter if people do not wish to consume them. A person will use their own judgement to decide whether an item is safe to eat. The argument put forward by Douglas and Wildavsky (1982b) in respect of individual decision making and risks is discussed in Chapter 2.

The commenter views GM crops as being unnatural and they believe these should not be allowed to be grown on an industrial scale. The BSE scandal highlighted the problems with industrial farming, however, in order to feed the population, food has to be grown on an industrial scale. In addition, agriculture can be seen as industrialised nature. Once this happens there is a move away from what is considered natural to that which is viewed as un-natural. This can lead to a fear in not knowing what is being consumed. Lupton (1996: 86) argues that ‘the symbol of nature is emotively connected to notions of purity and goodness, relating to a nostalgic discourse around the healthiness and wholesomeness of rural life’. This commenter draws on their own expertise as a consumer and refers to scientific expertise when constructing their comment. They appear to favour their expertise as a consumer over science. In relating back to the BSE crisis, the commenter draws attention to the risks associated with food when science is involved. Their comment is in terms of BSE being a scientific issue and how science failed citizens. Irwin (2009: 5) describes the use of science in the BSE crisis as ‘a rhetorical weapon aimed at closing down discussion’. Whilst there was concern amongst citizens about the existence of risk with BSE, this was seen as irrational by the Government. Science was used by Government to dismiss any elements of uncertainty surrounding the consumption of British beef, and it was deemed a safe product to consume. As such, the way in which BSE was handled as a food scare, could potentially impact the way in which GM foods are perceived.

> Because CJD was a completely unforseen consequence of a farming / food processing practice that offered no benefit to the consumer and was motivated purely by greed.
> If we introduce lots of new chemicals into our diet (or increase the quantity of existing chemicals), sooner or later we will discover that we have been eating something that causes culmulative or delayed damage to our bodies.

Extract 15 Comment relating to the article ‘GM crop vote was just the beginning of Europe's biotech battle’ (The Guardian, 19 January 2015h).

Here, the commenter draws on their knowledge and experience of previous food scares. The spelling mistakes of ‘unforseen’ and ‘culmulative’ are made by the commenter and these should be ‘unforeseen’ and ‘cumulative’. For this commenter, BSE and the associated vCJD was caused by the food industry and farming practices. The food industry was ‘motivated purely by greed’ and this suggests the commenter believes the food industry were concerned with only their economic interests as opposed to the safety of consumers. Jasanoff (1997) argues how some of the fault of BSE in Britain lay with the Ministry of Agriculture, Fisheries and Food (MAFF). She suggests this organisation considered the concerns of the agricultural industry to be more important than those of consumers and the issue of public health. The UK beef industry were concerned about the effect on sales caused by the food scare, whilst British officials were anxious about other European countries introducing a ban on beef exports. Consumer concerns were addressed and diluted in order to protect the agricultural industry. This though can lead to a lack of trust. For consumers, a food scare disrupts what is known and experienced by them through everyday living. The disturbance created by the food scare remains until the situation is over. This abatement of disturbance usually occurs when new understandings are created, and a consensus is established. Food scares undermine consumer trust because risks are ‘put onto the consumer without prior informed consent’ (Lang and Heasman, 2015: 148). Consumers are unaware of risks to their food until a problem arises.

Chapter Conclusion

The environmental movement are quoted in the online articles with Greenpeace being featured. Quotations from spokespersons from these groups highlight the importance of the use of scientific evidence for NGOs. Science is as important to the environmental movement as it is to those in political authority in Chapter 6.

Scientific evidence is important for Greenpeace. Here, there are disputes over which science and scientific evidence are correct. However, the comments are not favourable towards Greenpeace. The comments illustrate how scientific evidence is perceived as being used by Greenpeace only if it fits with their ideology.

Not only were NGOs appearing as sources in news articles, they were also authoring articles and appearing in the comments section. Dan Crossley, the Executive Director of the Food Ethics Council authored an article and posted a comment in the comments section. Liz O’Neill from GM Freeze also posted in the comments section. This illustrates how NGOs are using news organisation web pages for their advocacy work. This suggests the openness in the ability to comment, may be limited if NGOs are entering the space in the same way as ‘ordinary’ readers and citizens. The democracy of equal access of disseminating an opinion in the comments, may be challenged by the existence of established actors.

When examining the GM food debate from the perspective of the consumer, the narratives in the comments relate to food consumption rather than science. The discussion relates to labelling, and consumers being unaware of what they are eating. This relates to trust in the food industry. Commenters also use the Frankenstein or ‘Frankenfood’ frame when discussing GM food. Often one of these words is used instead of GM food. Commenters also believe their food is contaminated if it is found to contain GM ingredients, or is genetically modified.

Certain commenters refer back to previous food scares and this illustrates how previous knowledge can be used to make sense of another food issue. Here, it was the BSE crisis and the relationship to vCJD, along with the horsemeat scandal. Again, this relates to the issue of trust in the food industry. There is a belief that scientists and the UK Government were dishonest and did not tell consumers the truth about these food scares.

In the final chapter, I discuss my overall findings.

Chapter 8: Conclusion

Using UK online news articles and below the line comments, this thesis has assessed the construction of claims of scientific authority, credibility and trust, together with the contestation and disputation of these claims in connection with online news coverage and audience reception of the genetically modified (GM) food debate. It has examined which actors from the food system are involved in these struggles. These actors include scientists (universities and research institutes); the European Union and European Parliament; the UK Parliament Science and Technology Select Committee; regional bodies (Scottish Government); food companies and supermarkets; NGOs; and citizens and consumers. This final thesis chapter provides a summary of the empirical findings and how these answer the research questions outlined in Chapter 1. The contribution to knowledge is stated, the limitations of the research are outlined and suggestions of further research are provided.

This study has presented evidence from 73 articles and 9,279 comments, drawn from a sample of five UK online news organisations, during the period 1 January 2015 to 31 October 2015. The sample included those titles traditionally viewed as the broadsheets (e.g. The Times) and the tabloids (e.g. The Daily Mail). The data analysis was conducted using a combination of grounded theory and sociological discourse analysis. The preliminary results obtained from the initial coding process signalled potential connections between the data and social theory. The focused codes which emerged from the analysis were scientific progress (good); scientific evidence; risk (social) fear; risk (social) morality or ethics; risk (social) poison/contamination; risk (social) trust; risk (social) uncertainty; and risk (environment) morality or ethics. Following this, the literature was searched and consulted for theoretical concepts and broader social trends which were relevant to these connections. These include areas such as expertise (Dewey, 2016; Giddens, 1991; Lippmann, 2008; Nichols, 2017), journalism (Maras, 2013; Schudson, 2008b), and risk (Beck, 1992, 1995; Douglas, 1992). The literature review considered various aspects in relation to the news coverage of GM foods in an online news setting. Chapter 2 started by defining values and beliefs, as these were terms which appeared frequently throughout the thesis. It then moved on to provide a brief history of science, before describing the production of scientific facts. The idea that science is deemed to be value free was also discussed. Whilst science has benefits it also has the potential to create risks, and risk became the next focus of the chapter. The different perspectives on risk put forward by Beck and Douglas (including Douglas and Wildavsky) were discussed. The final focus in this chapter was on expertise. A definition of trust was provided, and the relationship between expertise and trust was described. The reliance on experts by citizens was discussed, along with how the relationship between citizens and experts can sometimes break down. Although scientific expertise has imperfections, the value of science and scientific expertise was also described. In Chapter 3, attention turned to journalism and science news. Just as facts exist in science, they also emerge through the course of journalistic activity. These were discussed in terms of the norms of journalism of objectivity and balance. The changing face of journalism was also discussed following the emergence of digital technologies. These digital technologies are providing an opportunity for engagement between producers and consumers of digital content. The focus then turned to authority and credibility in the media. This included how experts are chosen to feature in news stories by journalists, as well as the use of experts and non-experts by journalists. The use of balance and objectivity in relation to science news was also discussed, and this described how scientific research is interpreted by journalists in order to make it accessible to the audience. However, the complexity of science can get lost in translation, as well as science appearing distorted when the journalistic norm of balance is applied. Nevertheless, journalists are able to provide legitimacy to their stories through the use of quotes provided by scientists. The final focus of this chapter was the reporting of risk and science in news stories. Once again, journalists have to interpret risks so that the audience comprehends the issues involved. Journalists also write stories which explain how risks remain uncertain until science resolves them, even if it was science which created the risk initially. Through the use of grounded theory and sociological discourse analysis, the relevance of the claims in the literature to the interpretation of the data were examined and assessed. In addition, quality assurance techniques of triangulation, reflexivity, transparency and procedural clarity were used to ensure a high standard of rigour and transparency.

Answers to the Research Questions

1) How are claims of scientific authority credibility and trust, constructed in connection with GM food in the online articles and comments?

As outlined in Chapter 7, the arguments made by protagonists in scientific controversies, are as much about creating trust, as they are about presenting facts. If facts are to be believed, the spokesperson for these facts must be trustworthy. Trust in scientists and scientific institutions can be contradictory. There is a prevailing but conditional trust in scientists and scientific institutions when problems are identified and solutions found, and distrust, doubt, and discontentment with them when controversy arises.

In respect of the articles in Chapter 5, the thesis illustrates how press releases are used to disseminate the work of scientists to the online news reading audience. Two of the articles were virtually identical even though they were from different news organisations. Journalists used the press release from the John Innes Centre to write these news articles. By writing the press release, the PR practitioner from the John Innes Centre was able to play a role in framing these articles. This reaffirms the statement made by Michael (1998: 317) whereby 'scientific knowledge is always mediated – it never appears in some abstracted, value-free, purely "cognitive form"'. In this sense, facts and values will never be able to be separated in science. New scientific knowledge appearing in the articles, has been shaped through texts, people and institutions (Michael, 1998). Whilst press releases are an important tool in disseminating scientific research to a wider audience, these can often be used in news stories where they are left unchecked and remain exactly as written by PR staff. The identical articles indicate how churnalism is occurring in science news. This supports the argument made by Davies (2009), in that journalists passively write out articles from press releases. It also affirms the argument put forward by Jackson and Moloney (2016), whereby public relations practitioners write material which can be copied and pasted into news stories by journalists. Lippmann (2008) describes how citizens have to rely on trustworthy or untrustworthy reporters because citizens lack knowledge and cannot choose between accounts which are true or false. This appears to be changing with the increased reliance on the use of press releases. Citizens are now having to rely on trustworthy journalists and trustworthy PR professionals. In respect of this study as a whole, the 'Dewey-Lippmann' debate has been considered, and the findings better align with the argument put forward by Dewey (2016). Those who comment about GM foods are interested individuals about this particular subject. The commenters can be seen as individuals who have formed an interested group. By posting comments, they are also actively engaged.

As Chapter 5 illustrates, the articles concerning the GM tomato research present the facts in the manner the research institute intended. As Couldry and Hepp (2017: 26) argue the 'process of construction is based on many patterns of practice whose validity is generally accepted (institutional facts). Institutional facts involve the work of institutions (in the everyday sense – major concentrations of material resource, like governments and courts) but also broader patterns of institutionalisation: all contribute to the construction of the social world'. In the two articles concerning GM tomato research, institutional facts are constructed as unproblematic and accepted without question. In connection with this project, it is the press releases which dominate and influence the construction of articles concerning new research with GM crops. As argued in Chapter 5, press releases focus on certain issues and facts which illustrate the research to greatest advantage.

Journalists just have to be persuaded to concentrate on the angles and information presented in the press release (Davies, 2009).

In Chapter 7, the articles concerning Greenpeace illustrate how NGOs base their claims of authority on science, even if their positions contradict and compete with definitions from governments. Couldry (2012: 146) contends 'the necessity for a media strategy, and the requirement to submit to something like a 'media logic', affects all political actors from traditional parties to protest groups to humanitarian NGOs. Political actors are differentiated in terms of their relative power to influence news production'. Here, science is used to confirm the position taken by Greenpeace. This illustrates that even when science is presented as facts only, it is subject to arguments and negotiation. As Yearley (1991) explains, NGOs may be ambivalent towards science, but they often find they require scientific evidence to support the claims they make. New scientific research appears in scholarly journals, at conferences and at seminars. Often, there are struggles between different research groups as to whose particular research is correct, and this is without any controversy attached to the science. 'Other resources may be mobilised in such struggles – monetary, reputational, political' and eventually, 'one faction is discredited while another emerges triumphant. It is at this point that what counts as 'a fact of nature' is settled' (Irwin and Michael, 2003: 31). Here, the trust in scientific evidence is dependent on who is considered trustworthy.

In Chapter 5, two scientists identified themselves as such when posting comments. In these comments, they provided links to websites which were scientific in nature. Some were to science journals, whilst others were to their own blogs. These links reinforce the notion of scientific expertise by the very fact it is scientists who are directing the audience to read further information. Participating in discussions about problems, concerns, and issues, enables those with certain knowledges to gain authority and recognition. Couldry (2012) argues that those contributing to media discourse are from a diverse range of backgrounds, and provide alternative voices to those who are considered official sources. Moreover, he believes these voices gain authority by expressing their opinion through the provision of blogs or tweets. Here, the scientists posting links to their own blogs are illustrating they have the expertise to comment about GM foods. By posting links, these scientist commenters direct readers to information they believe is most pertinent. Couldry (2012: 121) claims these people are 'no longer just the charismatic party or strike leader, or the authorised commenter on mainstream politics (journalists), or the silent party member or demonstrator, but the individual – without any initial store of political authority – who can suddenly acquire status as a significant political actor by acting online'. As scientists, they are able to reinforce the notion that science is able to provide the necessary answers in the GM food debate. However, the contributions in the comments section by scientists, still rely on established forms of authority. These commenters ensure they are considered trustworthy, because they tell readers they are scientists with scientific credentials.

2) How are claims of scientific authority, credibility and trust, disputed and contested in connection with GM food in the online articles and comments?

In Chapter 6, the articles concerning the UK Parliament Science and Technology Select Committee, of renaming GM crops, revealed a default to the authority of science. The Science and Technology Select Committee, on behalf of scientists are looking to re-energise GM crop research and production, through rebranding. The suggestion this should happen was due to the hope that the renaming would enable citizens to be more accepting. The claim was how the name of genetic modification was creating a sense of fear, and this was undermining public support for GM. In turn, this was preventing new GM crops being developed. The authority of science is challenged by the public's fears and relates to the issue between scientific facts and values (see Chapter 2 for a discussion on values). In this instance, it is values which are enabling science to be contested. According to Irwin and Michael (2003), values can be viewed as preventing the comprehension and acceptance of science and can act as a resistance against scientific facts.

As science is assumed to be free of values, it is possible that advocates of a particular position can disguise their values behind disputed scientific research.

The Science and Technology Select Committee did not approve of the EU's use of the precautionary principle concerning GM crops (Chapter 6). They were framed in the articles as believing the EU based their decisions on values and beliefs as opposed to scientific evidence. The claims made by the Science and Technology Select Committee, are based on the belief that scientific evidence is clear and unequivocal with no uncertainty surrounding it. The decision making process should concern scientific facts only and should not include values and beliefs. The evidence used in decision making achieves scientific legitimacy through peer review (this is believed to be an impartial assessment of new knowledge). Whilst values are connected to the concerns noted above (such as social and ethical), the 'language of science emphasizes generalisation, 'facts' and the need for objectivity' (Irwin, 2001: 107).

Scientific evidence can be used to both negotiate authority and dispute it. This was in evidence with Peter Melchett from the Soil Association, dismissing claims by the Science and Technology Select Committee in respect of renaming GM crops. He believed the scientific evidence which showed harm being caused to wildlife, was dismissed by the Science and Technology Select Committee because it undermined the position they wished to take. This supports the argument made by Yearley (1991), whereby the use of scientific evidence in claims making is not straightforward, as scientists can be aligned on both sides of the argument. The value of wildlife and the ethics attached to the research highlighted by Peter Melchett, illustrates how it is difficult to differentiate between facts and values at times with scientific evidence. 'For many scientific institutions, 'facts' are central with 'values' secondary to these' although there is an opposite line of thought whereby 'public values must come first with technical debate following' (Irwin and Michael, 2003: 8). It is the second line of thought which is demonstrated by Peter Melchett in his belief in the use of scientific evidence.

The comments illustrate how the rejection of science by citizens is not always connected to the science being conducted. At times, this is related to political implications. Those commenting believed scientists and governments inform citizens about what is going to happen, as opposed to citizens having a choice. Beck (1995) argues that science influences policy decisions, but political agencies only act if scientists advocate for change. Scientists are considered as having the expertise to make scientific judgments, whilst citizens are not considered knowledgeable. The point made by Beck (2009), is that specialist knowledge can only be held by those with expertise. Therefore, decisions about risk are principally made by those who are deemed to be experts. Commenting provides those who wish to do so, an opportunity to express their opinion. The capacity to comment enables new voices to be heard. Where once there was only the possibility to remark to a friend or shout at the television, our opinions can now be expressed to anyone who wishes to read them (Couldry, 2012). Commenters can draw attention to how citizens are not given a choice about issues such as GM food, and can express their dissatisfaction. In some comments, those commenting apportioned blame in order to encourage other citizens to join the debate. This relates to the argument made by Douglas (1992) in Chapter 2.

In Chapter 7, Dan Crossley, the Executive Director of the Food Ethics Council authored an article in respect of how science is not always as impartial as it could be due to connections with industry. He advocates that citizens should also be given an opportunity to voice their opinion. As Irwin and Michael (2003: 28) argue, citizens 'may not only possess knowledge, but have knowledge of how they know: they are able to reflect upon why they take on board some 'scientific facts' but not others; they are competent in accounting for why they prefer some sources of knowledge (e.g. personal experience) over others; and they can justify why they trust some expert authorities and are suspicious of others'. In addition to the article, Dan

Crossley also responded by posting a comment. In this, he argues that whilst scientific authority is important, this should not be the only consideration in the decision making process. The values and beliefs of citizens should also be taken into account. Additionally, Liz O'Neill from GM Freeze posted a comment, and what this and the article and comment from Dan Crossley illustrate, is how NGOs are able to heighten awareness with the messages they wish to convey by appearing in these online spaces. The NGOs are able to challenge scientific evidence and authority through the claims they make. The ability for established actors such as NGOs to enter this space just like 'ordinary' readers and citizens, suggests the openness in the ability to comment is limited. The democracy of equal access of disseminating an opinion through the comments, is challenged by the existence of established actors.

Issues of trust and uncertainty were also prevalent in the findings throughout Chapter 7. Once a risk is known to exist, citizens have to find strategies of coping. The claims made by commenters in connection with supermarkets and labelling, illustrate a means in which consumers can mitigate their chances of being exposed to the risks associated with GM foods.

Food labels are a replacement for the lack of knowledge which is associated with growing your own food. Additionally, commenters claimed there would be no requirement for ingredient labels on food if it were not for genetic modification. The comments illustrated how trust was built up between consumers, supermarkets and retailers. Commenters believed this was achieved by supermarkets and retailers advising consumers of ingredients which could be found in food. However, this trust could be immediately lost, if consumers found they were eating products with ingredients that should not be there. This was the case with the Horsemeat Scandal in 2013.

The association between risk and blame arose. This is described by Wilkinson (2001: 105), whereby 'we may be convinced of the true 'reality' of future hazards, then the language of risk may serve as a 'forensic resource' for casting blame on those who are perceived to have placed us in danger'. This was addressed in an article concerning Hershey's, which reported citizens as campaigning against the company in order for them to remove GM ingredients from their chocolate. The activist group GMO Inside mobilised citizens to use Facebook and email to write to Hershey's demanding they remove the unacceptable ingredients.

Additionally, this aspect of risk and blame was also a narrative in the comments, when previous food scares were alluded to. The crisis surrounding BSE was frequently referred to, and this previous food scare enabled commenters to draw comparisons between this and GM foods. New means of understanding may emerge from discussions, whilst existing interpretations either continue to be drawn upon or discarded (Irwin and Michael, 2003). The food industry as a whole was seen as not being able to be trusted. The claims provided a sense of how corporate interests, especially from a financial perspective, were more important than the safety of citizens. When discussing previous food scares or lack of trust in the food industry, the expertise of consumers was drawn upon. Here, we should remember that 'individuals are actively involved in the social process of producing a diversity of meanings for topics of public debate' (Wilkinson, 2001: 124).

3) How are the different key actors constructed in terms of their authority, credibility and trust, in the online articles and comments concerning GM food?

As discussed in Chapter 2, an expert is a person whose specialised knowledge is viewed as genuine and acknowledged as such by society. In this regard, they have authority in their particular area of expertise (Dewey, 2016; Nichols, 2017). As citizens we have lay knowledge, but in order to conduct our daily activities, experts with specialised knowledge have to be trusted (Giddens, 1991). Also described in Chapter 7, is how trust can underpin how we identify with certain people or organisations. For example, the argument made by Irwin and Michael (2003) is that if we trust an organisation such as Greenpeace, then we identify with the claims and arguments made by Greenpeace or other social movements. This appeared to be the case when the journalist described consumers and GMO Inside campaigning against Hershey.

In Chapter 5, the article concerning the lamb containing the jellyfish gene, slaughtered for human consumption, demonstrated how scientists do not normally have to contend with their work coming under attack. The narrative in the articles presented these scientists as untrustworthy because they put citizens in needless danger. The incident undermined the credibility and authority of these scientists. However, as INRA, the research institute involved in the incident issued a press release, this could be their attempt to demonstrate how they were managing the situation. Although citizens may have concerns about a particular issue, this may not be the sole reason for news coverage and this may in part, be explained by whom is controlling the agenda (Wilkinson, 2001).

A key point was raised by a commenter concerning what expertise in science means. For this commenter, their claims put forward the argument that scientists were only knowledgeable in their particular area of specialism. The plant scientists producing GM crops could only produce facts and create certainty in a restricted manner, and as such, they have limited authority. Scientists working in other disciplines would have to establish whether a GM crop posed a risk to the environment. This affirms the argument put forward by Giddens (1991: 124) whereby as 'specialisms become concentrated, the smaller the field in which any given individual can claim expertise; in other areas of life she or he will be in the same situation as everyone else' and as such 'we are all laypeople in respect of the vast majority of the expert systems which intrude on our daily activities'. As alluded to in the comments, in order to be an expert in a particular area of science, a person has to undertake specialised training. This supports the argument made by Dewey (2016) and Turner (2001) which was described in Chapter 2.

For the scientists who posted comments (Chapter 5), they were able to assert their authority and expertise by stating who they were and linking to the content they had produced. This content reaffirmed the authority of science and therefore, the expertise of the scientist who created it. This use of the comments section demonstrates an argument put forward by Couldry and Hepp (2017: 73), whereby ‘collective actors like social movements and other corporate actors use media to construct their common agency in various ways’. This argument can be extended to include these scientists, who use the comments to promote scientific thinking.

The issue of a lack of trust in politicians was evident in the comments. The fact that politicians did not protect citizens from BSE was alluded to by commenters and was drawn into the discourse in the comments. Comments underlined how a lack of trust from previous food scares could undermine the authority and credibility of the Government’s ability to deal with GM crops. This supports the argument made by Macintyre et al. (1998) in that not only does the market and the government influence the provisioning of food, but they also influence what information is made available to the public concerning the impact of food on health. Commenters believed politicians were not educated in science (although some probably are), and therefore, they should not be making decisions about it. For these commenters, it is only scientists who have the expertise to make decisions about science. This has serious consequences though as science shapes the everyday lives of citizens, through medical provision, environmental protection, communication, travel and so forth. By suggesting it is only scientists who should be making decisions about science, these commenters may be talking themselves out of any input into decisions concerning scientific research and activities.

Commenters claimed they would not purchase certain foods, and explained the reasons as to why they believed they should not have to eat GM food products. According to Wilkinson (2001: 126), a response to a ‘particular ‘food scare’ cannot be considered purely on its own terms; rather, people’s opinions are shaped by their responses to other topics of public debate and patterns of media consumption'. As a consequence, there are a myriad of understandings and meanings brought into the debate by commenters. Certain commenters believed their food was contaminated if it contained GM ingredients. As Douglas (1992) argues, if contamination of food is believed to be a danger, then it is possible to apportion blame. When commenting, they drew on their expertise as a consumer, and used their knowledge of their experience of previous food scares. They trusted themselves in knowing what can and should be eaten, and what was best avoided. This aligns with the argument made by Michael (1998: 320) in that the '"authority of the consumer" … is guided by many considerations that draw on many different sorts of knowledges that cannot be brought exclusively under the rubric of science'. As Blue (2010) contends, little work has been undertaken to address the points raised by Michael (1998), whereby public engagement with science needs to examine consumer based practices. This thesis has gone a small way in raising the awareness that citizens will not necessarily consider scientific issues when reflecting on mundane items such as food. It is not unsurprising this is the issue with GM food.

For citizens, making choices concerning food can be considered mundane. Science is not generally considered in everyday activities and as such, common sense and pre-existing food knowledge is relied upon. An individual will decide whether an item of food is safe to consume. As Swidler (1986) explained (see Chapter 2), values enable individuals to clarify and confirm the choices and decisions they make. Citizens use their own knowledge when making claims about labelling and purchasing of food. This demonstrates the argument made by Wilkinson (2001: 124) regarding 'the importance of social context for understanding the ways in which people make sense of the terms of public debate and incorporate its significance into their everyday conversations and activities'. As the comments illustrate, digital media provides an opportunity for non-formal engagement with scientific and food issues. As stated in Chapter 2, Stilgoe et al. (2014) believe non-formal engagement processes should not be discounted or ignored. Those commenting can 'play a part in 'shaping' the ways knowledges – scientific, personal, experiential, ethical, economic, political – interact, come together, combine or polarise' (Irwin and Michael, 2003: 133).

Contribution to Knowledge

This thesis provides an original contribution to knowledge to the study of non-formal public engagement with science. As Stilgoe et al. (2014) argue, there has been little research on informal approaches to public engagement with science and in so doing, there is a risk these informal approaches are overlooked. By choosing to study the UK online news organisations and the below the line comments, the thesis is able to provide an insight into the interested publics of the online GM food debate. Those who take part in the online debate are those who wish to engage with science. The extracts from comments which appear in Chapters 5, 6, and 7 are the first-hand accounts from those interested in providing their views and opinions about GM foods. These extracts provide understandings which may not be evident in more formal settings of public engagement with science. As these comments illustrate, the GM food debate is opened up. Those audience members who choose to participate, discuss the aspects of GM foods they wish to talk about. In a formal public engagement with science setting, questions can be staged-managed to ensure the correct questions are asked of citizens in order to meet the needs of policymakers. The thesis shows that in an online setting where users choose to engage, the existing power relations between scientists, policymakers and publics are dismantled. The comments are able to generate and shift existing sites of authority and expertise because science can be contested. The news articles are fundamental to this process as they often form the basis of the discussion. Scientists have the authority to speak about their research, and the news articles present the facts about the work being produced. As the thesis shows, commenters are able to contest the information they are presented with. However, as is seen in Chapter 5, scientists are willing to enter the online arena and post comments. In these comments, the scientists discuss the scientific aspects of the GM food debate as well as providing hyper-links to work they have conducted. To my knowledge, this thesis is one of the only studies to have revealed scientists engaging with citizens in an informal setting.

The thesis also contributes to raising awareness between public engagement with science and consumer based practices. According to Blue (2010), little attention has been paid to consumption practices and public engagement with science. As Chapter 7 illustrates, many commenters discuss GM foods in terms of food consumption as opposed to science. As the comments illustrate, GM foods as a consumption practice should not be overlooked. Commenters discuss what they are willing to consume, and how they trust or distrust organisations involved in the food industry. These commenters are able to draw on their knowledge from previous food scares, and as a result, their consumer expertise can be used to challenge and contest the claims made by scientists. The thesis illustrates how consumers discuss what they do and do not wish to eat, and by doing so, become involved in food politics. Commenters when considering the GM food debate as a consumer will consider both scientific knowledge and consumer knowledge. Science will be used to partially inform food choices, and will be one element amongst other knowledges. As the thesis illustrates, with scientific controversies, there needs to be an awareness of the alternative knowledges which are being drawn on by citizens.

Press releases play an important role in the news coverage of the development of GM crops and foods. These press releases carry the facts that scientists, universities, and research institutes wish news organisations to publish and readers to be exposed to. As such, scientific expertise is constructed through the press releases. Scientists have the authority to speak about their research, and the use of press releases by journalists reinforces the authority. In Chapter 3, the argument put forward by Lippmann (2008) is discussed, in which citizens are unable to choose between true or false accounts because of lack of knowledge. Instead, citizens have to rely on trustworthy or untrustworthy journalists. The reliance on journalists now appears to be altering due to the increased dependence on press releases which is discussed in Chapter 5. The thesis illustrates how audiences are going to have to become more reliant on the trustworthiness of both journalists and PR professionals.

Finally, the thesis has combined the theoretical perspectives of both Beck and Douglas. Whilst there are differences in their points of view (see Chapter 2), both have been useful in explaining different aspects of the study. Although Latour (2004) describes weaknesses in the concept of both ‘facts’ and ‘values’ (see Chapter 2), scientific debates are still based on the premise of these terms. The use of ‘facts’ and ‘values’ can be seen throughout this study. The findings of this study suggest the following in connection with the online GM food debate. The theoretical arguments put forward by Beck are more helpful at explaining risks associated with scientific facts and science. The theoretical arguments suggested by Douglas are more useful for explaining the relationship between risks and values (e.g. morals and ethics). Both theoretical perspectives are equally valid in this study.

Limitations of the Research

Although techniques have been used to ensure quality in the data analysis, there are limitations inherent in the study design. Firstly, only articles and comments from the online news organisations are included in the study. Television, radio and social media platforms are also important sources of news but these are not included here.

Secondly, I had to make a decision after conducting the Initial Coding as to which codes to focus on. I believe those such as Sustainability, Power (over food), and Food Security would have yielded useful information if I had used them as Focused Codes. However, I chose to exclude these as I considered them to be unsuitable for answering my research questions. In this respect, I did not believe these codes would assist in addressing the issues of authority, credibility and trust in respect of the science surrounding genetic modification. Nevertheless, these could be deemed important codes because an issue such as sustainability is not a trivial matter.

Learning from Practical Experience

I have outlined the approach to this research in Chapter 4. Here, I provide a reflection on the methods chosen and why the frameworks used in the research enabled me to understand the processes under investigation. Firstly though, I discuss the different approaches which could have been used in this research. The merits of a particular research design are related to the rationale for selecting it as the most appropriate approach for addressing the research questions. A quantitative approach 'is informed by objectivist epistemology and thus seeks to develop explanatory universal laws in social behaviours by statistically measuring what it assumes to be a static reality. It emphasises the measurement and analysis of causal relationships between isolated variables within a framework which is value-free, logical, reductionistic, and deterministic, based on *a priori* theories' (Yilmaz, 2013: 312, emphasis in original). Alternatively, qualitative research 'is based on a constructivist epistemology and explores what it assumes to be a socially constructed dynamic reality through a framework which is value-laden, flexible, descriptive, holistic, and context sensitive' (Yilmaz, 2013: 312). Deciding on a quantitative or qualitative approach depends on whether the findings are to be generalised, or whether an in-depth understanding of the issues are required.

Various studies of newspaper coverage of genetic modification are discussed in Chapter 3. These studies used a range of methods to analyse data including cultivation analysis, case studies, the Downs issue attention cycle, content analysis, frame analysis, and discourse analysis. These different approaches are now discussed, along with the reasons for not using these in this research. (Discourse analysis will not be discussed as this has been used in this research.)

Cultivation analysis is a form of media effects research. This analysis looks to see if the long-term repetition of the main messages in the media correspond with the beliefs and opinions of media audiences. This approach was not used as it did not answer my research questions. I was not trying to establish if the beliefs and opinions of the audience in the below the line comments were the same as the messages contained in the news articles.

Downs proposed the ‘issue attention cycle’ as a means to describe the manner in which social problems emerge in the public arena, remain there for a while, and then fade from public attention even if they are unresolved. Downs (1972) describes the five stages as:

1) A pre-problem stage
2) Alarmed discovery and euphoric enthusiasm
3) Realising the cost of significant progress and the sacrifices required to solve the problem
4) Gradual decline of intense public interest
5) The post-problem stage, where the issue has been replaced at the centre of public concern and there are occasional recurrences in interest

This approach was not used as it did not allow me to examine the specific mechanics and practices associated with scientific claims in relation to issues of concern. However, I acknowledge the model does fit the GM debate well as there was a peak in journalistic reporting in the 1990s.

Content analysis is one of the most widely used methods in media and communication research. It is a quantitative method and involves the systematic and transparent coding and counting of specified characteristics or elements of content in media samples. The data can be used in statistical analyses, and the same statistical analysis can be applied to data collected over different time periods. This approach was not used as I was not looking for specific themes and the amount of times these occurred throughout the sample. I was interested in gaining an in-depth understanding of the issues.

Frame analysis investigates how ideas, ideology and culture, are used in order to comprehend how audiences understand the media. 'For communication scholars, "framing" happens at many different levels; the sender of the message, such as a social movement organisation, frames the message in one way; a journalist may present it in a different frame, paying attention to journalistic professional norms; and the audience again has its own framing of the same message' (Lindekilde, 2014: 200). Framing analysis could have been used in this research if I had only been interested in explaining similarities and differences on the issues covered in the news articles or below the line comments. Discourse analysis was more appropriate as I was interested in understanding the meaning in the news articles and below the line comments, along with how the key actors were constructed.

The decision I took in deciding to use a combination of grounded theory and discourse analysis was driven by my research questions, and the robustness of this approach. Once I developed my research questions, I then proceeded to think of the best possible ways in which to answer these through data collection and analysis. As Thomas (2013: 116) states, your 'research approach should be the servant of your research question, not its master'. Regularly referring back to my research questions ensured I developed an effective research design. I believe the choices I made were the correct ones for this research project in terms of the data collection and analysis. I had to make decisions as I proceeded with the research and these are outlined in detail in Chapter 4. The methods I chose enabled me to successfully complete my research and answer the research questions posed. As discussed in Chapter 4, reflexivity was conducted to ensure transparency in the research process. Reflexivity ensures the 'researcher is aware of experiencing a world and moves back and forth in a kind of dialectic between experience and awareness' (Finlay, 2002: 533). Being reflexive means considering different lines of enquiry and being open to other possibilities before embarking on a particular route. I considered the different approaches outlined above, before settling on the methods which best suited answering the research questions.

By comparing the data, codes, and categories, I gained an understanding and developed my analysis through engagement with the evidence and data. My interpretation of the data shaped how I used grounded theory and discourse analysis. Interacting with my data meant I placed an interpretation on what I found. When we interact with anything, we have to make sense of the situation, assess what is happening, and draw on language and culture to interpret what is happening. As a result, interaction resulted in interpretation. Using existing studies enabled me to say ‘look this happened here’ and it is happening in a novel way in an online setting. My research shows that established theories which are acknowledged for explaining the offline world, can be transferred to the online world.

In combining the grounded theory and discourse analysis, I was able to examine the data and look at potential theories. By theorising, I attempted to see what possibilities there were for the data, what questions I could ask of the data, and the connections I could establish. Applying the research approach outlined in Chapter 4, enabled me to discover new patterns (see Contribution to Knowledge in this chapter). I was also able to use existing theory to substantiate some of the smaller findings. These theories assisted in substantiating my claims and supporting my arguments. Charmaz (2014: 228) describes how ‘theories offer accounts for what happens, how it ensues, and may aim to account for why it happened’. I found comparing and contrasting my findings with those obtained by others an important approach in understanding what was happening with my data. Existing theories explain some of the phenomena found in my findings, and these have been illustrated throughout the thesis. As illustrated in the Contribution to Knowledge section, the below the line comments have provided an opportunity to see how some of the existing theory played out in an online setting. Existing theories provided reference points in which I could compare my data and discuss my findings. The relationship between the existing literature and my findings was a practical one. Theoretical ideas and other empirical studies were identified and consulted as the study progressed. This enabled me to draw conclusions and propose certain arguments. This ability to generalise between studies emerged from the analytic process. Charmaz (2014: 322) argues that ‘the generality arises here from scrutinising numerous particulars and, after developing a substantive theory, may include analysing and conceptualising the results of multiple studies to construct a formal theory’. She goes on to state that ‘situating grounded theories in their social, historical, local, and interactional contexts strengthens them and supports making nuanced comparisons between data and among different studies’ (Charmaz, 2014: 322). These statements are pertinent as I have been able to generalise between my research and other studies. Charmaz (2014: 323) describes grounded theory as a means to learn about ‘the specific and the general – and seeing what is new in them – then exploring their links to larger issues or creating larger unrecognized issues in entirety’. I believe I have been able to achieve this, and I discussed my contribution to knowledge earlier in this chapter. Although there are similarities in some of my data with previous studies, as researchers, we look at the objects of our analysis from different vantage points. My findings have the interpretation of theory placed on them by me, and my view is imposed on the findings. I argue that the approach I have used has provided an original contribution to knowledge (see earlier in this chapter for a full discussion).

A further consideration which was also important was the literature review. One of the fundamental issues associated with grounded theory is when to conduct the literature review. Some researchers believe the literature review should be conducted after data collection and analysis, whilst others believe it should be carried out beforehand (Charmaz, 2014; Dunne, 2011; McGhee et al., 2007). As Charmaz (2014: 306, emphasis in original) argues, the ‘intended purpose of delaying the literature review is to avoid importing preconceived ideas and imposing them on your work. Delaying the review encourages you to articulate *your* ideas. That’s fine in principle. In practice it can result in rehashing old empirical problems and dismissing the literature’. For Charmaz (2014) engaging with the literature involves more than the literature review alone. She also views it as an opportunity to make comparisons between the data and the extant literature, and to show how your research either fits or extends the existing literature. Using literature in this way enables you to make clear, explicit associations and connections between your research and existing studies. Throughout the thesis I have attempted to make connections between my research and existing findings. However, one of the arguments against taking this approach, is that by using literature, the data is forced to fit with an existing theory. I was not naïve to the extant literature when conducting the data analysis, but I tried to not let this influence my thinking. As Urquhart (2007: 351) contends, 'there is no reason why a researcher cannot be self aware, and be able to appreciate other theories without imposing them on the data'. She argues that the literature review is initially considered as an orienting process, but this is later re-examined and expanded after the data analysis has been conducted. Additionally, McGhee et al. (2007) argue that the constant comparison method removes any bias from pre-existing knowledge gained from conducting the literature review. The constant comparative method enables analytical and reflective thinking. As Dunne (2011: 118) states, 'the researcher is required to reflect on how extant knowledge and collected data can be integrated into the emerging grounded theory'. It provides the opportunity for data and the emerging analysis to be compared with the existing literature. I believe the timing of the literature review also depends on certain circumstances. In my particular case, the University of Warwick 'upgrade' process from MPhil to PhD required a research proposal be submitted at the end of the first year. This meant a literature review was required, so in my case, it was not possible to delay the literature review until after the data had been analysed. The structure of the thesis was also important when considering how best to present my findings and the relationship to extant literature. I took the decision with my thesis to have two literature review chapters, and then to weave the discussion of the theoretical concepts into the presentation of the research findings. Where the theoretical concepts had already been discussed in the literature review, these were referred back to.

I believe the methodological choices I made (see Chapter 4), produced a robust study which answered the research questions. The contribution to knowledge which has been generated by these research questions is outlined earlier in this chapter. ‘As with the enterprise of qualitative research itself, the answer lies in learning from other pieces of research and giving careful consideration, in the light of others’ experiences and one’s own past experience’ (Barbour, 2018: 164). This is an important point, and one that I have considered. I have learnt that the research process is not straightforward, and I needed to be critical and reflexive throughout the whole process in order to achieve what I set out to do.

Further Research

In an era of growing fake news and misinformation, I believe this is an area where further research could be undertaken. In relation to the findings outlined in this thesis, additional research should be undertaken into the linking to other websites by commenters. Whilst I established this is occurring and to the types of websites which are being linked to in the comments, I believe it is important to establish the extent these websites are being consulted by those reading the comments. In addition, this research should focus on how credible these websites are considered to be by those linking to them, as well as by those reading them. Additionally, research needs to examine the reasons why those posting links are doing so.

As described in Chapter 4, when I first started this research, the intention was to include data collection from Twitter, and to use tweets in the analysis. As I did not find the tweets very helpful in answering my research questions, I decided against including them in the research. However, an aspect which requires additional investigation is concerning the activists and NGOs who use social media. As this thesis highlights, they also use scientific evidence to substantiate their claims concerning GM foods. Therefore, the audience who follow these organisations on Twitter and Facebook will be exposed to their claims regarding scientific information.

Platforms such as Twitter and Facebook are useful tools for social movements to use in order to organise and promote their message.

An additional area of research concerns the production aspect of news. It would be useful to understand how journalists writing the GM food news stories, feel about the comments posted about their work. It would also be valuable to understand if those commenting can provide worthwhile contributions to journalists.

Having established both scientific and consumer knowledges are drawn upon in the online GM food debate, I believe this needs to be taken into account when looking at science issues concerning food. As this thesis illustrates, there is as much concern about the ability to choose food by examining labels, as there is to the scientific nature of the debate. Therefore, research which examines food in the future, from a public engagement with science perspective, may also need to investigate how consumer knowledge plays a role.

Concluding Remarks

This thesis has examined some of the competing struggles surrounding the GM food debate which are revealed in both the news articles and below the line comments. Additionally, it has considered which actors from the food system are involved in these struggles. These actors include scientists (universities and research institutes); the European Union and European Parliament; the UK Parliament Science and Technology Select Committee; regional bodies (Scottish Government); food companies and supermarkets; NGOs; and citizens and consumers.

Science conducted by those at universities and research institutes is considered as legitimate because it is certified as true by those with the authority to do so. However, science is actually a constructed reality, and those with different concerns in a controversy will arrive at alternative constructions of scientific reality. Therefore, when we talk about science, we should consider it not as one entity but as many. The UK Parliament Science and Technology Select Committee, the Scottish Government, and NGOs such as Greenpeace, all rely on the use of scientific evidence in decision making processes.

Whilst science and scientific expertise is important, consumer expertise also plays a significant role. In assessing the risks associated with GM foods, consumers use knowledge which falls outside the definition of science. Citizen’s knowledge and opinions are shaped by other aspects of public debate, and this is employed in making sense of the GM food debate. The thesis has illustrated the different forms of expertise associated with the GM food debate. All should be seen as valid forms of knowledge, especially considering for the majority of the time, we are only laypersons.

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Appendices

Appendix A - Codebook

Category	Description	Example
View of nature	What nature means to someone. A description of nature.	**Articles** Genetically engineering plants and crops to change their DNA has been a cause of much controversy in recent years. But new research has found that Mother Nature might be making its own GM food, as sweet potatoes have been found to genetically modify themselves. And this seems to have been occurring for thousands of years, meaning humans have been unknowingly eating GM foods for much longer than they thought. From ‘GM food is natural: 'Foreign DNA' in sweet potatoes suggests plants genetically modify themselves’ (The Daily Mail, 22 April 2015) **Comments** It is imperative that we understand the consequences of the choices we’ve been making in attempting to ‘improve’ on the way Mother Nature does things. A

		normal seed can reproduce itself, these new breeds have pesticides inside of them, and many are not capable of reproducing, this puts the burden on the farmers to keep up with new 'genetic' developments. From 'Monsanto's new $1bn herbicide shows our bias towards hi-tech solutions' (The Guardian, 24 July 2015)
Scientific progress (good)	The benefits genetic modification can bring to either crops or food. How benefits relate to either people or the environment.	**Articles** Fish oil grown on the farm has come a step closer following promising results from a genetically modified crop trial. British scientists have developed a GM oilseed plant, Camelina sativa or false flax, whose seeds contain omega-3 fatty acids normally only present in oily fish such as salmon, mackerel and herring. From 'Farm-grown fish oil a step closer following GM crop trial' (The Guardian, 8 July 2015)

		Comments Monsanto’s business practices are abhorrent, but GMO does not equal Monsanto. There is Golden Rice and a friend of mine is working on a transgenic approach to produce better crop yields in saline soils. I’m sure there are many more examples. From ‘Monsanto's new $1bn herbicide shows our bias towards hi-tech solutions’ (The Guardian, 24 July 2015)
Scientific progress (risk)	How progression in the science of genetic modification can be a risk to either people or the environment. (Science or scientists have to be specifically mentioned.)	**Articles** The illegal variety of oilseed rape found in British fields includes genes from the antibiotics kanamycin and neomycin, which are used in human medicine. Biotech companies inserted these genes into the first generation of GM plants as a 'marker' to confirm that the desired transformation had occurred. The transformation gave the plants resistance to a particular weedkiller, which meant they could be doused with the chemical without being damaged. However, laboratory studies on the added genes - which are found naturally in the environment - have shown that they can be transferred to bacteria in soil. There is also a danger that they might produce resistance in humans to the beneficial

		effects of the important medical antibiotic gentamycin. From ‘GM blunder contaminates Britain with mutant crops’ (The Daily Mail, 27 September 2015). **Comments** The science' is a continuous stream of gambles that GM products won't hurt us, biology is a massive incredibly complex field that we have a lot to learn about, we simply don't know enough to be randomly throwing bits of genes together like some frankenstein who doesn't really know what he's doing. From ‘UK should be given power to regulate GM crops, MPs say’ (The Times, 26 February 2015).
Scientific evidence	Decisions concerning the genetic modification of crops and food should be based on scientific research.	**Articles** In unusually strong language, they state: “As you and others have indicated, this decision is political and not based on any informed scientific assessment of risk.

	Decisions concerning the genetic modification of crops and food should not be based on scientific research alone.	This is, of course, your prerogative. It is an approach to evidence that surprises and disappoints many scientists and non-scientists alike.” From ‘Ban on GM crops ‘uninformed’’ (The Times, 18 August 2015). **Comments** The scientific evidence is clear that crops developed using genetic modification pose no more risk to humans, animals or the environment than equivalent crops developed using more ‘conventional’ techniques Well said andrew. Problem is you can say it until you're blue in the face and still get nowhere with a lot of people. The anti-GMO movement has it's mind made up and does not wish to be confused with additional facts. From ‘UK should be given power to regulate GM crops, MPs say’ (The Times, 26 February 2015).

Failed Science	The failure of genetic modification of crops and food (e.g. how the supposed benefits of the technology have not lived up to expectation).	**Articles** A trial to create a genetically-modified wheat that would drive away insects without the need for powerful insecticide sprays has failed. Millions of pounds of public money was spent on the trial of a crop that GM scientists and supporters hoped would win over consumers sceptical about the technology. The wheat was genetically modified to release a scent that would supposedly drive away aphids or pests, so allowing the crop to flourish. However, while the idea worked in the laboratory, it did not when it came to growing the wheat in field conditions at Rothamsted Research Institute in Harpenden, Hertfordshire. Taxpayer-funded trial of GM wheat designed to beat bugs and cut need for insecticides ends in a £3million failure. From 'GM whiffy wheat fails to deter aphids' (The Times, 26 June 2015).
Risk (individual)	People making their own choice on what they feel is a risk to them personally in respect of genetic modification of crops and food.	**Comments** To my knowledge, no scientist has ever claimed ingesting GM food is a healthy option. There is only no universally accepted evidence to support that ingesting them is bad. However, in the face of not knowing if something is bad for me, I -

		and many people like me - would rather not ingest it. From 'Science bodies urge Scottish government to rethink GM crops ban' (The Guardian, 18 August 2015).
Risk (social)	The risks to society from the genetic modification of crops and food (e.g. health). This code is divided into sub-codes which are described below.	
	Fear – concerns about the impact on health due to growing GM crops or consuming GM foods.	**Articles** The term 'GM food' should be abandoned, say politicians who are calling for an extraordinary rebranding exercise. MPs on the science and technology select committee has demanded a 'reframing of the public conversation' about genetically modified food. In an inflammatory report today, it says the GM label has become a 'lightning

		rod’ for fears about designer crops. From ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (The Daily Mail, 26 February 2015). **Comments** Everything that is made can be used as a weapon or a tool. If GM foods can be engineered to produce beneficial effects at the genetic level in human beings can they not also be engineered to produce destructive effects at that level? Is there a military aspect to GM research that ensures its continued development? The 20th century gave us the Stealth Bomber; could GM research give us the Stealth Bomb? From ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (The Daily Mail, 26 February 2015).

	Labelling – the use of labelling to advise citizens about GM foods. The effectiveness of using labelling on GM foods. The purposes of labelling GM foods.	**Articles** Lord De Mauley, the environment minister, told anti-GM campaigners last month that "pragmatic rules" would be put in place to segregate GM and non-GM crops. In a letter to Beyond GM, he suggested that GM fruit and vegetables would be labelled as such in shops and restaurants. Beyond GM said Lord De Mauley's assurances were hollow because products from GM-fed livestock were already widely sold in Britain without such labels. 'Britain must be free to grow GM food, says minister' (The Times, 8 January 2015). **Comments** Shhh! the government has spoken! and you have no say in it! let's give it some happy, none offensive, distracting name, after all, the majority of the public don't want GM foods so lets fool everyone into eating it by making it harder for us to spot it in the small print of ingredients on the back of stuff. why not do the same as the US (and UK) does for High Fructose Corn Syrup and give it hundreds of

		different names so you have no idea what to look for to avoid it. From ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (The Daily Mail, 26 February 2015).
	Morality or Ethics – reasons why GM crops should not be grown or GM foods should not be sold in order to protect the health of citizens. Reasons as to why citizens may be exposed to GM foods.	**Articles** A judicial inquiry has been launched to find out how Rubis, a female lamb belonging to the French national institute for agricultural research (Inra) ended up on dinner plates. Destined for animal research only, the lamb was sold to an abattoir in November 2014 along with unmodified sheep and then onto an unsuspecting customer, who has not been identified to date. From ‘Genetically modified jellyfish lamb accidently hits French dinner plates’ (The Telegraph, 23 June 2015).

		Comments Somehow Scotland is deemed to be "backward" because it fails to be fooled by the hype and the spin of the GMO industry? Who wants GMOs anyway? Has anybody ever asked for a GMO product in a supermarket? There is no market demand -- so it is perfectly sensible to try and keep Scotland free of GMOs. And just a reminder. There is still not a single epidemiological study showing that GMOs are safe to consume -- and many laboratory studies that suggest otherwise. In making this move, the Scottish Govt is properly applying the Precautionary Principle and seeking, at the same time, to gain a competitive advantage over England. It also has concerns about public health. Bravo! From ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015).
	Poison – specific use of the word poison. Reasons for how GM crops may poison citizens.	**Comments** Don't let the Gov. get away with this ! Just last week, glyphosate (Round-up) was found in Pediasure fed to children in their feeding tubes in hospital. Where did it come from? The GMO corn fed to the milk cows, GMO soybeans, etc. The

		American people are getting tired of being poisoned. They've killed most of the bees, are we next? From ‘Eco-friendly Frankenfoods should be grown in Britain says Minister as she backs controversial technology for the first time’ (The Daily Mail, 8 January 2015).
	Trust – reasons as to why agricultural biotechnology companies should not be trusted with GM crops. Reasons as to why the food industry should not be trusted. The procedures put in place to protect citizens by those in authority.	**Articles** The double-dealing has been identified by GM Freeze, which is campaigning to raise awareness about how GM foods are creeping into the national diet without the knowledge and approval of consumers. The group’s director, Liz O’Neill, is now demanding an investigation to see if Domino’s has broken labelling laws – as firms using GM ingredients are required to label their use. ‘Now GM-free Domino’s is selling Frankenfood Pizzas’ (The Daily Mail, 21 March 2015).

		Comments Even if everything done so far was absolutely safe we cannot tell whether there might be rash behaviour in the future that would put the population at major risk and certainly it would be madness to allow Corporations to self regulate and I believe totally unacceptable to the electorate. Certainly we should be able to regulate GM crops and, in my view, it would put the Nation in jeopardy to trust to the integrity of any business or Company or Corporation and I am not convinced that the EU is not corrupt in this or that money has not changed hands to give lobbyists improper access. From 'UK should be given power to regulate GM crops, MPs say' (The Guardian, 26 February 2015).
	Uncertainty – the unknowns surrounding GM crops and foods and how their use may impact citizens.	**Articles** But Liz O'Neill, of the campaign group GM Freeze, insisted the proposal was ludicrous. 'Arguing about the semantics is just a smokescreen,' she said. 'All of the crops that are currently producing food and all the ones waiting in line within the EU approvals process are first-generation GM. 'Looking at what's

	Potential problems that may arise due to the growing of GM crops or the eating of GM foods.	coming out of the lab, it is vital to remember any attempt to artificially engineer DNA can cause unexpected and unpredictable effects.' From 'Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops' (The Daily Mail, 26 February 2015). **Comments** The same as it is now looking back at 'mad hatters' because of all the 'safe' lead they ingested, Among the ill informed concerns are real ones - it pays to be cautious. Some genetic modifications are carried out using viruses to carry the genetic modification into cells. Those viruses remain in as part of the genetically modified plant and are ingested by anything eating the plant. Ask one of the GM companies to guarantee in writing that they will take full financial responsibility for both direct and indirect effects if that implanted virus causes harm. They won't because they don't know if the virus will cause harm. That's before you get to the problems of overuse of pesticides due to 'roundup resistant' crops.

		From ‘Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops’ (The Daily Mail, 26 February 2015).
Risk (environment)	Risks to the environment from the genetic modification of crops and food (e.g. increased use of herbicides, the effect on ecosystems). This code is divided into sub-codes which are described below.	
	Fear – concerns about the damage that may occur to the environment due to the use of GM crops.	**Comments** They are not safe in the environment (Bt-resistant pests: thanks biotech companies!), they are not consistent with any form of farming apart from big

		agribusinesses, and they provide a short- term sticking plaster over the very real threat of climate change, telling a small minority of humans that they will be okay provided they are protected by the right technofixes. It's the agricultural equivalent of geoengineering. From ‘Tens of thousands march worldwide against Monsanto and GM crops’ (The Guardian, 24 May 2015).
	Morality or Ethics – reasons why GM crops should not be used in order to protect the environment.	**Articles** Greenpeace also opposes the review proposal, arguing that this constitutes an assault on the ability of democratically-elected governments to protect their environments and peoples from potential risks, where the science is contested. Efsa has never refused a GM authorisation. From ‘EU clears path for 17 new GM foods’ (The Guardian, 16 April 2015).

		Comments Set aside the emerging dangers, the presenting of the food market from seed to plate to the multinationals as a gift, the fact that pretty much all GM is chemical-sodden monocultures which kill off the soil and wildlife, and look at our "freedoms" - IF people are stupid enough to want to put inherently unstable, generally completely untried substances into their bodies, that's fine by me - but how dare anybody effectively denote our environment a "smoking carriage" and light up? - forcing all the rest of us to suffer passive GM fallout. By all means grow the damned stuff in sealed facilities, put a bubble over Alaska and grow it there, but don't DARE sell us out to the profiteers by allowing it in the UK countryside - we've seen the total amoral behaviour of the likes of Monsanto From 'GM crop vote was just the beginning of Europe's biotech battle' (The Guardian, 19 January 2015).
	Poison – specific use of the word poison. Reasons for how GM	**Articles** "We have all these chemical companies poisoning the land, poisoning the reef and the sea and the fishes," Bruch said.

	crops may poison the environment.	From ‘Hawaii groups plant coconut trees, protest against Monsanto’ (The Daily Mail, 24 May 2015). **Comments** Enjoy your superweeds, the ever stronger herbicides trying to kill them, and the poisons in your water and food. From ‘Half of Europe opts out of new GM crop scheme’ (The Guardian, 1 October 2015).
	Trust – reasons as to why agricultural biotechnology companies should not be trusted with GM crops. The procedures put in place to protect the environment by those in authority.	**Articles** Last night Professor Huw Jones, head of Cereal Transformation Lab at Rothamsted (correct) Research, took a slightly different view. He said: ‘It is unfortunate that GM seeds have been found in a batch of imported conventional oil seed rape but this confirms that UK screening procedures are robust and this was identified at an early stage of cultivation to allow effective remedial actions to be taken.’

		From ‘Alarm as GM crops planted by mistake’ (The Daily Mail, 30 October 2015). **Comments** I believe that the effect on the environment, on insects and on humans can never be fully understood because of the sheer complexity of the interrelationships and dependencies. If you trust Monsanto and the US Government then frankly, I think you're off your head and out of your mind. You are a typical acolyte of politically and economically controlled 'science'. This is a far, far greater danger to humanity and the world than so-called 'global warming'. Blinded by the propaganda you place faith in something that can never be proven safe. From ‘GM crop vote was just the beginning of Europe’s biotech battle’ (The Guardian, 19 January 2015).
	Uncertainty – the unknowns surrounding GM crops and how	**Articles** Mr Parr added: “If those who are cautious about it like us are wrong the upshot will be a few years delay on some returns to shareholders for large international

	their release may impact the environment. Potential problems that may arise due to the release of GM crops into the environment.	companies. "If on the other hand the pushers are wrong then we've potentially changed our environment with uncertain consequences for both the ecology and for health for a really for time immemorial." From 'Campaigning against GM crops is morally unacceptable says former Greenpeace chief' (The Telegraph, 8 June 2015). **Comments** No, the report is wrong because it cannot quantify the risks associated with the unknown unknowns of altering genes in the food chain. What it does is attempt to prove that certain uses of the technology do not cause harm. What it can't do is predict what will happen when we engineer genes to achieve a specific outcome in a complex environment. Complex systems are inherently unpredictable, and the environment is by definition (as everything is within it) the most complex system there is.

		From ‘UK should be given power to regulate GM crops, MPs say’ (The Guardian, 26 February 2015).
Risk (time)	How genetic modification may not be seen to cause problems now but may do so in the future.	**Comments** Thus it might so happen, for example, that one or two decades after a certain GM product became widely cultivated and consumed, the rates of some kind of cancer go up significatively: we simply don't know and can't trust the industry to come clean about it even if they know it for sure. From ‘GM crops to be fast tracked in UK following EU vote’ (The Guardian, 13 January 2015).
Power (over science)	Who has control over science? (E.g. Scientists, Government, companies.) How is this control exercised?	**Articles** The Scottish government announcement on Sunday did not say whether this new legal power would extend to a ban on scientific and experimental research, but a spokeswoman confirmed that laboratory research on GMOs would continue. From ‘Scotland to issue formal ban on genetically modified crops’ (The Guardian, 9 August 2015).

		Comments How does Monsanto manage to prevent meaningful research on its crops? GMO seeds are patentable inventions under U.S. law. This allows the companies broad power over who can study their products and how. Using this power, Monsanto refuses to provide seeds to independent researchers, and when it does it imposes restrictive conditions that limit research options." From 'Scotland to issue formal ban on genetically modified crops' (The Guardian, 9 August 2015).
Power (over food supply)	Who has control over food supply? (E.g. Scientists, Government, companies, farmers.) How is this control exercised?	**Articles** Monsanto caused a furore in the 1990s by considering a controversial crop technique dubbed the 'terminator technology' that could have prevented timeless agricultural practices such as seed saving that are key to crop resilience and farmers' livelihoods. While this technique was not commercialised, a similar outcome was achieved by Monsanto having its customers sign an agreement that states they will not save seed to plant the following year, ensuring the purchase of new seed every season. Several crops such as cotton and soy beans depend on

		proprietary pesticides and herbicides such as Monsanto’s controversial glyphosate-based Roundup brand. From ‘Monsanto's new $1bn herbicide shows our bias towards hi-tech solutions’ (The Guardian, 24 July 2015) **Comments** It's all about profit so of course they are going to lie, forget about they want to feed the world, they want to hold the farmers and countries to ransom, if I remember right these crops are sterile which means you cannot save seeds to plant you must constantly purchase seeds from the manufacturers, this is the biggest danger from GM crops. Once cross pollination occurs between natural and GM and all crops become modified and sterile who do you think will profit from it, once it starts you will not stop it. From ‘Call for ban on toxic GM corn after tests reveal wind can carry it 2.7 miles, not 65 feet as previously claimed’ (The Daily Mail, 5 March 2015).

Contamination	The specific mention of contamination.	**Articles** The government has not decided what these separation distances should be. Any farmer where pollen does spread to pollute crops belonging to another person is at risk of being sued for the resulting loss in value. An organic farmer whose crop became contaminated may find it loses its status and value if contaminated with GM genes. From ‘Britain to sprout Frankenfoods after EU ruling: controversial crops could be grown from next year after being approved’ (The Daily Mail, 14 January 2015). **Comments** You don't need to be a scientist to know that individual plants growing in the middle of roads in the centre of towns got there either on the wind or on the feet of birds, so how anyone can declare there will be no cross contamination must have a vested interest in their introduction From ‘Call for ban on toxic GM corn after tests reveal wind can carry it 2.7 miles,

		not 65 feet as previously claimed' (The Daily Mail, 5 March 2015).
Natural/un-natural	The perception of natural or un-natural. What people think natural is. The specific mention of natural or un-natural.	**Comments** Genetically modified is just that. Genetically modified !! Reformed, recreated, restructured - it doesn't matter what the heck you call it . But it is playing with nature and it is also exceedingly dangerous From 'Call GM food something else to ease public fears, say MPs: Report says label is 'lightning rod' for fears of designer crops' (The Daily Mail, 26 February 2015).
Food security	How the problem of food security could be solved.	**Articles** The danger of a focus on magic bullets is that, where hunger is concerned, it conveys the message that feeding the world is a technical problem, when decades of analysis show it to be a profoundly political and economic one. From 'Monsanto's new $1bn herbicide shows our bias towards hi-tech solutions' (The Guardian, 24 July 2015)

		Comments I find the "we need to embrace GM to feed the world" argument spurious. It assumes that producing more food is the answer. I'm not anti-innovation and technology. I believe that in the west we need to change our diets (more plants, less meat), our business models, our structures of governance and our consumerist habits. We need to empower smallholder farmers and citizens around the world. From 'GM technology isn't good or evil – its what we do with it that counts' (The Guardian, 28 August 2015).
Sustainability (GM needed)	How genetic modification is needed in crops and food in order for there to be sustainability in food supply.	**Articles** Rothamsted scientist Dr Olga Sayanova said "We are delighted with the results of our first year field trial. Finding a land based source of feedstocks containing omega-3 fish oils has long been an urgent priority for truly sustainable aquaculture. Our results give hope that oilseed crops grown on land can contribute to improving the sustainability of the fish farming industry and the marine environment in the future".

		From 'Farm grown fish oil a step closer following GM crop trial' (The Guardian, 8 July 2015). **Comments** Looks like a whole lot of people would rather exploit more destitute poor farmers in Ghana or Ivory Coast, and use more resources in order to make chocolate. Heaven forbid we grow more crops using less water, less fertilizers, and higher yield. You can't really have this both ways, either you want to grow crops the old way and use more resources, or grow them the new way genetically modified. From 'Hershey's pulls GMO ingredients from best selling chocolate bars amid backlash against Frankenfoods' (The Daily Mail, 24 February 2015).
Sustainability (GM not needed)	How genetic modification is not needed in crops and food in order for there to be sustainability in food supply.	**Articles** We can ask what is the problem to which GM crops are the only or best solution? There are almost always choices to consider. If weeds are a problem you can modify a crop for herbicide resistance, as Monsanto has done, or you can use a combination of unglamorous but effective ground cover, mulching, soil

	How sustainability in food supply could be achieved by using other means.	management, rotation, weeding or even use weed crops in other constructive ways. From 'Monsanto's new $1bn herbicide shows our bias towards hi-tech solutions' (The Guardian, 24 July 2015) **Comments** So far, GM foods haven't really even attempted to feed the world. For the most part, they involve agricultural practices that are not sustainable in the long term, and that isn't going to help anyone eat better. In some cases, they have created problems like resistant weeds which seem to make high production levels less likely. Overall, very localized food systems are better at actually feeding people adequately and even well. From 'Canadian company's genetically modified apples win US approval' (The Guardian, 14 February 2015).

Edible/inedible	People do not know what they are eating. Food which triggers a response such as disgust.	**Comments** No thanks, let her eat gm, they do enough to our foods as it is, fruit, under ripe on day, off the next. Never used to, down to all the processing to make it look good for longer. From 'Eco-friendly Frankenfoods should be grown in Britain says Minister as she backs controversial technology for the first time' (The Daily Mail, 8 January 2015).

Appendix B

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Scientists produce beneficial natural compounds in tomato – with potential for industrial scale up

26 October 2015

Scientists produce beneficial natural compounds in tomato – with potential for industrial scale up

Given the opportunity to drink fifty bottles of wine or eat one tomato, which would you choose?

Scientists at the John Innes Centre have found a way to produce industrial quantities of useful natural compounds efficiently, by growing them in tomatoes.

The compounds are phenylpropanoids like Resveratrol, the compound found in wine which has been reported to extend lifespan in animal studies, and Genistein, the compound found in soybean which has been suggested to play a role in prevention of steroid-hormone related cancers, particularly breast cancer.

As a result of the research led by Dr Yang Zhang and Dr Eugenio Butelli working in Professor Cathie Martin's lab at the John Innes Centre, one tomato can produce the same quantity of Resveratrol as exists in 50 bottles of red wine. One tomato has also produced the amount of Genistein found in 2.5kg of tofu.

Drs Zhang and Butelli have been studying the effect of a protein called AtMYB12 which is found in *Arabidopsis thaliana*, a plant found in most UK gardens and used as a model plant in scientific investigation.

The protein AtMYB12 activates a broad set of genes involved in metabolic pathways responsible for producing natural compounds of use to the plant. The protein acts a bit like a tap to increase or reduce the production of natural compounds depending on how much of the protein is present.

What was interesting about the effect of introducing this protein into a tomato plant was how it acted to both increase the capacity of the plant to produce natural compounds (by activating phenylpropanoid production) and to influence the amount of energy and carbon the plant dedicated to producing these natural compounds. In response to the influence of the AtMYB12 protein, tomato plants began to create more phenylpropanoids and flavanoids and to devote more energy to doing this in fruit.

Introducing both AtMYB12 and genes from plants encoding enzymes specific for making Resveratrol in grape and Genistein in legumes, resulted in tomatoes that could produce as much as 80mg of novel compound per gram of dry weight –demonstrating that industrial scale up is possible.

Tomatoes are a high yielding crop - producing up to 500 tonnes per hectare in countries delivering the highest yields (FAOSTAT 2013) and require relatively few inputs. Production of valuable compounds like Resveratrol or Genistein in tomatoes could be a more economical way of producing them than relying on artificial synthesis in a lab or extracting them in tiny quantities from traditional plant sources (e.g., grapes, soybeans, etc.). The tomatoes can be harvested and juiced and the valuable compounds can be extracted from the juice. The tomatoes themselves could potentially become the source of increased nutritional or medicinal benefit.

Professor Cathie Martin said:

"Our study provides a general tool for producing valuable phenylpropanoid compounds on an industrial scale in plants, and potentially production of other products derived from aromatic amino acids. Our work will be of interest to different research areas including fundamental research on plants, plant/microbe engineering, medicinal plant natural products, as well as diet and health research."

Dr Yang Zhang, said:

"Medicinal plants with high value are often difficult to grow and manage, and need very long cultivation times to produce the desired compounds. Our research provides a fantastic platform to quickly produce these valuable medicinal compounds in tomatoes. Target compounds could be purified directly from tomato juice. We believe our design idea could also be applied to other compounds such as terpenoids and alkaloids, which are the major groups of medicinal compounds from plants."

This research was strategically funded by the BBSRC, the EU ATHENA collaborative project, the Major State Basic Research Development Program (973 Program) of China, the John Innes Foundation, and the DBT-CREST Fellowship.

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Associated Scientists

Prof Cathie Martin
View profile

Yang Zhang

Dr Eugenio Butelli

Figure B1 Press release issued by the John Innes Centre on 26 October 2015.

Appendix C

PRESS ROOM

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INRA reports to the legal authorities that it sold an animal bred in the context of a research programme

INRA reports to the legal authorities that it sold an animal bred in the context of a research programme

A ewe lamb born to a genetically-modified mother in the context of a medical research programme was sold to a private individual in the Paris region in October 2014. Although this lamb presented no risk to humans or the environment, the Institute has just informed the Public Prosecutor's Office in Meaux of this violation of the French Environment Code. This event had in fact been concealed by an INRA employee.

En français

PUBLISHED ON 06/23/2015 UPDATED ON 06/23/2015

KEYWORDS: GFP - SHEEP

Born in the context of a research programme on human cardiology (see insert) being carried out by a research unit and experimental facility at the INRA Centre in Jouy-en-Josas (Yvelines), a ewe lamb from a genetically-modified mother was shipped on 5 August 2014 to a partner abattoir (1) and then its carcass was sold to a private individual on 28 October 2014.

A research programme in human cardiology

The research programme that gave rise to the ewe lamb thus sold was designed to understand, in sheep (a "model" animal for humans), how cells could be grafted to restore deficient cardiac function following a myocardial infarction. To evaluate the viability of such grafts (site and evolution of the cells used), it was necessary to employ animals expressing a substance called Green Fluorescent Protein (GFP), which renders their cells fluorescent. Obtained from a jellyfish (*Aequorea victoria*), this protein is wholly non-toxic and is widely used in research protocols on cancer or in the field of orphan diseases. The discovery and applications of GFP were acknowledged in 2008 by a Nobel Prize.

The ewe lamb put on the market did not express this protein.

This breach of Article L 536-4 of the French Environment Code (2) was concealed from the Research Centre's managers by the employee until 5 November 2014. After informing the appropriate Ministries (3), INRA carried out an immediate internal administrative inquiry in December 2014 and the necessary measures were implemented very rapidly (suspension of the sale of all livestock, suspension as a precaution of the staff member who concealed the sale, a halt to all experiments by the research unit concerned and the destruction of all its genetically-modified materials). The resulting report issued in April 2015 highlighted certain stresses and dysfunctions within the unit looking after the ewe lamb, as well as individual behaviours incompatible with the missions of a public service research institution.

Without prejudicing any ongoing disciplinary procedures, INRA took responsibility for this event (4) because of the gravity of the individual actions mentioned above, and reported the facts to the Public Prosecutor's Office in Meaux on 15 June 2015, providing all the information and documents it held concerning the case.

Under current regulations, this ewe lamb was qualified as a group I genetically modified organism "involving risks to human health and the environment that are null or negligible" (5). The research unit managing the scientific project was fully accredited for such activities.

Faced with this unprecedented incident, INRA has acted in a wholly transparent manner in terms of the actions and procedures implemented, and in accordance with the values it has been defending for nearly 70 years.

(1) Some research projects require the implementation of experimental protocols on animal models which comply with European and French regulations regarding animal experimentation and welfare. To obtain these animals, some INRA units, including the Joint Animal Experimentation Unit (UCEA) in Jouy-en-Josas, rear their own livestock. The animals selected for research are then isolated, while those that are "supernumerary" are sold in compliance with the regulations applicable to livestock farms.

(2) Article L 536-4 of the French Environment Code, prohibits "the sale of any product consisting of genetically modified organisms or containing such organisms."

(3) Ministry of Agriculture, Agrifood and Forestry, Ministry of Education, Higher Education and Research, Ministry for Social Affairs, Health and Women's Rights.

(4) Article 40 of the Code of Criminal Procedure provides that "Any established authority, public officer or civil servant who while carrying out their duties becomes aware of a crime or offence, is required to inform the Public Prosecutor's Office immediately and to transmit to this magistrate all related information, official statements and documents."

(5) Confined use of genetically modified organisms: French Environment Code

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Figure C1 The press release issued by the National Institute for Agronomic Research (INRA) in connection with the lamb incorrectly sent to an abattoir.