Chlorinated chicken, hormone beef and Genetically Modified Organisms (GMOs).

A critical discourse analysis of news and tweets regarding the GMO debate during the political uncertainty represented by Brexit negotiations.

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Abstract

This study comprises a critical discourse analysis of digital news and tweets discussing genetically modified organisms within the critical discourse moment of 2017 Brexit negotiations. Genetically modified organisms (GMOs) have a long history of controversy in the UK spanning from the introduction of the first genetically modified crops in the 1990s to the recent developments of precision plant breeding techniques. Results show that the negative portrayal of GMOs across both platforms was associated with a negative representation of Brexit. This portrayal was achieved using discursive strategies, such as othering and anchoring. Also, articles showing anti-Brexit sentiment used negative hyperbolic language to portray GMOs as alien, associating them with other controversial US food imports, such as chlorinated chicken and hormone-treated beef. In contrast, the discursive representation of the technology within the rarely represented pro-Brexit propaganda used de-politicisation and economic reasoning to frame biotechnology, especially gene editing, in a non-problematic way within discourses on progress and innovation.

The marginal coverage of GMOs within the broader media discussion on post-Brexit trade agreements was reversed on Twitter, where the topic became central in tweets. Prominent views on this social media platform against the cultivation of GMOs in the UK reinforced a politicised representation of the technology, which was associated with environmental and social justice via a cohesive network of anti-GMO activist groups. Other influential voices associated the potential adoption of GM crops with an aversion towards government decisions and a yearn for regulatory independence via highly retweeted Scottish politicians. Social Network Analysis (SNA) demonstrated the cohesive behaviour of anti-GMO activist groups was central to the Twitter debate on GMOs and Brexit. The use of compelling narratives and the efficiency of the network of anti-GMO groups eclipsed the reasoned and detached pronouncements of scientists.

Table of Contents

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1. Introduction: providing context to the GMO controversy

It could be argued that humanity has been *genetically modifying* crops since the beginning of agriculture when humankind started domesticating plants and selecting high yielding varieties to produce more food. Nevertheless, nowadays, genetically modified organisms' (GMOs) legal definition is narrower, pertaining only to organisms obtained by so-called *recombinant DNA techniques*. In fact, in the European Union, GMOs are defined as *organisms in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating or natural recombination*.

Since the production of the first *modern* genetically modified foods, the adoption of these technologies has obtained great media attention, inspired political debates and generated strong public reactions. Furthermore, there has been academic interest in the GMO debate for decades to explain the biotechnology controversy's origins and development, especially concerning GM (genetically modified) foods. Salient areas of research have investigated the psychosocial aspects of public reaction to GM crops and food, public perception of risk associated with the technology and knowledge of the science behind it, media portrayal of GMOs and the implications of political discourses in the debate.

In light of the recent development of CRISPR-Cas9 and the history of controversy associated with GM food safety, this work aims to analyse the way GMOs and CRISPR-Cas9 were portrayed in media and social media in 2017. When the project was originally designed, the Brexit referendum of 2016 had not yet taken place. When the outcome showed that the United Kingdom was going to leave the European Union, there was academic curiosity in seeing whether GMOs would be a conversation point during Brexit negotiations. This was of particular interest given the implications of Brexit on food trade with EU and non-EU countries and internal disagreements amongst nations of the UK regarding GM foods' cultivation and marketing.

In this introduction I will describe how public opinion can influence science policy, explain what GMOs are with a focus on explaining the different genetic engineering techniques, especially CRISPR-Cas9. I will discuss the EU and USA GMO regulations. Furthermore, I will describe the controversial history of GMOs and the role of media in the discursive representation of biotechnology in Europe. Lastly, I will expand on the meaning of Brexit and the role of social media in news dissemination.

1.1.   Public opinion can shape science policy.

In a democratic society, public opinion can have a great impact on the regulation of science and technology (Malyska, Bolla and Twardowski, 2016) and, in some cases, a discrepancy between public opinion and scientific consensus can be cause for intense debates, with long-lasting effects on government policy (McFadden, 2016). Although there are arguments that science policy should be produced by only consulting experts, there is evidence that involving the public in policymaking regarding new technologies can increase support (Sapp *et al.*, 2013). Nevertheless, obtaining support can be challenging when the scientific discoveries in question push society's ethical boundaries (Brossard, 2019).

Differences in opinion between experts and the general public have often been attributed to lay people's lack of understanding of complex scientific notions (Simis *et al.*, 2016). However, there is strong evidence showing that knowledge of a scientific issue or a new technology does not always correspond to a reduction in concern or an increase in acceptance (Connor and Siegrist, 2010; Mielby, Sandøe and Lassen, 2013).

While scientific knowledge can be a useful predictor of technology's acceptance (Rollin, Kennedy and Wills, 2011), when it is used as sole criterion, the analysis hides the important role of psychological and sociological context in the formation of opinion (Finucane and Holup, 2005; Fluegge, 2016). Filling the discrepancy in knowledge, might not be the ultimate solution to the problem because, faced with a new piece of information, a person will rely on the social and psychological context to estimate the risk presented by the new item and determine whether it should be considered a threat (Renn and Benighaus, 2013).

Figure 1.1 Contextual filters that influence a person's perception of scientific innovation.
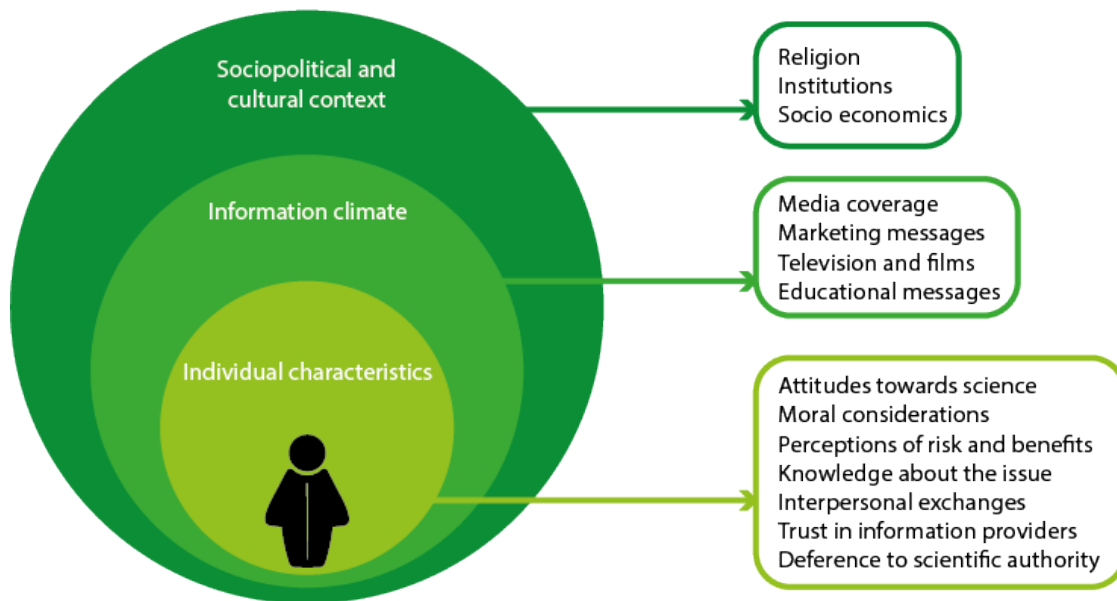
Figure 1.1. *The diagram shows the different spheres of influence which contribute to an individual's interpretation of the world. These include contributing factors that strictly pertain to the individual (individual characteristics), the sources of information to which they are exposed (information climate) and the broader societal context in which they exist (socio-political and cultural context). D. Brossard, 2015 as cited by the National Academy of Science and Technology, 2016.*

As Figure 1 shows, a person's perception of new technology can be influenced not only by what they know about it but also by individual characteristics such as pre-existing attitudes towards the technology, interpersonal exchanges with a group of peers or family members (Falk and Scholz, 2018; Whittingham, Boecker and Grygorczyk, 2019), ethical and moral stand (Dizon *et al.*, 2016), perception of risks and benefits associated with the technology (Siegrist, 2008), their trust in information providers (Mathew D Marques, Critchley and Walshe, 2015) and their *deference* to scientific authorities (Wang, 2017). Furthermore, there are factors external to the individual, which can influence their perception, such as the quantity and type of information to which they are voluntarily or involuntarily exposed (Frewer, Miles and Marsh, 2002): the so-called *information climate*. The latter does not pertain only to content created for information, such as what might come from an educational setting (educational messages); instead, it includes traditional media coverage, digital media, social media, marketing and advertisement messages, entertainment messages from television, music, and even art (Hagtvedt and Patrick, 2008). In the information climate, use of language, framing and

narrative surrounding the issue are particularly important in the perception of risk (Claire Mcinerney, Bird and Nucci, 2004; Cook, 2004; Burscher, Vliegenthart and Vreese, 2016). Finally, opinions on scientific innovations can be influenced by the broader religious, economic and socio-political context (Paoletti *et al.*, 2008; Kahan, Jenkins-Smith and Braman, 2011).

If science communication efforts fail to contextualise new scientific discoveries appropriately, the divide between scientific consensus and public opinion can be exacerbated, especially when a technology is breaking new ground and thus falls outside the existing regulation's scope (Malyska, Bolla and Twardowski, 2016). If there is an urgency to regulate such technologies, but there is no debate resolution, governments can find themselves having to decide whether to follow expert advice or listen to public opinion, thus resulting in controversial policy decisions (Pechar, Bernauer and Mayer, 2018). An example of public opinion contributing to the drafting of *controversial* regulation is the case of the European Union's (EU) legal framework for GMOs (Loeber, Hajer and Levidow, 2011) which will be discussed in section 1.3.

1.2.   GMOs: a boundary-breaking technology

To better understand the reason for the existence of the current European legislation on GMOs and the way new developments in the technology are *challenging* European regulations, one must first understand biotechnology's recent progress and contextualise it in light of differences amongst techniques available to produce genetically engineered food. Below is provided a brief history of plant breeding and biotechnology.

1.2.1.   A brief history of genetically modified organisms (GMOs)

The selection and cultivation of the best-performing crops is a procedure as old as agriculture itself. Since 10,000 BCE, hunters and gatherers in the fertile crescent started domesticating crops beginning what is defined today as the *First agricultural revolution* (Riehl, Zeidi and Conard, 2013). Since then, *intuitive farmer selection* has contributed over the centuries to the development of better-performing crops (Breseghello, 2013). For example, after centuries of selection, teosinte, the ancestor of corn, resembles wild grass more than contemporary corn (see Figure 1.2). However, up until the second half of the 20th century, there was minimal understanding about the heritability of complex plant traits, so stabilising the transmission of

certain characteristics from a plant generation to the next was a major undertaking that took many years (Shull, 1909).

Figure 1.2 Graphic representation of a Teosinte plant
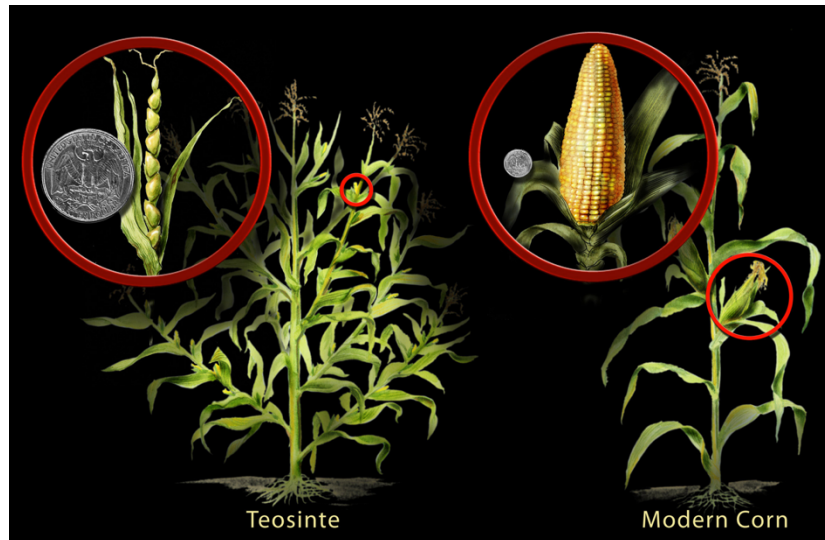
Figure 1.2. Teosinte (on the left) is considered the primary ancestor of modern corn (on the right). Note how modern corn has only one main stem as well as fewer and bigger ears. (Image by Nicolle Rager Fuller, National Science Foundation)

One of the first steps towards understanding heritability's inner workings in plants was Gregor Mendel's population genetics research in the second half of the 19th century. Even though his work had not yet been recognised for its importance at the time, Gregor Mendel shined a light into the vertical transmission of plant traits and gene segregation with his study of phenotypic markers. With Charles Darwin's theory of evolution, his research laid the groundwork of modern plant biology (Gayon, 2016).

The issue with selecting phenotypes for the greatest yield, pest resistance or stress tolerance was that it could lead to the co-selection of undesirable traits and the elimination of characteristics that might improve stress resilience of crops in the field (Hetrick, Wilson and Cox, 1993). This was partially overcome with mutagenesis technologies. In fact, in the 1920s, scientists discovered that by submerging seeds into specific chemicals or using radiations, they could induce random heritable mutations fixed in the plant's germline. Although only a small percentage of seeds resulted in advantageous mutations, the entire process was much less time consuming than traditional crossbreeding. Since its discovery, breeding by mutagenesis has

been used successfully for many years (SENSE ABOUT SCIENCE, 2009) and is currently considered safe by the European Food Safety Authority (Andersson *et al.*, 2012). However, the use of random mutagenesis in selective crop breeding is limited by its imprecision, since the mutating agent could affect all genes across the plant genome and it is impossible to target one gene responsible for a certain trait specifically. Therefore, random mutagenesis causes non-target effects that require multiple rounds of time-consuming backcrossing and selection to eliminate random mutations in other parts of the genome.

Despite its limitations, in the 1950s, mutagenesis and the so-called *nuclear farms* facilitated the development of new high yielding wheat varieties. Together with the advent of modern fertilisers, the latter brought about what is known as the *Green Revolution*. This was a period of high investment in agricultural research, which facilitated new hybrids in key food crops. It helped alleviate world hunger, especially in developing countries; an achievement which won Norman Borlaug a Nobel Peace prize in 1970 (Pingali, 2012). Notwithstanding this progress in crop improvement and hybridisation, it was only after Rosalind Franklin's research in 1951 that the double helix structure of Deoxyribonucleic Acid (DNA) was uncovered (Braun *et al.*, 2011). In 1953, Jim Watson and Francis Crick's Nobel Prize-winning paper finally explained the function of DNA as a *genetic library* at a molecular level (Watson and Crick, 1953). This ground-breaking discovery laid the foundations for modern biotechnology.

Figure 1.3. History of plant breeding

10.000 BCE
FIRST AGRICULTURAL REVOLUTION

1840s
MENDEL DISCOVERS PLANT HYBRIDISATION LAWS

1920s
SEEDS IRRADIATION USED TO INDUCE RANDOM MUTAGENESIS

1953
WATSON AND CRICK DISCOVER THE STRUCTURE OF DNA

1972
FIRST RECOMBINANT DNA MOLECULE

1973
FIRST GM BACTERIA MADE RESISTANT TO KANAMYCIN

1977
AGROBACTERIUM TUMEFACIENS MEDIATED MODIFICATION IN CROPS

1980s
BIOLISTIC APPROACH TO DELIVERY OF NEW DNA. INVENTION OF THE GENE GUN

1990s
DISCOVERY OF RNA INTERFERENCE

1994
FLAVR SAVR TOMATO FIRST COMMERCIALISED GM FOOD

2010s
DEVELOPMENT OF GENE EDITING TECHNIQUES

2010s
EPIGENETICS APPLIED TO PLANT BREEDING

2015
PATENT FOR ROUNDUP READY SOYBEAN EXPIRES

2015
DEVELOPMENT OF GOLDEN RICE: VITAMIN A RICH RICE

2020
GENE EDITING WINS NOBEL PRICE IN CHEMISTRY

2019
FIRST GENE EDITED SOYBEAN COMMERCIALISED IN THE USA

Figure 1.3 shows a timeline summarising important developments in the field of plant breeding and agricultural biotechnology. Note how all of the molecular breeding techniques were developed from the 20th century onwards. Some of the less precise techniques, like mutagenesis, were developed before the 1950s. Only after the discovery of DNA structure and function, it was possible to develop precise molecular breeding techniques.

Vectors created by bakar105, macrovector_official, rawpixel.com (www.freepik.com)

7

In the end of the 20th century the advent of genetic engineering reshaped agriculture and plant breeding (Fernandez-Cornejo and Caswell, 2006) by making it possible to introduce specific DNA sequences into living organisms generating so-called *genetically modified organisms* (GMOs)[1]. The first organisms to be genetically engineered were microbes (Hershfield *et al.*, 1974), and the first genetically modified food to be marketed was the Flavr Savr Tomato in 1994 (Martineau, 2001). The latter contained a section of antisense DNA that inhibited polygalacturonase production, an enzyme involved in ripening of fruits and vegetables. The reduced concentration of polygalacturonase delayed the fruit's ripening and potentially prolonged its shelf life, thus reducing spoilage, especially during transport. Although the Flavr Savr is no longer available on the market, to date, other fruits (Gonsalves, Street and Ferreira, 2004), plants and even some animals have been genetically engineered and are commercially available in countries across the globe. Since 1996, more than 2.7 Billion hectares of GM crops have been planted (ISAAA, 2017).

Techniques used to produce GMOs have evolved over the years, reflecting advances in genetic engineering.

Figure 1.4. Plant transformation by A. tumefaciens and by biolistic approach.
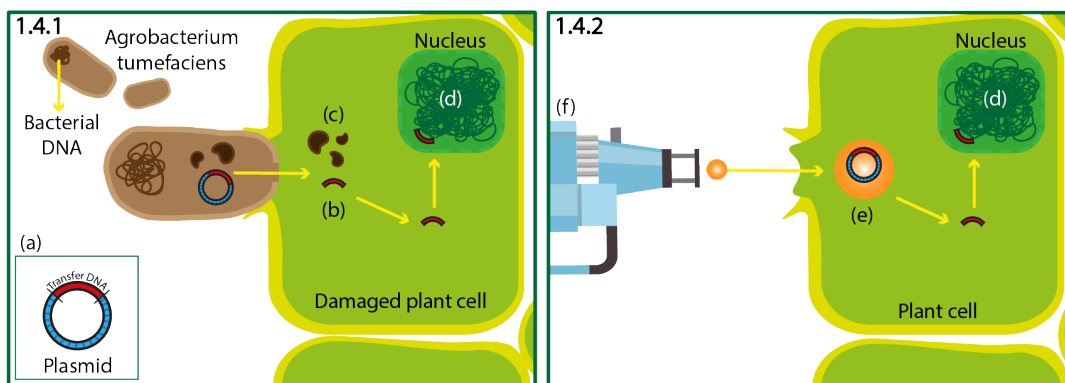
Agrobacterium tumefaciens is a bacterium naturally present in soils with the ability to transfer and incorporate small circular DNAs called plasmids into the genome of damaged plant cells. In genetic modification by A. tumefaciens (1.4.1) the DNA transfer happens by the introduction of virulence proteins (c) and so-called "Transfer-DNA" (b) that shall be incorporated in the genome of the host (d). The biolistic method (1.4.2) on the other hand, entails loading multiple copies of a vector (a) on gold nanoparticles (e) and "shooting" them into plant cells with a gene gun (f).

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[1] GMOs are defined by the European Union in Directive EC 2001/18 as *organisms, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination.*

The first GMOs were *transformed* employing the bacterial plant pathogen Agrobacterium tumefaciens or by biolistic particle delivery (see respectively Figures 1.4.1 and 1.4.2). These techniques have been used widely in crops for a variety of purposes including: to increase pest resistance (Wu *et al.*, 2008), introduce herbicide resistance (Owen, 2000) or increase nutritional value (Moghissi, Pei and Liu, 2015). This transformation technique's success has since allowed scientists to introduce specific desired traits into a small percentage of individual cells and subsequently select for transformed cells, tissues, and/or regenerated plants that contain the transgene. The latter selection process is often based on the addition of an antibiotic resistance gene (marker gene) to the gene-set of the transfer-DNA. By growing the infected plant cells/tissues on a medium containing the antibiotic, only the cells/tissues containing the resistance would grow.

Once the transgenic plant tissue has been selected, the antibiotic resistance is of no other use to the GM plant. So, to speed up the otherwise long and costly safety assessment related to the presence of the antibiotic resistance, scientists have been working on removing the unwanted marker genes. There are currently different ways to achieve this, including co-transformation, transposon-mediated approaches and site-specific recombination (Woo, Suh and Cho, 2011).

Two of the disadvantages of the aforementioned GMOs are that the new genetic material is randomly inserted and that the genetic modification results in non-native protein production. The issue with random insertion is that it can lead to knock-out mutation of native genes, whereas the production of a new protein can act as an allergen in the final food product. Also, the idea of introducing genes from animals or viruses into food crops is disturbing to many consumers (Scott *et al.*, 2018).

The development of RNA interference (RNAi) partially solved these issues. This technique reduces the expression of one or multiple plant genes. RNAi is based on the insertion of a gene cassette encoding strands of sense and antisense RNA that are complementary to the gene of interest. Expression of such RNAi gene constructs results in *gene silencing*, a reduction in the expression of an existing gene[2]. This method's applications include reducing the allergenic activity of food (Gilissen *et al.*, 2005) or reducing unwanted enzymatic activities like browning in pre-cut fruits (Okanagan Specialty Fruits, 2012). Another advantage of RNAi is that a single construct can silence multiple taxonomically related genes, thereby bypassing the problem of gene redundancy in conventional mutagenesis. Nevertheless, this technology's strength is also

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[2] This was the technology behind the Flavr Savr tomato, even though it was not fully understood at the time.

a limitation, since the range of possible applications is restricted because it is only possible to repress genetic traits that are already present in the plant.

1.2.2. Gene editing techniques: a new frontier for biotechnology?

Recent techniques include Zinc Fingers Nucleases (ZFNs), Transcription Activator-like Effector Nucleases (TALENs) and Clustered Regulatory Interspaced Short Palindromic Repeats associated with the Cas9 Nuclease (CRISPR-Cas9). All three techniques require the temporary introduction of a foreign gene construct via conventional transformation to induce the targeted mutation in the host genomic DNA. These novel techniques are generally referred to as 'gene editing' (Gaj, 2014) because they represent a customisable way to introduce mutations and/or foreign DNA at specific loci within the plant genome while it was previously impossible to predict where the introduced transgene was incorporated within the GMO's genome.

While this form of site-directed mutagenesis can also be achieved via RNA interference or (non-GM) random mutagenesis followed by molecular-genetic (PCR-based) selection of the desired mutation ('Targeting Induced Local Lesions in Genomes'; TILLING), gene editing is less time-consuming (and cheaper) than TILLING, and more efficient and stable than RNAi.

Of all three gene-editing techniques, the CRISPR-Cas9 technique (as seen in Figure 1.5) is considered to be the most precise with relatively low non-target effects (Doudna J.A. and Charpentier E., 2014) and is being praised by scientists for its precision, cost-effectiveness and speed (Wang and Guo, 2018). In addition to site-directed mutagenesis, all gene-editing methods also allow for the introduction of foreign 'donor DNA' at the mutated locus (Li *et al.*, 2016). Moreover, after the mutation/editing has been achieved, the transgene effector can be removed in the germplasm via outcrossing, thereby removing any trace of its GMO status. This inability to distinguish organisms produced by mutagenesis from those obtained by gene editing creates a quandary for regulators. In fact, as the modification is created through gene-editing it can be argued that it should be regulated as traditional GMOs. However, it is possible that an identical product could be obtained through traditional breeding techniques, meaning one would have two essentially identical products one classed as a GMO and the other as non-GMO (Janusz *et al.*, 2017). A major downside of the first generation of CRISPR-cas9 technology was that the cell's innate homologous repair mechanisms after the double-stranded DNA break by the Cas9 enzyme could lead to off-target mutations (Kleinstiver *et al.*, 2016).

This limitation has recently been addressed and the latest innovation of CRISPR-Cas9 technology, called 'Prime-Editing', also allows researchers to edit more types of genetic mutations than conventional CRISPR-Cas9 (Yasinski, 2019).

Figure 1.5. The CRISPR -Cas9 system
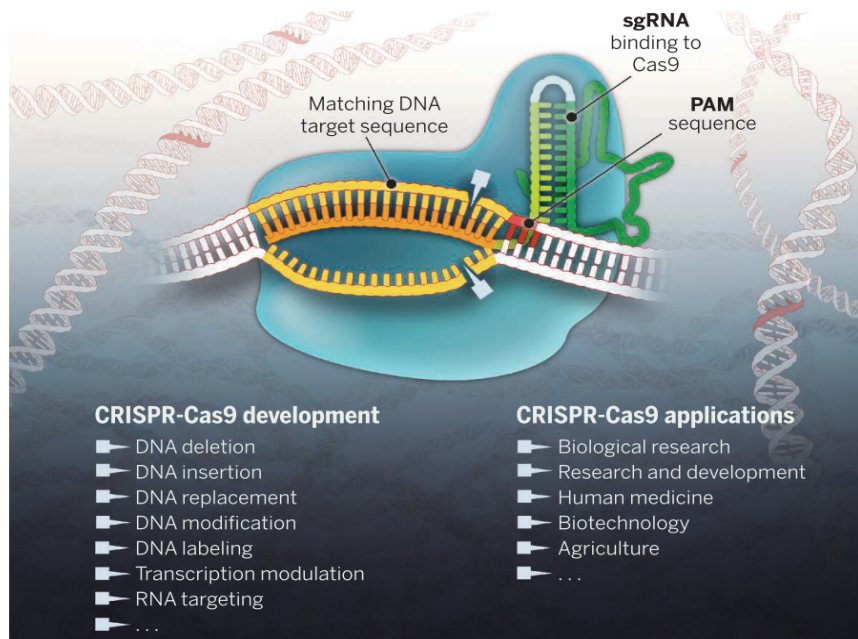
Figure 1.5. *Upon infection by hostile viruses, some bacterial species have the ability to incorporate small pieces of the viral DNA in their genome. This provides the bacterial cell with immunological memory against future infection; the incorporated viral DNA is transcribed into RNA and bound to a specific Nuclease that can track down and inactivate the viral DNA. Researchers found that this so-called CRISPR- Cas9 system can be customised and used to create locus-specific double-strand cuts in any organism's genomic DNA and insert new DNA sequences within the mutated locus. Illustration: N.Cary/Science,* (Doudna J.A. and Charpentier E., 2014)*.*

Most recently, scientific attention has turned to the use of epigenetics in plant breeding. Epigenetic traits are heritable traits that affect gene expression and/or responsiveness, but they are not determined by DNA sequence. Most epigenetic traits are caused by biochemical modifications to the DNA (e.g., cytosine methylation) or associated proteins (chromatin). Recent evidence shows that specific environmental stimuli can be *imprinted* in the plant's epigenetic makeup and transmitted from a generation to the next (Springer, 2013) without changing its DNA sequence. Further studies on the matter are to investigate the stability of these epigenetic traits. If epigenetic features could be passed onto multiple generations of a cultivar, this might not only lead to a better understanding of genetic engineering as we know

it today, but it could create new opportunities for *GMO-free* plant breeding which would not fall under current GMO regulation. This is particularly relevant in light of studies on media portrayal and public perception of epigenetics, which show that the technology, since its discovery, has been received positively in the public sphere (Seitz and Schuol, 2017; Dubois *et al.*, 2019) in stark contrast with the events surrounding the introduction of GMOs in Europe where a combination of concerns from the general public, pressure from sectorial interest groups (Maeseele, 2009) and media attention (Mathew D. Marques, Critchley and Walshe, 2015) have dramatically influenced the EU's legal framework for these technologies. An overview of the EU regulation of GMOs is provided below.

Table 1. Key features of different molecular breeding technologies.

	Random mutagenesis	*A.tumefaciens*	*Biolistic approach*	*RNA interference*	*CRISPR-Cas9*	*Epigenetics*
Allows insertion of novel traits	NO	YES	YES	NO	YES	NO
Allows regulation of existing traits	YES	YES	YES	YES	YES	YES
Allows locus-specific DNA insertion	NO	NO	YES	YES	YES	NO
Requires presence of viral promoters and/or terminators	NO	YES	YES	YES (can be removed)	Only in preliminary phase	NO
Requires marker genes	NO	YES (can be removed)	YES (can be removed)	YES (can be removed)	Only in preliminary phase	NO
Leaves behind a unique DNA identifier	NO*	YES	YES	YES	NO*	NO

Table 1 shows a list of the main molecular breeding technologies discussed previously (rows) and their main features (columns). Please note the limitations of all techniques compared to CRISPR-Cas9. Particularly noteworthy is the comparison between random mutagenesis and CRISPR-Cas9 (*). In fact, although the latter requires the temporary insertion of supplementary DNA material, it does not leave a trace of the modification process in the final product except for the mutation itself. This makes products of this technology indistinguishable from the products of mutagenesis.

1.3.   Regulating GMOs

1.3.1. Fundamental differences between EU and USA

Both for labelling requirements and food safety, the United States' Food and Drug Administration (FDA) has a very different approach to GMOs compared to the EU (DeFrancesco, 2013). In fact, the USA system is based on one piece of regulation from 1986 which sets a series of product-based voluntary measures (Montpetit, Rothmayr and Varone, 2007). the monitoring of these measures is delegated to the pertinent regulatory bodies based on the type of modification such as the US Department of Agriculture (USDA) or the Environmental Protection Agency (EPA). The relevant authorities then enforce two main principles:

- History of safe use: food that has been part of the diet for several generations is considered safe. Food *generally recognised as safe* (GRAS) does not require further authorisation.

- Substantial equivalence principle: everything can be marketed if substantially equivalent to a pre-existing product.

In comparison to other countries, the US regulatory framework has been described as permissive towards GMOs (Montpetit, Rothmayr and Varone, 2007) and the country is currently the global leader for the cultivation of biotech crops with 75 million hectares planted in 2018 (ISAAA, 2018). Nevertheless, the US GMO regulatory framework is not without controversy (Schurman and Munro, 2006). Some argue that the anti-GMO movement originated soon after the first GM crops were commercialised in the USA in the mid 1990s (Yang and Chen, 2016). In fact, the US government has faced critiques especially regarding the lack of labelling requirement for food products containing GMO ingredients up until 2016 when a compromise was found in the form of Public Law 114-216 (Bovay and Alston, 2018). Nevertheless, there are very few limitations to the introduction of new GMO products into the US market.

The EU, on the other hand, applies the *precautionary principle* where any new food product being released on the market, including any newly developed GM crop, must be approved by EFSA after undergoing complex, lengthy authorisation procedures. Some scientists would argue the EU's approach is too strict (Mampuys and Brom, 2015; Tagliabue, 2017; Halford, 2019) especially in light of recent advances in genetic engineering techniques which might

render the current European legal framework on food biotechnology obsolete (Hartung and Schiemann, 2014; Sprink *et al.*, 2016).

1.3.2. EU legal framework on GMOs

The European Union (EU) legislation on GMOs is a complex set of legal instruments implemented by national law in EU member states. The main legal instrument is Directive 2001/18 EC, which, as previously mentioned, provides a legal definition of GMOs and guidelines for their release into the environment (European Parliament and the Council, 2001), Directive 2001/18 EC is accompanied by Regulation (EC) 1829/2003, which specifically addresses genetically modified food and feed (European Parliament and the Council, 2003). Most EU legislation on GMOs covers pre-marketing processes such as application, risk assessments carried out by the European Food Safety Authority (EFSA, 2020), and authorisation procedures (European Commission, 2015b). Also, Regulation (EC) No. 1830/2003 covers labelling requirements for GMOs as, in the EU, labelling is mandatory for any marketed product containing more than 0.9% GMO.

As part of the precautionary *farm to fork'* approach to food safety (Bánáti, 2014), in the EU, the European Food Safety Authority (EFSA) must clear any application for marketing or cultivation of a new GM crop. Subsequently, the final decision on the authorisation is passed onto the Standing Committee on Plants, Animals, Food and Feed (PAFF), a committee of scientific experts representing the individual member states. However, to date, all deliberations by the PAFF committee have been inconclusive due to lack of a qualified majority, so authorisations have been referred back to the European Commission (EC), which has largely based its decisions on the scientific risk assessment. In a nutshell, if the risk assessment carried out by EFSA demonstrates that a GM product is safe for human health, animal well-being and the environment, then it is likely going to be authorised by the EC; albeit that the support of half of the member states is lacking (European Commission, 2015a).

To date, 107 GMOs have passed EFSA's risk assessment. Of these, 100 have been approved for import and marketing as animal feed, while 99 have been approved as food for human consumption (ISAAA, 2020). Nevertheless, only one maize variety is authorised for cultivation across the EU and, as of 2020, it is cultivated only in Spain and Portugal. This pest-resistant maize (referred to as MON810) produces a BT protein that protects the crop against chewing insect herbivores, in particular lepidopteran pests (Hellmich and Hellmich, 2012).

To address the issue of the division amongst member states representatives, in 2015 the European Commission amended Directive 2001/18 EC with Directive (EU) 2015/412, giving countries who do not wish to cultivate GMOs on their territory the power to restrict or prohibit GMO cultivation (European Parliament and the Council, 2015). Many member states have adhered to this amendment, including, in the UK, Scotland, Wales and Northern Ireland (Ryan-Hume, 2015). England, on the other hand, has not yet opted out of cultivation of GM crops.

1.3.2.1. *New breeding techniques in the European context.*

CRISPR-Cas9 has recently won the 2020 Nobel Prize in Chemistry (The Royal Swedish Academy of Sciences, 2020) and is praised by the scientific community as a ground-breaking technology with a vast range of applications from plant biotechnology, to medicine (Adli, 2018; Jaganathan *et al.*, 2018). Although the EU has not produced a scientific opinion on CRISPR-Cas9 yet (Laaninen, 2020), the European Commission has established a deadline to produce a thorough report by the end of 2021 amidst NGOs advocating to regulate these technologies according to the existing legal framework (Helliwell *et al.*, 2017; Court of Justice of the European Union, 2018) and pressure from the scientific community to produce what they referred to as sensible, evidence-based policy (Group of Chief Scientific Advisors, 2018).

Whether or not New Breeding Techniques (NBTs) will rekindle the GMO controversy in the EU is yet to be determined (Hunter, 2014; Friedrich, 2020), but if the past has shown anything, is that the decision-making process will take time and the public, interest groups and the media might all play a role in deciding the future of NBTs in Europe (Hundleby and Harwood, 2018) and, notably, in the UK. In the meantime, the technology has already been adopted for food crops and products have been commercialised in non-EU countries like the USA (Waltz, 2016; Wilke, 2019).

The difference in approach to biotechnology between the United States and the EU has contributed to international disputes, particularly regarding the import of some US foods. A few important examples of products that were the subject of these disputes were genetically modified foods (Punt and Wesseler, 2016); chicken washed in chlorinated water (Johnson, 2015) and beef reared with the aid of growth hormones (Calzolari and Immordino, 2005). EU member states have argued, in the past, that US food safety and quality are insufficient to meet EU food standards (Carlarne, 2007), making them unfit to enter the EU Single Market. This has caused a stall in the approval and importation of new GMO crops from non-EU countries. This lasted for a few years, until the USA, interested in trading with the EU and flanked by Argentina and Canada, appealed to the World Trade Organisation (WTO) arguing that such

concerns were not supported by scientific evidence and thus accusing the EU of obstructing the free circulation of goods without evidence showing these controversial products were unsafe for human consumption. In fact, according to the General Agreement on Tariffs and Trade (GATT), one can only prohibit the circulation of food if there is a scientifically proven safety concern (Carlarne, 2007). However, EU countries still refuse to accept such products and differently from Argentina and Canada, disputes with the USA have been paused but remain unsolved (Punt and Wesseler, 2016). This behaviour by EU member states suggests a rejection of these products is elicited by reasons more complex than just safety concerns.

1.4. Public rejection of GMOs: more than safety concerns?

Much of the EU caution towards GM foods can be described as driven by the public's rejection of the technology. This systematically precautionary approach was initiated in an era of food scares when the fragmentation and globalisation of the food chain meant consumers often did not know where their food came from. The arising of food-related health incidents exacerbated feelings of uncertainty surrounding the safety of food. The events of the food scares era (which will be discussed in section 1.4.3) had repercussions on the European food policy landscape especially regarding novel products such as GM foods. Although the safety concerns for the emergence of new technology might have subsided over the years, as shown by some European surveys (Ahteensuu, 2012), the cultural significance of food scares has persisted for many years and the public perception of food related risks has been subject of scholarship with various approaches attempting to explain the phenomenon. All these aspects to the construction of public rejection of GMOs will be discussed in this section.

1.4.1. The Eurobarometer surveys

One of the most geographically comprehensive sources of information about public opinion on GMOs in the EU is the Eurobarometer survey. The Eurobarometer surveys on biotechnology are carried out in the EU member states by the European Commission. The purpose of this kind of surveys is to give a longitudinal perspective on public attitudes towards emerging technologies and the perception of risk and trust in institutions around specific topics. At the time of the latest Eurobarometer on biotechnology (2010) all 27 member states participated in the survey and according to the results 62% of EU citizens were either *very worried* or *fairly worried* about GMOs. The survey also showed that most European citizens agreed with the statements *GM food is fundamentally unnatural* and *GM food makes you feel uneasy*. Results of the Eurobarometer for consumer opinion about GMOs shows that consumers were wary of

GMOs because they were *unnatural* or because of health and safety concerns while only a minority perceived GMOs as beneficial for food security and the economy (European Comission, 2010).

The Eurobarometer survey also gives an overview of the results for the single member states. In the UK only 33% of participants believed that GMOs were safe for health in 2010, against 39% who disagreed. Furthermore, over half of Britons (55%) agreed with the statement *GM food benefits some people but puts others at risk*. An earlier Eurobarometer report of 1997 tried to quantify knowledge of the participants on the topic of genetic modification by asking generic science-related questions. When asked to assess if the statement *ordinary tomatoes do not contain genes, whereas genetically engineered tomatoes do* was true or false, only 35% of EU participants answered correctly (the statement is false).

As was discussed in section 1.1, although knowledge plays a role in public perception of GMOs, acceptance can also vary depending on the type of information one receives. For instance, the information consumers want might not be the same as the one provided by scientific experts or government officials. Furthermore, making sure that scientific facts reach all parties involved equally and that they are accessible to a lay audience is a difficult task as proven by past attempts at public participation in science policy. One of these examples is the *A GM Nation?* debate in the UK which will be described below.

1.4.2. The *A GM Nation?* Debate

An example of nationwide science communication efforts from the government was the *A GM Nation?* debate in the UK. In 2002-03 the British government ran a social experiment to understand the public's position on GMOs' commercialisation. The *A GM Nation?* debate, so it was named, called upon British citizens to engage with a website containing informative material on the science, economic, and political effects of GMOs' commercialisation in the UK. Public meetings were also held, and public opinion was collected quantitatively with surveys and qualitatively with focus groups. Findings showed that most participants opposed the idea of allowing GMOs' cultivation and marketing in the UK (Heller of Clarity, 2003). Nevertheless, researchers found that flaws in the organisation and the data analysis may have influenced the outcome and consequently, political decision-making processes (Horlick-Jones *et al.*, 2006). In fact, even though the debate was held across the country on a local level, many uninterested citizens did not participate in the discourse, raising questions regarding the

sample's significance and representativity (Pidgeon *et al.*, 2005). Furthermore, research showed that many people who took part in the national debate had a pre-existing firm negative opinion towards GMOs. Regarding the information provided, an effort was made to produce neutral information. Thus, the scientific material produced for the general public had been stripped of context, leaving only the bare science which made it difficult for the public to relate to and interpret (Pidgeon *et al.*, 2005).

The print media coverage during and after the *A GM Nation?* debate has been studied using different approaches (Gaskell *et al.*, 2003; Cook, Robbins and Pieri, 2006). Augoustinos et al. (Augoustinos, Crabb and Shepherd, 2010) analysed the representation of stakeholders in the A GM Nation? Debate in the print media from January to March 2004. Employing critical discourse analysis, the study found recurring motifs in the portrayal of the different players in the debate. The public was pictured completely against GMOs; on the other hand, the government was portrayed as a pro-GMOs stakeholder by most newspapers, leaving out of the discourse the government's effort put into allowing public participation in the debate. The study also highlighted a lack of trust in institutions and the agricultural biotechnology industry was portrayed as profit-driven, more so when Bayer decided to withdraw a new GMO application because of the strict series of measures put in place by the British government. The *A GM Nation?* debate might have set a negative example of how public engagement and science communication should be handled. Nevertheless, it showed the importance of the use of language and need for contextualisation in the GMOs discourse. Also, it was suggestive of the complexity of the socio-cultural and historical dimension of the debate.

1.4.3. Understanding public dislike of GM foods.

In the 1990s, the fragmentation and globalisation of the food supply chain increased the likelihood that incidents associated with certain foods' production or consumption became more difficult to trace and control (Loeber, Hajer and Levidow, 2011). This, alongside increased media attention, contributed to rising public concerns regarding the risks of foodborne diseases and infections, thus changing consumer purchase behaviours, culminating in so-called *food scares* (Beardsworth, 1990). These events increased public uncertainty regarding food safety and affected public perception of the first genetically engineered crops, products of relatively new technology that had never been applied to whole foods.

1.4.3.1. *Food scares lay the foundations for dislike of GMOs in Europe.*

Whitworth et al. define a food scare as the *response to a food incident (real or perceived) that causes a sudden disruption to the food supply chain and to food consumption patterns* (Whitworth, Druckman and Woodward, 2017). This escalation of events was seen in Europe in the late 1990s when a series of food-related incidents caused thousands of people's death and contributed to consumer behaviour changes, which brought significant economic losses in the farming and food sectors (Bánáti, 2011).

Major examples of European food scares include the 1986 Bovine Spongiform Encephalopathy (BSE) outbreak (Washer, 2006) and the 1988 Salmonella outbreak (Knowles, Moody and McEachern, 2007) in the UK. Other examples are the dioxin contamination crisis in Belgium (Verbeke, 2001), and the European Foot and Mouth Disease (FMD) outbreak (Sobrino and Domingo, 2001) which spread from the UK into Europe at the beginning of 2001. At the time, the management, evaluation and communication of health risks associated with food consumption were tasked to national governments which would also oversee the crises' resolution. Nevertheless, in many instances, European governments found themselves unprepared to handle the complexity of the situation. For example, the UK government underplayed the risk of BSE to be transmitted to humans with terrible repercussions on public health (Gerodimos, 2004). Furthermore, the UK government's inability to respond quickly and cohesively to these food safety emergencies and its information campaigns' inconsistency contributed to increased public distrust of national institutions and uncertainty regarding foods' safety (Smith, Young and Gibson, 1999; Mazzocchi *et al.*, 2008).

In this climate, to address the public's need for reassurance regarding food safety, many European countries founded independent authorities for monitoring food safety on a national and international level. Examples of these newly founded organisations were the UK's Food Standards Agency (FSA) and the Belgian Federal Agency for the Security of the Food Chain (FASFC). The European Food Safety Authority, a *supra-national* authority with the mandate to review evidence on the safety of food ingredients, was also created at this time (Knowles, Moody and McEachern, 2007). EFSA communicates the risk associated with foodborne diseases and provides council to member states representatives in the European Commission regarding the safety of novel foods. The institution of EFSA and other national organisations provided, at the time, a more structured risk management framework and a systematic emergency response thus laying the foundation of the European precautionary farm to fork approach to food safety that is still in place today.

1.4.4. Approaches to the study of risk perception: an overview.

Since the *era of food scares* there has been great interest from academics in uncovering the psychological mechanisms underlying public perception of risk with the dominant approach focusing on psychological factors influencing rational judgment - the cognitive approach to risk perception (Whittingham, Boecker and Grygorczyk, 2019). Other more articulated models incorporate social, cultural and emotional responses to risk (Joffe, 2003; Finucane and Holup, 2005; Gupta, Fischer and Frewer, 2011).

Cognitive approaches to risk perception are based on the analysis of intra-personal information processing. Perception of risk is framed as a process limited by individuals' use of knowledge and their capacity to evaluate the likelihood of being affected by the risk (Rollin, Kennedy and Wills, 2011). According to these approaches, a negative perception can be portrayed as a *deficit* phenomenon (Bauer, 2009). Based on the idea that science can be obscure and complex to understand to a non-specialised audience, the deficit model hinges on filling gaps in scientific knowledge. The model posits that, if the public gained a greater understanding of scientific facts, this would invoke a more positive attitude towards new technologies (Mielby, Sandoe and Lassen, 2013). Nevertheless, as elaborated in section 1.1, knowledge of the technology only covers one aspect within people's interpretation of reality so the deficit model is arguably a reductive approach (Ahteensuu, 2012).

To overcome these critiques the cognitive approach to risk perception has been further elaborated to include emotional responses to hazards. The main proponent of such an approach has been Paul Slovic. His research on risk perception has shown that when people are confronted with a supposed hazard they use emotional shortcuts (affect heuristics), which influence their rational judgement of risk and decision making (Finucane *et al.*, 2000). In the first chapter of his book *The feeling of risk*, Slovic analyses how events as simple as gambling can be affected by feelings and how a person's emotional sphere is a central driver in decision making. While these approaches focus on individual perception of risk, they ignore the influence of societal factors. To frame risk perception within society and to scale up individual perception to public perception of risk, one cannot leave out the role of context and social interactions (Renn and Benighaus, 2013).

The neglected social aspects of risk perception have been addressed in Social Representation Theory (SRT) which aims to consider not only psychological but also external factors, lying

outside of individual behaviour. Furthermore, it considers emotions as inseparable from rational thinking due to the complexity of social interaction and personal characteristics. In SRT, an individual's assessment of risk is seen as an intuitive choice more closely related to *meaning* rather than *knowledge*. In view of this, SRT takes into account ethical beliefs around food (Mohr and Golley, 2016), stance towards environmentalism (Lu, McComas and Besley, 2017), food culture and history (Heller, 2002), trust in institutions (Mathew D Marques, Critchley and Walshe, 2015) and finally media portrayal (Curtis, Mccluskey and Swinnen, 2008; Mathew D Marques, Critchley and Walshe, 2015).

The three pillars of SRT are emotional anchoring, objectification and symbolic representation. Emotional anchoring refers to the instinctual feeling arising when trying to estimate the risk associated with something new that is not comparable to any past experience (Castro and Gomes, 2005). Objectification is the tendency to make something more concrete and relatable by comparing it with personal experiences (Höijer, 2010). Finally, symbolic representations can describe otherwise abstract concepts and contextualise them in a more comprehensible framework (e.g. science-fiction). In using these combined aspects, SRT creates a holistic framework that goes beyond the reductive approaches of science communication and risk perception which reduce risk perception to mere lack of understanding or irrational negative reactions (Joffe, 2003).

SRT describes the perception of risk as a social phenomenon subject to influence from pre-existing experiences, social interactions, and mass media. The latter is found to be particularly important in the communication of risk because of its role as *simplifier* of scientific information into lay concepts and compelling narratives. The social amplification of risk framework (SARF) supports this idea focusing on the information climate (as seen in Figure 1.1). It was first developed in 1988 when a need arose to study how social factors can influence public perception of risk (Kasperson *et al.*, 1988; Slovic, 2010; Cho, Reimer and McComas, 2015). SARF posits that, in the pursuit of a good news story, media (and more recently social media) can misrepresent risk and can act as an *amplification station* either amplifying or attenuating risk while fulfilling the role of translating complex scientific information (Frewer, Miles and Marsh, 2002; Sarathchandra and McCright, 2017; Fellenor *et al.*, 2018). SRT therefore suggests that media plays an important role in the public perception of risk.

1.5.   The role of media in forming public opinion

There are different ways media can contribute to influencing public perception of risk, such as volume and tone of reporting (Frewer, Miles and Marsh, 2002; Claire Mcinerney, Bird and Nucci, 2004) or framing and contextualisation of the news item (Entman, 1993). In the words of Robert Entman, through *metaphors, keywords, stereotyped images and sources of information* news articles can contribute to *thematically reinforcing clusters of facts or judgements*. Furthermore, whether consciously or unconsciously, journalists can introduce their point of view into their writing and give salience to certain aspects of an issue while omitting others, often adopting the lexicon of social actors with whose opinion they agree (Zajc and Erjavec, 2014). Also, while covering issues of public interest, media can act as "*sieve*", giving salience to chosen topics and sources of information (Zajc and Erjavec, 2014). In this section I explore this with respect to European food scares and GMOs.

1.5.1.   Media involvement in European food scares

In the event of a food crisis, this pattern of giving relevance to specific opinions over others can determine the dimensions of food scandals (Augoustinos, Crabb and Shepherd, 2010). For instance, in the 1990s, the extent of media coverage has been shown to have impacted public opinion regarding food safety (Finucane and Holup, 2005). In fact, attention from the media contributed to a drop in the purchase of incriminated foods (Böcker and Hanf, 2000) and influenced the length of the period, right after the outbreak, in which consumers went back to their pre-crisis purchase choices (Knowles, Moody and McEachern, 2007).

Particularly, the media's role in the 1986 BSE crisis has been the subject of scholarship (Miller, 1999; Washer, 2006). Researchers found that the media initially framed risk as an animal health issue, and the story disappeared from newspapers while the government reassured the public that there was no risk for human health (Miles and Frewer, 2003). It was only much later when BSE was linked with Crueutzfeldt-Jacobs Disease (CJD) that press coverage increased again. The UK government was pilloried by the media, accused of keeping *secrets* and being undemocratic which contributed to the social amplification of the BSE issue in such a way that attempts to avoid a food crisis failed, and beef consumption dropped significantly across Europe (O'Brien, 2000).

Similarly, the media was implicated in food scare that happened in 1999 involving the Belgian meat industry. This time, dioxins caused a mass poultry intoxication. One lot of animal feed

was found to be contaminated with these highly toxic environmental pollutants that can accumulate in the food chain, especially in animal fat (WHO). Again, a solid risk assessment from an independent food safety body was missing and contradictory messages circulated in the media about risks for human health (Verbeke, 2001), resulting in much public confusion. The aftermath of this crisis caused great losses for the Belgian meat industry and repercussions on a political level, especially in the wake of the BSE crisis (Böcker and Hanf, 2000; Stassart and Whatmore, 2003; Lloyd *et al.*, 2006).

1.5.2. The first GM foods

While Europe was going through such a spike in public fear of food-related hazards, major technology advancements were being made in the field of biotechnology (Loeber, Hajer and Levidow, 2011): the first sheep was cloned (1996) and the first GMOs were starting to hit European supermarket shelves. In fact, as previously mentioned, the Flavr Savr tomato was produced by a US company called Calgene in the early 1990s and authorised for commercialisation in Europe in 1994 (G. Bruening; J.M. Lyons, 2000). Advertised as having a longer shelf life, the product did not do as well as expected, and the company had to declare bankrupt.

Although the Flavr Savr tomato's demise was related to its *overpromised and underdelivered* benefits other than its safety (Martineau, 2001), at the time, GMO technology was still relatively new especially its application to food production. This novelty generated many questions amongst the general public, especially about its potential long-term effects on the environment (Marks *et al.*, 2007). The unknown risk perceived regarding the consequences of GM foods' adoption was amplified by pre-existing public anxiety surrounding recent food scares (Miles and Frewer, 2003; Milne *et al.*, 2011) and by the increased media attention (Beardsworth, 1990; Brookes, 1999).

1.5.3. Media reporting of GMOs.

Particularly, the timely publication of controversial studies about health and environmental risks associated with GM crops elicited negative media reporting of the technology (Verbeke, 2001; Vilella-Vila and Costa-Font, 2008). For instance, in 1998 Dr Pusztai, a British scientist reported a link between GM potatoes' consumption and intestinal damage in rats and his study was published in a high-profile medical journal (Ewen and Pusztai, 1999). Elsewhere, Losey et al. implicated GM crop cultivation as an important factor in the demise of the Monarch

butterfly populations (Losey, Rayor and Carter, 1999). Although the scientific robustness of both these findings was questioned, the media furore around the studies is thought to have contributed to negative public opinion about the safety of GMOs (Frewer, Miles and Marsh, 2002; Finucane and Holup, 2005; Lucht, 2015; Mathew D Marques, Critchley and Walshe, 2015). The Monarch butterfly is still a symbol of GMO labelling campaigns in the United States (Claire Mcinerney, Bird and Nucci, 2004) demonstrating the continued influence of these studies on public opinion.

Media framing has been shown to have the ability to influence public perception of biotechnology, both negatively (Cook, Robbins and Pieri, 2006) and positively (Lu, McComas and Besley, 2017). Analysis of media coverage of the GM debate over the years has shown how the framing of the topic as *controversial* in itself contributed to shaping public opinion and policymaking in many countries across Europe (Horlick-Jones *et al.*, 2006; Vilella-Vila and Costa-Font, 2008; Vicsek, 2013). For instance, in the early 2000s framing of GMOs in the French national media outlets (newspapers and television) contributed to a shift in France's political leadership (Sato, 2013). The media portrayed GM-foods as alienated from French food culture and, instead, associated with American industrial farming practices, fast food chains and highly processed foods. This contributed to French policy evolution from liberal, progress-oriented and pro-GMO to precautionary, strict and anti-GMO. Such shift shows how media, by commenting on the debate, can play an active role in shaping public opinion and policymaking (Heller, 2001).

In Belgium, where social movements have strongly opposed GM crops' cultivation, a critical discourse analysis of media coverage revealed different ideological stances in elite newspapers, some of which attempted to *de-politicise* the GM debate and others which *politicised it* (Maeseele *et al.*, 2015). Maeseele asserts that *De Standaard* played a crucial role in de-politicising the GMO discourse (Maeseele, 2015) allowing the broad scientific community to argue for technical solutions to address practical problems and taking political agendas out of the equation. This framing, according to Maeseele, is implicated in the *techno-environmental fault line* (Lang and Heasman, 2015), on the one hand the *De Standaard*'s stance assumes the intrinsically unbiased nature of scientific progress which tends to dismiss any counterargument as *Luddite* or anti-science (Cook, Robbins and Pieri, 2006). On the other side of the fault line, *De Morgen* predilected social movements' view of biotechnology which was often politicised (Yang, Xu and Rodriguez, 2014). The politicisation strategy in *De Morgen* reintroduced social values and cultural aspects to the debate by calling upon ethics and social justice issues under

what is recognised as an *ecologically integrated paradigm*. The latter contemplates a wider, more contextualised scope for biotechnology in the light of an underlying need for experts and stakeholders to adopt a more holistic view of scientific progress that is not just oriented at solving specific problems by applying technical solutions, but instead is inextricable from its social context and does not exempt scientists and stakeholders from taking responsibility for social change (Lang and Heasman, 2015).

What Maeseele's work highlights is an ideological divide between two main stands. On one side those who believe that science is *unproblematic* and as such should not be subject of political or social debate. On the other hand, there is an argument for science to be held accountable of its ecological and economic repercussions in the name of social justice.

1.5.4. The media's use of language in the GMO debate

As previously stated, there is great emphasis on news framing and contextualisation of GMOs (Marks *et al.*, 2007; Listerman, 2010), but this should not undermine the linguistic aspects of GMO portrayal in the media. In fact, a lexicon exists for genetically engineered food which was partially built through sensational media headlines. The term Frankenfood, for example, was adopted by the Daily Mail[3] in the 1990s after being coined by Paul Lewis in a letter to the editor if the New York Times (O'Neill, 1992) and is still used by media outlets today to refer to products of biotechnology (Clancy and Clancy, 2016). The term has a negative connotation, and, in fact, it evokes images of the mad scientist who voluntarily *tampers with Nature*, creating something fundamentally *unnatural* (Cook, 2004) because of greed (Zajc and Erjavec, 2014) or because of a *God complex* which brings them to challenge the limits of what is acceptable from an ethical perspective (Holmgreen, 2008). Linguistic devices such as these have been shown to impact public perception of GM crops and food negatively; in fact, images such as these can evoke strong emotive reactions (Claire Mcinerney, Bird and Nucci, 2004; Mallinson *et al.*, 2018). Another common trope in media debates is the imagery of a battlefield. In the UK this was a literal reference to the war in Iraq (Cook, Robbins and Pieri, 2006), in Hungary, it was used as a metaphor to stress the controversial nature of the issue (Vicsek, 2013). Moreover, the use of language in the GM debate has also been described as a *war on words* where the language used to support an argument can often be more powerful than the factual evidence that supports it (Castro and Gomes, 2005; Cook, Robbins and Pieri, 2006).

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[3] The Daily Mail has an active campaign against GMOs since 1999 called *Genetic Food Watch*.

In summary, evidence shows that the media can create very specific discursive representations of GMOs with the intention to tell a compelling story to their audience. However, when they build a narrative, media platforms have agency over the discourse and can insert themselves in the controversy. Therefore, they circulate their perspective aided by linguistic strategies that can be, knowingly or unknowingly, ideologically charged. News framing of issues such as GMOs as *controversial* can contribute to the social amplification of risk associated with the technology which, in turn can have long lasting effects on policy making and public opinion.

1.6. What is Brexit?

The United Kingdom joined the EU in 1973 and held its first referendum to leave it in 1975. Although the country decided to remain at the time, Euroscepticism became a part of British politics, especially after Margaret Thatcher successfully advocated for more benefits to the UK's membership to the bloc (Koller, Kopf and Miglbauer, 2019). Scholarship attributes the rise in Euroscepticism to an increase in economic insecurity that is likely to have generated discontent in the European Union's authority and facilitated the furthering of political tropes such as sovereignty, *taking back control* and nativism (Muis and Immerzeel, 2017). This rise in authoritarianism and populism is not exclusive to the UK but was seen in the election of Donald Trump in the USA and in the rise of authoritarian populist parties across Europe. In the UK, a sense of nostalgia in the older population contributed to generalised discontent towards the EU (Arnorsson and Zoega, 2018) and negative attitudes towards immigration exacerbated by the refugee crisis seem to have contributed to the majority of the UK public voting to leave the EU. In the Brexit referendum of the 23rd of June 2016, 51.9% of Britons voted to leave, against 48.1% who voted to remain in the EU (Arnorsson and Zoega, 2018).

1.6.1. Why Brexit?

After holding the 2016 referendum, on March 29th 2019, the UK government triggered Article 50 of the Lisbon treaty thus initiating the two year transition period before the official Brexit (Walker, 2019). After several extensions to the transition period and the agreement on a withdrawal deal (Task Force for Relations with the United Kingdom, 2020), the UK officially left the EU on December 31st 2020. The negotiations of a withdrawal agreement, which have been happening in the wake of the Brexit referendum, have generated discussions on the free

movement of people but also goods and, notably, food. In fact, the UK's food supply chain heavily relies on imports from Europe (DEFRA, 2020). Discussions on food import-export are of interest to this work because, genetically modified foods, amongst other products, have been a point of contention between the EU and other non-EU countries during the drafting of international trade agreements (Carlarne, 2007).

The EU membership entitled the UK to be a part of the Single Market, allowing freedom of movement for people and goods in the absence of tariffs on import/export. Also, being part of the Single Market meant the UK received, amongst other benefits, subsidies for agriculture (through the Common Agricultural Policy), conservation, urban development and financial support for EU funded research projects (e.g. Horizon 2020). On the other hand, the EU membership implied compliance and implementation of EU laws on various grounds such as environmental protection, food safety and GMOs.

A soft Brexit would have implied the UK remain part of the European Economic Area (EEA), thus allowing membership to the Single Market. This is not the case. As of the finalisation of the UK-EU Brexit agreement on 24th December 2020, there is confirmation that the nature of the deal is similar to the one currently held with Canada (CETA) (European Commission, 2020). This implies the UK is no longer part of the Single Market or the customs union and will negotiate trade deals with third countries independently while having to uphold EU standards when trading with member states.

In the process of leaving, the British government has been faced with producing laws in areas previously regulated at a European level. Amongst these is the marketing and cultivation of GMOs. In fact, at time of writing (December 2020) the United Kingdom's regulation on genetically modified crops and food is still provided by the European Union (EU) but as stated in section 1.3.2, there are different regulatory stances on GMOs amongst the nations within the UK, and this poses a challenge as the country approached its exit from the European Union. In fact, any agreement the UK government made with the EU will be crucial in determining the UK's future position on GMOs and will define the trading relationship with the EU's Single Market and with non-EU partners. At the moment, it is still unclear whether the UK will allow the devolved governments to maintain their GMO-free status or develop a generally more permissive regulatory approach towards GMOs. Currently, the British government has addressed translating European law into national law with the *Great Repeal Bill*, which allows all European regulation, including the GMOs legal framework, to be incorporated into British

national law automatically. This legislation gives the country time to review them later by enforcement of the Henry VIII clauses which, added to the Great Repeal Bill, give the government the power to amend and repeal legislation without parliamentary scrutiny.

With GMO governance reverted to the UK Government, political discussions on whether genetically engineered crops should be imported, cultivated, or used in food production could be rekindled in the UK considering the recent development of new breeding techniques such as CRISPR-Cas9, which, as discussed in section 1.2.2, posit peculiar regulatory challenges.

1.6.2. The future of GMOs in the UK

Support for a less restrictive, product-based approach for GMO regulation and gene editing in the UK has been voiced by the Agricultural Biotechnology Council (ABC) in a briefing paper (Brookes, 2018) and favour towards biotechnology has also been expressed by several political head figures, namely by Michael Gove in his role as Environment Secretary during a farming conference in November 2018 (David Brown, 2018) and by Boris Johnson in his opening speech as prime minister of the United Kingdom in 2019 (BBC news, 2019). At the same time, scepticism has been voiced by NGOs towards the adoption of the technology (Helliwell, Hartley and Pearce, 2019) while the British government has not yet officially expressed an opinion for or against GMOs in the UK.

Although the UK already imports large amounts of genetically modified crops as animal feed, no fresh GM vegetables are sold in UK supermarkets, however some processed food products containing GM ingredients can be found in the UK (Royal Society, 2021). Should the UK establish a trade agreement with the United States when it leaves the EU, there is a possibility that it will allow the importation of new products of biotechnology. This would require the UK to have adequate regulation, thus providing a testing ground for a way of regulating commercially available GMOs and products of NBTs that differs from that of the EU. Understanding the framing of GMOs within online discourses on Brexit negotiations and trade agreement is of interest because it could help understand and predict future policy decisions in the UK. In fact, the UK legislative vacuum, filled by the translation of EU law into UK national law by means of the Great Repeal Bill, is likely to only be a temporary solution. Meanwhile, the UK will eventually come to evaluate its position on regulatory issues which brought the country to leave the EU in the first place. For instance, the UK's approach to GMOs and novel

gene editing techniques is no longer defined within the rules posited by the EU which means the UK could seek allyship and regulatory stimuli from non-EU countries like the USA. This could intensify the divide between the UK and the EU.

1.7.   Science communication in the social media age

The information climate was somewhat more straightforward before the advent of social media, with conversations being fewer and mostly unilateral between a message broadcaster and message readers/listeners (Hoadley *et al.*, 2019). In the so-called *post-truth society*, the task of making scientific facts widely available to a lay audience, might prove more difficult to achieve (Lewandowsky, Ecker and Cook, 2017). In fact, the context in which scientific discoveries exist today is more globalised than ever and science news can travel instantaneously. Therefore, one might be inclined to think that communications about science can reach everyone equally, but that would be incorrect.

Despite many people still relying on media outlets to *translate* complex scientific information into understandable language, digital news readership grows higher every year at print media expenses (Werliin, 2017). Furthermore, social media platforms have become a chosen source of breaking news, especially Twitter (Anna Sophie Kümpel, Karnowski and Keyling, 2015; Büchi, 2016). Twitter is a microblogging platform with 340 million users worldwide (We Are Social, 2020) where the term *microblogging* stands for the production of content in the form of brief posts (280 characters on Twitter). Social media platforms like Twitter take a step further than the Web 1.0 which made news and information widely more available through the invention of the internet. The Web 2.0 is characterised by the advent of social media platforms, new spaces for live interactions and news sharing with so-called *user-generated content* (Zappavigna, 2013). The shift to the *social web* has contributed to creating new spaces in which users are not only just consuming digital content but are actively taking part in the discussion.

These aspects of social media have sparked the interest of many researchers in the digital humanities and there is now a plethora of research that relies on social media content, especially Twitter, as a source of Big data (Anber, Salah and Abd El-Aziz, 2016; Martínez-Rojas, Pardo-Ferreira and Rubio-Romero, 2018; Zimbra *et al.*, 2018) spanning from the analysis of sentiment (Maynard and Bontcheva, 2015) to the evolution of language (Chew and Eysenbach, 2006). Furthermore, researchers have explored how social media contributes to building digital

communities, places where like-minded individuals can find each other and create networks (Himelboim *et al.*, 2016).

Although there is literature showing that factual information on GMOs is re-posted more than rumours about the technology (Xu, Yu and Song, 2018), Xu et al. also found that networks of misinformation are more stable and well connected than networks of what they call *true information* on GMOs (Xu *et al.*, 2020). This is particularly important because in the social media sphere, *echo-chambers* can form. In these, users with similar interests rely on a select few sources of information which confirm their beliefs (Goldie *et al.*, 2014) and they are unlikely to seek and be exposed to people with diverging views (Himelboim, Smith and Shneiderman, 2013). Even before the Web 2.0, the dissemination of information was not *democratic* (Himelboim, Smith and Shneiderman, 2013) with newspapers publishing news to appeal to specific demographics, often based on political alignment or personal interests. The advent of social media has only exacerbated the *undemocratic* nature of information dissemination (Iyengar and Massey, 2019). However, social media has proven to be a powerful instrument to further specific agendas, such has happened in the case of Russian anti-GMOs news items (Dorius and Lawrence-Dill, 2018). It can also be fertile ground for spreading misinformation (Ryan *et al.*, 2020). Finally, it has been shown how Twitter can be a social barometer to predict social and political behaviours (Krzyżanowski and Tucker, 2018) as shown by analysis of the Barack Obama and Donald Trump election and the Brexit discourse on Twitter (Koller, Kopf and Miglbauer, 2019; Lockhart, 2019).

This is particularly interesting when it comes to controversial issues such as GMOs. Research regarding the presence of the GM debate on social media has used Twitter as a data source to look into personality traits of individuals in relation to risk perception of biotechnology (Whittingham, Boecker and Grygorczyk, 2019), as well as analysing the spreading of misinformation (Ryan *et al.*, 2020) and the geographical distribution of users involved in the debate (Munro and Hartt, 2015). Nevertheless, there is more potential for research to explore news sharing patterns on the issue of GMOs, particularly in the context of Brexit negotiations.

1.8.   Research questions

This introduction provided context to better understand the reasons for the existence of the current European legislation on GMOs, the controversial past of GM foods and the novelty represented by CRISPR-Cas9 in the context of the Brexit discursive moment. Furthermore, by explaining why public opinion is important for science communication and policy making, it should have clarified why 2017 Brexit discussions in media and social media was considered an important moment to analyse the portrayal of GMOs. The information provided on the current legal framework for GMOs in the EU will be important in contextualising the results, especially regarding Brexit trade agreements. Details on different techniques available to produce genetically engineered food should help understand why gene editing has changed the way biotechnology is being done on a global scale. The description of food scares and other contributing factors to public opposition of GMOs together with an overview of media and social media involvement in the public perception of risk will be important in understanding the implication of this research's results.

This work aims to describe 2017 online portrayal of GMOs, focusing on UK digital newspapers and Twitter. The Brexit discourse and negotiations are a new *discursive moment* which has created an opportunity to analyse the GM debate in the light of an evolving political landscape.

Particularly this work aims at answering the following questions:

1. Do GMOs and Brexit cross paths in British media? Moreover, if so, how prevalent is Brexit in the GMO debate?

2. What are the emerging themes in the discourse?

3. How was the controversial nature of GMOs at play within the Brexit debate? Which underlying arguments and ideologies emerge in the discourse?

4. How was language used in portraying GMOs and Brexit in the debate?

5. What stances are represented in digital media? Does sentiment towards Brexit align with sentiment towards GMOs?

6. Is there a discourse on Twitter regarding GMOs and Brexit?

7. What types of tweets emerge in this debate?

8. Which news items from the media discourse get the most exposure on Twitter?

9. In what way does the Twitter discourse differ from that in digital news? Are the themes, arguments and stances on Twitter similar to those presented in the media?

10. Who is producing the most content on Brexit and GMOs on Twitter? Are there any *powerful* voices in the debate?

11. Is there interaction amongst users on different sides of the debate, or are there separate echo-chambers?

1.9.   Outline of chapters

Chapter two will explore the study design and analytic methods used in the thesis. It will include a theoretical background to the methodological approach that was used, it will discuss how the digital news articles were collected from Google News and LexisNexis and how tweets were obtained through the Twitter API. It will discuss the analytic techniques chosen, namely critical discourse analysis of news articles, critical discourse analysis of tweets and social network analysis applied to URLs and Twitter users. It will also elaborate on why they were seen as appropriate for chapters three, four and five respectively. Finally, it will give a description of how the techniques were applied.

Chapter three will be dedicated to answering questions one to five. It will show the results of a critical discourse analysis of digital news articles that mentioned both GMOs and Brexit. Particularly it will give a temporal overview of news items in the year 2017 and pinpoint events which might have influenced the discourse. Secondly, it will show the magnitude of coverage of GMOs and Brexit and highlight any correlations. Each news item's stance will be determined, considering results from the analysis of themes, arguments and underpinning ideologies in the discourse. This way, the chapter should unveil any role GMOs might play in the Brexit debate and vice versa. Furthermore, it will show how GMOs were used to support or refute arguments with different stances and how they were portrayed compared to gene-editing techniques.

Chapter four will answer questions six to nine. It will show a qualitative critical discourse analysis of tweets mentioning both GMOs and Brexit. This section will provide a temporal overview of tweets in the year 2017, highlighting moments where the discourse was most active on Twitter. The chapter will also discuss the amount of original content compared to retweeted content, provide a classification of the tweets into different types based on the tweets' content, and shine a light on the uptake of news items from the previous chapter. Then,

mirroring the structure followed in chapter three, it will provide details on themes, arguments and underlying ideologies present in the debate to establish each tweet's stance regarding both GMOs and Brexit. The results of the Twitter analysis will be compared to those from the digital media analysis to highlight differences and similarities between the two environments.

Chapter five will answer questions ten and eleven. It aims at shining a light into the interactions amongst users involved in the Twitter debate on Brexit and GMOs using social network analysis. Through whole network analysis, it will determine whether there is a conversation happening amongst Twitter users and if there are subgroups (components) of the network which are *segregated* from each other. Furthermore, extrapolating from the whole network analysis, ego networks will be analysed to highlight users playing a central role in the debate either as news broadcasting stations or as prominent voices in the conversation.

Finally, a discussion chapter will provide a reflection on the results from the three analytical chapters, going back to the original research questions and discuss the limitations of this work and the implication of the results for the future of GMOs in the UK after Brexit.

2. Methodology

This chapter will elaborate on the methodologies used to answer the research questions discussed in section 1.8. It will include a theoretical background to Critical Discourse Analysis (CDA) and an overview of Anabela Carvalho's approach (Carvalho, 2008), which Maeseele adopted in his research analysing risk conflicts in the GMO debate in elite Belgian papers (Maeseele, 2015). It will then provide detailed information regarding the methods for the collection of digital newspaper articles and tweets going through the different layers that were implemented to analyse the complexity of the discourse in digital media (in chapter three) and on Twitter (in chapter four). Finally, it will provide an overview of the Social Network Analysis approach adopted to extract *relational* information obtained from the Twitter metadata the results of which will be described in chapter five.

2.1. Theoretical background

2.1.1. Choosing Critical Discourse Analysis (CDA)

When dealing with prosaic data there are a plethora of methodologies that could be suited for its analysis (Kuckartz, 2014; Snelson, 2016). Whether the source is social media content, newspaper articles or interview transcripts, the qualitative analysis of text has been successfully carried out through frame analysis (Vicsek, 2013; Wang and Guo, 2018), sentiment analysis (Tabei *et al.*, 2020), thematic analysis (Braun and Clarke, 2006), content analysis (Mintz, 2017) and many others. Due to the possibility of entanglement of the GMO debate with the political discourse surrounding Brexit, Critical Discourse Analysis (CDA) was considered most appropriate for this work, however, before choosing CDA, qualitative content analysis (CA) was considered.

Content analysis can be defined as a *social scientific methodology for making sense of human communication*. More specifically it entails the classification of manifest content into smaller categories or codes (Baxter, 2009). There is literature showing that content analysis (CA) can be effectively used to identify potential patterns emerging across multiple sources (Marks *et al.*, 2003; Graneheim and Lundman, 2004). Furthermore, a qualitative approach to CA is appropriate for data that requires some interpretation seen as it can capture valuable nuances

of meaning that can add layers to the interpretation of manifest content and thus being more descriptive than quantitative CA (Daniel Riffe, 2014, page 30). For this reason, qualitative CA was originally thought to be an efficient methodology for digital and social media data. However, an initial attempt to create a coding framework by CA for the GMO discourse resulted in the creation of a complex but unyielding structure. It also became clear that the contextual and historical aspects of the GMO debate were vital to understanding the themes and patterns emerging in this corpus of news articles. Furthermore, when Brexit was chosen as a focus for this work, a need emerged to consider the contribution of underlying political ideologies and power dynamics in the debate.

Richardson describes this issue very well when discussing the complexity of media discourse:

This problem can, to some extent, be alleviated through increasingly detailed coding, but at some point the codes recording exactly 'how' words, phrases, concepts and arguments are employed in text will be so complex that they become unworkable. (E. Richardson, 2007, page 19)

In a nutshell, analysing content alone was not going to be enough to paint an accurate picture of the discourse so the methodology had to reach beyond the interpretation of manifest content. Furthermore, the methodology had been successfully applied to the analysis of the Belgian media discourse on GMOs by Maeseele. As hinted in section 1.5.3., Maeseele's work on the discursive representation of techno-environmental controversies in the Belgian elite press allowed for the uncovering of the newspapers' conflicting ideological stance and processes of politicisation and de-politicisation of scientific progress. By analysing the discursive strategies of social actors involved in the GMO debate Maeseele unveiled processes of legitimisation and de-legitimisation of democratic participation in policy decisions around biotechnology. Thus, his analysis made a valid contribution to understanding of the role of media in the discursive construction of biotechnology in Belgian society (Maeseele, 2015). Given the methodological difficulties presented by content analysis and the successful example given by Maeseele's use of Carvalho's approach to CDA, the latter seemed the most logical choice.

2.1.2. What is CDA

Wodak and Meyer (Wodak and Meyer, 2016, page 3) state that CDA encompasses a plurality of methodologies aimed at the observation of discourses and their context and impact on society. In the words of Fairclough, considered the first herald of this methodology, CDA is

"[…] not analysis of discourse 'in itself' as one might take it to be, but analysis of dialectical relations between discourse and other objects, elements or moments as well as analysis of the 'internal relations' of discourse (Fairclough, 2013, page 4)

This definition outlines a few properties of CDA: its relational and dialectical properties and its applicability to a plurality of situations *objects, elements and moments*. Each of these properties is crucial to understanding what CDA involves. CDA is **dialectical** because it accounts for the continuous exchange and flow of meaning between physical objects and language. It is **relational** because it analyses discourse in relation to other things, the latter being other parts of the discourse or entities outside of the discourse, constituting its context. It is **transdisciplinary** because the flow of meaning regards societal aspects beyond language alone. So, a critical analysis of discourse might require a plurality of disciplines other than just linguistics such as philosophy, economics, history, human geography, or political sciences, depending on the nature of the discourse under investigation. But what can be considered discourse and how does Critical Discourse Analysis differ from Discourse Analysis? An answer to these questions is provided below.

2.1.3. What is discourse?

Discourse is any form of communication under investigation. When imagining discourse, it is common to think of a conversation, a speech, a statement, or of written text such as a news article, advert, a policy (E. Richardson, 2007). Nevertheless, a piece of visual media can also be considered discourse such as a painting, a monument, a photograph, or a film (Machin and Mayr, 2012). Basically, anything that was made with intention and its relation to the context in which it is situated can create discourse.

Richardson describes the two main approaches to defining discourse in his book on the critical discourse analysis of newspapers: a structuralist-formalist approach and a functionalist approach. The former considers discourse as a unit of analysis that is bigger than a sentence but mostly pertains to consequential relationships between different parts of a text. The latter

pertains more to "what people do with language" (E. Richardson, 2007). Critical discourse analysis adopts this second approach in that it pertains what is said, but also what is omitted and what is implied and given for granted (Fairclough, 2003)[4].CDA also incorporates a perspective on how discourses change and how these changes can affect society and are affected by society. This is one of the aspects of this approach that makes it "critical".

2.1.4. Discourse in society

An important feature of CDA, especially for the analysis of media communication, is the idea that the message and the context it lives in are inextricable and that language *shapes and is shaped by society* (Machin and Mayr, 2012, page 4). For this reason, this approach does not pertain only to the description of themes and syntax in a piece of writing, instead it aims at uncovering and addressing *social injustice* by highlighting the imbalances of power between those who produce and disseminate media messages and those who receive them (Carvalho, 2005a). By adding a level of critique to the analytical process, CDA allows exploration of connections between text and underlying ideologies supporting different arguments in the discourse.

This *ideologically charged* side of CDA has been criticised (Waugh *et al.*, 2015), but it is in the nature of this methodology to be normative and go beyond what is stated, to analyse and sometimes infer underlying agendas expressed or unexpressed through the use of language. CDA aims at answering questions such as *what brought a journalist, a broadcaster, an interviewee, to use a certain word rather than another?* (E. Richardson, 2007; Carvalho, 2008). Especially in discussions as controversial and as long lived as the GMO debate, one can hardly assume the use of a metaphor or a verb as coincidental (Cook, 2004).

Although Fairclough is considered the main proponent of CDA, there is a plurality of methodologies associated with critical discourse studies (Waugh *et al.*, 2015), other well-established approaches are the Socio-cognitive approach (SCA), proposed by Teun van Dijk (van Dijk, 1993) and the Discourse-Historical approach (DHA) developed by Ruth Wodak and Martin Reisigl (Wodak and Meyer, 2016, page 24). SCA encompasses two main aspects of discourse, a cognitive side and a social side and supports the idea that the construction of

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[4] There is, however, another definition of discourse coined by Foucault to "*denote a historically contingent social system that produces knowledge and meaning*" (Adams, 2017).

discourse happens just as much in social interactions as it does in individuals' cognitive processes. What this implies is the analysis of the interface between social interaction and social representation of reality (inspired by SRT, as discussed in section 1.4.4) and personal experiences (van Dijk, 2016). DHA recognises a complexity to the construction of discourse and hence entails an interdisciplinary approach to its analysis which accounts for the way social actors use language, but also for the context of discourse and especially, as the name suggests, a historical dimension to CDA (Wodak and Meyer, 2016, pages 31-32). DHA, SCA and many other approaches have been thoroughly described by Wodak and Meyer and Waugh and have been provided as examples here to contextualise the methodology adopted in this analysis. Although all of these approaches have been successfully applied to the analysis of media discourses, some more than others (Ramanathan and Hoon, 2015), this work applies a CDA framework developed by Anabela Carvalho which was specifically aimed at the analysis of media outputs.

2.1.5. Anabela Carvalho's approach to CDA

Carvalho's approach takes classical CDA and enriches it by emphasising what in her opinion are three neglected aspects in this field (see figure 2.1), namely the *time plane* in discourse analysis, the *discursive strategies* of social actors and the *effects of mediated discourse* (Carvalho, 2008).

Figure 2.1 Visual representation of Carvalho's approach to CDA applied to the GMO discourse
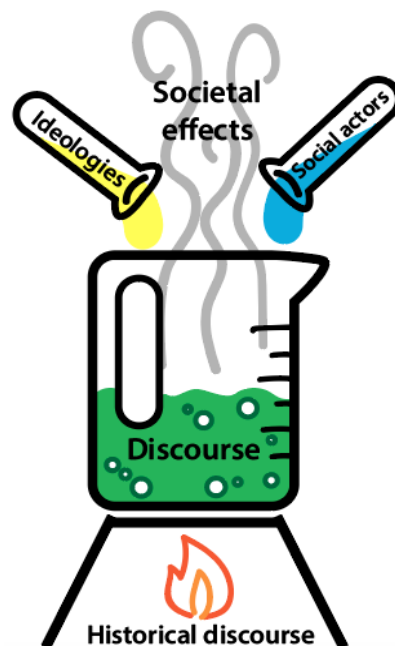
Figure 2.1. *Visual representation of Carvalho's approach to CDA applied to the GMO discourse. In this representation the legacy of metaphors, semantic choices, and discursive strategies (historical discourse) is shown as influencing the present media representation of the GM debate (discourse). Also, journalists and stakeholders in the debate (social actors) and political agendas (ideologies) can have an impact on the discussion potentially causing the present discourse to have effects on society and future policy making (societal effects).*

The first neglected aspect accounts for a historical dimension to CDA. In fact, according to Carvalho, critical discourse is often applied to short time periods, providing only a snapshot of the discussion, whereas media representations can often be built and consolidated over time and do not exist in isolation from their previous history. This can be seen as a *diachronic* dimension to the analysis of discourse (Carvalho, 2005b). An alternative term to describe this is *biographical study of discourse,* implying that to be able to understand the *symptoms* of the

discourse in a time frame, an *anamnesis* can aid in understanding pre-existing *conditions*. This is very fitting for the study of the GMO debate in online media because the current framing of GMOs in contemporary press might still show ties to discursive representations of the technology since the time of 1990s *food scares.*

The second neglected aspect in CDA encourages a deeper analysis of social actors and their agendas beyond what is expressed in the text. Social actors can be individuals cited in the text of a news item, those who are reading the content (although this last aspect is not explored in this work); they can be social media users who, by discussing a topic online, create a new platform for discourse. Social actors can also be the journalists writing a news piece. The latter can act on the discourse by giving salience to specific topics over others (Entman, 1993) or by introducing their personal stand in a news article (Vicsek, 2013). Anyone who has agency over the discourse is a social actor and analysing the discursive strategies of these actors allows for contextualisation of the discourse in areas such as politics, science, and environmentalism.

Finally, the third neglected aspect according to Carvalho involves considering that a discourse can be platform for something beyond the message itself; in other words, discourse can *mediate* for social and political change. Carvalho gives examples of *discursive effects* such as the institutionalisation of a discourse by a political entity or the closure of a discussion because of the resolution of an emergency. Extending the analysis to incorporate a reflection on the manner of mediation provides important information as to how discourse interplays with political and societal actions (Carvalho, 2008). This moves the meaning of discourse towards a more Foucauldian understanding of discourse (Maciag, 2018) and is particularly relevant for the GMO debate where media portrayals have been shown to interplay with policy and social movements (Sato, 2013).

2.1.5.1.   Critical discourse moments

Considering these extra-textual variables can be time consuming in the case of an extensive corpus, especially if consisting of big discursive units such as newspaper articles. To counteract the extensive widening of material required for this process, Carvalho suggests choosing *critical discourse moments* as units of analysis (Carvalho, 2008). Her approach to data collection involves a preliminary critical reading of what she calls *critical sampling* in substitution to random sampling. This gives the opportunity to critical discourse analysts to

direct the focus of the analysis towards a smaller pool of units of enquiry to facilitate a more in-depth analysis of crucial points of the debate. Carvalho calls these crucial points *critical discourse moments* defining them as:

periods that involve specific happenings, which may challenge the 'established' discursive positions. Various factors may define these key moments: political activity, scientific findings or other socially relevant events.

Carrying out a critical sampling of sources rather than a random one done after a preliminary exploration of a small section of the data, she says, can highlight variations in the debate or the reinforcement of a point of view caused by particularly significant events (Carvalho, 2008). Decisive changes in the debate can happen due to external factors such as scientific findings, political changes, and societal events. Brexit has been a fraught political situation within the UK with different sides co-opting into the discourse any material they felt would further their argument. Where Brexit intersected with the GMO debate, it produced a series of discursive moments that are the focus of this work.

2.2. Methods

2.2.1. Choosing a unit of enquiry and units of analysis

In critical discourse studies there is no specific set of rules on how to design the data collection (Wodak and Meyer, 2016) mainly because the plurality of approaches means a variety of tailored methodologies could fall under the umbrella of critical discourse studies. Furthermore, providing a strict framework would restrict one of the advantages of this methodology, which is to be very flexible, circular, and adaptable depending on the applied disciplines. Notwithstanding, there are some generally shared practices such as the definition of a unit of enquiry and units of analysis. Firstly, one must indicate a unit of analysis and units of enquiry. The former is represented by the discourse under investigation; in this work that is the discourse on GMOs, with a particular focus on food and crop applications of genetic engineering. The GMO discourse was chosen as a unit of enquiry in light of recent developments in NBTs (as discussed in chapter 1.3.2.1). Within this discourse digital news articles and tweets were chosen as units of analysis. This section will delve into exactly what these units of analysis consist of, why they were chosen and how they were collected.

2.2.2. The pilot study

A preliminary exploration of print media was carried out with two UK national newspapers chosen: The Daily Mail (and Mail on Sunday) and the i-Newspaper. Seen as English is my second language (more details in section 2.5) these physical newspapers were chosen as a first point of contact with English journalistic language and discursive strategies. Furthermore, The Daily Mail is a so-called *Tabloid newspaper* with one of the largest readerships in the country and a special extended edition on Sundays, whereas the i-Newspaper is a smaller independent newspaper (see table 2.1) with a joint weekend newspaper edition for Saturdays and Sundays together. The reason for the choice of these two print editions was to highlight the differences between different kinds of news items based on the newspaper typology. The exploratory reading of news items showed i) articles on GMOs were present in different sections of the newspapers, such as science or policy ii) article types varied between features, letters to the editor or comment pieces.

Although the print media was a valued source of preliminary information, this analysis focusses on digital media. This choice was made firstly because there has been a marked decline in readership of UK print newspapers from 2006 accompanied by a growth in readership of digital equivalents (Werliin, 2017). Also, having links (URLs) corresponding to specific news items was considered a strength in the method because it could allow for the analysis of the uptake of news on Twitter. Furthermore, as previously mentioned in the introduction, there is already a large body of literature which has looked at media portrayal of GMOs over the years (see section 1.5). However, although there are scholars which have looked into digital media portrayal of GMOs (Clancy and Clancy, 2016; Huang, 2019), to my knowledge, nobody has integrated the investigation of digital media discourse with the uptake of GMO related news on Twitter and the associated social network on platform. Therefore, a decision was made to only investigate digital newspapers to potentially find cross-platform patterns and parallelisms between the discursive representation of GMOs on digital media and Twitter. The next sections will provide details on the choice of units of analysis, the data collection process for digital news articles and, later, tweets. Furthermore, I will expand on the choice of keywords for the searching of GMO related news and will provide information on the critical sampling process that brought the scope of this research to be narrowed down into the Brexit subset. The data collection method for social network analysis will, instead, be discussed in section 2.4.

2.2.3. Data collection

2.2.3.1. Digital media collection

Firstly, articles were collected using an advanced keyword search on Google News using the following query:

"GMO" OR "GMOs" OR "genetically" OR "gene editing" OR "genome editing" OR "gm crop" OR "GM food" OR "CRISPR".

The multiple keyword search was devised so that different variations on the word *GMOs* would be picked up. Particularly, a decision was made to search for *genetically* instead of *genetically modified* because of the many variations on the expression. This proved highly effective because combinations such as *genetically tweaked, genetically engineered* and *genetically altered* were found in articles upon further analysis. The text of each article was manually checked so that articles containing irrelevant variations could be discarded from the corpus. Examples of such irrelevant news items contained expressions such as *genetically blessed* (an expression often used by The Daily Mail as a synonym for *beautiful*), *genetically diverse* or *genetically inherited*.

After collecting news items from Google News, a different news archive called *Lexis Nexis* was consulted. Upon using the keywords search in *Lexis Nexis*, Google News was found to be underestimating the total number of articles. Therefore, to have a corpus of sources that was as close as possible to the real population of online articles, results from the Google News search were integrated with articles from the *Lexis Nexis* database for British national newspapers. The combined search identified 1482 articles mentioning one or more of the selected keywords in the period between January 1st and December 31st 2017.

2.2.3.2. Critical sampling

Following Carvalho's recommendations, of these 1482 articles, 106 articles published between January 1st and January 31st 2017 were selected for a preliminary critical reading. This analysis helped identify a cluster of articles presenting co-occurring topics with a focus on Brexit. Examples of thematic macro-areas in these articles were *international trade*, *food standards*

and *policy* with a flurry of articles of this type surrounding Theresa May's state visit to the United States and her mention of potential trade talks with non-EU countries after the UK had left the EU. These preliminary findings hinted to the possibility of a lasting discussion in digital media regarding GMOs that was elicited by the flux in the dominant political discourse on Brexit. At this point in the analysis the appearance of GMOs within the Brexit discourse could have been suggestive of a new political framing of the technology or of the reinforcement of existing discursive representations of GMOs. This constituted a *critical discourse moment* worthy of an in-depth analysis. Therefore, from the original corpus of 1482 articles on GMOs, the subset of articles that talked about Brexit was selected by searching for the word "Brexit" within the existing corpus. This subset comprised of 131 articles.

Table 2.1 Sources of news in the corpus of digital media news articles

DIGITAL NATIONAL NEWSPAPERS	Daily average browsers (Ponsford, 2017)	Article count	Editorial stance on Brexit (Ridley, 2016)	Paywall
Mail online (http://www.dailymail.co.uk/home/index.html)	15,641,619	16	LEAVE	NO
The Guardian (https://www.theguardian.com/uk)	8900000[5]	24	REMAIN	NO
Mirror (http://www.mirror.co.uk/)	5453722	3	REMAIN	NO
Independent (http://www.independent.co.uk/)	4830779	16	*	NO
The Sun (https://www.thesun.co.uk/)	4247921	2	LEAVE	NO
The Telegraph (http://www.telegraph.co.uk/)	4044489	20	LEAVE	NO
The Express (https://www.express.co.uk/)	1637521	10	LEAVE	NO
The i Newspaper (https://inews.co.uk/)	*	6	REMAIN	NO
The Times and The Sunday Times (https://www.thetimes.co.uk/)	*	22	REMAIN	YES[6]
OTHER ONLINE NEWS OUTLETS				
The Huffington Post (https://www.huffingtonpost.co.uk/)	*	3	*	NO
BBC news (http://www.bbc.co.uk/news)	*	7	*	NO
Reuters (https://uk.reuters.com/)	*	2	*	NO

Table 2.1. *Sources featured in the corpus with number of daily average browsers according to Press Gazette, number of articles analysed by source, editorial stance on Brexit according to Ridley, 2016 and presence of a subscription fee (paywall) at the time of collection. (*) This information was not available in the relevant source.*

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[5] This value was an estimate made by the relevant source as data on the Guardian was not available.
[6] Note that, at the time of the analysis, The Times and Sunday Times imposed a limit to the amount of online newspaper articles that can be visualised per day. To access the full archive without limitations there is a subscription fee. Although the Telegraph has currently a similar paywall (July 2019), it did not have one at the time of analysis.

The online news outlets represented in this subset included webpages of most UK national newspapers as well as other online media which do not have a print counterpart, such as *BBC news*, *Reuters,* and *the Huffington Post*. Table 2.1 provides descriptive information on the sources featured in this corpus including online readership, when available, number of articles in the corpus and editorial stance on Brexit. It is noteworthy that the Mail online is by far the digital newspaper with the highest online readership (*daily average browsers* are an indicator of the number of users who accessed the newspaper's website daily). Nevertheless, the Guardian was the one with the greatest number of articles discussing Brexit and GMOs, closely followed by The Times, and The Telegraph. For optimal comparability, a similar approach was applied to the data collection on Twitter. In fact, tweets were collected from the same period. However, the search was directly edited to collect tweets discussing both GMOs and Brexit.

2.2.4. *Twitter data collection*

Twitter allows for real time data scraping across its platform. This can often be done through what is called a *Stream application programming interface (stream API)* using a query containing specific keywords, following a specific user account, or monitoring the use of a hashtag. This is often done to analyse discourse regarding time sensitive or time delimited events such as international celebrations or disease outbreaks (Chew and Eysenbach, 2006; Reyes-Menendez, Saura and Alvarez-Alonso, 2018). Moreover, the Twitter stream API can be used in combination to a variety of softwares (Python, R, NodeXL) and the corresponding data can be stored in a variety of formats (json, excel, csv) but regarding historical tweets the situation is different.

The Twitter Analytics platform allows for the download of data archives and analytics reports regarding one's own profile. These reports include data in the form of spreadsheets containing a chronological overview of all tweets produced, number of likes, a list of followers, impressions and engagement on each tweet produced. Nevertheless, a comprehensive list of historical tweets from unknown users based on a specific keyword search can only be obtained for up to 7 days in the past, unless one is investigating only one specific Twitter profile.

Because the Twitter data collection for this study was carried out in 2019, to access tweets in the designated time of analysis (January to December 2017) access to historical Twitter data was required through the creation of a Twitter Developers profile. Tweets were collected using

a paid subscription through the creation of a specific Twitter Developers endpoint according to Twitter Developers guidelines (Twitter.com, 2019). Once the Twitter developers app and authorisation keys were obtained, tweets and metadata regarding the tweet were then collected in json format and converted into an Excel spreadsheet using Python (APPENDIX A).

In a nutshell, this entailed the drafting of a keyword search or *query* similarly to the one used on Google News and Lexis Nexis but adapted for Python and Twitter (Chatterjee and Krystyanczuk, 2017, page 102) as follows:

q = ('gmos "Brexit" OR GMO "Brexit" OR "GM food" "Brexit" OR "GMfood" "Brexit" OR "GM crops" "Brexit" OR "gmcrops" "Brexit" OR CRISPR "Brexit" OR "gene editing" "Brexit" OR "geneediting" "Brexit" OR "genetically -blessed" "Brexit" OR "genetically -inherited" "Brexit" OR "genetically -identical" "Brexit" OR "genetically modified" "Brexit" OR "genetically" "Brexit" OR "frankenfood" "Brexit" lang:en')

Particularly, the query was adapted not only for the syntax appropriate for python but also to pick up the potential use of variations on certain expressions as hashtags (#) such as "#GMCrops".

Please note the term "Frankenfood" was added to the list of keywords because, as mentioned in section 1.5.4. it has been adopted to refer to the products of biotechnology in the past so there was an interest in investigating if this was a popular hashtag on Twitter. The Twitter environment only allows a certain number of characters per tweet, so it would be unlikely that one would use both words, differently from what could happen in a more extensive unit of analysis such as a news article. Furthermore, the query was designed so it would not specifically favour other popular hashtags regarding GMOs such a #NoGMO, #NonGMO #GMFree. Because, given their negative connotations, they could create an imbalance towards negative sentiment in the results. The intention was to replicate similar conditions to the ones created for the digital media collection considering the limit in the number of characters allowed in the query formulation.

This data collection method allowed for the harvesting of 4449 tweets and corresponding contextual information about the tweets (metadata), in a spreadsheet format. Tweets' content was collected in the form of tweet text including hashtags used, other users mentioned in the tweet, URLs contained in the text, URLs linking to images, if applicable, extended tweet text if truncated, information on whether the tweet was a retweet, and, where applicable, retweeted

text. Metadata was collected in the form of tweet ID number, date and time of publication of the tweet, Twitter username and user ID number, retweeted username and user ID number. This type of search did not provide information on the number of likes associated with tweets nor did it provide information on whether users in this dataset followed each other. The latter is a limitation in this method and this will be taken into account during social network analysis (chapter 5).

2.2.4.1.   Ethical considerations of Twitter data scraping

Given the nature of the data used in this work, especially the data collected for investigation in chapters 4 and 5, there are some ethical considerations to be made. In fact, the purpose of digital news media is that of being disseminated and its scope, although sometimes behind a paywall, is that of being publicly available and consumed. Differently, Twitter users, although agreeing to Twitter's terms and conditions, do not specifically agree to their tweets being made available for the scrutiny of social scientists or to be published in scientific literature. Therefore, following ethics guidelines provided by the University of Sheffield, in this work all usernames that have been identified as private individuals were anonymised and the only tweets reported will be those tweeted in a public capacity, for the consumption of others. Particularly, I will not cite, partially or in full, paraphrase or screenshot tweets made by private individuals or made by public figures in a personal capacity. I will, instead, produce constructed tweets to illustrate the language or themes emerging in a private individual's tweet if this is considered necessary. Tweets the content of which will be cited are those produced by Twitter user accounts which, to my knowledge, tweet content on behalf of a public organisation, political figure (MP, MEP, prime minister etc.), newspaper headline, charity organisation, NGO, or other public figure. This approach will be carried over when referring to private individuals in the Social Network Analysis and their names will be anonymised unless users fall under any of the aforementioned categories.

Finally, it should be emphasised that Twitter is not an accurate representation of society. Instead, it is a platform with a specific age demographic (We Are Social, 2020) so, in collecting data from this platform there is an awareness regarding the fact that it does not represent an accurate replica of what people think of Brexit and GMOs outside of this context. In fact, this research is not devised to analyse public perception of GMOs in the light of Brexit, but to describe the discursive representation of biotechnology across digital news and Twitter and to

unveil power dynamics in the discourse. The importance of social media platforms for news sharing has been recognised by scholars (Anna Sophie Kümpel, Karnowski and Keyling, 2015) meaning that by analysing Twitter data one can investigate the dissemination of news on social media. Furthermore, the possibility for researchers to access historical Twitter data since the creation of the platform, allows for the scraping and analysis of snapshots of the discourse at any given time. Therefore, though with its limitations, Twitter constitutes a great repository of Big Data and is a great resource for the digital humanities.

2.3. Methods of analysis

2.3.1. CDA of digital media

After gathering the corpus of 131 articles discussing both GMOs and Brexit, all articles were categorised based on the source of the publication, the author and the date they were originally published (APPENDIX B). Most importantly, the core of the classification and analysis was based on a tailored coding framework (APPENDIX C) developed using NVivo 12 (QSR International, 2021). The coding process encompassed 4 facets. These were 1) magnitude of coverage of GMOs and Brexit per article, 2) articles' stance on GMOs and Brexit, 3) thematic content, 4) analysis of arguments and ideologies.

The assessment of coverage of GMOs in each article was done on a three-level scale: main focus, subtopic or mention. The categorisation of main focus reflected a thorough discussion of GMOs or a feature of the topic in the article title. The categorisation of subtopic meant that only part of the article focussed on GMOs amongst other topics. Mention meant the issue of GMOs would be cited briefly without elaboration. The same categorisation was carried out for Brexit.

To identify stance, the articles were read critically and classified according to a 5-point sentiment scale: *strongly anti, cautiously anti, neutral/undecided, cautiously pro, strongly pro*. This classification was done manually, taking into consideration the dominance of GMOs and Brexit over the whole article, the language used, the use of caveats in the assertions versus the categoric stating of facts.

Thematic content coding was carried out to discern recurring themes. Co-occurring themes were grouped to identify thematic macro-areas, which could also be considered frames (Maeseele, 2015). The categorisation according to frames allowed for the identification of arguments supporting viewpoints. As highlighted by Carvalho (2008) and Entman (1993), the framing of a news story is not-optional as, just by deciding which story to tell, a journalist has willingly selected what to omit. Codes were created for thematic macro-areas and subcodes subsequently made to accommodate a variety of sub-topics. The 6 macro-area codes were Economics, Farming, Food, Policy, Science, and Society.

The critical discourse analysis of arguments was carried out giving particular attention to contextual factors intervening in the debate. Particularly, following Carvalho's approach, notice was given to the resurfacing of historical debate features, the emergence of new discursive representations and the agenda of social actors mentioned in the articles. This type of analysis facilitated identification of underpinning ideologies. The alignment of these ideologies within the discussion and in the context of key socio-political events provided insight into the role of the media within the debate. Statements supporting different viewpoints in the debate were analysed in detail for their use of discursive strategies. Particular attention was given to the use of language but also to the use of anchoring and objectification in the contextualisation of GMOs and Brexit. Codes were also created for the use of specific terminology, metaphors and expressions such as the use of the term Frankenfood or references to the *special relationship*. Results from the four different facets were then compared, where possible, to highlight correlations and unveil potential parallelisms and differences emerging in the corpus.

2.3.2. Twitter CDA

Tweets were categorised based on date and time of the tweet and who they were tweeted by before any analysis and any irrelevant tweets were removed. Tweets considered irrelevant were those in languages other than English, tweets containing irrelevant variations on the term *genetically* such as *genetically superior*. Manual coding of tweets resulted in 49 irrelevants. SPSS was used to determine whether tweets were original or whether they were a retweet of other content from the corpus[7]. A case was created in NVivo for each tweet and relevant

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[7] Retweets referring to content laying outside of the time frame under analysis were considered originals.

retweets were coded under the case of the original tweet. This classification gave 1254 original tweets and 3148 retweets. Please find below a simple scenario that explains this.

@User1 published Tweet1

Tweet1= #GMOs in Britain after #Brexit?

@User2 and @User3 have both retweeted this content respectively with Tweet2 and Tweet3 as follows:

Tweet2= RT @User1: #GMOs in Britain after #Brexit?

Tweet3= RT @User1: #GMOs in Britain after #Brexit?

Tweet1 is an original tweet, Tweet2 and Tweet3 have been created as subcases of Tweet1 seen as they are not original but are retweets of Tweet1.

The critical discourse analysis of tweets was carried out in a similar fashion to the digital media with one main difference in the analysis of *magnitude of coverage* of GMOs and Brexit. This is because, although the length of a tweet was augmented from 140 characters to 280 in November 2017, a tweet is still a very small unit of analysis to determine which topic between GMOs and Brexit was dominant in such a small amount of text. Therefore, the magnitude of coverage classification was replaced with a *tweet type* classification composed of six separate categories: news sharing, news comment, interaction, call to action or appeal, event-focussed and singleton.

News sharing tweets included a hyperlink (or URL) and only contained text that was part of the original headline of an external source (such as a website, a blog, a news website, a government webpage). Tweets categorised as news comment contained a URL from an outside source as well, but, to be categorised as comments needed to contain original content in the form of new text, new URLS, hashtags or user mentions. Interaction tweets refer to tweets including a tag (@User) outside of the retweet tag (RT: @User) and implied a reply to a pre-existing tweet. A call to action or appeal tweet had to include text encouraging others to take action towards a cause or attract attention towards a problem. These tweets also might have

included a URL to an external source. Finally, event focussed tweets referred to tweets containing a comment on a conference or other event that is taking place at the time of tweeting or in the near future with respect to the time and day the tweet was published. This type of tweet often contained the event hashtag. A singleton was categorised as a tweet that was not directly correlated to sources outside of Twitter, it might have been commenting on the news, use hashtags, but it was a piece of original content not linked to a URL. Information on highly referenced URLs was collected and their distribution throughout the year was tabled, mostly to help determine which news items should be further explored by Social Network Analysis (SNA).

2.4. Social network analysis

Data collected from Twitter to carry out Critical Discourse Analysis was also used as a starting point to carry out Social Network Analysis (SNA). This section will provide a general overview of what social networks are, why it was important to look into social networks in this project, how data was extracted from the Twitter dataset and how SNA was carried out.

2.4.1.   What is SNA and what is a network?

Social network analysis is not technically a methodology, but instead is a perspective to look at relational data within a group of points, also called nodes (Borgatti, Everett and Johnson, 2013, page 2). These nodes can be classified according to specific attributes but in SNA they are mainly defined by their relation to each other. For instance, one could look at a group of individuals and classify them by age, eye colour or hight, but these attributes do not provide any information on the *connectivity* of nodes unless information is provided regarding some form of relationship amongst them. This can be a parental relationship, friendship, a professional relationship. Providing relational data makes it so that points start connecting to each other with lines or arrows (also called ties) and those lines are what produces a network. In the words of Borgatti et al. networks are

a way of thinking about social systems that focuses our attention on relationships among the entities that make up the system […]

Traditionally, when thinking of *social systems* it is easy to think about human systems (Moukarzel *et al.*, 2020), but SNA can also be used to describe systems of words (Wonneberger, Hellsten and Jacobs, 2020), or geographical and spatial networks (Liu, Wang and Zhang, 2017). Nodes can represent anything in SNA and so can ties but how does one obtain information on a network? Firstly, the source of data has to be defined, then a method of data collection. In smaller studies with individuals, this can be done by means of interviews, questionnaires or observations depending on the situation. In bigger studies with many nodes, there are automated ways to collect data which can produce a matrix output (Ediger *et al.*, 2010). In one mode analyses, such as the one carried out in this work, the output is an adjacency matrix (Borgatti, Everett and Johnson, 2013, page 63). This is a square table where every node is plotted against themselves and every other node in the network. The value contained in a cell provides information on whether nodes are *adjacent*, in other words, it is a matrix of all relationships in the network where a "0" represents the lack of connections and a "1" or a number higher than "1" represents the presence of a tie between the two nodes. The higher the number, the stronger the tie.

Once an adjacency matrix is produced, it can be used to do a *whole network* analysis or an *ego network analysis*. The former, as the name hints, provides an overview of the entire network (Borgatti, Everett and Johnson, 2013, page 249) whereas the latter has a focus on a specific node and its connections (Crossley *et al.*, 2015, page 77). The nodes connected to the *ego* are usually referred to as *alters*. Both these analyses have their methodological validity and are fit for the exploration of network data. In this work, both will be used as will be explained in section 2.4.4 and both can be obtained through network analysis software. In this study UCInet and NVivo were used, but these analyses can also be done using NodeXL or R.

2.4.2. How to do SNA

There are two main outputs obtained in SNA and they can be equally important: network parameters and network visualisations. Firstly, a network can be analysed through the calculation of specific parameters such as cohesion, density, and centrality measures. Cohesion is a measure of how well connected a social system is. Looking into cohesion measures in a network is also called *community detection* because it helps find *close knit* groups of nodes: the more ties, the higher the cohesion. The most cohesive networks have nodes who are connected to all other nodes in the network, and these are called *cliques* which are groups of

nodes that are very well interconnected and can be pivotal in the successful sharing of information in a network.

Density is the *number of edges* (also referred to as ties or connections) divided by the total number of *possible edges*. Very large networks with many nodes, can often have very low density, but if different parts of the network are analysed separately, often the density will vary across the network, providing valuable information on how information travels across different groups. In SNA there are many different centrality measures. In general, they are an indicator of the importance of individual nodes in the network by calculating the number of connections they have (degree centrality). Betweenness is also a centrality measure and provides information on how important a node is for the connection of other users in the network (Grassi *et al.*, 2019). For instance, if Karen works in human resources for a company and knows everyone in the human resources floor personally, but she is the only one who usually contacts the IT department, the betweenness of Karen will be high, because she is instrumental in the efficient communication of any IT issues to the relevant office.

All these parameters can provide a lot of information about a network, but they are often better understood if accompanied by a network visualisation. The latter is a qualitative representation of the network and, even before looking into network parameters, can provide insight into the internal structures of a social system. For instance, low density networks are often composed of many isolated nodes (isolates) and contain more than one component, where *components* are clusters of nodes that are not connected to each other. The visualisation can be useful in the identification and analysis of the main component (MC) which is the cluster of nodes containing the highest number of nodes and ties. The MC also contains nodes that are very central in the network, because they tend to have a very large number of ties. If a node is very central in the network but the other nodes are not well connected to each other, the network tends to assume a *firework* shape. Finally, network visualisation software can aid in the identification of echo-chambers (Goldie *et al.*, 2014).

Using network parameters in combination with network visualisation tools can help unveil hidden structures in the network and summarise data that would otherwise get lost inside an adjacency matrix.

2.4.3. Why is SNA important?

The value of social network analysis, especially through data visualisation software, is that it allows to quickly summarise data efficiently, to have an idea of how information has travelled across a network of individuals and to identify who is responsible for the travelling of such information (Kalsnes and Larsson, 2018). In the case of this work, social network analysis enriches the analysis of discourse on Twitter with another layer of complexity. Particularly, it provides a more holistic view of relationships within the discourse on GMOs and Brexit than that provided by meticulously analysing the corpus tweet by tweet. Twitter data provides a great amount of detail regarding the content of tweets and the tweets' characteristics. However, in its raw form, it does not give any information on how Twitter users are connected to each other (if at all), and how news items are disseminated across the platform. SNA was chosen because it adds meaning to information on the interactions amongst Twitter users, whether they might be mentions, replies or retweets. Furthermore, it allows for the analysis of the relationship between Twitter users and the content travelling across the platform (Rudat and Buder, 2015).

Lastly, this approach was chosen to investigate the Brexit and GMO discourse on Twitter because the latter is often characterised by factions, often simplified as *pro* and *anti* GMO or *Brexiteer* and *Remainer* for Brexit. As hinted in the introduction, there is literature discussing how *birds of a feather* often *tweet together* (Himelboim, Smith and Shneiderman, 2013) meaning that on social media platforms users often tend to interact with content that reinforces their beliefs; SNA could help identify ideological separations in the discourse and cases when individuals with disagreeing opinions interact (Brady *et al.*, 2017).

2.4.4. Methods of SNA

In this work, the aim was to use SNA to analyse both the dissemination of news on Twitter (Bruns and Burgess, 2012) and to analyse and visualise the interconnectedness of the social system composed of Twitter users who have mentioned GMOs and Brexit in a tweet, see whether they have retweeted content from other users, mentioned other users or replied to them. The latter was done with a whole network analysis approach as will be described in the next section whereas the analysis of news dissemination was carried out by ego network analysis for a selection of popular news items.

2.4.4.1. Data preparation

The data collection for both types of networks entailed the use of the already existing dataset from the Twitter CDA. Using NVivo, a *case* was created for each Twitter user present in the corpus of collected tweets. These included different categories of users:

- those who created original content (User1 from the scenario in section 2.3.2),
- those whose content was retweeted (again like User1)
- those that actively retweeted other users (User2 and User3)
- users mentioned in the tweets' text.

2.4.4.2. Whole network data collection

As the name suggests, whole network analysis entails the identification of ties amongst ALL users. In a nutshell, **nodes** in the **whole network analysis** carried out in chapter 5 represent **Twitter users** and what constitutes a tie in this network of users is any form of interaction between them, particularly, retweets, mentions and presence alongside other users in the same tweet. Normally, the strength of each tie is represented by the total number of interactions between each combination of users. Because creating the adjacency matrix was a very time-consuming process a decision was made to aggregate information regarding mentions and retweets so that only one adjacency matrix was required. This was not considered a hinderance to the method. In fact, although they mean different things, both retweets and mentions are signs of a connection between two users, either voluntary or constructed by the creator of the tweet so it seemed appropriate to aggregate the two types of information and, should the need arise, go back to the dataset to check the type of connection.

Once the adjacency matrix was created, the data were input into UCINet where the matrix was dichotomised, meaning absent ties remained equal to "0" but any present tie with a value equal or above "1" was reduced to a value of "1". This is often done in high complexity matrixes with a high number of nodes and/or edges.[8] Seen as the original dataset contained 3828 users this process seemed appropriate so that there would be no need to *prune* the network and to lose potentially interesting data (Borgatti, Everett and Johnson, 2013, page 252). Then, a one-

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[8] This was a limitation in this method because it reduced the richness of the data discernible from the network analysis; however, it could not be remedied because UCInet could not cope with the analysis of weighted data.

mode analysis with undirected ties was carried out and the network was finally visualised using NetDraw. There are limitations to the adoption of a non-directed matrix, however, because of the availability of detailed metadata about each tweet, the Twitter dataset could be manually consulted, when appropriate, to gain information on the direction of the retweet or the mention.

2.4.4.3.   News sharing on Twitter: data selection of Ego networks

To analyse the sharing of news on Twitter, a case was created for URLs linking to specific news items outside of the Twitter domain. We chose five news items that were highly popular in this discourse: an article from the Guardian, one from the Telegraph, two articles from two Scottish newspapers and a news item from AnonHQ.com (the reason for this choice will be made clear in chapter 5).

Firstly, using NVivo, the dataset was queried searching for *alters* to the ego. In this work, alters are all users in the corpus that mentioned the URL in a tweet, or were mentioned alongside it in a tweet or retweeted a tweet containing the URL. The resulting subset of users (or alters), somewhat connected to one of the aforementioned news items, was then used in a new NVivo query to create an adjacency matrix with the aim to investigate whether there were any *alter-alter* ties. Alter-alter ties in this work represent any interaction between alters which happened regarding the sharing of the news item or outside of the discussion of the news item, within the limits of the Twitter debate over GMOs and Brexit in 2017.In summary, to carry out ego network analysis, one needs to identify all nodes connected to an ego (in this case the URL) and then, to analyse the social network of alters through the production of an adjacency matrix (Crossley *et al.*, 2015, page 50). Once the adjacency matrix for each ego network had been obtained, it could be input into UCInet and NetDraw for the extrapolation of network parameters and to obtain a network visualisation.

It needs to be noted that normally, in EGO network analysis, the ego, in other words the individual whose network of contacts is under analysis, is a node of the same nature as the alters. For instance, the ego can be an employee in an office network (like the example of Karen), or a political figure interacting with other individuals (Arnaboldi *et al.*, 2017). In this work, the ego (a URL) is of a different nature compared to the alters (Twitter users). However, the URL was only used to find the subset of alters. After the creation of the alters adjacency matrix, the URL was removed from the network, to analyse interactions amongst all Twitter

users who mentioned that URL in a tweet or a retweet. Removing the ego is not uncommon in SNA, especially if the focus of the analysis is on the interactions between alters, such as in this case. A limitation of this is provided by the fact that the relationships between alters represented in the ego network are only the interactions which included the searched keywords. Therefore, there is no information on whether the alters interacted further regarding GMOs and Brexit unless they used both keywords in their tweets.

2.4.5. SNA Data analysis

Ego network analysis and whole network analysis were carried out by a critical evaluation of network parameters and by analysing the visual representation of the networks. These two activities were then integrated with further investigation of degree centrality and betweenness measures to verify the position of Twitter users of interest such as influencers, NGOs, political figures, scientists, and news outlets. The analysis of the position held by these Twitter users was enriched by reconciling users with the content they produced to see if they were mentioned, whether they were retweeted often, or if it was one particular tweet they produced that was really popular (Wadbring and Ödmark, 2016).

CDA and SNA on Twitter, however conscribed by the limits of the platform's demographic (Mellon and Prosser, 2017), help shine a light on potentially different sides of the discourse on GMOs and Brexit. With the digital media analysis, the aim was to provide an overview of how GMOs and Brexit were portrayed, but with the Twitter critical discourse analysis and Social Network Analysis it is possible to analyse the space where a gap is bridged between communicators and a part of their audience, to see whether users interact with digital media content and digital media journalists and to investigate the ways in which they themselves represent GMOs and Brexit in the discourse. Furthermore, SNA allows for the unveiling of potentially new social actors and their role in the debate outside of the media sphere.

2.5. Reflection

Before diving into the specific methodological choices made for this work, I would like to take a moment to introduce myself, my background and academic curiosity so that it might guide the reader into understanding better the path taken and the particular attention given to the exploration of certain thematic areas in this research rather than others. The point of this

reflection is to highlight how this perspective might be peculiar and how this project would have been carried out differently if it was done by someone with a different experience but, in this instance, it seemed advantageous to explore aspects that were familiar to this research group.

Firstly, I am a researcher with a background in food sciences and European GMO policy. Had I been a linguist, I might have had the opportunity and skill to explore the use of language in more depth, instead this analysis focuses more on the arguments, misconceptions and simplifications around GMO regulation and food safety. Having a linguistics background could have created different analytical opportunities but it might have required sacrificing other interesting aspects of the data.

Other aspects that might have shaped the way this research was carried out are the fact that I have ADHD and the fact that English is not my first language. The former meant that I had a proclivity to thinking critically about the development of the methodology and that I would often think tangentially about themes and patterns, thus granting me a particularly creative outlook on the corpus. Not being a native English speaker meant that the linguistic analysis of the discourse was one of the most challenging aspects. The language analysis alongside the production of a tailored Python script were the two things that took the most training and took the longest time to implement. Furthermore, I am funded by the Grantham Centre for Sustainable Futures and the training and experience within the Grantham Centre meant I had an attentive eye for the emergence of sustainability tropes in the data, as well as for mentions and framing of issues surrounding climate change.

My supervisory team was also unusual in make-up: a professor in plant pathology, a food nutritionist with an interest in public attitudes to food and a methodologist who supports qualitative and quantitative researchers in a wide range of areas. None of them would claim to be social scientists although the second and third have experience of working qualitatively within the social sciences domain. This gave me two distinct advantages. On one side, I was able to check any of the scientific claims made on biotechnology with an expert in the field, on the other I had insight into the public discourse on food and methodological support.

Doing the work of a qualitative researcher, coming from a scientific background was a very complex adaptation process and, although I was proficient in most of the topics of this research and I was familiar with historical discourses on GMOs, the qualitative methodology was entirely new to me. So, I have taken particular care to explain the various methodological

choices and shifts made in the four years of this PhD, so that future scholars will not have to go through the same hurdles and they will know what challenging aspects to expect by *switching gears* from the hard sciences to the flexibility of qualitative research and social sciences.

This chapter elaborated on the methodologies used to answer the research questions discussed in section 1.8. It included a theoretical background to the meaning of Critical Discourse Analysis (CDA) and an overview of Anabela Carvalho's approach, which was adopted by other researchers looking into media portrayal of the GMO debate (Maeseele, 2015). It has provided detailed information regarding the methods for the collection of digital newspaper articles and tweets unpacking the different layers that were implemented to analyse the complexity of the discourse in digital media (in chapter three) and on Twitter (in chapter four). Finally, it provided an overview of the Social Network Analysis approach adopted to extract *relational* information obtained from the Twitter metadata, the results of which will be described in chapter five.

3. Critical discourse analysis of digital news articles.

This chapter will show results from the critical discourse analysis of digital news. It will provide details on the temporal distribution of articles mentioning GMOs and Brexit in 2017 as well as an overview of political events that might have influenced the flux of articles in specific periods. It will then provide information on the magnitude of coverage of Brexit and GMOs, an analysis of the stance of articles, an analysis of emerging themes and their co-occurrence, and finally an overview of the main arguments and underlying ideologies. By doing so, it will provide an exhaustive picture of discursive representations of GMOs in the Brexit discourse in digital media.

Findings from the critical discourse analysis of articles from 2017 will show that the discursive moment created by the occurrence of Brexit negotiations and elucubrations on trade was an agenda setting political frame for GMOs which reinforced pre-existing narratives regarding an inherently bad nature for American food and, by association, GMO imports. Although this argument was refuted on scientific grounds, it presented with a strong moral stand on farming practices and social justice which reached outside of the Brexit agenda, and was in fact represented in more elaborate anti-GMO arguments. On the other hand, news items articulating an in-depth discussion on GMO technology were more balanced and in the rare instances of a positive narrative for GMOs, often referred specifically to gene editing and included positive sentiment towards the research and development opportunities created by Brexit.

Figure 3.1 Temporal overview of digital media articles discussing GMOs and Brexit in 2017

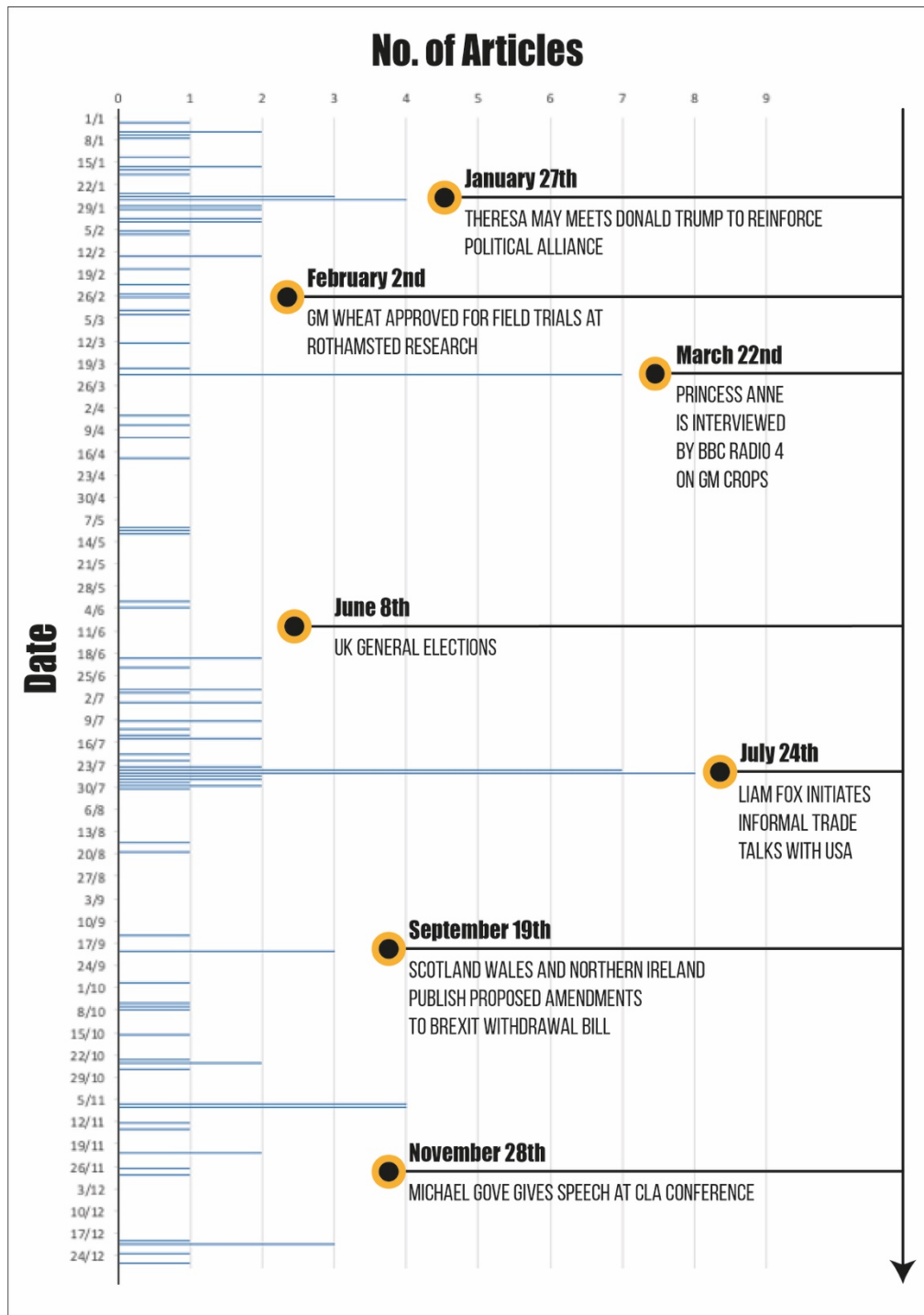*Figure 3.1* Shows a daily breakdown of the number of UK digital news articles mentioning both GMOs and Brexit in the year 2017. The timeline, on the right, highlights key events in British politics during the period of analysis.

The corpus of 131 articles was not uniformly distributed throughout the year. Figure 3.1 provides a temporal overview of the distribution of articles mentioning both GMOs and Brexit

during the year 2017 and provides bookmarks for critical events which might have contributed to the peaking in the number of articles. Firstly, there was a flurry of articles in correspondence of the British prime minister Theresa May's state visit to the president of the United States, Donald Trump on January 27th 2017, during which she expressed interest in a trade partnership with the United States. Although discussions on international trade were reported as early as January 5th in the corpus, this particular event caused a flux in articles.

On March 21st 2017 there was a flux in articles in correspondence of a BBC radio interview with princess Anne (in the media from March 21st, airing on BBC radio on March 22nd). In the interview, although she refrained from expressing opinions on Brexit, she expressed her positive attitude towards the potential adoption of genetic engineering in the UK farming sector. Coverage of this story in digital media happened before the airing of the interview, but the actual programme coincided (on March 22nd) with a major terrorist incident in London and, understandably, reporting of princess Anne's interview on GMOs was secondary. In fact, it is common for topics such as biotechnology to be subsumed by more pressing issues (C. Mcinerney, Bird and Nucci, 2004; Kristine Grace N. Tome, Marechel J. Navarro, Sophia M. Mercado, 2017). However, the BBC radio interview with princess Anne was covered in 7 news articles and was only covered at this time, differently from discussions on trade which appeared repeatedly throughout 2017.

Another critical event that caused the highest peak in digital coverage of GMOs and Brexit for 2017 was the international trade secretary Liam Fox's visit to the USA to initiate informal trade talks on July 24th. During his visit, there was intense coverage of potential food imports that would be coming to the UK after a trade agreement was struck with the United States. All these events, as will be discussed in the analysis of themes and ideologies (sections 3.4 and 3.5), created a base for a wider discussion around Brexit in digital news which included the issue of GMOs and, particularly, GM foods. Other key political events around Brexit which were prominent in the media in 2017 did not lead to an increase in news on GMOs and Brexit and thus are not highly represented in this corpus. Examples of these political events were the UK general election on June 8th or the publishing of suggested amendments to the Brexit withdrawal bill by the devolved governments of Scotland and Wales on September 19th.

3.2. Magnitude of coverage of GMOs and Brexit

As discussed in chapter 2 articles were coded for the *extent* to which they covered both GMOs and Brexit. Particularly, articles were categorised based on whether they were heavily covered

(Main), somewhat covered amongst other topics (Subtopic) or barely covered (Mention) in each article. Figure 3.2 shows the magnitude of coverage of Brexit, (in blue) and GMOs (in orange). In this figure it is immediately visible that Brexit, on the left, was most often the main topic of articles whereas there were many articles that only mentioned GMOs in passing. This suggests that GMOs might be a small part of the broader political discourse. However, to verify how coverage of Brexit intertwined with that of GMOs, more information was needed.

Figure 3.2
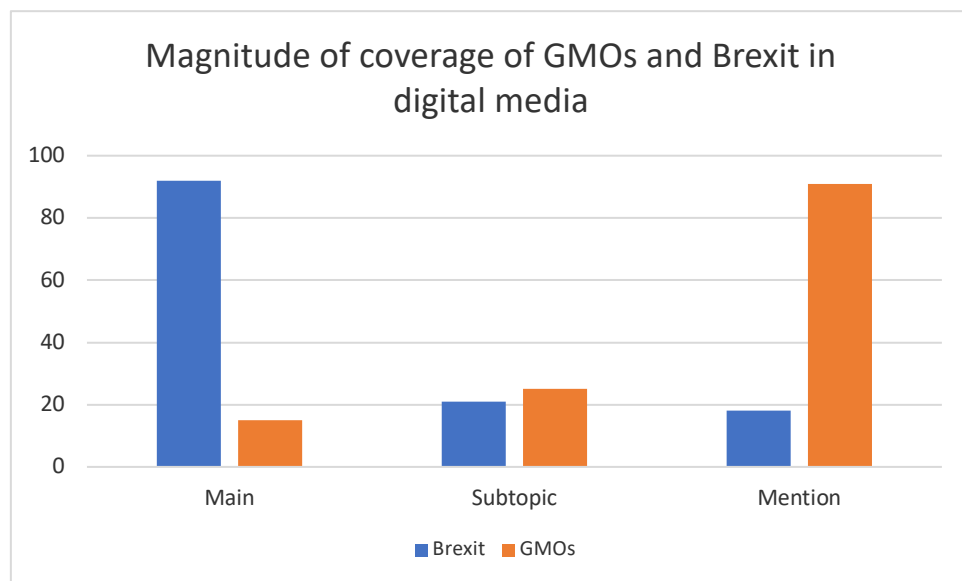
Figure 3.2. Shows magnitude of coverage of GMOs (orange) and Brexit (blue). Notably, most articles in the corpus mainly discussed Brexit and only mentioned GMOs in passing.

Cross-tabulation by Brexit and GMO coverage (Table 3.1) provided this information by showing the percentage of articles corresponding to each possible combination of coverage of Brexit and GMOs. The table shows the distribution of these articles was not random (X-squared = 39.335, df = 4, $p<0.001$) which means the magnitude of coverage of GMOs is not independent of the magnitude of coverage of Brexit.

Table 3.1 Magnitude of coverage for GMOs and Brexit.

Magnitude of coverage	GMOs Main	GMOs Sub-topic	GMOs Mention	Total
Brexit Main	2.30% (-2.32)	9.20% (-1.33)	**58.80% (1.64)**	70.20%
Brexit Sub-topic	3.10% (1.03)	6.10% (1.99)	6.90% (-1.46)	16.00%
Brexit Mention	**6.10% (4.14)**	3.80% (0.84)	3.80% (-2.12)	13.70%
Total	11.50%	19.10%	69.50%	100.00%

Table 3.1. *The table shows the percentage of articles falling into each category; chi-squared residuals in parenthesis.*

Particularly, while almost 59% of all articles fell into the Brexit Main/GMO mention cell (see table 2), in the table the main divergence from expected frequencies was in the cell of GMO Main/Brexit mention, which at 6% of articles was quite a bit higher than expected. Indicative examples of how Brexit and GMOs are discussed in these two cells will be provided anon.

Articles that extensively covered Brexit while only mentioning GMOs in passing are exemplified by the following quote from the Independent online which, while featuring Brexit in the title, only included a single reference to GMOs within a 1563-word article. As in this quote, these articles frequently positioned GM foods alongside chlorinated chicken and hormone-treated beef (31% of all articles) which were purportedly portrayed as unsafe. The conflation of GM foods with these supposedly risky products was commonly portrayed as either an openly denigrated catastrophic consequence of a potential post-Brexit trade deal with the USA, as in quote [1], a compromise on food standards, or sarcastically welcome.

[1] A US trade deal would likely mean ripping up regulations around workers' rights, environmental protections and the EU Reach health and safety regulations. Food and drug standards would then only have to comply with inferior US regulations. Thus, we can look forward to toxic pesticides, unsafe hormones in the food chain, chlorine chicken, acid-washed

*meat and **GM food**. ("Post-**Brexit** Britain: This is what taking your country back looks like", 11th April 2017, Independent)*

Articles in the GMO Main/Brexit Mention cell included those reporting the approval of a new GM wheat field trial at the Rothamsted Research institute (quote [2]) and those reporting on princess Anne's interview about farming GM crops in the UK.

*[2] The **GM variety**, called superwheat, has been engineered to use sunlight more efficiently and produce bigger grains. [...] No GM food is grown in the UK because of EU regulations. Ministers are drawing up new rules that could permit widespread planting of GM crops in England after **Brexit**. (GM 'superwheat' trial will start in the spring, 2nd February 2017, The Times)*

As is typical in these articles, Brexit is cursorily mentioned within a report of scientific developments of the technology, accompanied by a thorough explanation of the science and/or a discussion of benefits and drawbacks of GMOs; thus, in this type of articles, Brexit is used to make the topic of GMOs more newsworthy and relevant to the broader contemporary discourse.

3.3. Stance towards GMOs and Brexit

After looking into the coverage of Brexit and GMOs, the article stance towards these topics was coded based on a 5-point scale ranging from strongly anti-Brexit/GMO to strongly pro-Brexit/GMO (as described in section 2.3.1). The attribution of each article to a point in the scale was based on an analysis of emerging themes, arguments and language in support of underlying ideologies which will be further elaborated in sections 3.4 and 3.5 of this chapter. The analysis of stance revealed that sentiment towards Brexit was mostly negative across the corpus (39% of articles) with 26% of articles being strongly anti-Brexit and 13% being cautiously anti-Brexit. 37% of articles were found to have a neutral stance and 24% of articles were positive towards Brexit with 13% being cautiously pro-Brexit and 11% strongly pro-Brexit. Sentiment towards GMOs was similarly distributed but more than half of the articles were found to be anti-GMO (52%). Particularly, most articles were strongly anti GMO (37%), 15% were cautiously anti-GMO, 25% were neutral and 22% were pro-GMO (11% cautiously pro, 11% strongly pro).

Notably, it was more frequent for sentiment towards GMOs and Brexit to align than otherwise (as can be seen in table 3.2). In fact, most articles were both strongly anti-GMO and anti-Brexit

(22%) or neutral towards both GMOs and Brexit (17%) and were strongly pro-Brexit and strongly pro-GMO whereas, for instance, very few were strongly anti GMO and strongly pro-Brexit (2%) and no articles were found to be strongly pro-Brexit and strongly anti GMO. As a matter of fact, the lower right quadrant of Table 3.2 is very sparsely populated, showing an overall lack of representation of pro-GMO and anti-Brexit sentiment combined in this corpus.

Table 3.2 Stance of digital news

STANCE	Strongly anti GMO	Cautiously anti GMO	Neutral (GMO)	Cautiously pro GMO	Strongly pro GMO
Strongly pro Brexit	2.29%	0.76%	1.53%	0.00%	6.11%
Cautiously pro Brexit	3.82%	1.53%	1.53%	3.82%	2.29%
Neutral (Brexit)	6.11%	5.34%	16.79%	6.87%	2.29%
Cautiously anti Brexit	3.05%	5.34%	3.82%	0.76%	0.00%
Strongly anti Brexit	22.14%	2.29%	1.53%	0.00%	0.00%

Table 3.2 *shows a cross tabulation of Brexit and GMO stance. This table shows how sentiment towards Brexit and sentiment towards GMOs combined. Notably, the lower right quadrant of the table does not contain any articles, this means there are no strongly anti-Brexit and strongly-pro GMO articles in this corpus.*

The information gathered through the stance analysis was then plotted against magnitude of coverage to verify whether there was a correlation between the two variables. The heat-maps in Figure 3.3 were obtained by overlaying magnitude of coverage and stance data from two categories of articles: those that discussed GMOs in depth, barely mentioning Brexit, and those talking mainly about Brexit and only mentioning GMOs. Figure 3.3 shows that GMO stance (b) is mostly negative in articles which only mention GMOs in passing and mainly focussed on Brexit. Instead, articles with a strong focus on GMOs which only briefly mentioned Brexit (a), presented no strong opinions on Brexit and fell in the neutral/cautiously positive part of the GMOs' sentiment scale. The difference in stance to Brexit and GMO was statistically significant between both article groups ($p < 0.001$ and $p = 0.01$, respectively) suggesting that

article focus is a determining factor for the stance of the article on Brexit and GMOs and, more broadly, that GMOs are embedded in a negatively charged discursive representation of Brexit. Nevertheless, in pro GMO articles, Brexit is often marginal to the discussion on the technology. This becomes clearer when looking more closely at the text.

For instance, quote [3] shows the only mention of Brexit within an article written by the Press Association for the Daily Mail online. The piece, like others in this category, remains mostly neutral towards Brexit and seems to use it as a mean to frame the interview within the current political context.

*[3] Asked if, in a post-**Brexit** UK where growing GM crops was allowed, she could see the plants being cultivated on her land, she replied "yes". (Princess Anne open to growing GM crops on her land, 22nd March 2017, Press Association on The Daily Mail online)*

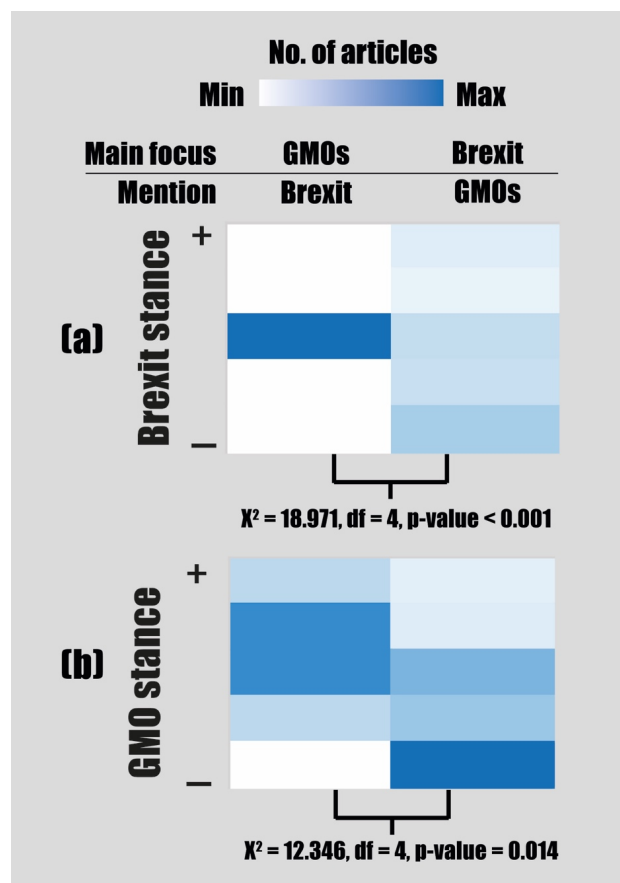**Figure 3.3 Stance on GMOs and Brexit by article focus**

Figure 3.3 Stance on GMOs and Brexit by article focus. *Articles were classified by their stance towards Brexit and GMOs and by article focus. (a) and (b) highlight the differences in stance in Brexit and GMOs respectively, against the focus of the articles.*

Quotes [4] and [5] were extracted from articles which only mentioned GMOs once, within the negative portrayal of Brexit. Both quotes refer to Liam Fox's visit to the US and the consequences that a free trade deal might have on UK food quality and safety. In the text, a strong negative sentiment towards Brexit is reinforced by the use of emotional hyperbolic language. In fact, verbs such as "*stomaching*" in reference to US food, the idea of a trade deal being rushed, the metaphorical "*ripping up*" of British regulations, the mention of pressure from American lobbies ("*lobbyists will push…*") all convey anti-Brexit sentiment.

*[4] In a rush to secure a post-**Brexit** trade pact with the US, Liam Fox is ready to allow American conglomerates to flood the UK with chlorine-washed chicken, **genetically modified crops** and hormone-fed beef. Dr Fox may find such a deal easy to stomach, but everyone who cares about food quality should be alarmed. (Hard Brexit to swallow as trade deals could crush our farmers and force us to eat junk food, 24th July 2017, Mirror Online)*

*[5] Similarly, American agriculture lobbyists will push for fewer restrictions on pesticide and herbicide use or the labelling of **genetically modified organisms**. If Britain resists, its farmers may simply get undercut by less-regulated rivals across the Atlantic. (A UK trade deal with Trump~ Be careful what you wish for, 16th January 2017, The Guardian)*

For comparison, see below quotes from an article which was classified as neutral [6] and one that shows positive sentiment [7].

*[6] "People aren't starving because photosynthesis isn't efficient enough; people are starving because they are poor," said Liz O'Neill from GM Freeze. "Techno-fixes like GM wheat suck up public funding that could make a real difference if it was spent on systemic solutions like waste reduction and poverty eradication. Then we could all enjoy food that is produced responsibly, fairly and sustainably." But supporters of the technology point out that if the GM wheat boosts yields it could allow farmers to grow greater amounts of the crop with fewer inputs such as nitrogen, decreasing emissions of CO_2 as well. Another concern is that the go-ahead for the new trial signals a different approach to GM as the UK faces up to **Brexit**. In the House of Commons last autumn, farming minister George Eustice indicated that the government was open to re-examining the position after the UK leaves the EU.*

*"As part of the preparations for **EU exit**, the government is considering possible future arrangements for the regulation of genetically modified organisms," he said in a written*

statement. "The government's general view remains that policy and regulation in this area should be science-based and proportionate." Both supporters and critics say the new trial does not signal a change in position. (New 'super yield' GM wheat trial gets go-ahead, 1st February 2017, BBC news)

Number [6] is a very long quote but needs to be reported in its entirety to exemplify the meaning of *neutrality* in this corpus. It is apparent that the text in this quote is not all inherently neutral towards GMOs, but there is room for arguments on both sides of the debate laying out what appears to be a balanced discussion. This balance is considered good practice in journalism, especially in writing about controversial issues (Boykoff and Boykoff, 2004). In this instance, George Eustice, who is a political figure, is talking about Brexit and GMOs. In the text he states the importance of evidence and the need for evidence-based policy on GMOs; he also mentions the government discussing *arrangements* for GMOs, hinting to the possibility of a change in the British agricultural policy. Nevertheless, he does not disclose his opinion or the government's views on the issue.

Differently, other social actors represented in this article are portrayed expressing their views more openly on GMOs. On one hand positive, with *supporters* of the technology and, on the other hand, negative with Liz O'Neill who is an anti-GMO activist representing GM Freeze, an NGO which has been voicing concerns on GMOs in the UK for many years. In quote [6] supporters are reported using arguments that strictly pertain the new GMO being discussed (yield, agrochemicals, and sustainable farming) whereas Liz O'Neill brings arguments against GMOs, such as lack of social justice (*people are starving because they are poor)* and the idea of GMOs as a quick fix (*techno-fix*) diverting public money from issues such as environmental sustainability and food waste.

*[7] Automation will help but Brexit will also liberate Britain's farms to harness the potential of **GM crops** after decades of EU resistance. Mrs Leadsom's task is to usher in a new green revolution, but it won't happen by itself. **Brexit is only the beginning**. (Freedom to Farm, 5th January 2017, The Times)*

Quote [7] exemplifies the alignment of positive sentiment on GMOs and Brexit. In this type of articles common threads were the portrayal of Brexit as an opportunity reinforced by language

conveying a sense of hope and optimism for the future (*Brexit is only the beginning*). This is similar to the portrayal of GMOs which are included within a group of technologies that have *potential*. The sentiment towards the two topics is intertwined as GMOs fit into a broader positive portrayal of Brexit.

The idea of Brexit *unleashing* the UK from the rules set by the EU and allowing the country to *harness the potential* of technology is one of a few recurring tropes in this corpus. An analysis of emerging themes as well as an in-depth reflection on arguments will be provided in sections 3.3 and 3.4.

3.3. Thematic content

As detailed in section 2.3.1, codes pertaining to six macro-areas were created. These were **economics**, **farming**, **food**, **policy**, **science** and, lastly, **society**. This section will elaborate on the meaning of each of these macro-areas and will provide examples of topics and related issues mentioned in the corpus that conflated into these groupings. The latter are also summarised in Table 3.3.

Table 3.3 Macro-areas and examples of relevant themes found in the corpus.

Macro-areas	Themes	Quotes
Economics	**Trade**	*Europe is the more valuable trading bloc, particularly for Britain*
	Tariffs	*With tariffs on goods exports already low, the toughest of all trade challenges for UK-US negotiators will be so-called non-tariff barriers.*
	Investments	*Brexit Britain needs a new innovation culture, not just investment, in order to take off*
Farming	**Pesticides**	*For those who would prefer we do without insecticides altogether: great idea, but we missed that bus 20 years ago when we turned our back on genetically modified crops.*
	Animal welfare	*In the US, antibiotics are routinely used to improve animals' growth, sparking fears that meat consumption could increase human resistance to antibiotics.*
	Subsidies	*At worst Brexit could devastate the farming sector; on average 60% of farm incomes come in the form of EU subsidies.*
	Productivity	*He said the damage was linked to the EU's focus on producing rather more food rather than "any other benefit".*
Food	**Labelling**	*We can, after Brexit, choose to import chlorinated chicken if we wish to; we can label it as we wish, and warn consumers about it as we wish.*
	Food prices	*Whatever happens post-Brexit, food prices are bound to go up as EU subsidies are withdrawn and new trade deals hammered out.*
	Food quality	*Once the UK is out of the EU, there's really no reason some manufacturers here won't press for US practices to be adopted – sacrificing quality for cost.*
	Meat processing	*The US is the second-largest exporter of poultry meat in the world, behind Brazil, but Europe has long banned its chickens from import, thanks to the American practice of bathing chicken carcasses in chlorine.*
	Permitted ingredients	*Environmentalists warn Britain may be forced to accept lower quality products, including the use of banned flavourings and increased pesticides.*
Policy	**Agriculture**	*The present three-crop rule requires no more than 75 per cent of farms (over 30 hectares) to be in a single crop*
	Environment	*This would take the shape of a coherent plan to maintain and enhance environmental standards, ambitions and drivers during and after the Brexit process.*
	Food labelling	*Food labelling standards may also confuse consumers, the committee said, as they do not make it clear where and to what standards meat and vegetables have been produced.*
	Trade policy	*MPs can block post-Brexit trade deal with US if it will damage animal welfare standards, Michael Gove says*
Science	**Risk/concern**	*"How many significant medical breakthroughs does this deliver? How many animals' lives are wasted on poorly conceived and poorly conducted science?"*
	Science explanation	*Orange petunias do not occur naturally, and the HTA believes that some plants may have been modified. Scientists suspect that the colour came from a maize gene.*
Society	**Public trust**	*Adam Bienkov tweeted: "If Liam Fox wants the public to trust him, he needs to devour a chlorine-washed chicken live on camera"*
	Social justice	*"At the moment we're told the solution is monoculture – GM crops – but the real truth behind that is that these systems are to drive profit and not the fair distribution of food," Hunt says.*

Table 3.3 *Shows the six macro areas with relevant examples of codes under each group and corresponding examples of citations from the coded text.*

The **economics** macro-area aimed at collecting codes discussing financial matters and economic transactions. Because of the early detection of discussions around trade in the pilot study, it was thought possible that different forms of trade could be discussed. Therefore, codes pertaining to this area were created to include international trade and related agreements, negotiations, and disputes as well as codes for the countries amongst which such trade was occurring such as the UK, the EU and the USA or other non-EU countries. Other codes

belonging to this group included mentions of tariffs on the import-export of goods and codes referring to public and private funding and investment on research and innovation.

The **farming** macro-area was created to encompass discussions on husbandry and agricultural practices in different countries. Agriculture-related topics represented in the corpus pertained to the use of agrochemicals in crop cultivation in the form of pesticides (including herbicides like glyphosate and insecticides like neonicotinoids), fertilisers and related topics such as biodiversity and sustainability. Articles were also coded for mentions of animal welfare and antibiotic use, references to the productivity of farmland and the financial viability of farms. The latter was mentioned especially as the ability of farmers to compete in the market and the availability of government support in the form of subsidies. Finally, this grouping included mentions of small-scale farms in opposition to large scale farms and associated practices (e.g. industrial farming).

The **food** macro-area pertained to any mention of food-related issues from production to consumption. Codes under this grouping included types of foods mentioned such as ingredients in foods, additives, fats and sugars, dairy and meat, particularly poultry and mentions of GM foods. Also, articles were found to mention food processing practices such as meat disinfection and mentions of food standards, mainly relating to quality, hygiene and safety. Other topics under this category regarded the consumer experience of food and included price, health-related to food, the appearance of food and its taste.

The **policy** macro-area included mentions of regulation which were further classified in groups based on the regulatory body issuing regulation, type of regulation and type of action associated with it. More specifically, regulatory bodies included national or supra-national organs such as the UK government, the USA government, the EU or the WTO; topics of regulation included, mirroring the other macro-areas identified, international trade, agricultural policy, animal welfare, food labelling and safety, GMOs, pesticides and environmental policy. Types of action mentioned in relation to these topics were changes to the regulation, namely, reinforcement of existing regulation, relaxation and, finally, harmonisation of rules.

The **science** macro-area aimed at collecting all mentions of science, new discoveries and associated discourses, but also, there was an interest in content that was explaining science. Codes under this grouping included technologies such as AI, gene editing and GMOs, pesticides, robotics and cryptocurrencies. Particularly codes were created to index various benefits and drawbacks of technologies, explanations of the science behind the technology, ethical considerations, testing and safety of the science.

The **society** macro-area was aimed at collecting mentions of the public and its agency over the discourse. Codes were created to identify mentions of societal factors, public perception and the public's involvement in decision making. The coding found mentions of different societal groups, namely young adults and children, but also consumers and especially topics related to consumers opinion, consumers rights and consumers choice. Furthermore, references were found to public opinion, public health and social justice, the latter pertaining mainly to income differences in society.

Although all of these topics were present in the corpus, some of them were more prominent than others not only in the amount of text dedicated to the discussion of these themes within each article but also in the number of times themes were found to be recurring across the corpus and the frequency with which they would be found to overlap.

3.3.1.   Co-occurrence of themes

Across the corpus, the most prominent topics pertaining to the six macro-areas were policy (95% of articles), followed by food (76% of articles), trade (68% of articles) and farming (67% of articles). Firstly, discussions on policy mainly concerned issues such as *GMOs, environmental policy, agricultural policy, health, food, safety, animal welfare and standards.* The *standards* code usually covered comparisons of different countries' regulations; 58% of articles mentioning policy were assigned to the *standards* code, making it the most prominent policy issue in the corpus. Quotes [8] and [9] exemplify the dominant issues related to the discussion of "standards" policy present in the corpus, namely healthcare, environmental regulations and food safety.

[8] If the UK's food safety standards do not meet the EU's requirements, then exports from the UK to the European bloc would also be affected. (How Brexit Could Force UK Farmers To Lower Standards To Compete With US Meat Market, 7th October 2017, Huffington post)

[9] On the UK side, there are mounting worries that reducing barriers for US exporters inevitably means lowering British standards on environmental rules, food safety and drug regulation: allowing GM crops, hormone treated beef or bleach-washed chicken. The US pharmaceutical industry has also sought greater access to the NHS and more protection from

cheap generic rivals. (May and Trump talks likely to reveal cracks in 'special relationship',
26th January 2017, The Guardian)

Another major area of overlap was between food production and policy. In fact, food standards featured in 37% of articles about food. Often, multiple food-related issues appeared in a single article; these included food safety (39% of articles mentioning food), food prices (31% of articles mentioning food), food quality (21% of articles mentioning food) and health in relation to food consumption (20% of articles mentioning food). Typically, quote [9] draws attention to *controversial* North American food production and processing practices: the cultivation or presence of GMOs in foods (57% of articles mentioning food), the use of hormones in beef rearing (55% of articles mentioning food) and the practice of sanitising chicken carcasses in chlorinated water (59% of articles mentioning food). Other issues such as the use of ractopamine and lactic acid in pork production, pesticide residues and the use of controversial food additives were less commonly cited. Moreover, the constellation of GMOs, chlorinated chicken and hormone-treated beef was routinely emphasised in articles discussing post-Brexit trade with the USA.

Trade with the USA featured in 45% of all articles, while trade with the EU had similar coverage (44% of total articles). This latter focus commonly addressed how changes to UK standards and regulations could affect the UK's exports to the single market (see quote [4]). The issues of compliance with EU food safety regulation raised in quote [8] were also addressed under the *farming* theme as related to the economic viability of British farming after Brexit (51% of articles coded under farming). Furthermore, issues such as the absence of European subsidies (26% of articles coded under farming) and the competition presented by cheaper food imports (31% of articles coded under farming) arose in this context.

The debate over the viability of British agriculture focussed on the influence of cheap food imports. Connected with this issue was the productivity of different farming systems (33% of articles discussing farming), especially due to the use of pesticides (20% of articles discussing farming) and hormones in animal production (55% of articles discussing farming) and protection of both animal welfare and the environment (respectively 28% and 25% of articles discussing farming). The presence of these themes is exemplified by quotes [10] and [11].

[10] Haworth's only concern was that if such controversial American products were allowed into the country, British farmers should be able to use the same production techniques to ensure

"an even playing field". (Is chlorinated chicken about to hit our shelves after new US trade deal?, 29th January 2017, The Guardian)

[11] "Dr Fox, who has the support of Boris Johnson, the Foreign Secretary, wants agriculture to be included in free trade discussions and believes chlorine-washed chicken is safe to eat and should be included in any deal.

But Michael Gove, the Environment Secretary, has insisted that British food standards will not be downgraded in any way, and Andrea Leadsom, the Leader of the House and former environment secretary, is opposed to the move, saying cheap, poor quality imports could damage British farming." (Liam Fox mocks concerns over chlorine-washed chicken and insists it is just 'detail' of trade deal with US, 24th July 2017, Telegraph)

It is noteworthy that 39% of all articles discussing policy, food and trade fell under the "Brexit Main/GMO mention" category (see Table 3.1). In contrast, only 9% of all articles contained what could be considered as an explanation of the science behind GMO technology with these articles falling entirely into the Brexit mention/GMOs Main cell (see Table 3.1). When scientific issues were given more space, they were usually accompanied by a discussion of the risks and benefits of GMO technology. The more extensive coverage of GMOs in this type of articles allows for the exploration of the wider context within which the views on GMOs and Brexit are formed as exemplified by quote [12]. The latter was extracted from an article written for BBC News about the approval of a new GM wheat field trial at the Rothamsted research institute.

[12] The GM wheat has been engineered to use sunlight more efficiently and has boosted greenhouse yields by up to 40%. Researchers in Hertfordshire now want to see if they can replicate these gains in the field. Critics say that boosting wheat yields is not an answer to global food shortages. (New 'super yield' GM wheat trial gets go ahead, 2nd February 2017, BBC News)

Notably, articles such as this one were less frequent occurrences, while the political discourses on Brexit dominated the thematic analysis, with a particular comment on post-Brexit trade

agreements, food imports from the United States and potential impact on the UK's food standards and farming practices. The political framing of biotechnology in the media is not unprecedented, in fact, there has been news coverage of the way GMOs are regulated in the UK (Ruan, Yang and Jin, 2019), nevertheless the frequent overlap of these themes created a very specific framing of the issue of both GMOs and Brexit within the political discourse while the scientific debate on the technology lied outside of such discussion.

3.4. Analysis of arguments and ideologies

An analysis of argumentations was used to identify underlying ideologies represented in the corpus; this aided the location of discourses around Brexit and GMOs within the broader 2017 socio-political timeline. The analysis, as described below with the help of quotes from relevant articles, showed the same themes were used as part of opposing arguments that addressed GMOs and/or Brexit. More specifically, it was evident that Brexit proponents took the initiative in starting the debate in these areas; this line of argument was then rebutted in anti-Brexit articles.

3.4.1. Free trade: centre of the pro Brexit/pro GMO argumentation.

One of the ideologies that emerged from the corpus was the idea that Brexit would encourage free trade (mentioned in 57% of all articles) with non-EU countries and that this would snowball into a more economically prosperous UK. Benefits mentioned in support of free trade, as hinted in the stance analysis, were the idea of being able to harness the potential of innovative technology free of the regulatory restraint represented by the EU and the possibility of cheaper imports arriving through new food trading routes. This ideology was central in the political discourse and its supporting arguments were met with criticism from political opponents. The next section will describe in depth each of the arguments for Brexit and free trade as well as the corresponding criticisms towards this ideological framing which were heavily represented in the corpus.

3.4.1.1. I want to break free: discursive representation of EU regulation as a burden

The opportunity to invest in technology and to strive for economic growth (mentioned in 25% of all articles) was a key argument in pro-Brexit articles. Headlines aligned with this sentiment

read *Brexit Britain is forging ahead with scientific research and discovery* (Telegraph) or *'We CAN call the shots!' Diplomat hits back at team Juncker and predicts golden UK future* (Express). Articles such as these centred around the contention that the UK was being *held back* by its membership to the European Union. These articles invoked the discourse of the EU as a *prison*, hindering UK progress thus evoking the idea that the UK's entrepreneurial spirit would be unfettered post-Brexit. This sentiment is exemplified by quote [13] which also contains an evocative representation of the EU as a *life-sucking* monstrous creature.

[13] "Europe will doubtless survive without us – we won't survive unless we break free from the EU which resembles an economic octopus sucking the life out of a still healthy economy." (Brexit news - former UK diplomat says Britain can negotiate with EU on own terms, 29ᵗʰ June 2017, Express.co.uk).

This argument is in line with sentiments of Euroscepticism and the refutation of a supranational control system creating the rules and putting on *the brakes* on the development of ground-breaking technology. It was argued that such regulation dampened creativity in product development; the most cited examples of this within the corpus were the fields of cryptocurrencies, Artificial Intelligence (AI) and gene editing (as seen in quote [14]). AI encompasses emerging technologies such as self-driving cars, drone technology and precision agriculture; whereas gene editing is a newly developed genetic engineering technology that allows for precise modification of DNA in food crops and other organisms (as explained in section 1.2.2). The reference to gene editing in these articles was made to the technology in general or to its medical application for the eradication of genetic diseases with no mention of its food or crop applications.

*[14] Regulatory frameworks in Europe put the brakes on development on promising technologies such as cryptocurrencies, "flying taxis" and **gene editing**, while autonomous vehicles and drones face fewer obstacles, the report says (Reuters).*

Notably, GMOs as such were not explicitly mentioned amongst these futuristic-sounding *new* technologies (see the reference to *flying taxis*). This is understandable since genetic engineering has been in use for a long time. Nevertheless, gene editing of crops requires the same genetic

transformation protocols that are needed to generate conventional GMO crops. According to supporters of Brexit mentioned in this corpus, rethinking the current legal framework for GMO crops could encourage investment in research and technology, catalyse innovation and benefit the productivity of UK farms as exemplified by quote [15] below.

[15] The eponymous Sainsbury Laboratory is attempting to grow blight free GM potatoes - eradicating a disease that costs the industry more than £5 billion a year. A British Innovation Principle would allow these scientists the space to flourish. (Brexit Britain needs a new innovation culture, not just investment, in order to take off, 21st November 2017, The Telegraph)

Explicit mentions of GMOs such as this featured within a more *grounded* version of this pro-Brexit discussion on economic growth and innovation, especially in the field of agriculture with mentions of *genetic modification*, *GM crops* and *blight free GM potatoes*. Whether consciously or unconsciously, social actors seem to share an understanding that genetic modification and gene editing are separate, when in fact they can both be used to produce what, for the moment, are still legally defined as GM crops. In this respect, some have argued that GMOs are ill defined and that the term *GMO* is often used improperly (Jiang *et al.*, 2018). A reflection on this idea will be provided in the general discussion (chapter 6). For now, it is important to highlight that in the corpus of news articles GMOs are rarely portrayed positively except in light of a plan for the growth of the UK economy and R&D (8% of Brexit Main articles).

3.4.1.2. An even playing field

In pro-Brexit articles, frequent were mentions of the benefits that Brexit would bring to the farming industry in the UK. The idea that Brexit would help farmers was seen in two particular discussion points: the potential to eliminate unfairly distributed European subsidies to agriculture, and the possibility to harmonise food production regulations across the Atlantic. The first argument is based on the idea that EU funding to agriculture has been inadequate and maldistributed and that it has not been tailored to UK farming, hence not addressing the needs of local producers. This argument also furthers the idea that the EU is an overly strict and controlling entity and that the UK's membership to the EU has not benefitted the UK economy. Secondly, pro-Brexit articles support the harmonisation of UK food and farming regulations

with the ones in the United States. This emerged during discussions on the UK-US trade agreement negotiations. According to this argument, British farmers would be able to operate on what is described as an *even playing field* of regulations. The idea behind this would be that, if the EU's regulations on issues such as GM crops and pesticides were to be redesigned according to the US model, farmers would have the opportunity to access instruments such as GM crops and pesticides similarly to their US counterparts.

The idea that harmonising standards would have a positive effect on UK farmers' livelihood was strongly criticised in anti-Brexit articles. The argument being that the farming industry in the US is *high tech* and way too powerful and efficient for British farmers to be able to compete with US food imports, even with the creation of a set of rules that is similar between the two countries (see quote [10] and [16]).

[16] That isn't a level playing field, that isn't an equal opportunity, that is the economics of the madhouse that will lead to us simply sucking in foods from other parts of the world produced to different standards (How Brexit Could Force UK Farmers To Lower Standards To Compete With US Meat Market, 7ᵗʰ October 2017, The Huffington Post)

3.4.1.3.   Empire strikes back: the anti-Brexit critique

The pro-Brexit idea of *taking back control* of trade, regulation, scientific development and investment in innovation was criticised as unrealistic by opponents for more than one reason. Firstly, there are those suggesting EU regulation was the last safeguard to prevent environmental degradation and that leaving the EU would leave the UK exposed (see quote [17]).

[17] Membership of the EU has been essential for environmental protection. The habitats and birds directives, for example, provide far stronger safeguards than any of our domestic laws by protecting specific species and the places they live. Moreover, challenges such as air pollution, sewage in the seas and threats to migrating species don't queue up politely at national borders, waiting for their passports to be checked. By their very nature, environmental problems are trans-boundary. (A 'green guarantee' could stop Brexit ruining our environment, (13ᵗʰ February 2017, The Guardian)

Others argued against the idea of a protectionist EU and critiqued the *UK's interests first* agenda pointing out that localism and UK-centric sentiment would be counterproductive towards striking deals with non-EU countries. This was portrayed as contradictory in light of other pro-Brexit arguments such as the idea of a new *global Britain* (mentioned in 22% of all articles). This last argument was also criticised, particularly for its tones of new *imperial dreams* and reminiscence of the pursuit of a *geopolitical hegemony* (as seen in quote [18]).

*[18] Bilateral trade agreements with other big markets are liable to leave us similarly exposed. Development secretary Priti Patel recently announced that the City of London should transform into a financial hub for the developing world and gateway to **imperial dreams** of Africa 2.0. […] MPs and humanitarian groups have criticised the visit due to human rights abuses including Saudi Arabia's devastating war in Yemen, which has killed over 10,000 civilians. Such concerns have been pushed aside with the Saudis considered a key ally in US-UK **geopolitical hegemony** of the Middle East. (Post-Brexit Britain: This is what **taking your country back** looks like, 11th April 2017, Independent).*

The *taking back control* agenda was thus denigrated as protectionist nationalistic fervour and a product of a political stance that was portrayed as inward looking. Frequently, parallels were drawn with Donald Trump's *America First* slogan. Such critique was flanked by the argument that, outside of the EU, the UK had very little negotiating power and might be bullied into subjecting to other countries' demands in terms of cutting down regulations or accepting controversial political agendas to be able to survive post-Brexit. This general dissent towards pro-Brexit statements on trade was highly represented in the corpus, especially tied to discussions of potential agreements with purportedly powerful countries such as the United States. It was explicitly argued that striking a trade deal with the United States would limit regulatory freedom as the US would demand a raft of regulatory changes that would favour US agri-business. In short, the UK would be *swapping one diminution of sovereignty for another.*

3.4.2.   Trade with the USA: a special relationship

Discussions on international trade arose in the corpus as early as January 5th 2017 in an article from BBC news discussing the future of UK farming after Brexit. Although some articles mentioned trade with the commonwealth and non-EU countries like China, the United States was the most frequently discussed as a potential trading partner (56% of articles). The first

flurry of articles discussing a potential UK-US trade deal was found in correspondence of the UK prime minister Theresa May's visit to the USA (as previously seen in Figure 3.1).

The press, which presumably had access to the speech before the official press conference, reported parts of the document and commented on her statements before and after the visit took place. In the speech she expressed her will to renew the UK's *special relationship* with the United States referring to the alliance between the two countries. This way of referring to the UK-US diplomatic relations is not new (Marsh and Baylis, 2006), rather it has been used to describe positive diplomatic relationships between heads of state and Theresa May herself is cited as referring to the history of this alliance as seen in this quote ([19]) from the Daily Mail online.

[19] Her message in the U.S. will include elements of gentle history lesson, as she urges the two nations to "lead together." In a speech to Republican legislators in Philadelphia on Thursday, May plans to say that the trans-Atlantic relationship "made the modern world" and built the institutions that have underpinned the global order since the end of World War II. ("May-Trump meeting to test UK-US 'special relationship', January 26th 2017, Associated Press in the Daily mail online)

3.4.2.1.   The Trojan horse

Her description of a UK-US trade deal as a good opportunity for the country was highly criticised in the digital media and the renewal of the *special relationship* described as a *pastiche* by opponents, a bad copycat of what once was a strong alliance between Ronald Reagan and Margaret Thatcher. This portrayal entailed a multifaceted critique of the deal. Firstly, the idea of a *quick* trade deal, which was mentioned by citing Donald Trump's speech, was described by opponents of Brexit as *reckless* and *rushed* in the light of the fact that, usually, trade agreements take years to negotiate (see quote [20]). Particularly, due to the UK's supposed lack of negotiating experience, the possibility of getting a good deal was considered very slim. In other words, should Theresa May continue with her *hasty courting of the US*, the net result would be an influx of food produced with lower animal welfare and environmental standards as depicted by quote [21].

[20] "A rushed trade deal with Trump may give ministers cover for their dangerous Brexit strategy but it will not hide the risk that this could be a Trojan horse for NHS privatisation,"

warned the shadow health secretary, Jonathan Ashworth on Monday. (A UK trade deal with Trump? Be careful what you wish for, 16th January 2017, The Guardian)

[21] New trading relationships with states outside the EU could lead to increased competition from countries with lower food, animal welfare and environmental standards (After Brexit: What happens next for the UK's farmers?, 5th January 2017, BBC News)

Secondly, in these articles, Donald Trump was portrayed as a controversial leader, associated with objectionable views on warfare, torture and a reluctance to support NATO. The drawing up of a trade agreement was reported as *contamination by association*, thus causing Theresa May to be embroiled with these controversial issues. Articles reporting this negative sentiment towards trade with the USA contained warnings such as *careful what you wish for* or *Theresa May's hasty courting of the US should be ringing alarm bells* suggesting a deal would be a dangerous choice.

The final criticism centred on the argument that the UK would be in great need of a trade agreement after Brexit. An article from the Guardian went as far as to use expressions such as *begging for trade, any trade,* or *scavenging* (as seen in quote [22]).

[22] The reality will be tawdry scavenging around the gulf dictatorships, beseeching the bemused Chinese, trying to recreate a lost white Commonwealth – and now begging Trump for trade, any trade. (On her flight May should read Trump's book~ the other guy is always shafted, 26th January 2017, The Guardian)

This need would put the country in a position of disadvantage when negotiating any deal and cause the UK to make *concessions* meaning a trade agreement would in fact be a Trojan horse (as mentioned in quote [20]) riddled with hidden risks. Particularly, the latter included possible privatisation of the NHS, lobbying by US pharmaceutical industries, lowering of local food regulations and consequent incoming of competitively priced foodstuff produced with subpar production standards (see quote [22]).

3.4.2.2. The sloppy Joe: a negative framing of American food

The inferiority of US standards was core to the anti-Brexit ideology. In fact, there was a highly covered critique towards import of *US-style* cheap food into the UK. In articles reporting this,

Brexit was often portrayed as an opportunity for US *hi-tech* big companies to lobby for the lowering of food production standards. Articles portrayed US imported foods as produced under *sloppier* standards or deceiving the consumer by looking fresher with the use of controversial *chemicals* (see quote [23] below).

[23] Many in Europe feel US farmers adhere to far sloppier standards, lower quality production, and more divisive processing, all hidden under chemicals. American producers also use 'washes' to increase the shelf-life of meat, meaning it's not as fresh as it seems. (Chlorinated chicken and acid-washed meat could soon be sold in British supermarkets, 29th January 2017, Mirror Online)

This argument was furthered by criticism of corporate intensive production in the United States, specifically *Big Food* which would not only competitively overwhelm smaller size UK food businesses but also endanger consumer health. In fact, according to anti-Brexit arguments, such dominance would create an unfair advantage in trade negotiations, pushing the UK to lower food safety and animal welfare standards, thereby sacrificing overall food quality to match US lower prices.

Products mentioned in anti-Brexit arguments such as these were foods derived from purportedly controversial agricultural and husbandry practices such as beef coming from animals reared with the use of growth hormones, chicken washed in chlorinated water to eliminate bacteria and foods containing ingredients coming from genetically engineered crops (such as high fructose corn syrup). Joanna Blythman, reporting for The Guardian, described these foods as *beef from cattle implanted with growth hormones, chlorine-washed chicken, and unlabelled genetically modified (GM) foods"* (see quote [24]).

[24] "Those of us who want to eat safe, healthy food awoke to a nightmare on Tuesday, a chilling interview on Radio 4's Today programme. Bob Young, chief economist at the American Farm Bureau Federation, made it crystal clear that any US trade deal struck by Theresa May would be contingent on the UK public stomaching imports of US foods that it has previously rejected: beef from cattle implanted with growth hormones, chlorine-washed chicken, and **unlabelled genetically modified (GM) foods**. *(Is chlorinated chicken about to hit our shelves after new US trade deal?, 29th January 2017, The Guardian)"*

As previously elaborated in the magnitude of coverage section, GMOs were often mentioned alongside hormone treated beef and chlorinated chicken and rarely discussed in depth. Nevertheless, a mention was often all that was necessary to immediately discern the stance of the article towards Brexit, trade and American food. This triad of products was already mentioned in articles from January 2017 but their discursive representation within the anti-Brexit ideology was reinforced after UK trade secretary Liam Fox's visit to Washington to initiate informal trade discussions. The importation of chlorinated chicken in particular became ubiquitous in anti-Brexit arguments and was often the centre piece of the Brexit trade discussions in the online and print media alike, as seen in Figure 3.4.

Figure 3.4. Double page spread about chlorinated chicken in the print Daily mail

Figure 3.4. shows a centrespread on chlorinated chicken in the print version of the Daily Mail published on July 27th 2017. The article in question only contained one single mention of GMOs.

Chlorinated chicken refers to the washing of chicken carcasses in chlorinated solutions and although this practice has been long condemned by many countries in the EU, it is considered safe by European safety authorities and widely adopted in the United States. In the corpus there were multiple reports of international trade secretary Liam Fox replying to questions on the topic. In various instances, he expressed a frustration about the British media's attention

towards chlorinated chicken, which he considered safe and of only marginal importance within the broader plan for a UK-US trade deal (as can be seen in quote [25]).

[25] Asked about chlorine-washed chickens Dr Fox responded: "The British media are obsessed with chlorine-washed chickens – a detail of the very end stage of one sector of a potential free trade agreement." (Liam Fox mocks concerns over chlorine-washed chicken and insists it is just 'detail' of trade deal with US, 24th July 2017, Telegraph)

Articles often accused Liam Fox of dismissing the topic, especially with respects to the fact that it was considered a practice potentially used to mask poor hygiene and inadequate animal husbandry practices. In a couple of instances Fox was also reported being mocked and challenged to prove he would be willing to eat the controversial chicken himself (see quote [26]).

[26] 'If the international trade secretary wants the public to trust him, he needs to take the opportunity while he's in the US and devour a chlorine-washed chicken live on camera. The choice of recipe is up to him, but one serving suggestion might be Chlorination Chicken.'(Fox admits UK unlikely to finalise free trade deal with EU before Brexit, 24th July 2017, The Guardian)

Interestingly, discussions about chlorinated chicken continued in the press throughout the entire year, long after Liam Fox's negotiating trip to the United States. Other foods portrayed as controversial, such as GMOs and hormone treated beef, were not discussed to the same degree.

3.5. Framing GMOs outside of Brexit and trade

Arguments against or in support of GMOs outside of the post-Brexit trade and policy framing were seldom encountered with a few exceptions. These articles featured in depth analysis of GM farming, new developments in genetic engineering of food crops and, in two articles only, the case of an unauthorised GM orange coloured petunia found on sale in the UK. Most articles discussing mainly GM farming were reports of Princess Anne's interview to BBC radio 4's programme *Farming Today*. In these articles, she is portrayed as being positive towards GMOs overall although, in the interview she hints to the controversial nature of the topic asserting that

GMOs *divide people*. One of Princess Anne's arguments was the possibility of GM technology to bring *benefits* to UK farming, not only regarding the production of crops that do not normally do well on UK soil, but also to the breeding of farm animals. In fact, she is cited discussing how GM technology could help render rare breeds of livestock more resistant to certain diseases. However, her statements were often reported alongside those of her brother, Prince Charles who has often spoken in favour of organic farming as opposed to GM farming. His views were reported as citations from a previous interview in which, differently from his sister, he shared his strong opposition to the idea of GM farming in general, mentioning what he thought are the risks that GMOs posed to the environment (see quote [27]).

[27] Britain's Princess Anne may have sparked some royal sibling rivalry after saying genetically modified crops had real benefits to offer, putting her at odds with her older brother Charles who says they would be an environmental disaster. (UK royals' sibling rivalry~ Princess Anne says GMO crops have benefits, 22ⁿᵈ March 2017, Reuters)

[28] Referring to plants, she added: "I don't see the problem in saying, 'well is there something we could do to improve their abilities to grow in this country slightly better than they were, with the things they suffer from'" (Charles and Anne at odds over GM crops~ Princess Royal says she would be happy to grow them on her estate, 22ⁿᵈ March 2017, The Telegraph).

Interestingly, although these articles were mostly reporting Princess Anne's interview, journalists chose to juxtapose her opinions on GMOs with those of her brother, giving a seemingly balanced portrayal of the topic. This way of balancing out the debate was common across articles which discussed GMOs in depth. Nevertheless, there is a striking difference between the tentatively positive language used by princess Anne such as *I don't see a problem* or *slightly better* (as seen in quote [28]) and the strong hyperbolic words used by prince Charles, such as *environmental disaster*.

Advantages and disadvantages of GMOs were also reported in articles which followed the authorisation of a field trial for a GM wheat that was newly developed at the Rothamsted Research Institute in the UK. This crop was genetically engineered to carry out photosynthetic processes more efficiently allowing it to produce bigger grains. Articles discussing this topic mention advantages such as the increase in economic benefits to farmers, the reduced effects of the crop on the environment and the possibility to help feeding the planet. Firstly, proponents of the technology are cited discussing the ability of the new GM wheat to be more productive

than its conventional counterpart, pointing out the increased economic benefits such crop would have on British farmers, and the return this crop represented for taxpayers whose money had been invested in this research (see quote [29]).

[29] Malcolm Hawkesford, head of plant biology at Rothamsted Research, said: "These field trials are the only way to assess the viability of a solution that can bring economic benefits to farmers, returns to the UK taxpayer from the long-term investment in this research, benefits to the UK economy as a whole and the environment in general (GM 'superwheat' trial will start in the spring, 2nd February 2017, The Times).

Secondly, developers of this new crop also discuss the fact that this technology entailed a new approach to increasing crop productivity which, they assert, is different from previous attempts. They also highlighted that this wheat could help reduce fertilizer inputs in UK agriculture and the positive effects this would have on the environment. Lastly, there were mentions of the potential for this technology to help address the need to *feed the planet* by overcoming what has been called a *yield stall* in agriculture. The latter describes the phenomenon according to which agricultural productivity has reached a plateau and crop yields of staple crops such as wheat, have not been increasing for years.

Supporters of this crop have been cited stating that this new technology could help resolve this issue. This last pro-GMO argument was counteracted by citing Liz O'Neill, a spokesperson for the NGO GM Freeze which advocates for a GM-free UK (see quote [30]).

[30] "People aren't starving because photosynthesis isn't efficient enough; people are starving because they are poor," said Liz O'Neill from GM Freeze. "Techno-fixes like GM wheat suck up public funding that could make a real difference if it was spent on systemic solutions like waste reduction and poverty eradication. Then we could all enjoy food that is produced responsibly, fairly and sustainably". (New 'super yield' GM wheat trial gets go ahead, 1st February 2017, BBC News) "

In her statements she refuted the idea that increasing productivity would contribute to solving global hunger, instead she introduced the argument that the main issue to be addressed was not a technical one, rather it was linked to poverty and should not be solved through development

of technical solutions (*techno-fixes*), but through increased attention to issues of social justice such as science accountability, fair trade and sustainability in food production.

As discussed in the analysis of stance, Brexit was marginal in articles which had a strong focus on GMOs. As mentioned earlier in this chapter, Brexit was often added to make articles on GMOs more newsworthy. However, the lack of discussions on Brexit in articles with a focus different from policy or trade, might also be due to the fact that some of the social actors intervening in in-depth debates about GMOs intentionally did not provide opinions on Brexit. Noteworthy is the case of Christine Raines, shown in quote [31]. Prof Raines is a scientist at the Rothamsted research institute who, in early January 2017 was interviewed by the I Newspaper regarding public perception of GM crops. In the interview, she was asked to weigh in on Brexit, but she refused, though she stated it could allow the country to have greater autonomy in the development of genetic engineering.

[31] Prof Raines refuses to be drawn on whether Brexit will be a good thing for Britain's GM industry, [...] However, she concedes a break with Europe will give Britain greater autonomy when it comes to GM crops, which at least provides an opportunity to push the technology in this country. (The public is finally coming round to GM crops, January 2nd 2017, i-newspaper)

Although Christine Raines did not provide any clear information regarding her stance on Brexit, statements like hers regarding the potential scenarios provided by Brexit are in line with arguments in support of the broader Brexit agenda of *taking back control*. This sentiment was also expressed in other articles which discussed UK farming and technology development. In these, Brexit was portrayed as a *chance* or an *opportunity*. Therefore, social actors who openly supported GMOs in the corpus, despite not expressing any positive or negative sentiment towards Brexit, often recognised independence from EU regulation as a new avenue for the technology.

3.6. Summary of digital media findings

This critical discourse analysis of the portrayal of GMOs and Brexit in the digital press showed that GMOs were often marginal within politically centred articles about the Brexit discourse. The opposite was seldom true, happening only in articles discussing the benefits and challenges of GM agriculture or reporting novel biotechnological advances. Within the Brexit discourse, GMOs appeared on both sides of the debate. In fact, GM foods were mentioned in the anti-

Brexit narrative as horrors coming from abroad should a trade agreement be struck with the United States after Brexit. On the other side of the debate GM crops and gene editing technologies were mentioned as a source of revenue for UK farmers or an opportunity for research and development respectively. The prominence of these portrayals in the corpus also showed the lack of representation of pro-GMO/anti-Brexit and anti-GMO/pro-Brexit arguments.

The highest peak in the concentration of anti-GMO/anti-Brexit articles was seen in correspondence of progressions in the negotiation of trade agreements with the United States. Particularly, coverage of GMOs, flanked by chlorinated chicken and hormone treated beef, was highest during coverage of the international trade minister's visit to the United States. As hinted in the introduction of this thesis, these topics were considered contentious in EU/USA international trade talks long before the Brexit discourse. GMOs, in particular, are still subject of regulatory frictions amongst nations of the United Kingdom (Ryan-Hume, 2015). Therefore, their fleeting presence in anti-Brexit arguments is not neglectable seen as they evoke controversy. Furthermore, the representation of GM foods as US products is constructed upon a political view of the EU as a protector, safeguarding the UK from unsafe imports. In this framing US foods are portrayed as subpar and produced with sloppy standards meaning the inclusion of GMOs within these *alien foods* suggests the intentional use of *othering* discursive strategies (Zajc and Erjavec, 2014) in support of the anti-Brexit argument.

On the other side of the debate, articles which contained positive discursive representations of GMOs often used *potential* framing. For instance, articles about the high yielding GM wheat discussed potential economic benefits for farmers and the potential to help feed a growing global population. Articles discussing GM farming in the UK reported opinions about the technology *potentially* being adopted after Brexit, *potentially* being a bonus. In feature articles where journalists chose to include opposing opinions on the technology, potential language was trumped by strong emotionally charged representations of environmental degradation, rural poverty, and social injustice.

These findings suggest the two sides of the debate, although they seemingly both discuss GMOs, are not only using different linguistic strategies, but are in fact portrayed as if talking about two very different issues. On one side alien US processed foods containing GM ingredients, on the other, genetically modified crops made in UK.

4. Critical discourse analysis of the Twitter discourse on Brexit and GMOs

As mentioned in section 2.3.3, the Twitter corpus comprised of 4449 tweets. Upon the first screen, 52 tweets appeared irrelevant to the topic under analysis and were therefore omitted. The remaining 4397 tweets are the units of analysis in this chapter, which presents a critical discourse analysis of tweets mentioning both GMOs and Brexit. The chapter will provide a temporal overview of tweets in the year 2017, highlighting discursive moments when Twitter users were most active with regards to the topics under analysis. The chapter will also compare original content versus retweets, provide a classification of all tweets according to their content, and shine a light on the uptake of news items from the previous chapter. Mirroring the structure of chapter three, it will establish each tweet's stance regarding both GMOs and Brexit and provide details on themes, arguments and underlying ideologies in the debate.

The comparison of results from this chapter with those from the digital media analysis will highlight how the discourse on Brexit and GMOs across the two platforms was not dissimilar in many ways. However, not all the news items in the digital news were disseminated on Twitter and, at the same time, some issues which were not prominent in the digital media corpus, were largely popular on Twitter. The analysis of tweets revealed how the overall stance of original tweets was even more predominantly negative towards both GMOs and Brexit than that found in the media, with arguments revolving around disgust towards American food and a rejection of government-imposed decisions on GM crops furthered by a select few social actors involved in journalism, policy and ant-GMO activism. Arguments against GMOs and Brexit were often supported using hyperbolic language and emotional triggers with a few instances of dissemination of inaccurate information. Moreover, tweets containing negative sentiment towards both GMOs and Brexit were more successfully retweeted than positive tweets.

4.1. Temporal overview of tweets

At a first glance, the temporal distribution of tweets mentioning GMOs and Brexit in 2017 seemed to correspond to that found in the digital media. To accurately compare the trends in the publication of articles and tweets in both corpuses, the percentage of articles per day was juxtaposed to the percentage of tweets per day and graphed in Figure 4.1.

Figure 4.1. Temporal overview of percentage of articles and tweets juxtaposed to a timeline of relevant socio-political events.
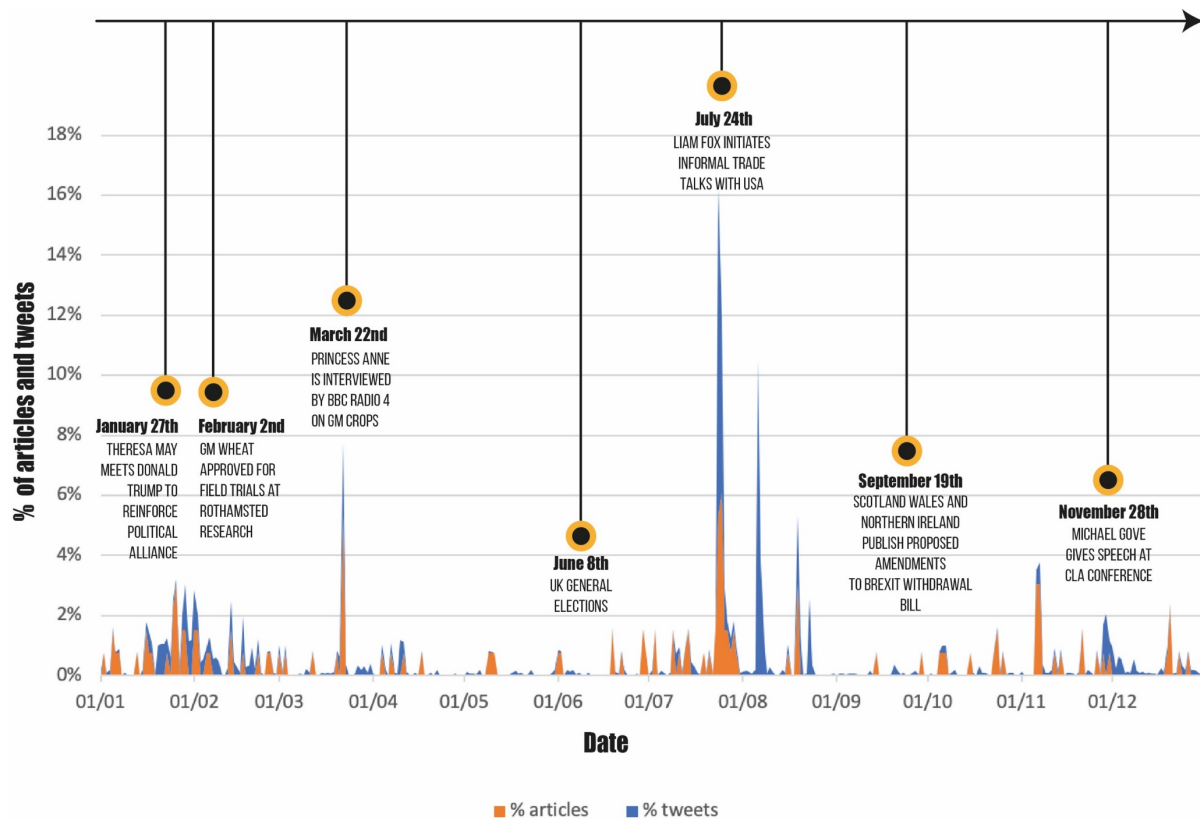
Figure 4.1 provides a temporal overview of the percentage of news articles (orange) and tweets (blue) published per day throughout the year 2017 juxtaposed with a timeline of socio-political events that could have influenced coverage of GMOs in the light of Brexit throughout the year.

From this presentation, it is evident that, in multiple occasions, a high percentage of tweets corresponded to a high percentage of news articles. This was especially visible in January, when a consistent stream of tweets was published surrounding initial discussions on international trade, similarly to the flurry in articles following Theresa May's visit to the United States found in the digital media. This similarity was also seen in March, although perhaps not as intensely, surrounding princess Anne's interview for Farming Today on the potential of GMO technology to be adopted after Brexit. Furthermore, the publication of tweets surrounding Liam Fox's visit to the USA on July 24th was very high, suggesting there might be an intense debate on this topic on Twitter as well as in the digital media. In fact, it is in correspondence of Liam Fox's visit that the highest peak in tweets is found (10.8% of all tweets). This tendency of tweets to intensify during high media coverage suggests that, when an issue was heavily covered in the news media, it was not only likely that it would be picked up on Twitter but also that it would be highly featured and potentially contribute to a debate

on this social media platform. However, there were a few exceptions to this tendency, in the sense that there were news items whose publication did not coincide with an influx in tweets[9]. Also, there were flurries in the number of tweets that were not met with a corresponding influx in media coverage. Below, key examples of cases where an influx in tweets corresponded to very little to no media coverage are presented.

The first example of this tendency was seen on 20th January and 21st January 2017 as seen in figure 4.1. This influx in tweets corresponded to tweets discussing a news item published on AnonHQ.com about GMO labelling regulations in the United States. The fact that these tweets did not correspond to the publication of news items from the UK national media is not surprising seen the main focus of the article, however they were picked up by the keyword search because Brexit was also mentioned in the headline. The interesting case presented by this article will be further analysed in this chapter (section 4.2.1.1) and also in the ego network analysis presented in chapter 5 (section 5.2.4).

On February 8th 2017 another small influx in tweets was found without correspondence to relevant media coverage. This related to a cluster of tweets mentioning an article published on July 18th 2010 in The Guardian titled *Scientist leading GM crop test defends links to US biotech giant Monsanto* field trials of GMO potatoes in the UK. This article discusses Jonathan Jones, a British plant scientist and biotechnology advocate, and his ties with the agribiotech company Monsanto in relation to approved GM potato field trials in the UK. A peak characterised by similar content was found on February 20th with tweets again mentioning an article from the website of an anti-GMO NGO called GM Watch. The article's focus was Jonathan Jones' potential affiliation with the biotech multinational company. This flurry of tweets so specifically discussing Jonathan Jones may have been sparked by an event taking place at London City College and organised by the Food Research Collaboration. The talk titled *Dysfunctional regulation of GM crops; scope for improvement post-Brexit?* took place on February 15th and featured the scientist as keynote speaker. Though not covered in the media, several tweets were found to discuss both the event and the scientist involved.

Another flurry of tweets was found discussing a statement by Viscount Ridley published in *The House* on March 27th regarding Brexit as an opportunity for research and development in the field of gene editing applied to both medicine and agriculture. The article talked about how Britain could be leading in the development of applications to this technology especially in

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[9] Information on which media articles were not cited on Twitter is available in Appendix B

light of the fact that, according to Viscount Ridley, the EU was being very slow in producing an opinion on the matter.

The most striking difference with the digital media is seen on August 6th 2017. Upon further investigation, this influx in published tweets happened in correspondence of the publication of tweets from Scottish political figures showing dissent towards the possibility of GMOs entering the UK after Brexit. This was not the case in the digital media, where Scottish regulation was mentioned in only 8% of the corpus. Within this small cluster, only one article was published in August 2017 discussing minister Liam Fox's proposals regarding international trade and agreements on imports. Further coverage of the issue was present later in the year, specifically on September 19th, 2017, in correspondence of the publication of a letter expressing the opinions of the devolved governments of Scotland and Wales. This peculiarity in the data will be further elaborated later in this chapter.

Finally, another obvious difference between the tweets and digital media was in late November. In fact, a flurry in tweets and retweets was found from November 29th continuing into the first week of December following the publication of a news article in the Telegraph. The piece discussed a speech by the environment secretary Michael Gove regarding GMO cultivation in the UK after Brexit. Although the news item in question was present in the digital media corpus, Gove's statements on GMOs did not correspond to the same heightened media coverage as had occurred previously in response to statements by Theresa May in January or Liam Fox in July. It is noteworthy that some instances where tweets did not align with an influx in digital news articles were generated by the reiteration of Joanna Blythman's popular news item on chlorinated chicken and other potential USA imports. The tendency of this article to be tweeted throughout the year characterises a different pattern compared to other news disseminated on the social media platform, so it will be analysed in more depth in chapter 5.

The comparison between the daily percentage of articles with that of tweets really highlights three main tweeting behaviours in the Twitter corpus: higher influx in articles compared to tweets, same coverage in both environments and higher influx in tweets with little to no coverage in the media. Firstly, points where there is a visible similarity between the percentage of tweets and the percentage of articles suggests that some news items from the digital media could have been highly cited in the Twitter sphere thus eliciting a large debate on the platform, or that highly relevant societal issues were discussed on each platform independently. Both these possibilities will be explored in the analysis of type of tweets (section 4.2), however this section already hinted to the fact that there is a certain degree of uptake of popular news items on the platform. Secondly, when high coverage was not always a driver of tweeting activity a

high number of tweets could correspond to one popular news piece published in the national news or elsewhere. In fact, there were peaks in tweeting activity that were not conducible to the publication of a news item in the digital media analysed in chapter 3. This suggests some socio-political issues that were not considered newsworthy in the national press were of interest to Twitter users and were potentially covered by *alternative* sources of news. Thirdly, as previously mentioned, the publication of some news items did not correspond to a high number of tweets.

Patterns in tweeting behaviours will be further explored in the following sections where connections between media coverage, tweet content and typologies will be described in more detail. In the next section the number of retweets will be compared with original content and users that were the most prolific in the production of original content will also be mentioned.

4.1.1. Temporal overview of tweets and retweets

Every relevant tweet was further categorised based on whether it represented *original* content or *retweeted* content. This categorisation resulted in 1246 original tweets and 3151 retweets. The tweet classification was then transported into NVivo for in depth coding and analysis, as explained in section 2.3.2. As can be seen in Figure 4.2, the number of original tweets and retweets fluctuated throughout the year 2017 with the highest concentration of both original tweets and retweets on July 24th with 70 original tweets and 413 retweets and August 6th with 50 tweets and 415 retweets. These two peaks corresponded respectively to a discussion around Liam Fox and US food imports and the debate initiated by a small number of political figures regarding the Scottish GMO-free status and potential import of GM foods in the country after Brexit.

Figure 4.2. Temporal overview of original tweets and retweets
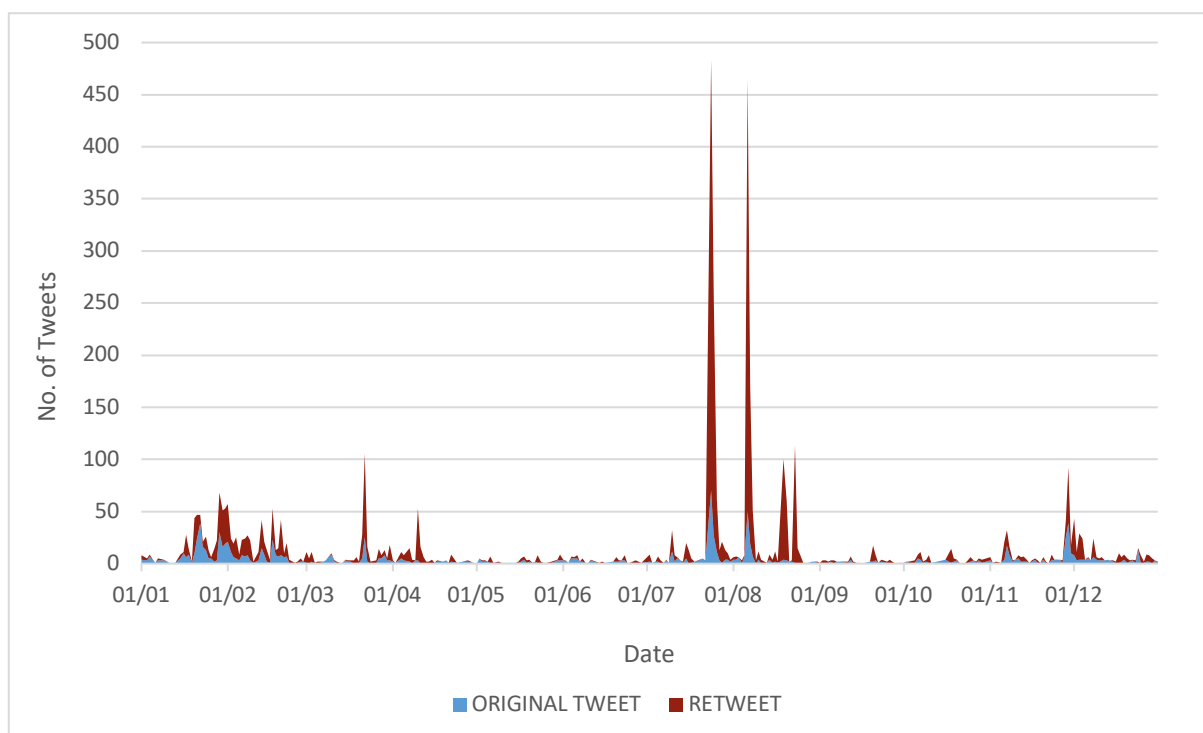
Figure 4.2 shows the number of original tweets and retweets throughout the year 2017.

Examples of tweets published on these crucial dates are provided by tweets [1], [2], [3] and [4][10]. Tweet [1] is a reconstruction of one of the original tweets produced on July 24th by a private individual mentioning chlorinated chicken, genetically modified food and hormone treated beef as examples of potential imports from the USA to the UK. Tweet [2] represents one of many retweets of a popular tweet by Paul Flynn expressing his disapproval regarding Liam Fox's statements on the import of GM food and chicken from the USA. The late Welsh MP was the third most retweeted political figure in the entire corpus following Alyn Smith, a Scottish member of the European Parliament (MEP), and Fergus Ewing, a Member of the Scottish Parliament (MSP). It is noteworthy that Paul Flynn, Alyn Smith and Fergus Ewing only produced one tweet each, [2], [4] and [3] respectively, and yet they were amongst the most retweeted users in the corpus. Furthermore, their tweets were the three most retweeted tweets in the corpus. Respectively Paul Flynn's tweet about Liam Fox was retweeted 382 times, Alyn Smith's tweet on GMOs being *forced* upon Scotland and containing Fergus Ewing's

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[10] Please note, as explained in section 2.3.3.1 tweets published by private individuals or by public figures in a private capacity were not reported. A *constructed* tweet with similar sentiment and structure was created to illustrate the language used, the emerging themes and arguments.

tweet as embedded content was retweeted 336 times and Fergus Ewing's own tweet regarding his letter to the UK government was retweeted 175 times.

[1] Our supermarkets will get chlorinated chicken, GM food and hormone beef but they are forbidden in the EU. https:/...

[2] RT @PaulFlynnMP: Disgraced Defence Minister Liam Fox explains that Brexit means GM food & Chlorine washed chicken. £350 million a week for NHS?...Go whistle!

[3] I have written to UKGov to seek assurances that it will not impose cultivation of GM crops against Scotland's will. https://t.co/o6vOcZt76y

[4] RT @AlynSmithMEP: Brexit could see GM crops forced upon Scotland against our will, where we currently have EU protection from them. https:/...

The high concentration of both original content and retweets on July 24th suggests that Liam Fox's statement not only generated a large discursive moment on Twitter, but that the debate was mostly driven by tweets from political figures with an interested audience. In fact, following their publication, these tweets resonated through these accounts' large following and were amplified by retweets. It is interesting to note that these political figures were not central in the Brexit/GMO debate in the digital media, however, they overwhelmingly surpassed the popularity of any other tweet in the corpus. Despite this, it needs to be noted that their popularity was also short lived, meaning their intervention in the debate was highly topical, but only relevant to the conversation over the devolved governments' rejection of GMOs and thus never appeared again in the corpus.

Other notable mentions of public figures or organisations amongst frequently retweeted users were politicians such as @GreenKeithMEP which is the Twitter account of a former Green Party MEP, Keith Taylor and @HannahB4LiviMP, the account of Hannah Bardell, an SNP spokesperson and member of parliament. The former tweeted about the Green party agenda and the latter expressed concern over the potential dismissal of the Scottish GMO ban by Liam Fox.

Different from the *Scottish debate* was the tweeting and retweeting behaviour associated with NGOs' accounts. In this category, accounts that were most often retweeted were @GMWatch and @GMFreeeze. The GMWatch is the official Twitter account of an independent

organisation whose mission is to counteract the political influence of GMO industry (GMWatch, 2021). The GMWatch was also one of the most prolific accounts in the corpus with 34 original tweets which were collectively retweeted 310 times and was only surpassed by @GMFreeze which, although not as highly retweeted (80 retweets collectively) produced 56 original tweets. The GM Freeze is also a registered non-profit organisation advocating for food that is produced *responsibly, fairly and sustainably* (GM Freeze, 2021) and whose spokesperson, Liz O'Neill, was cited in a few news items in the digital media.

Furthermore, other accounts of organisations which advocate against GMOs featured less heavily in the corpus were @NonGMOProject with 7 original tweets and 147 retweets, @GenEngNetwork with 5 original tweets and 19 retweets, @NoGMOsVerified with 10 original tweets and 27 retweets. The Non GMO Project is a non-profit *dedicated to building and protecting a non-GMO food supply* (Non GMO Project, 2021). In practice, the Non-GMO Project's logo can be found on food products, especially in the United States, which have been verified to not contain GM ingredients. A web page associated with the Twitter username @GenEngNetwork could not be found, but from the small amount of information gathered, the Genetic Engineering Network is an environmentalist organisation. Finally, No GMOs Verified is another account advocating for a *right to know* associated with the presence of GMOs in the food chain. Notably, the @NoGMOsVerified account has been suspended, similarly to that of another anti-GMO advocate appearing in this analysis named David Icke, a British conspiracy theorist who's account has recently been permanently suspended by Twitter for violating rules regarding Covid19 misinformation (Spring, 2020).

Results from this categorisation of tweets into original and retweeted content showed a prevalence of retweets in the corpus. This is suggestive of the fact that at least part of the content produced on Twitter somewhat resonated with users on the platform and was thus amplified and shared by them. Although assumptions cannot be made regarding the potential endorsement of retweeted topics, the retweeting behaviour found in this corpus shows that there was public interest from private individuals on the topics being discussed on the platform, mainly prompted by public accounts. This was especially the case for the high retweets regarding US imports and the attention-grabbing tweets about the devolved governments ban on GMOs. This section also showed that, though they were not the most retweeted, the accounts producing the most original content in the corpus were anti-GMO organisations, suggesting these accounts had a lasting role in setting the *tone* of the discourse throughout the entire year under analysis.

4.2. Types of tweets

This section provides an analysis of tweet types as described in section 2.3.2. These categories were created with the aims of understanding the nature of the Twitter discourse and of answering more detailed questions regarding the apparent similarities between the trends in tweeting and digital media publication throughout 2017 (as seen in Figure 4.1). This section will discuss the occurrence of tweets sharing news, tweets commenting on news, tweets discussing events, tweets that show interactions between users in the form of replies, tweets containing a public appeal or a call to action and singletons which do not contain any links to external sources but represent only Twitter content. This categorisation should provide insight into the type of Twitter discourse in relation to the broader societal context.

Figure 4.3. Tweets by type
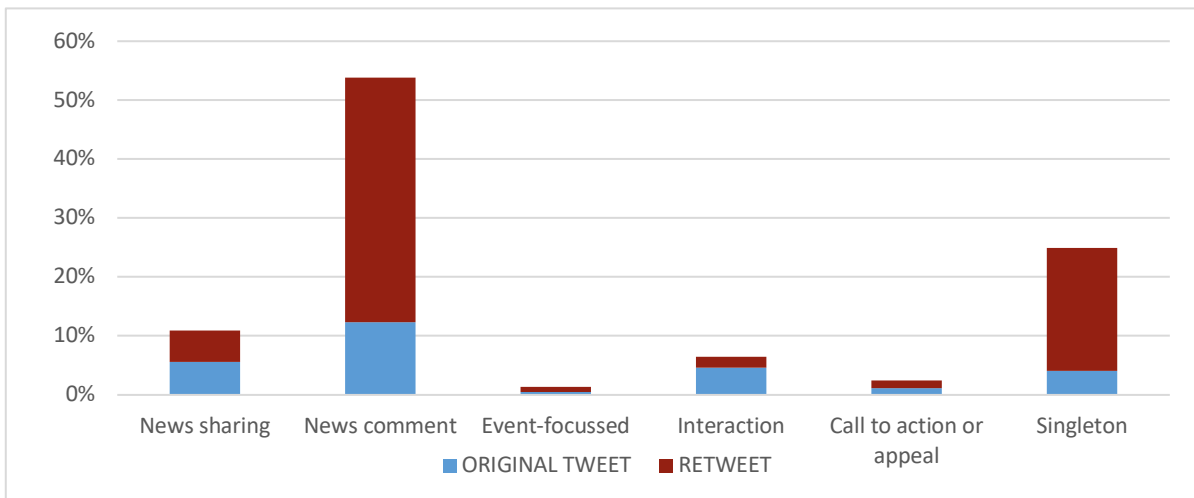
Figure 4.3 shows the abundance of the various tweet types in the corpus. The stacked bars show in red the percentage of retweets and in blue the percentage of original tweets for each tweet type.

4.2.1. Reaching outside of Twitter

Tweets containing links to external webpages, as exemplified by tweet [5], were the most common in the corpus. These consisted of tweets sharing links to external news items or other sources (11%), commenting on the news (54%) or encouraging followers to sign a petition or advocate for a cause (3%), all these tweets reached outside of the Twitter realm through the use of hyperlinks (URLs). The next three sections will discuss how these types of tweets were distributed throughout the year and what topics were prevalent in each category.

[5] GM crops will continue to be banned in Britain after Brexit, says Michael Gove -
https://t.co/lA37H6iTt9

4.2.1.1. News-sharing tweets

Figure 4.4 Temporal overview of news sharing tweets
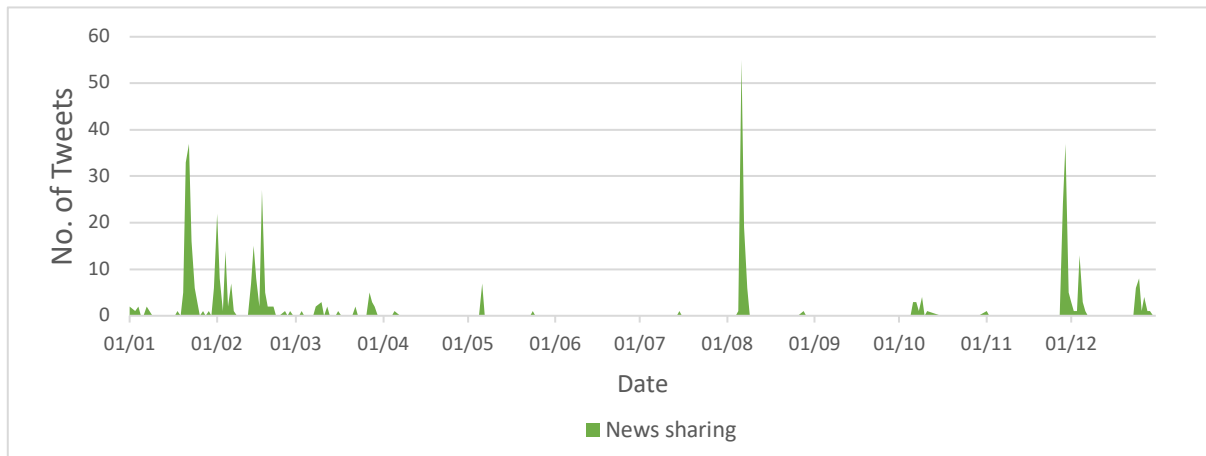
Figure 4.4 *shows the temporal overview of news sharing in the year 2017. Notably, the highest peak was found on August 6th.*

As Figure 4.4 shows, the highest concentration of news-sharing tweets was found on August 6th, in correspondence of the debate on Scotland and GMOs with tweets reporting news articles from Scottish online headlines such as The Herald and the Scotsman or The Orkney, as exemplified by tweets [6], [7] and [8] respectively. All three of these articles from different sources concerned the letter written by Fergus Ewing (MSP) to the UK government asking to maintain Scotland's GMO-free status after Brexit. Despite the topic being discussed in various news outlets, the letter was not picked up by the national press, as discussed in section 4.1.

[6] RT @heraldscotland: SNP Minister insists Scotland's GM crops ban must continue after Brexit https://t.co/N8XOPa7jaE

[7] RT @TheScotsman: Fergus Ewing seeks pledge on GM crops opt-out after Brexit https://t.co/LNB8cuIwZr https://t.co/UTfIvIbmuP

[8] RT @NewsOrkney: Will Brexit Affect the Ban on GM Crops in Scotland? https://t.co/VZbSaKfxpw https://t.co/IRj6wAU6fW

As seen in Figure 4.4 there were other peaks for news-sharing tweets in the corpus. One of these was found on January 21ˢᵗ and January 22ⁿᵈ 2017. On these dates, news-sharing tweets exclusively cited headlines of an article by AnonHQ regarding changes to regulations on the labelling of GM food in the United States. As previously stated, in this instance, the news item in question did not appear in the UK national press, but instead on AnonHQ.com which is a news website that can allegedly be traced back to the *hacktivist* group Anonymous (Goode, 2015) although there is no official proof for this affiliation. An example of the headline snippet found in these tweets can be seen in tweet [9].

[9] While You Were Distracted by BREXIT and TRUMP, Monsanto's Senate Puppets Push Through Bill to OUTLAW GMO Labeling... https://t.co/Iwam0mTXcM

The headline of the piece implied a negative portrayal of political agendas. This idea of governments averting attention from what are the *real issues* is not unseen in the media analysed in chapter three, as well as the overarching trope of a deceitful aspect to political figures. Furthermore, being mostly focussed on US politics and regulation, the article only tangentially discusses Brexit and uses it as a discursive device to criticise the distracting nature of certain political discourses while laws that are purportedly damaging to the public, are passed without any fervour in the media.

Another smaller flurry in news-sharing tweets was found on February 1ˢᵗ when various Twitter users shared, but mostly retweeted an article from Farming UK (@FarmingUK), as seen in tweet [10]. The article headline suggests the UK voted in favour of GMOs thus hinting to the potential adoption of the technology in the near future. In truth, the vote being discussed had happened at EU level and concerned the potential approval of two new GM maize varieties[11] (resistant to both lepidopteran pests and a common herbicide) in the EU. Although the UK had voted in favour of cultivation of these varieties and a majority of member states were against, a qualified majority was not reached, meaning the decision went back to the European Commission. As explained in the introduction (section 1.3.2), this is not uncommon for new applications for the cultivation of GM crops in the EU.

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[11] DuPont Pioneer's 1507 and Syngenta's Bt11 (Chow, 2017)

[10] UK votes in favour of GM crops, paving way for potential post-Brexit approval - Farming UK News https://t.co/p8ysL3TnyE

This tweet is of interest in light of the broader Brexit/GMO discourse, because it wants to suggest, citing only the article headline, that steps are being taken for the approval of GM crops in the UK. Upon reading the full piece, the body of the article contained reporting of George Eustice, UK farming minister, stating there is a possibility GMOs will be cultivated in the UK after Brexit. However, the vote mentioned in the article did not involve any decisions affecting GMO regulation at the government level. However, the UK voted in favour of two new GM crops at the EU level is in line with England's policy to not opt-out of cultivation.

[11] RT @SoilAssociation: Brussels 'will block' GM food from being imported from Britain to the EU post #Brexit! https://t.co/30eoJkZDNc

A peak on February 7th consisted mostly of retweets of @SoilAssociation ([11]) and @4bitNEWS ([12]) regarding a critique to the Brexit agenda and potential issues in EU/UK trade due to the UK opening up to GM food. The Soil Association is particularly noteworthy as it is a UK national charity campaigning for *healthy, humane and sustainable food, farming and land use* (Soil Association, 2021). The fact that this organisation intervened in the debate on GMOs and Brexit is interesting because, whereas the Soil Association openly campaigns against GM crops and in favour of organic farming, in this tweet, they comment on the potential negative consequences of a *GM Brexit* despite the fact that there is no official stance on Brexit on the Soil Association website. The involvement of the Soil Association in this corpus reinforces the presence of anti-GMO social actors and their role in amplifying news that raise concerns about potential issues caused by the cultivation of GMOs.

[12] RT @4bitNEWS: Brexit and "Softening-up" the British Public https://t.co/HYXCrTqS7r in Favour of #GMO Food; https://t.co/UWlRKaTakg

Lastly, a flurry in news sharing was found on November 28th and November 29th in correspondence of an article by the Telegraph about Michael Gove's statements on GM crops at a farming conference. It is notable that the peak in tweeting activity on these dates was mostly related to this piece of news ([13]). Although in the original speech the environment secretary mentioned the *deployment of responsible genomics*, in the article, he is reported

stating that GM crops will still not be allowed in the UK after Brexit and is portrayed as being weary of GM crops. His statement which sets him apart from other ministers, such as Liam Fox, who had been advocating for a trade agreement with the USA. Gove's position will be expanded on in section 4.5 as it represents a peculiar combination of agendas concerning GMOs and Brexit, as well as another instance of misrepresentation of the current regulation of GMOs in the UK.

[13] RT @TelegraphNews: GM crops will continue to be banned in Britain after Brexit says Michael Gove in blow to UK/US trade deal https://t.co/2…

Although news-sharing tweets were not the most abundant, they provide a first insight into what kind of sources are frequently linked in the corpus. In fact, the aforementioned cases showed examples of different tweeting behaviours. The Scottish news example showed that news on GMOs and Brexit that were popular on Twitter were not necessarily coming from the UK national press but also smaller local newspapers. The example of The Telegraph article showed how one single news item from the national press could, alone, generate a lot of momentum on Twitter. The AnonHQ tweet showed that the issue of Brexit was resonating internationally and, finally, the presence of the Soil Association showed how some stakeholders expected to intervene in the GMO debate, voiced opinions within a Brexit framing of the issue.

4.2.1.2.   *News-commenting tweets*

The most common tweet type across the corpus was *news-comments* in both original content and retweets (as seen in Figure 4.3) and, in fact, one of the most heavily retweeted tweets in the corpus was a news-comment. These tweets didn't only report a news headline or title of a blog entry, but also included a *comment* in the form of discourse tagging with hashtags or in the form of extra text, as exemplified by tweet [14].

Figure 4.5. Temporal overview of news-comment tweets
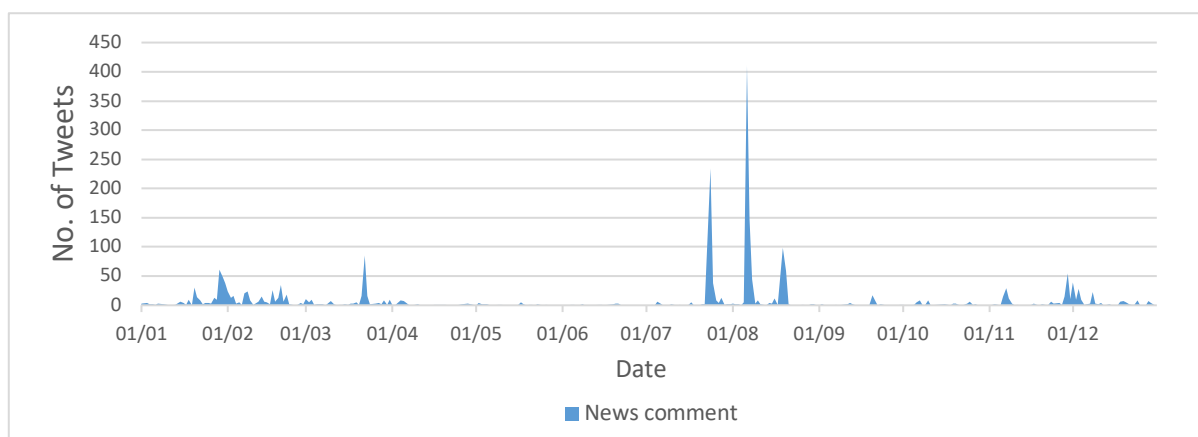
Figure 4.5 shows the temporal distribution of tweets commenting on the news throughout the year 2017.

[14] *#GMcrops will continue to be banned in Britain after #Brexit https://t.co… #vegan*

Looking at the year 2017 chronologically, it is noticeable how tweets commenting on external sources of news were initially spread throughout the months of January and February with a higher peak on January 29th. On this day, a key news article of high relevance in the digital media was published in The Guardian. This article by Joanna Blythman discussed the possibility of chlorinated chicken and other food imports entering UK supermarkets after Brexit. A representation of tweets commenting on this article is exemplified by tweet [15] and it needs to be noted that this article was the most abundant hyperlink throughout the entire corpus (Table 4.1). This suggests that the narrative against the import of US foods was represented on Twitter as it was in the digital media. The extent of coverage of this issue will be further explored in section 4.4.

[15] *Stop processed meat, unlabelled GMOs and cheese full of hormones. Stop Brexit! https://t.co/jV2ZKfkryq*

On March 22nd, an influx of tweets was caused by comments on the news about Princess Anne's interview to Farming UK and the retweeting of comments by users, such as @FarmersWeekly or @davidicke. Both used Twitter to promote an article they had each written about in their respective websites (see [16] and [17]). It is notable that conspiracy theorist David Icke's blog link to this news item was included in 64 tweets (1.5% of the corpus), making it the sixth most common URL in the corpus (as seen in Table 4.1).

Table 4.1 Popular URLs

Article headline	News source	No. of mentions
Is chlorinated chicken about to hit our shelves after new US trade deal - Environment	The Guardian	**100**
GM crops will continue to be banned in Britain after Brexit says Michael Gove in blow to UK - US trade deal	The Telegraph	**96**
UK votes in favour of GM crops, paving way for potential post-Brexit approval	Farming UK News	**84**
While You Were Distracted by BREXIT and TRUMP, Monsanto's Senate Puppets Push Through Bill to OUTLAW GMO Labeling	AnonHQ.com	**75**
Princess Anne says GM crop fears are 'not a practical argument' – and she may grow them after Brexit	David Icke	**64**
Brussels 'will block' GM food from Britain	The Times	**54**
Fergus Ewing seeks pledge on GM crops opt-out after Brexit	The Scotsman	**47**

Table 4.1 *shows headlines of the seven most frequently tweeted news items in the corpus, the source of the article and the number of times it was mentioned. Notably the two most prominent URLs in the corpus belong to the corpus of national press articles analysed in chapter 3.*

[16] RT @FarmersWeekly: Princess Anne disagrees with Prince Charles and backs GM crops and livestock https://t.co/eWEPbBGhQO #GMcrops #foodsecur…

[17] RT @davidicke: Princess Anne says GM crop fears are 'not a practical argument' – and she may grow them after Brexit https://t.co/3EraJpONEx…

As Figure 4.5 shows, the highest influx in news-comments was found on August 6th (410 tweets) and many on this date were retweets of very popular tweets by Alyn Smith and Fergus Ewing. The content of these tweets, as broadly described in section 4.1.2, regarded criticism towards the possibility of GM food to enter Scotland in case of a trade deal with the United States. Fergus Ewing's tweet linked to a Scottish government webpage reporting his letter to the UK government, asking for the Scottish GMO-free status to be maintained, whereas Alyn Smith added his own comment on the matter and embedded Fergus Ewing and the URL to the document in his tweet as seen in tweets [3] and [4]. Due to their high number of retweets, the

stance, emerging themes and arguments expressed in these tweets contributed to the overall negative stance on both Brexit and GMOs as will be discussed in section 4.3.

Another flurry in tweets commenting on the news was, predictably, found on July 24th. This peak could not be reconciled with one specific news items, but to a variety of articles from multiple sources discussing statements made by Liam Fox and Theresa May regarding negotiations of a UK/US trade deal. A constructed tweet below exemplifies a news comment by a highly retweeted private individual ([18]). As seen in tweets commenting on Joanna Blythman's article, the following example contains the usual controversial foods reiterated many times in the digital press: chlorinated chicken, hormone treated beef and GMOs.

[18] Is this the promised land of Brexit? GMOs, chlorinated chickens and hormone beef. #StopBrexit https://t.co/cPBa67BH3U

On August 19th more tweets commented on Liam Fox's statements regarding the devolved governments and their *ban* against GMOs. According to one of the linked news items from The Times, Liam Fox suggested limitations on the ability of the devolved governments to vote on the approval of trade agreements. The statement seemed to have elicited a large reaction on Twitter. For instance, on this date, the news was tweeted by political figures such as the Hannah Bardell, but also by the GMWatch. It is noteworthy that there is a recurring pattern for the GMWatch which, alongside other anti-GMO organisations, is a prolific tweeter of news on the platform, and appears to reliably retweet and comment on GMO-related news. Further investigation of the role of the GMWatch and other anti-GMO accounts on Twitter will be investigated in chapter 5.

[16] RT @GMWatch: Liam Fox tries to bypass Scots and Welsh #GMO bans in bid for #Brexit trade deals https://t.co/7FfCGEoUK3 https://t.co/qFc5aPz...

[17] RT @HannahB4LiviMP: Dismissing Scotland's GM crops ban sets a dangerous precedent https://t.co/2yOB7yjT3x #Brexit -

Tweets commenting on external sources and talking about the news constitute a major part of this corpus, suggesting that the Twitter discourse is, in many instances, tied to the production of content outside of the platform. Furthermore, these tweets were often used, as was seen with news-sharing tweets, to showcase specific websites or articles and draw attention to one

specific URL. This section also showed that news items were not the only highly retweeted URLs in news-commenting tweets as exemplified by Fergus Ewing's tweet showcasing his letter on the Scottish government webpage. Other types of URLs tied to tweets will be discussed in the next section.

4.2.1.3.   *Call to action or appeal*

Figure 4.6. Temporal overview of calls to action/appeals
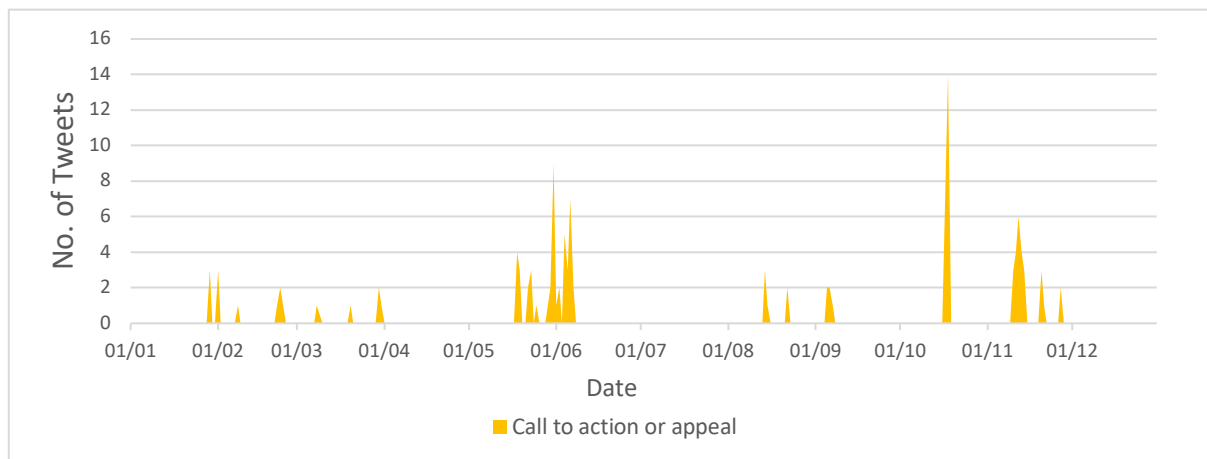
Figure 4.6 *shows the temporal distribution of tweets containing a call to action or an appeal throughout the year 2017.*

Figure 4.6 shows a temporal distribution of tweets containing an appeal to sign a petition or a call to activism throughout the year 2017. Although these tweets made up a relatively small percentage of the total number of tweets in the corpus (Figure 4.3), they generated academic curiosity because of their very specific intent to encourage other Twitter users to take action. In other words, these tweets not only aim at showcasing content outside of the platform but use Twitter as a platform to incite public participation.

The two highest peaks in this type of tweets occurred on June 5th and on October 18th. The first one, seen below ([18]), was in correspondence of the UK 2017 general elections and sees the GM Freeze, encouraging followers to interact with political candidates and interrogate them about their plans for GMOs. As previously stated in this chapter, the GM Freeze's mission includes advocating against the cultivation of GMOs in the UK so it is not surprising, in a time of political transition, to find tweets containing a link to their *Take action* web page. Notably, these tweets also contained a discourse tag, specifically the general elections hashtag: #GE2017 suggesting the GM Freeze uses the platform to increase the visibility of their viewpoint within the general election discourse and, ultimately, to influence government's policy on GMOs.

The October peak saw the GMWatch as protagonist with a tweet discussing, once again, chlorinated chicken, GMOs and hormone beef, with a link to a news piece and a call to action to engage with local MPs and request to stop these foods from entering the country (see [19]). So, whereas tweet [18] was a way to bring GMO regulation into the general election agenda, tweet [19] was a rallying cry to voice complaints to elected officials regarding post-Brexit trade agreements.

[18] RT @GMFreeze: Best ways to ask ur #GE2017 candidates about #GMO and #Brexit https://t.co/JfcCHnCA6p

[19] RT @GMWatch: Chlorine-washed chicken, beef fed on hormones & GMOs heading our way! Tell MPs not to put food at risk post-#Brexit https://t....

In this small group of tweets the most prominent behaviour was to call upon the general public to lobby political figures regarding GMO regulation. Once again, the involvement of anti-GMO groups into the Brexit discourse on Twitter is noteworthy. In fact, they seemed to take a multifaceted approach to their use of the platform. On the one hand, they were actively participating in the discourse and optimising their exposure by creating original content and showcasing relevant news items; on the other, they seemed invested in using Twitter to advocate for their mission and ask the public to act.

4.2.1.4. Event focussed

Figure 4.7. Temporal overview of event focussed tweets
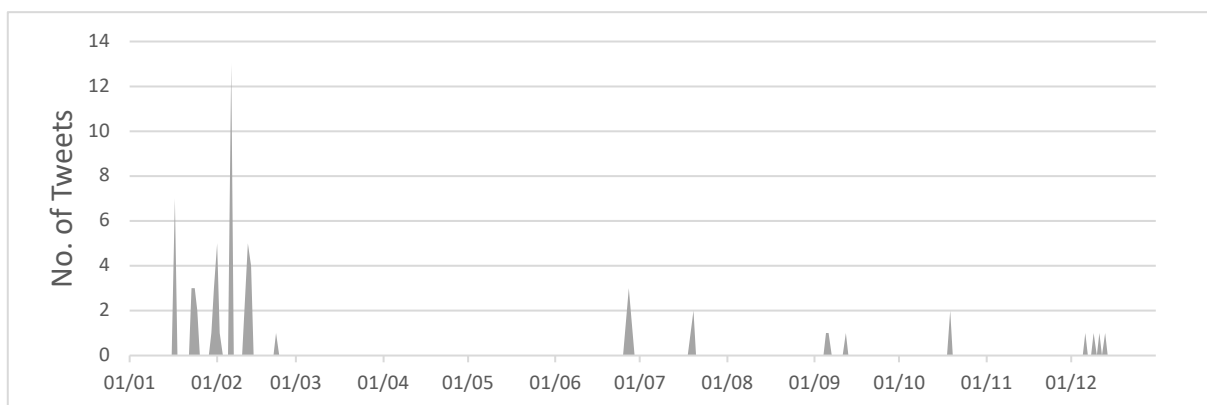
Figure 4.7 *shows the temporal overview of event focussed tweets throughout the year 2017*

The event-focussed category represents a niche of tweets that is less directly focused on the overall discourse on US imports to the UK and associated controversy. Tweets belonging to this group often contained discourse tagging for a specific event, as seen in the constructed tweet below ([23]). The use of hashtags in these tweets is customary to make content searchable and to link a tweet to the broader Twitter discourse regarding a conference or a tv show.

[23] *After an appetising lunch we will be hearing about #Brexit #CRISPR #Conference2017 https://...*

[24] RT @BSUFN: GM crops increasingly produced globally, in post-Brexit trading partners @speaker #bsufn17

[25] RT @GMWatch: #GMO scientist Jonathan Jones promoting the idea that #Brexit could mean reduced regulations in the UK for GMO crops. https://...

The main peak for this group was found on February 6th, which corresponded to tweets about two events: the Brighton and Sussex Universities Food Network (BSUFN) Annual Symposium 2017 and an academic presentation as part of the *Food Thinkers* series, organised by @foodresearchuk. Tweet [24] is an example of retweet from BSUFN regarding worldwide GMO production, while tweet [25] shows a response from the GMWatch account that links to the event's booking page mentioning Jonathan Jones, who, as explained earlier in the chapter, gave a presentation regarding his thoughts on GMO regulation after Brexit. As is evident from the content of these tweets, the topics of conversation are not directly referring to the larger discourses on Scottish regulation or US imports to the UK but are still relevant to the main discourse on post Brexit trade and regulation. Although one might be tempted to dismiss this category as irrelevant, there was a possibility that the scientific community would feature here, with conversations about GMOs and Brexit during science-related events. In fact, academic conferences are often an opportunity for scholarly communication and networking on Twitter (Lee *et al.*, 2017). Such discourse was seldom found in this corpus of tweets and was also rarely retweeted. It is interesting, however, that the GMWatch took this opportunity to voice concerns about Jonathan Jones credibility by scorning his views on GMOs and Brexit (Koller, Kopf and Miglbauer, 2019, page 60).

Figure 4.8. Temporal overview of tweets showing interactions
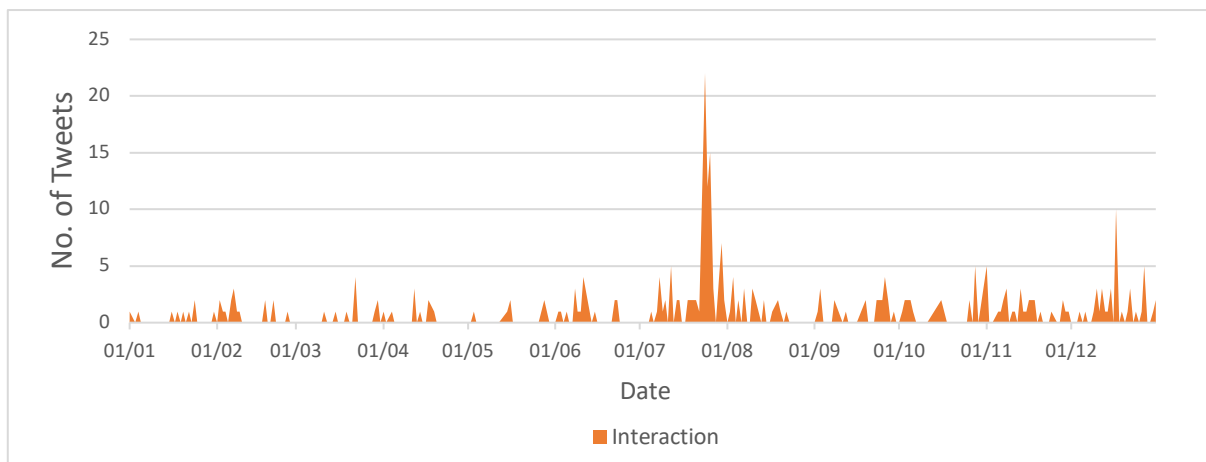
Figure 4.8 *shows the temporal overview of tweets representing interactions between users such as mentions and replies, throughout the year 2017*

Figure 4.8 shows an overview of the temporal distribution of tweets showing an interaction between users happening through mentions (using the @username). This particular category is a true indicator of conversations happening between users or instances where a user is seeking an interaction or a response from another account on Twitter. Although in this relatively small category, these tweets occurred consistently throughout the year, a peak influx of this type of tweet was seen on July 24th. Tweets on this day are exemplified by tweet [26] below.

[26] @liamfox UK citizens don't want you to accept acid washed chicken, chemicals and GMOs

The latter shows a constructed reproduction of a private individual tweeting *at* Liam Fox (@liamfox) questioning his choices in international trade and imports. This tweet is an interesting case because it shows a private individual seeking the attention of a government official, in this particular instance, calling them out on their political agenda. Furthermore, it is also noteworthy that Liam Fox did not engage with a reply. Similarly to this instance, Theresa May's Twitter account was involved in unidirectional communication, as will be further discussed in chapter 5.

4.2.1.6.   Singletons

Lastly, a timeline of tweets expressing original ideas through newly created content can be found in figure 4.9. The highest number of these so-called singletons was found on July 24th and 25th. Tweets on these dates include mostly retweets of Paul Flynn's very popular critique to Liam Fox regarding his statements on Brexit, chlorinated chicken and GM food ([2]) and other tweets by private individuals which showed similar sentiment. Some of these private individuals used the hashtag #newsnight (see tweet [27]) suggesting the issue was being discussed on the homonymous BBC programme. Another form of unlinked news *sharing* that was found in this category was a highly retweeted tweet on August 23rd by a private individual who added a screenshot of previously discussed Joanna Blythman's article for the Guardian to their tweet. So, although the singleton tweets did not include a link to a news piece, they were commenting on a discourse happening on a different media outlet. Although these tweets only existed within the Twitter sphere, they appeared to discuss other forms of media, using discourse tagging as a means to link to a news discussion.

Figure 4.9. Temporal overview of singletons
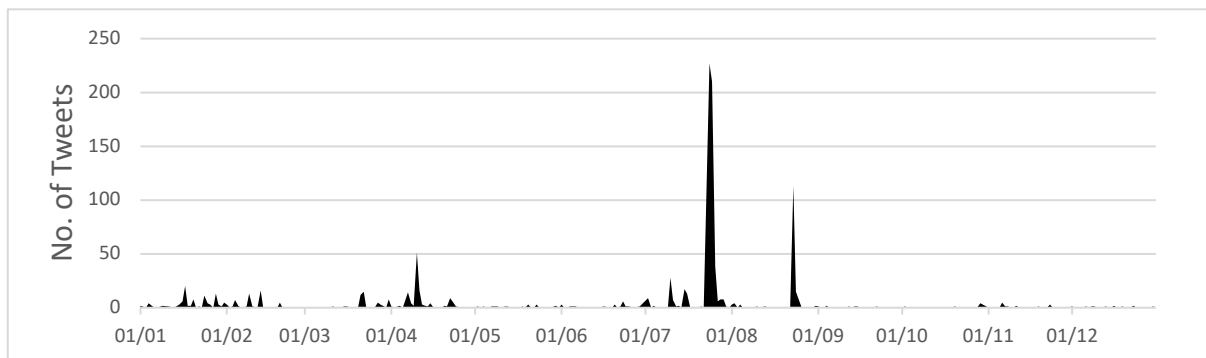
Figure 4.9 *shows the temporal overview of tweets representing singleton tweets, throughout the year 2017.*

[27] What a treat #Brexit! Liam Fox wants us to eat acid washed meat full of hormones and GM foods. Idiot. #newsnight

In summary, results from this section show that the high influx of tweets on July 24th and August 6th 2017 is exemplary of two main behaviours found in this corpus: the publication of many tweets according to a trending topic and the intense retweeting of a few influential figures, respectively. On the one hand, news trickled down to Twitter from a variety of sources and through various accounts, private or otherwise, because they discussed topics that either reinforced the ideologies of Twitter users or enraged them. These tweets created space for

debate on trending topics, often recognisable by the use of discourse tagging. On the other hand, some tweets had a high degree of success on Twitter (one could argue they went 'viral') because they were published on the platform by figures with a large Twitter following, as was the case for Scottish politicians in this corpus. Thus, the trickling of national news, only partially explains the abundance of tweets seen as some peaks in high tweeting activity were caused by URLs that did not correspond to articles from the UK national press. Particularly striking is the example of the discourse surrounding Scottish newspaper articles in the corpus seen as the issue of Scottish regulation on GMOs was only marginally covered in the national press. However, there were individual articles from the digital press that were heavily mentioned in tweets. Firstly, the Guardian's article by Joanna Blythman, tweeted in January and then referenced many other times throughout the year. Secondly, the Michael Gove article in the Telegraph which, alone, caused a high peak in tweeting activity at the end of November. The concept of news dissemination on Twitter will be further explored in chapter 5 with ego network analyses to better understand who, on Twitter, initiates the discourse on the news.

4.3. Stance analysis

So far, this chapter has discussed how much tweets have been retweeted, what type of tweets can be found in the corpus, which ones were the most frequent types and how they were distributed throughout the year. This section will discuss results from an analysis of each tweet's stance which was carried out mirroring that done in the media. Firstly, we analysed the stance of original tweets and then reported this stance on the respective retweets. Before diving into the results of this analysis it needs to be noted that stance was attributed to tweets based on the tweet content. The overall stance of cited articles was not considered especially seen as, in the previous section, article headlines were shown to often be deceiving and to report different stance to the content of the news piece. For this reason, it was thought important to attribute the stance of tweets only based on the available tweet content.

The analysis of original tweets' stance revealed that the content of these mostly conveyed negative sentiment towards Brexit (69% of tweets) with 51% of them being strongly anti Brexit and 18% being cautiously anti Brexit. Furthermore, 19% of original tweets had a neutral stance, while only 12% were positive towards Brexit, with 8% being cautiously pro-Brexit and 4% strongly pro-Brexit. The negative sentiment towards GMOs was even more pronounced, with 79% of original tweets being anti-GMO. The original tweets were strongly anti-GMO (71%), 8% were cautiously anti-GMO, while 11% were neutral and only 10% were pro-GMO (4%

cautiously pro, 6% strongly pro). Collectively, once the retweets were accounted for, the anti-GMO and anti-Brexit sentiment was intensified with 63% of all tweets being strongly anti-Brexit and 79% being strongly anti-GMO.

Table 4.2 Stance of original tweets

STANCE	Strongly anti GMO	Cautiously anti GMO	Neutral (GM)	Cautiously pro GMO	Strongly pro GMO
Strongly pro Brexit	2.01%	0.00%	0.16%	0.08%	1.85%
Cautiously pro Brexit	4.65%	0.24%	0.08%	1.69%	0.96%
Neutral (Brexit)	5.78%	0.72%	9.15%	1.69%	1.77%
Cautiously anti Brexit	10.43%	6.66%	0.64%	0.24%	0.08%
Strongly anti Brexit	**48.23%**	0.72%	0.48%	0.16%	0.96%

Table 4.2 *shows all possible combinations of stance towards GMOs and Brexit in the entire Twitter corpus. Each cell shows the percentage of original tweets for each combination. Notably most original tweets fall into the Strongly anti-Brexit/ Strongly anti-GMO cell.*

As was also clear in the digital news media, it was more common for the sentiment towards GMOs and Brexit to align than otherwise (as can be seen in table 4.2), meaning that most tweets were both strongly anti-Brexit and strongly anti-GMOs (49% of originals, 62% overall), or neutral towards both GMOs and Brexit (9% of originals, 5% overall). This association in sentiment was illustrated by tweet [2]. By contrast, very few tweets were strongly pro-Brexit and strongly anti-GMOs (2% of originals and 1% overall) and less than 1% of tweets were strongly anti-Brexit and strongly pro-GMOs. The latter is in line with what found in the digital media. Consequently, the strong pro-GMO sentiment in combination with anti-Brexit sentiment is almost absent from the corpus apart from 13 tweets mostly from private individuals with various focuses, some criticising pseudoscientific claims, others suggesting innovative policies on gene editing or sarcastically agreeing with political agendas. Notably only one of these retweets was retweeted. The only public figure expressing a stance in favour of GMOs and expressing Brexit in a tweet was @AgBioWorld. This is the account of scientist and science communicator Channa Prakash who often advocates in favour of biotechnology

on Twitter. In this corpus, he expresses dislike towards both Brexit and a Greenpeace's campaign against GMOs by commenting on an article from the Greenpeace website about GM crop cultivation in Spain seen in tweet [28] below.

[28] Greenpeace's dirty war against #GMO (cow costumes; tomatoes w/ fish genes) in Europe is worse than #Brexit campaign… https://t.co/q2B6v3XOEJ

The lack of tweets with this type of stance is interesting in light of the fact that other public figures present in the corpus are known to share similar sentiment to this, however, the content they produced or retweeted in 2017 did not openly align with these views nor did it express this sentiment.

Table 4.3 Stance of all tweets (including retweets)

STANCE	*Strongly anti GMO*	*Cautiously anti GMO*	*Neutral (GM)*	*Cautiously pro GMO*	*Strongly pro GMO*
Strongly pro Brexit	0.93%	0.00%	0.09%	0.02%	0.82%
Cautiously pro Brexit	3.55%	0.09%	0.05%	1.16%	0.50%
Neutral (Brexit)	4.14%	0.48%	4.69%	**2.80%**	**2.50%**
Cautiously anti Brexit	8.62%	6.23%	0.27%	0.11%	0.02%
Strongly anti Brexit	**62.09%**	0.41%	0.23%	0.09%	0.30%

Table 4.3 shows all possible combinations of stance towards GMOs and Brexit in the entire Twitter corpus. Each cell shows the percentage of tweets (including both original and retweeted content) for each combination. Notably, most of the corpus falls into the strongly anti-Brexit/ strongly anti-GMO cell.

The main difference between the stance of original tweets (Table 4.2) compared to the stance of all tweets (original tweets + retweets; Table 4.3), is that the percentage of most stance combinations was reduced in favour of the strongly anti-GMO/strongly anti-Brexit stance. This suggests that tweets expressing strong negative sentiment towards both GMOs and Brexit were retweeted more frequently than others. The two exceptions to this trend are the Brexit

neutral/Cautiously pro GMO cell, which went from 1.7% for the original tweets to 2.8% for the total number of tweets, as well as the Brexit neutral/Strongly pro-GMO cell, which went from 1.8% for the original tweets to 2.5% for the total number of tweets. Examples of tweets falling under these last two categories are provided below in tweets [29] and [30] respectively.

[29] RT @crownchronicles: Princess Anne backs GM crops and livestock – may farm them after Brexit https://t.co/NKvwEwJhtC https://t.co/WBnjFMFZTA

[30] RT @murdo_fraser: SNP promoting anti-science policy on GM crops https://t.co/8tlU53q6hY. Sad, but all too typical.

The first one is a retweet of a @crownchronicles article commenting on princess Anne's interview and only reports the headline of the piece, so the stance is that expressed in the title: '*princess Anne **may** farm GM crops*'. Seen as there is no weighting on Brexit, the stance on Brexit was considered neutral. Similarly, a retweet of @murdo_fraser (see [26]), who is a conservative Member of the Scottish Parliament, does not mention Brexit (the headline of the linked article does; hence it was picked up by the search), but strongly criticises Fergus Ewing's statements in the Scotsman on his will to continue banning GMOs by judging them as unscientific. The argument that Scottish restrictions on the cultivation of GMOs are unscientific was also seen in a small number of articles from the digital media alongside mentions of *luddite prejudice* or *anti-science* behaviour and mostly associated with articles that were overall neutral or positive towards both GMOs and Brexit. Similarly, on Twitter, this rebuttal of the validity of the anti-GMO ban was rarely seen, especially if it was based on scientific evidence.

Despite the retweets of the two aforementioned categories, the bulk of retweets (67%) was still strongly anti-GMO and strongly anti-Brexit. Alyn Smith's highly retweeted statement belonged to this anti-GMO/anti-Brexit cluster ([4]). Typical statements of private individuals in this category are illustrated by tweets [31] and [32], which expressed a sentiment that was very critical of US imports, including GMOs. Furthermore, these tweets often contained derogatory language towards the products themselves, the political figures involved and their decisions to express dissent, sometimes using a sarcastic tone. This tendency to use strong derogatory language was sometimes observed in the digital media, although, in the context of Twitter, it was amplified. In fact, on Twitter it is not uncommon to find slang or to see

individuals writing in casual language (Zappavigna, 2013, page 129) meaning that although Twitter has rules in place to limit racial slur, offensive language and misinformation (Twitter Help Centre, 2021) there is less policing on the way private individuals express their opinion. Thus, negative sentiment in tweets is often expressed with more hyperbolic words, in the case of this research, this was directed towards GMOs, with the use of words such as *toxic* or *poison*, or with words such as *idiot* or *disgraced* in reference to political figures. The latter is particularly interesting in light of research showing that the use of ridicule is a way to create affiliation on Twitter (Koller, Kopf and Miglbauer, 2019). In other words, individuals who wish to express negative sentiment towards a public figure's statement, especially political figures, will often use sarcasm and specific slang or discourse tagging as a means to appeal to individuals with similar views to generate a conversation.

[31] A hoard of toxic foods like #GMOs coming this way after #Brexit

[32] Trump's secretary is ready to batter down UK food standards. #GMOs #Brexit #chicken https://t.co/06rWnU8NNG

At the opposite end of the spectrum, the relatively rare pro-GMOs and pro-Brexit tweets also mirrored sentiments expressed in the digital media (see [33] and [34]). Particularly, users producing these tweets expressed enthusiasm and support by using hopeful and uplifting language, often mentioning Brexit as an *opportunity* and GMO technology as something to be embraced, so that the nation could be at the forefront of progress. Once again, like in the digital media, many of the tweets including positive sentiment towards both biotechnology and Brexit discussed gene editing technology, as seen in tweet [35].

[33] #Brexit is a good time to invest in technology #CRISPR https://t.co/D9wOjFEMe7

[34] I agree with the princess. The UK has the potential to be at the forefront of technology #Brexit https://t.co/V0lQhCA7KS

[35] Viscount Ridley: Brexit gives the UK an opportunity to attract the best gene-editing talent |... https://t.co/wCc6l9JS1N

The latter was published by @TheHouseLive regarding a statement by Viscount Ridley published on *The House*'s website. As mentioned in section 4.1, the opinions shared in this statement regard the potential of Brexit to allow for the adoption of gene editing technology.

Figure 4.10. Stance by tweet types
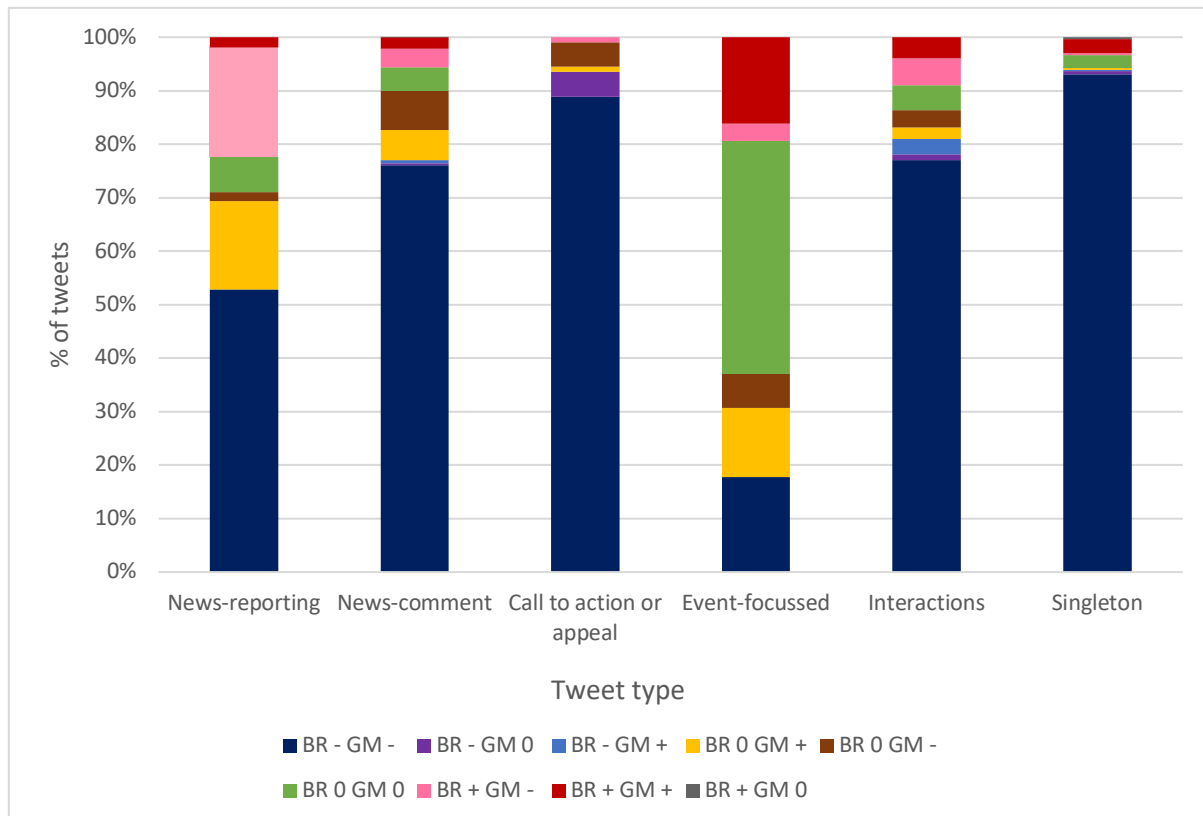
Figure 4.10 shows the percentage of tweets with different stances on Brexit and GMOs within every tweet type group. From the figure, it is clear how tweets that were negative towards both GMOs and Brexit (BR- GM-) dominated every category except event-focussed tweets which were mostly neutral (BR0 GM0).

Upon breaking down the various tweets into typology groups and crossing this classification with the tweets' stance it is even more evident how anti GMO/anti Brexit sentiment (BR- GM-) dominated every category (Figure 4.10), apart from event-focussed tweets, which were mostly neutral. Singletons and appeals were found to be the most negative (93% and 89% respectively), followed by interactions (77%), news comments (76%) and news reporting (53%). The less pronounced expressions of views in news-reporting tweets are likely due to the fact that sentiment did not always emerge from the headline of the piece, even though the cited news items often expressed strong clear views on Brexit and GMOs in the body of the article. For instance, the headline from the article about Michael Gove was often chopped to fit the maximum number of Twitter characters, meaning there was no space left to express

sentiment about Brexit. Thus, although the tweet was clearly negative towards GMOs, it did not share sentiment towards Brexit as seen in the example below [36].

[36] GM crops will continue to be banned in Britain after Brexit, says Michael Gove - https://t.co/71VW6rE1zV

In summary, the stance of tweets in this corpus resulted to be mostly negative and it was also more negative than the overall stance expressed in the digital media. However, the tendency for both GMO and Brexit stance to align either negatively or positively, was maintained on Twitter too. It is noteworthy that, in the Twitter corpus, content expressing anti-GMO sentiment was overall more *retweet-worthy* than tweets expressing pro-GMO sentiment within the political discourse on Brexit thus amplifying the negative portrayal of both GMOs and Brexit in the debate (Wonneberger, Hellsten and Jacobs, 2020). Furthermore, the bulk of popular content containing anti-GMO/anti-Brexit sentiment, while being ubiquitous across most types of tweets, could be traced back to a handful of accounts and comprises a small number of very popular tweets.

4.4. Thematic content

Discourse tagging in the form of hashtags, can function as topic markers and can contribute to the generation of a conversational space by making content searchable on social media platforms (Zappavigna, 2015). Therefore, hashtags provided a first insight into the topics and thematic areas represented in this corpus of tweets.

The most used hashtags in the corpus were #Brexit and #GMO or #GMOs, as shown by table 4.4. However, this is not surprising given that these words were used in the Twitter keyword search (as seen in chapter 2), it is interesting that the fourth most common hashtag was #stopbrexit (128 mentions). This expression of negative sentiment towards Brexit is in line with the stance of tweets presented in the previous section, in that it corroborates the prevalence of negative sentiment towards Brexit in the corpus. Another popular hashtag was #dieselgate (94 mentions), which was used in a specific cluster of tweets about a carbon emission scandal involving car manufacturers. Although not related to GMOs, this hashtag was exclusively part of a frequently retweeted tweet by Keith Taylor MEP. The tweet described the activities of the green party, as seen in tweet [37], and included GMOs in an infographic of the party's action points.

[37] *Tough action on #Dieselgate, putting citizens' rights at centre of #Brexit, slashing roaming charges & blocking untested GMOs. A busy week! https://t.co/YI4aJdJD8t*

Trump and Monsanto were also popular hashtags (49 and 39 mentions respectively), and often occurred together in news-commenting tweets about the AnonHQ.com article on GMO labelling in the USA ([9]). Furthermore, mentions of pesticides and herbicides were prominent in the corpus, in the form of two main hashtags: #neonics and #glyphosate. The former is a short term for neonicotinoids (European Commission, 2021) which are broadly available insecticides used in agricultural pest management. Glyphosate, on the other hand, is a broad-spectrum herbicide. The reasons for these two agro-chemicals to be mentioned in association with GMOs and/or Brexit are several. On the one hand, within the Brexit discourse, they are part of a larger controversy on the differences in regulation between the US and the EU, and the possibility of a harmonisation of rules as one of the consequences of Brexit (see tweet [38]). On the other hand, the most widely adopted GM crops globally are often herbicide resistant, or produce their own insecticide, or both. Furthermore, the EU has recently put more restrictions on the use of these chemicals which could be another cause for their appearance in the discourse.

[38] *RT @GMWatch: Don't let Brexit open the pesticide floodgates. Tell yr MP https://t.co/8feRhrEcGi And mention GMOs too!! #glyphosate #neonics…*

Lastly, two notable mentions, although less frequently found in the corpus framed Brexit and GMOs within two political discourses on Twitter: the UK general election (#GE2017) and the possibility of a Scottish independence referendum (#indyref2 #scotref). The former denoted the fact that GMOs were discussed within the election discourse on Twitter. This is interesting because, between the announcement of the elections in April 2017 and the elections in June, there was very little coverage of GMOs and Brexit in the digital press and, as previously mentioned in section 4.2.1.3, NGOs were found to make this association. Similarly, instances of mentions of a Scottish referendum were rare in the digital press (2% of articles), however, this is in line with the sentiments expressed regarding the possibility of GMO cultivation in the UK and the prominence of the discourse on Scottish regulation in the corpus. The discursive implications of the association of GMOs and Brexit with the pesticide conversation and the Scottish debate will be discussed in section 4.5.

Table 4.4. Frequently used hashtags

Hashtag	No. of mentions
brexit	**1177**
gmo	**831**
gmos	**153**
stopbrexit	128
dieselgate	94
trump	49
ge2017	47
neonics	37
monsanto	35
glyphosate	32

Table 4.4 *Provides a list of the ten most popular hashtags in the corpus and the number of occurrences. Notable was the presence of the hashtag #stopbrexit, denoting the presence of negative sentiment towards Brexit and the popularity in the corpus of mention of pesticides such as #glyphosate and #neonics.*

Although hashtags can provide a first insight into the thematic content of the corpus, a more in-depth analysis was carried out manually on the themes emerging from the 1246 original tweets, as was done for the digital media in chapter 3. Themes emerging in original tweets were categorised according to the six macro-areas developed for the analysis of the digital media: economics, farming, food, policy, science, and society. The Twitter corpus required the addition of a new category that was called *miscellaneous* to code for a few small thematic areas that were not discussed in the original corpus. Examples of themes pertaining to this new macro-area were drugs and diseases, fracking, the *dieselgate* scandal, and conspiracy theories (often involving *chemtrails* and climate scepticism). Often, themes in the miscellaneous group, seemed unrelated to the issue of GMOs and/or Brexit and were only linked by the use of #GMO or #Brexit or because mentioned within a list of issues. Themes and arguments emerging from the miscellaneous group will be discussed in the analysis of arguments and ideologies as part of a more comprehensive analysis of misinformation in the corpus.

Table 4.5 Percentage of tweets discussing thematic macro-areas

Macro-area	% of tweets
ECONOMICS	38%
FARMING	16%
FOOD	27%
MISCELLANEOUS	5%
POLICY	**40%**
SCIENCE	7%
SOCIETY	7%

Table 4.5 shows the thematic macro areas and how prominent they were within the Twitter corpus. Similarly, to what found in the analysis of digital media, the policy thematic macro-area was the most prominent in the corpus.

Most themes in the tweets were also present in the digital media, although often in different proportions. A summary of themes found in the Twitter corpus, with examples of tweets is in Table 4.6. The percentage of coverage of the different macro-areas in table 4.5 shows how the thematic macro area **policy** was the most prominent (40% of original tweets). Issues subject of regulation under this group related to GMO policy, food, health and pesticide regulation, while issues associated with these subjects were policy restrictions, especially bans, maintaining standards, changes to the regulation and new approvals. Furthermore, the most mentioned regulatory bodies in original tweets were the UK, the EU, and Scotland. Themes belonging to the **economics** macro area (38% of original tweets) emerging from the Twitter corpus were mostly discussions on trade agreements (32% of original tweets), especially regarding the USA (22% of original tweets), with very few mentions of tariffs, public funding and paid labour.

Within the **food** macro-area (27% of original tweets) themes mostly pertained, other than GM foods, chlorinated chicken (13% of original tweets). Other issues which were mentioned less frequently were permitted ingredients, sugar and pesticide residues. Issues associated with food mentioned in original tweets were food labelling (10% of original tweets) and food standards (4% of original tweets), followed by food prices, health in relation to food, food safety and food quality.

The most prominent theme pertaining to the **farming** macro-area was the use of hormones in cattle rearing (8% of original tweets) with a few mentions of pesticide use in agriculture, (as emerged in the analysis of hashtags). Other issues discussed surrounding agriculture were the economic viability of farms, especially the topic of subsidies and ability to compete, the environmental impact of farming and productivity with a few mentions of crop contamination, farming standards, land preservation and animal welfare.

Table 4.6 Thematic macro-areas and corresponding tweets

Macro-areas	Themes	Quotes
Economics	Trade	*I don't think conservatives will be pleased about having to abide by EU bans on #GMOs after #Brexit trade deal.*
	Tariffs	*What about trade tariffs, chlorinated chicken and GMOs?*
Farming	Pesticides	*We need the EU's protection after Brexit to stop toxic pesticides and #GMOs. Talk to your MP https://t.co/NgLMl3m2gT*
	Animal welfare and land preservation	*@user Big agri will take over and damage small farmers and our farmland by using GMO seeds The Tories have no idea of the consequences of "taking back control" #Brexit*
	Subsidies	*Thanks @michaelgove after Brexit there will be subsidies for virtuous producers of good food & and GM crops will continue to be banned https://t.co/vMTTCzs4jJ*
Food	Standards	*Protect our food and farms by asking your MP to support #Brexit amendments on food standards & environment #GMO https://t.co/rkHURBsxKX*
	Food quality	*This is ridiculous! After Brexit Liam Fox wants to allow sickly sweet US junk food and GM fed chlorinated chickens. #dumb*
	Chlorinated chicken	*Is chlorinated chicken about to hit our shelves after new US trade deal? #GMOs #Brexit https://www.theguardian.com/environment/2017/jan/29/britain-us-trade-deal-gm-food-eu-rules*
Policy	Pesticides	*Vast majority of UK public, incl leave voters, want to keep EU pesticide bans after #Brexit https://t.co/Q5lYAgtrPZ @GMFreeze info on why we also need to retain strict rules on #GMO https://t.co/ecPxG0TROU*
	GMO policy	*GM crops will continue to be banned in Britain after Brexit says Michael Gove in blow to UK/US trade deal https://t.co/lARHOoAKUB*
	Food labelling	*How can we protect our food and farms in #Brexit Britain? Retain principles of #precaution and #pulluterpays then give consumers choice with #GMO labelling. https://t.co/oGwwiKRhXz*
Science	Progress and innovation	*Innovation-focussed policy is the way to go. What are the implications of a #GMO ban on research? https://t.co/lARHOoAKUB*
	New technologies	*What about unregulated new genetic engineering techiques like gene editing? https://t.co/J0gVPZBNgZ*
Society	Consumer choice	*How does this tie in with the Conservative views on consumer choice? Oh my…https://t.co/jnV73EUMj3*
	Poverty	*https://t.co/GybfZs0wMv Terrible quality meat will line supermarket shelves and will have no choice but to eat it because they will be poor after Brexit.*
Miscellaneous	Conspiracy theories	*The worst is yet to come #GMOs #Chemtrails #5G #vaccines #Brexit #Russia*

Table 4.6 shows examples of tweets pertaining to specific thematic macro-areas. Please note most of these are constructed tweets as they are representations of content created by private individuals. However, others were tweeted by the GM Freeze such as the one on food standards and on pesticides whereas others represented news sharing and hence only contained the news headline such as the tweet pertaining chlorinated chicken and the one about GMO policy.

As was also clear in the digital media, the areas of **science** and **society** were only marginally discussed in tweets. The former was predominantly covered in tweets talking about new technologies, particularly gene editing, or in tweets about progress and innovation. However, there were no hints to the explanation of the science behind GMOs in any of the original tweets in the corpus. This difference with the digital media is likely due to a difficulty of explaining scientific concepts in the span of 280 Twitter characters, but also to the prevalence of the political framing of the issue of GMOs. The society macro area mostly occurred in the form of mentions of public opinion, consumer choice and social justice, particularly poverty and class differences in association with food labelling and imports after Brexit.

The analysis of themes only pertains original content and does not account for the number of retweets; nevertheless, as shown in the analysis of tweets and retweets, the most highly retweeted content pertained the Scottish opt-out of GMO cultivation and US imports, especially GM crops, GM food, and chlorinated chicken. Therefore, most retweets would only reinforce thematic areas that are already prominent in the corpus. However, there is one theme that could have greater weight due to the amount or retweets of Paul Flynn's content, which was the NHS amongst things that could be influenced by Brexit and by an agreement with the USA.

There are striking similarities between themes in the digital media and in the Twitter-sphere. Furthermore, these themes often co-occurred in creating very similar framing for GMOs within the Brexit discourse. However, a key difference with the digital media was identified in this corpus and that was the association of GMOs and Brexit with broader and sometimes seemingly unrelated issues. Some of them pertained to the UK political landscape more than Brexit itself such as the general elections, Scottish regulations and independence, the dieselgate scandal, fracking and pesticides. However, some themes were more tangential to the topics under analysis and sometimes associated with conspiracy theories and pseudoscientific claims such as chemtrails (as shown in table 4.6). The following section will address whether themes are used to support the same arguments and ideologies about GMOs and Brexit found in the digital media.

In the previous sections, the temporal distribution of tweet types and the analysis of emerging themes suggested there are similarities between the digital media and the Twitter discourse. This section will expand on whether the thematic content is used to support underlying arguments and ideologies in tweets, like those found in the digital media. Firstly, the similarities will be discussed briefly, providing some examples, but most importantly, the focus will be on new and emerging ideologies which distinguish the portrayal of GMOs and Brexit on Twitter from that in the digital news.

4.5.1. Strongly against *toxic, poisonous* GMOs and *stupid* Brexit

Due to the juxtaposition of certain digital media articles with high influxes of tweets in the 2017 timeline, it was not unexpected to find that arguments emerging in the Twitter debate majorly involved opinions on the trade agreements and, as seen in the stance analysis, most of these arguments supported both anti-Brexit and anti-GMO sentiment with the presentation of GM crops and/or food flanked by other controversial US products that could potentially enter the UK in case of a trade deal between the two countries. On Twitter, as seen in the media, common products were chlorinated chicken (see tweet [39]) and, though not as frequently, hormone treated beef (as seen in the prevalence of themes).

Two main aspects distinguished the Twitter discourse on these topics from that of the media. Firstly, what was a passing mention in most of the digital press, in tweets became centre of the discussion, meaning that, especially in singletons, GMOs, chlorinated chicken and hormone beef were often chosen as issues associated with Brexit. Secondly, the negative sentiment towards Brexit was intensified through the use of derogatory language towards the politicians involved, particularly the international trade secretary Liam Fox who was described with synonyms of *stupid*. Even more frequently, negative hyperbolic language was used to refer to the food itself, especially in news comments and singletons, which entailed Twitter users being able to express thoughts in their own words. Often, users chose to use emojis (🤢) or onomatopoeic words such as *yuck, ew* or, sarcastically, *yummy* or *nom nom* to express disgust. This was particularly true when referring to GM foods and, more broadly, to American imports. Other frequently used terms were *toxic* or *poison.* The latter were especially found alongside mentions of the potential relaxation of pesticide regulations after Brexit. The association of Brexit with the issue of pesticides, as mentioned in the analysis of themes, is not completely

unexpected seen as the UK government will oversee the regulation of pesticide use in agriculture after the exit from the EU. However, the salience given to pesticides in tweets needs to be noted because the use of neonicotinoids in the EU has been subject of controversy (Lang, 2017) due to their association with detrimental effects to bee health (Muth and Leonard, 2019). This is relevant to the Brexit discourse in light of the fact that the UK public has been shown to positively value the ecosystem services provided by bees (Mwebaze *et al.*, 2018), suggesting neonicotinoids could be used in arguments against Brexit and GMOs because of their triggering nature.

Furthermore, glyphosate, is a herbicide ubiquitous in agriculture the use of which has been at the centre of controversies due to studies suggesting its toxicity and ill effects on human health (Mesnage and Antoniou, 2017). Despite European authorities concluding that it is *unlikely to pose a carcinogenic hazard to humans* (European Food Safety Authority, 2015), the topic is still central in anti-GMO campaigns, especially in association with herbicide resistant GM crops and a critique of unsustainable agricultural practices and big agricultural companies (Tosun and Varone, 2020).

Some tweets in the corpus went as far as to describe GMOs as carcinogenic. This could be legacy of claims that GMOs could be associated with adverse health effects (Andreoletti *et al.*, 2012). Nevertheless, there is large scientific consensus that commercially available genetically modified foods are safe for human and animal consumption (National Academies of Sciences, 2016). Although it is clear that the use of strongly negative terms in these tweets was not intended to be scientifically accurate, the use of hyperboles, flanked by references to controversial and emotionally triggering topics, signified an intention to anchor GMOs to issues that are publicly recognised as controversial and to frame Brexit supporters as heartless villains in contrast with a portrayal of the EU as saviour and protector. Despite the absence of scientific claims to support the argument that GMOs are unsafe for human health, this *damnation by association* of GMOs and Brexit was widely adopted on Twitter as it was in the digital media.

[39] @politician what were you thinking? There is no such thing as freedom to trade. Now we will get toxic #GMOs and chlorinated chicken #BBC

On the topic of sharing potentially incorrect information, a tendency was seen in the use of the term *ban* to describe the current legislation on GMOs in the UK and Europe. The term was used in one of the most popular news items in the corpus, the article was published in the Telegraph on November 28th 2017, titled: '*GM crops will continue to be **banned** in the UK after Brexit says Michael Gove, in blow to UK/US trade deal*'. Tweets reporting or commenting on this article seemed to imply GMOs are fully banned in the UK. However, there were others who used the same term to describe the EU's approach to GMOs. Neither are entirely correct. In the year in which the Twitter data was collected (2017), GMO regulation in the UK was still provided by the EU. The EU legal framework (as discussed in chapter 1) allowed for a number of GM crops to be marketed but, due to lack of agreement amongst member states, only one GM crop has ever been allowed for cultivation, which at the time of writing (2021) is farmed in Spain and Portugal (MON810; a Bt-expressing maize variety that is highly resistant to insect herbivory). As explained in the introduction of this thesis, due to repeated lack of agreement between member states, the EU has given each country the opportunity to restrict or prohibit (*opt-out*) GMO cultivation autonomously since 2015 (European Parliament and the Council, 2015). Since then, Northern Ireland, Scotland and Wales have opted out of cultivation, whereas England has not. Nevertheless, the only GMOs being cultivated in the England are part of field trials for research purposes.

Although it is correct to consider the opt-out a *ban*, as it causes the prohibition of GMO cultivation, it is incorrect to imply the cultivation of GM crops is being prohibited all over the UK. Looking into the political context of the news item, it was noticed that Michael Gove's statement came sometime after a letter written by the Scottish and Welsh devolved governments to Theresa May, in which they expressed their will to continue maintaining their GMO opt-out after Brexit. This could suggest Michael Gove's statement was an attempt to reassure those concerned about a potential change in GMO regulation. The way the term *ban* is being used in the headline of this news piece and the minister's choice to use the expression *responsible genomics* in his speech suggests a need to reassure the public that they should not be concerned about the US/UK deal disrupting farming regulations on GM crops; nevertheless, the environment secretary has not been consistent in his opinion on the matter offering contradicting statements over the years. However, this was not the only instance in which the term *ban* was used.

Twitter users discussing the possibility of a US/UK trade deal and the import of GM foods into the UK used it to refer to pesticides, GM crops and controversial husbandry practices common

in the United States but *banned in the EU*. Again, this is incorrect. Although many have described the EU legal framework as a *de facto* moratorium and have criticised it for being too strict (Tagliabue, 2017), the European Commission has not banned GMOs that have passed the required safety assessment. Furthermore, EU regulation on marketing of authorised GMOs allows for the marketing of GM food products, while following labelling regulations, meaning some of these products are available on UK supermarket shelves right now. Thus, although it is correct to state that not all pesticides allowed in the USA are permitted in the EU and that some US meat is not allowed for importation due to safety and animal welfare concerns, this is not true for most GMOs.

In the case of EU *bans*, the term brings attention to the difference in approach between the USA and the EU when it comes to the regulation of GMOs, with the former being more permissive and the latter applying the precautionary principle. In both the digital media and on Twitter, this difference in approach has been described as a difference in *standards*, with the USA being inferior compared to the EU and, by association, the UK. Therefore, the term *ban* when referring to the EU regulation, might have been used, either voluntarily, involuntarily, or for lack of knowledge, to stress anti-Brexit sentiment. This implication is strongly intertwined with a strong dislike of GMOs, with tweets and articles portraying the current UK and EU legal framework as very restrictive towards GMOs. Some Twitter users even used the word *protection* to refer to rigid EU regulation on the matter when, in fact it is not as severe as other countries in the world (Montpetit, Rothmayr and Varone, 2007, page 7). Asserting the UK bans GMOs means sacrificing the complexity of the relevant regulation to appeal to a pre-existing anti-GMO agenda and to help alienate GM crops and food as something that is foreign and new.

Twitter users have also implied that farm animals in the UK are not fed on GM crops. This is also incorrect. In fact, it is very common for conventional farmers across Europe to rely heavily on GM feed, especially GM soybean and corn (ISAAA, 2018). Some of the tweets sharing this idea seemed to belong to a small cluster of singletons which commented on a tv programme called Panorama (see tweet [40] below), so it is possible that this incorrect information was passed on from an external media outlet. However, there were other isolated instances such as that exemplified by constructed tweet [41] which also mentioned farm animals being fed on GM wheat, a GM crop that is not yet on the market. This insertion of GM food and feed in a negative portrayal of the US/UK hypothetical trade agreement suggests once again the discursive representation of GMOs as inherently bad and their use as a scaremonger in the anti-Brexit discourse.

[40] We don't want beef fed on GM crops from the US #StopBrexit #Panorama

[41] Not only will we get chlorinated chicken in the UK after #Brexit, but it will be fed on GM wheat! #trade

With the exception of the word *ban*, contained in highly retweeted content, the actual number of tweets containing largely incorrect information is limited in the Twitter corpus (2% of original tweets), but this is still noteworthy, especially if compared to the overall lack of tweets stating more scientifically accurate claims, or just representing arguments in favour of GMOs. The latter were, similarly to the media, only seen in co-occurrence to discussions on progress and innovation opportunities after Brexit, alongside a few comments on princess Anne's interview on GM crops cultivation after Brexit, as was shown in the analysis of stance and, lastly, in a relatively popular tweet by Murdo Fraser, criticising Fergus Ewing's statements on the Scottish opt-out as *unscientific*. The latter is an inversion on the main trend seen in the digital media, in which most of the discourse was a critique of pro-Brexit arguments. This is one of very few instances where the opposite is true, with a conservative MSP criticising anti-GMO arguments as unscientific.

4.6. Chapter summary

This chapter showed that in many instances throughout the year 2017, issues that were frequently discussed in the digital press were also popular on Twitter. Particularly, the discourse on post-Brexit trade and food imports from the USA was highly relevant to the Twitter corpus. However, the results showed that only 11% of news items from the digital press trickled down to Twitter, and amongst them (Appendix B), only a select few were highly cited on the platform. This was the case for the article on chlorinated chicken in January and the Michael Gove article in November. Furthermore, some trending topics found in the corpus of tweets were barely mentioned in the press like the Michael Gove speech which was mentioned in one article but was shared and retweeted intensively.

The detailed analysis of tweet content and ideologies showed that Twitter not only amplified some of the less prominent discourses in the media, but was also a space for new discursive moments, such as that created by the AnonHQ.com article on US GMO labelling or the the one regarding the Scottish GMO opt-out. Furthermore, prominent voices in the Twitter debate were

not always the same as the ones in the digital press. Clear examples of this were Scottish political figures such as Alyn Smith and Fergus Ewing in contrast with Theresa May and Liam Fox. The role of frequently retweeted political figures in the corpus will be further explored in chapter 5. However, it is already notable how a few key politicians which we could call *active* politicians appeared to be important voices in the anti-GMO Twitter discourse and used the platform as a way to promote specific viewpoints (Arnaboldi *et al.*, 2017). Moreover, with their large following, these accounts generated great momentum and, arguably, *went viral* (Al-Rawi, 2019) thus creating a new discursive moment that was not found in the national coverage. At the other end of the spectrum, *passive* political figures were often mentioned, but did not take an active part in the Twitter debate, namely Theresa May, Michael Gove and Liam Fox.

Despite the prominence of political figures in a few discursive moments, it could be argued that anti-GMO groups also had a more long-lasting presence in the debate than politicians. In fact, NGOs such as the GMWatch and the GM Freeze took a multifaceted approach to their Twitter presence, tweeting about timely news items and producing original content, with a focus on citizen mobilisation and government lobbying (Wonneberger, Hellsten and Jacobs, 2020). A whole network analysis of the Twitter corpus will help understand the role of political figures and NGOs in more detail (chapter 5).

The analysis of tweet types also showed that a high percentage of the Twitter corpus comprised news sharing and news commenting tweets. This is in line with the idea that Twitter is often used as a platform to share (Anna Sophie Kümpel, Karnowski and Keyling, 2015) and discuss the news (Hermida, 2010). Furthermore, although the analysis of retweets suggested that some users were important in the sharing of news items on the platform, it did not provide information how specific news pieces were disseminated across the platform. Whether news broadcasting outlets, politicians, journalists and NGOs played a part in the dissemination of popular news items will be discussed in the analysis of EGO networks in chapter 5.

This chapter has reinforced the findings from the digital media analysis, regarding the fact that GMOs were often a buzzword within the negative discursive representation of Brexit and used as a scaremonger within anti-Brexit arguments. This was already evident from the analysis of themes and corroborated by the stance of tweets. The analysis provided evidence that negative representations of GMOs were overwhelmingly more frequent than pro-GMO arguments in both original tweets and retweets, showing anti-GMO/anti-Brexit tweets were more successfully retweeted on the platform. Anti-GMO tweets framed GMOs within a cluster of highly processed unhealthy foods from the USA and toxic pesticides and portraying them as controversial products banned under the EU's protection. By contrast, though very rarely in

the corpus, gene editing was used as an example of promising technologies to be harnessed after Brexit in the pro-GMO arguments. Therefore, the framing of GMOs within the argumentation on Twitter is not necessarily different to the representation painted in the digital media, but rather an intensification of what was already a strongly negative discursive representation of the technology, often with bordering pseudo-scientific claims driven by hyperbolic language.

5. News dissemination on Twitter and Social Network Analysis

The critical discourse analysis of tweets described in chapter 4 relied mostly on the content of tweets to shine a light into the debate surrounding GMOs and Brexit. However, the detailed analysis of themes, arguments and ideologies emerging in the debate did not provide information on *how* the popular news items in the corpus were disseminated on Twitter, nor did it provide *relational* information about the social actors involved in the debate. To understand news dissemination on Twitter, relational data gathered with NVivo (as explained in section 2.3.2) was used to carry out social network analysis in two different ways: 1) an ego network analysis to investigate alter-alter relationships amongst users tweeting about the same piece of news and 2) a *whole network analysis* to provide an overview of the network in its entirety.

5.1. Sharing news on Twitter:

5.1.1. Popular URLs and their sharing networks

The first part of this chapter will examine the type of URLs and their popularity in the corpus. Once categorised and determined which external links were the most popular, four highly mentioned URLs were selected for ego network analysis based on what was found in the analysis of tweet types in chapter 4. Namely, these were links to the chlorinated chicken story by Joanna Blythman for the Guardian, links to the article on Michael Gove from the Telegraph, the two regional news items from the Herald and the Scotsman regarding the Scottish GMO opt-out and, finally, the article from AnonHQ regarding GMO labelling in the United States as listed below.

- *While you were distracted by Brexit and Trump, Monsanto's senate puppets push through bill to outlaw GMO labelling. (hqanon, 5th December 2016, AnonHQ.com)*
- *Is chlorinated chicken about to hit our shelves after new US trade deal? (Joanna Blythman, 29th January 2017, The Guardian)*
- *Fergus Ewing seeks pledge on GM crops opt-out after Brexit (The newsroom, 6th August 2017, The Scotsman)*
- *SNP minister insists Scotland's GM crops ban must continue after Brexit (Peter Swindon, 6th August 2017, The Herald)*
- *GM Crops will continue to be banned after Brexit says Michael Gove in blow to UK/US trade deal (Christopher Hope, 28th November 2017, The Telegraph)*

It should be noted that the *ego* in these networks was removed to analyse alter-alter relationships and to highlight any evidence of retweeting patterns or particularly central users (see section 2.4.4.3).

Table 5.1 Abundance of URL categories

Type	*No. of URLs*	*No. of mentions*
Online newspapers	81	552
Other news outlets	68	311
Blogs	24	166
Anti GMO group websites	23	157
Magazines	10	139
Other NGOs' pages	15	91
Government websites	3	43
Radio and podcasts	4	16
Youtube	10	11
University websites	1	10
Powerbase	1	6
Scientific journal/science magazine	3	3
Company websites	2	3
Eventbrite	1	2
Facebook	2	2
Surveys	1	1
Miscellaneous	13	19
Page not found	n.a.	141

Table 5.1. The table shows the different types of URLs found in the Twitter corpus, how many different URLs belonged to each category (No. of URLs) and the number of instances the category was mentioned in the corpus of tweets. As seen in the table, most URLs were links to news items from online newspapers or other news websites. However, mentions of blogs and NGO web pages, including anti-GMO groups' websites were also prominent in the corpus.

Table 5.1 shows that the most common types of URLs were hyperlinks to online news outlets such as regional and national newspaper websites, but also specialised news outlets like Farmers Weekly. It is notable that 14 of the mentioned news items linked in the Twitter corpus were articles from digital media already presented in chapter 3 (Appendix B). Although only a

relatively low number of blogs was linked in the tweets, the few ones present in the corpus were the most abundant external source after online newspapers and other digital news outlets[12] with prominent examples being David Icke's website, and the *CAP reform* blog.

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[12] Similar to suspended Twitter users, many URLs were no longer available at the time of the analysis and so the categorisation could not be applied to them.

Figure 5.1 Temporal distribution of popular URLs

Legend:

- While You Were Distracted by BREXIT and TRUMP, Monsanto's Senate Puppets Push Through Bill to OUTLAW GMO Labeling – Anonymous
- Is chlorinated chicken about to hit our shelves after new US trade deal~ ~ Environment ~ The Guardian
- UK votes in favour of GM crops, paving way for potential post-Brexit approval - FarmingUK News
- Brussels 'will block' GM food from Britain ~ News ~ The Times & The Sunday Times
- David Icke ~ Princess Anne says GM crop fears are 'not a practical argument' – and she may grow them after Brexit
- Fergus Ewing seeks pledge on GM crops opt-out after Brexit - The Scotsman
- GM crops and Brexit - www.gov.scot
- SNP Minister insists Scotland's GM crops ban must continue after Brexit ~ HeraldScotland
- GM crops will continue to be banned in Britain after Brexit says Michael Gove in blow to UK~US trade deal ~ The Telegraph
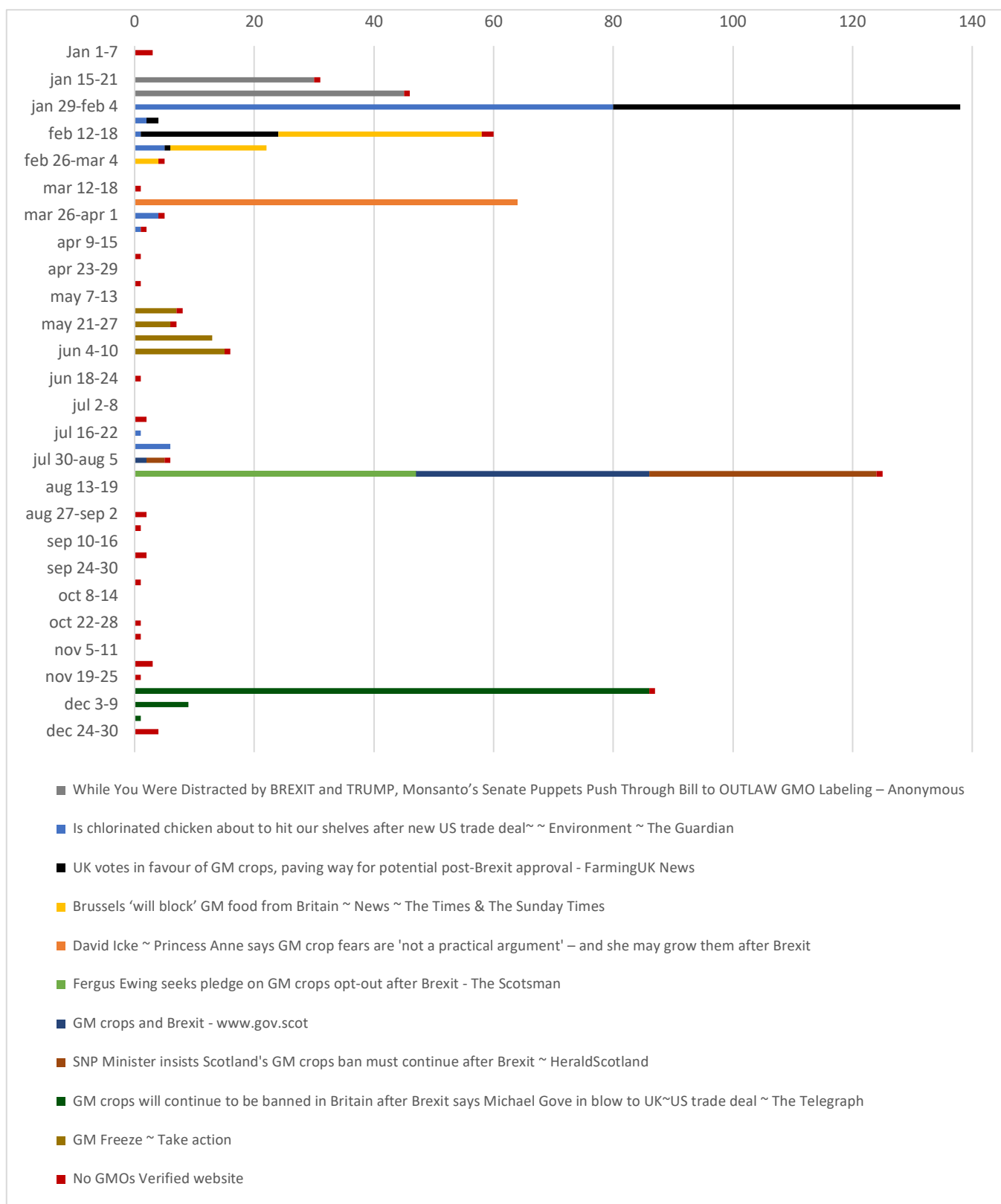- GM Freeze ~ Take action
- No GMOs Verified website

Figure 5.1 shows eleven URLs and their abundance throughout 2017 to highlight differences in the temporal distribution of time sensitive tweeting and periodic tweeting.

Upon carrying out a temporal analysis of URLs' mentions in tweets, it was evident that the sharing of most URLs was time sensitive. In other words, shortly after the publication of the news item, there was a flurry of tweets containing a link to the source, but the link was no longer tweeted beyond a week after its publication. This was the case not only for links to the Scottish news items, but also for links to a letter on GMOs by Fergus Ewing published on the Scottish government website, the Telegraph news piece on Michael Gove, as well as a GM Freeze petition link, which was shared during the UK elections and was not seen again in the 2017 corpus (Figure 5.1). These URLs were popular in the debate on Twitter but their influence was largely confined to immediate aftermath of them being published. Such transient nature of news sharing tweets is in line with the notion that Twitter is often used as a source of breaking news (Anne Sophie Kümpel, Karnowski and Keyling, 2015).

In a few instances, however, the temporal pattern of news tweeting was different. Firstly, there was some evidence of bots posting when a single URL was tweeted periodically as part of a small number of tweets (Lokot and Diakopoulos, 2016). For instance, tweets linking the URL for the No GMOs Verified webpage were retweeted consistently on a fortnightly basis, which suggests a scheduled tweet or a bot[13]. Secondly, one article recurred in the database in response to events (figure 5.1): the Joanna Blythman article in the Guardian was mostly shared in January but was tweeted again at the end of March, beginning of April, and also in correspondence of the discussion on US imports sparked by news reporting of statements by Liam Fox in July. Furthermore, Joanna Blythman's article was pasted as an image, although not directly via URL, in another popular tweet by a private individual on August 23rd, (as discussed in section 4.2.1.6). The tweeting pattern of this news item suggests that the article was particularly impactful as an example of anti-Brexit/anti-GMO stance, a sort of *manifesto* for opponents of post-Brexit trade with the USA, chlorinated chicken and GMOs. To better understand news sharing patterns surrounding popular URLs, in the next section the network of users who shared these articles will be discussed.

5.2. Analysing news dissemination with EGO network analysis

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[13] Please note @NoGMOsVerified has currently been suspended for violating Twitter rules.

5.2.1. Chlorinated chicken

Chapters 3 and 4 partially elaborated on the *agenda setting* nature of Joanna Blythman's article on chlorinated chicken, GMOs and other imports from the USA after Brexit. This news piece was one of the first articles portraying these imports in in a strongly negative way and became the most highly retweeted piece of news in the Twitter discourse on Brexit and GMOs. Based on the centrality of this piece in the discourse, an ego network analysis was carried out firstly by querying the dataset to find all *alters*, (users who tweeted or retweeted the article link or were mentioned alongside it) and, secondly, by creating an adjacency matrix of Twitter users to look for any further connections amongst the alters (as explained in section 2.4.4.3).

The network of users discussing the chlorinated chicken article included 104 users (*nodes*), of which 32 were isolated. These so-called *isolates* were users who i) have tweeted about the article by directly citing the source even though they did not interact with any other users in the network and ii) did not gain access to the article through another user's tweet or *vice versa*. Other than isolated individuals, there were a few small *components* in this network (defined in section 2.4.2) consisting of two or three users each and one component of 5 nodes (black coloured nodes in figure 5.2). The latter was a small cluster of users who interacted with Theresa May's Twitter account (@theresa_may). This case, exemplified by tweet [40], represents an instance of one-sided interaction between political figures and private individuals on Twitter. As mentioned in chapter 4, this is not an isolated occurrence in the corpus. In fact it happened with other government officials like Liam Fox. Tweets such as these, signify an attempt to draw the attention of political figures in positions of power towards specific issues (Tromble, 2018), in this case, chlorinated chicken coming to the UK.

The main component (MC) of the network contained 42 nodes (red coloured nodes in figure 5.2) and had at its centre Joanna Blythman's Twitter account. As the author of the piece, she was often mentioned alongside links to the article, as shown by tweet [41].

[40] @theresa_may I cannot believe these will come to the UK? https://....

[41] RT @user: https://t.co/alKkB6l28s @JoannaBlythman suggests potentially lower standards as effects of #Brexit. #chlorinatedchicken

The centrality of Joanna Blythman in the ego network of her article is corroborated by the fact that hers is the node with the highest degree of centrality (degree centrality=32). Furthermore, the journalist appears to use Twitter as a participant within the discussion on GMOs and Brexit.

Her activity in the broader discourse is supported by the fact that she also retweeted other users' tweets within this corpus, such as a tweet from the GM Freeze and one from the GM Watch. This demonstrates that not only she used the social media platform to promote her work (Hedman and Djerf-Pierre, 2013) but she also confirmed her dislike of GMOs in line with the opinions expressed in her article by amplifying the voice of anti-GMO activists, hence declaring her allegiances to her social media following (Bruns, 2012).

Although there is no evidence for a clear path by which this news item was shared on Twitter, three behaviours emerged from the chlorinated chicken ego network. Firstly, it is evident that many users tweeted the article on their own accord (isolates), without actually being part of a conversation around the news piece. Secondly, the analysis also showed evidence of a few users attempting to draw the attention of a politician to the issue, though not successfully in this case. Lastly, this ego network showed a journalist playing an active role in the dissemination of the news piece on Twitter and also participating in the broader conversation.

Figure 5.2. Network visualisation of alters who mentioned the chlorinated chicken article
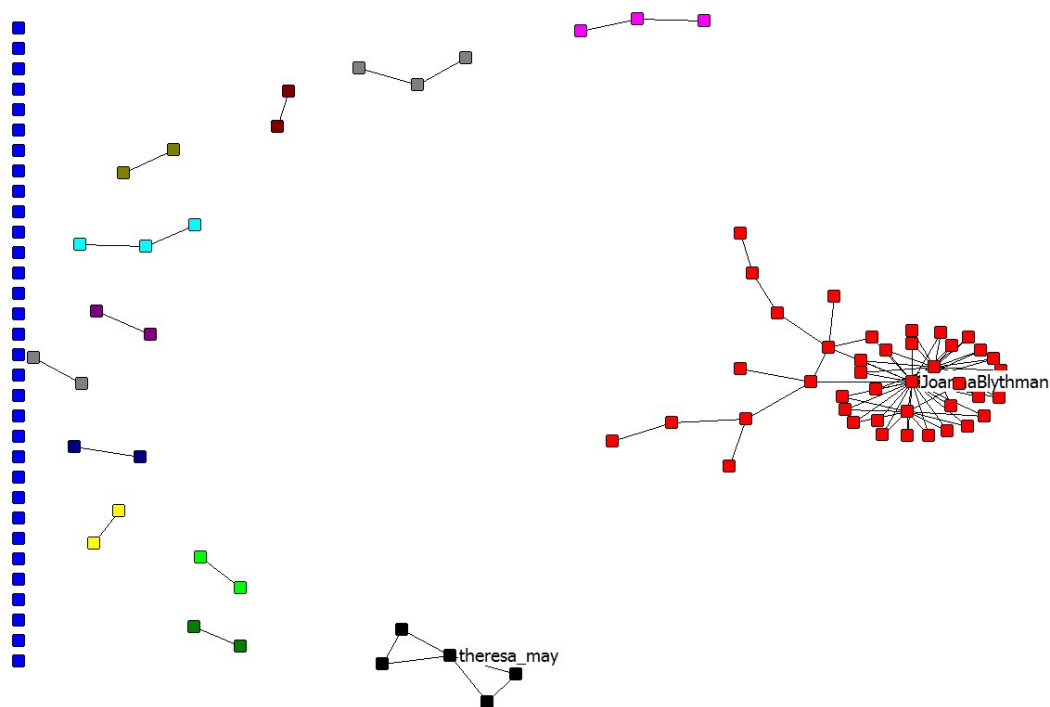

Figure 5.2 is a visual representation of connections amongst users who used the URL linking to the chlorinated chicken article by Joanna Blythman. The main component, in red, shows Joanna Blythman at its centre.

5.2.2. Michael Gove

The network of users discussing the Michael Gove article followed a similar pattern to the previously mentioned network. However, this case presents a clearer path for the dissemination of the news piece. The network consisted of 107 nodes, with 34 isolates, a few small components of two, three or four users, one component of 11 nodes surrounding @telegraphnews and one 10 nodes component. The main component comprised 28 nodes and contained users, such as the_ecologist, @UE (Unearthed, investigative journalism for Greenpeace) and a few anti GMO advocacy groups such as GMOfreeEurope, NonGMOProject and GMFreeze. In the network, the user with the highest degree of centrality is the_ecologist. Upon further investigation, it was found that the news was originally shared by UE within this cluster, but the tweet with the most resonance was actually the retweet by The Ecologist (shown in tweet [42]). The latter was then retweeted by GMFreeze and shared across the other anti GMO platforms. In contrast with what previously found regarding Joanna Blythman, the author of this article, Christopher Hope, only interacted with three other users in this network and did not play a central role in the dissemination of the piece.

[42] RT @UE: UK environment secretary hints that GM crops will still be banned after Brexit https://t.co/XqQzskqGDL https://t.co/5JYiFn4OvY

As per the smaller components, a tweet was frequently retweeted by multiple users without further relationships between them. These nodes, which are referred to as *pendant* nodes, assume a *firework* shape around the tweet that had been retweeted. This happened in two instances in the analysis of this ego network. The first instance was a small cluster of 9 individuals retweeting a private individual's account (which has now been suspended by Twitter), while the second instance happened in response to a tweet by the Telegraph (@telegraphnews). The latter tweeted about the piece and was retweeted by 10 users. It is interesting to note that the Telegraph official account, which was the original source of the article, was not part of the main component. Furthermore, despite being one of the first accounts to tweet about the article and having a large following, the Telegraph was not central to the dissemination of the news piece across the platform (Hong, 2012). Instead, the highest centrality and betweenness measures (defined in chapter 2) in this network lie with NGOs, activist groups, and an environmentally conscious magazine (The Ecologist). Furthermore, Michael Gove, who is the main focus of the article, did not actively take part in this debate, even though he was mentioned contextually to the piece in a small number of tweets and was

part in one of the smaller components of this ego network (see Figure 5.3). This is similar to what was seen in the previous section with Theresa May where she was tagged, but actually did not participate in the conversation.

Figure 5.3 Network visualisation of alters who mentioned the Michael Gove article
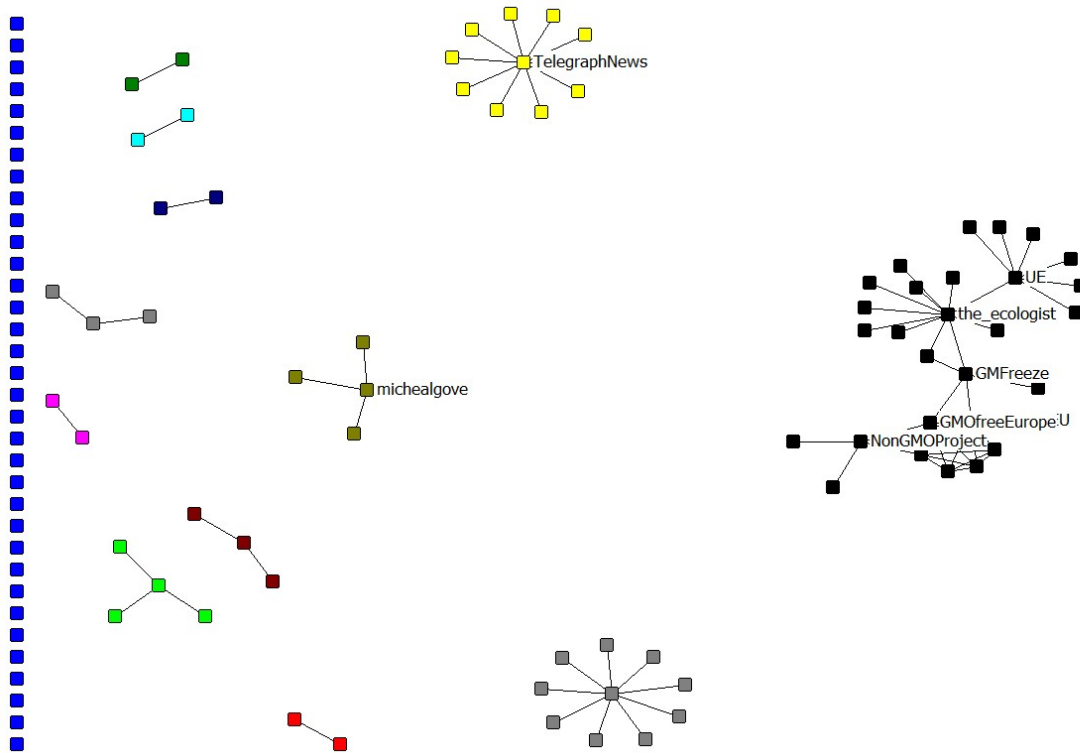
Figure 5.3 *shows a visualisation of connections amongst users mentioning the Telegraph article about Michael Gove. In black are users belonging to the main component of the network. In yellow is the component with @TelegraphNews at its centre.*

5.2.3.   The Scottish news

Michael Gove's passive role in the news shared on Twitter is in stark contrast to what was seen in the tweets about the Scottish news. The network of users sharing news from two Scottish newspapers was analysed separately at first, and then joined to highlight connections between the two. Details on the two networks as separates is available in Table 5.2. In this section, we will provide more details on the joint network (see figure 5.4). The latter comprised 77 nodes with 8 isolates, 3 small components composed of private individuals and 3 larger components. Firstly, one component of 12 nodes had the GM Watch at its centre with mostly pendant

nodes[14], including private individuals and, notably, two anti GMO advocacy groups, namely @GenEngNetwork and @GMOFreeEU. Secondly, a 20-node component contained three Scottish news outlets at its centre: @heraldscotland, @TheScotsman and @scotonsunday. Interestingly, this component is *held together* by two private individuals who retweeted both the Herald article and the Scotsman article. In fact, if it weren't fot these two individuals, this component would have been split into two: those who retweeted the article from the Herald, and those who retweeted the Scotsman article from either the @TheScotsman or @scotonsunday. The Scotland on Sunday is produced by the same publisher as the Scotsman and it is thus plausible that there is commonality of interest between people who Tweet both @Scotsman and @scotonsunday. Lastly, the largest component of the network comprised 23 nodes and was, again, composed of one central user, @murdo_fraser, a senior conservative and MSP in Scotland and the individuals who retweeted his content. Notably, in his tweet, Murdo Fraser criticised the Scottish anti-GMO opt-out as an example of *unscientific* policy. Notably, his tweet was retweeted by 4 other conservative political figures in the component and a few private individual, suggesting it gained some exposure. However, it is noteworthy that this criticism towards anti-GMO policy was segregated from the main discursive moment generated by Scottish news outlets, thus suggesting that, although discussing the same issue, users who interacted with Murdo Fraser's tweet were actually part of a pro-GMO/pro-Brexit echo-chamber (Goldie *et al.*, 2014).

Of particular interest are the tweeters who are absent from this network. Highly retweeted political figures, such as Fergus Ewing who was the subject of the Scottish news article and who has been highly retweeted in the discourse, was not present in this ego network. The same held true for Paul Flynn and Alyn Smith who were also very vocal about the issue. This contradicts the idea that these figures are highly connected to these news items in the debate. In fact, similarly to Michael Gove in the Telegraph article, Fergus Ewing could have been tagged in these tweets, but he was not. However, the ego network only shows part of the Twitter interactome, since users who have retweeted these news items could have interacted with the tweets produced by the aforementioned politicians, but this would only be visible in the whole network analysis which will be discussed later.

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[14] Pendant nodes are nodes at the edge of the network, connected to only one other node. Multiple pendant nodes connected to a central user form a *firework shaped* component/network.

Figure 5.4 Network visualisation of alters who mentioned the Herald and/or the Scotsman article.
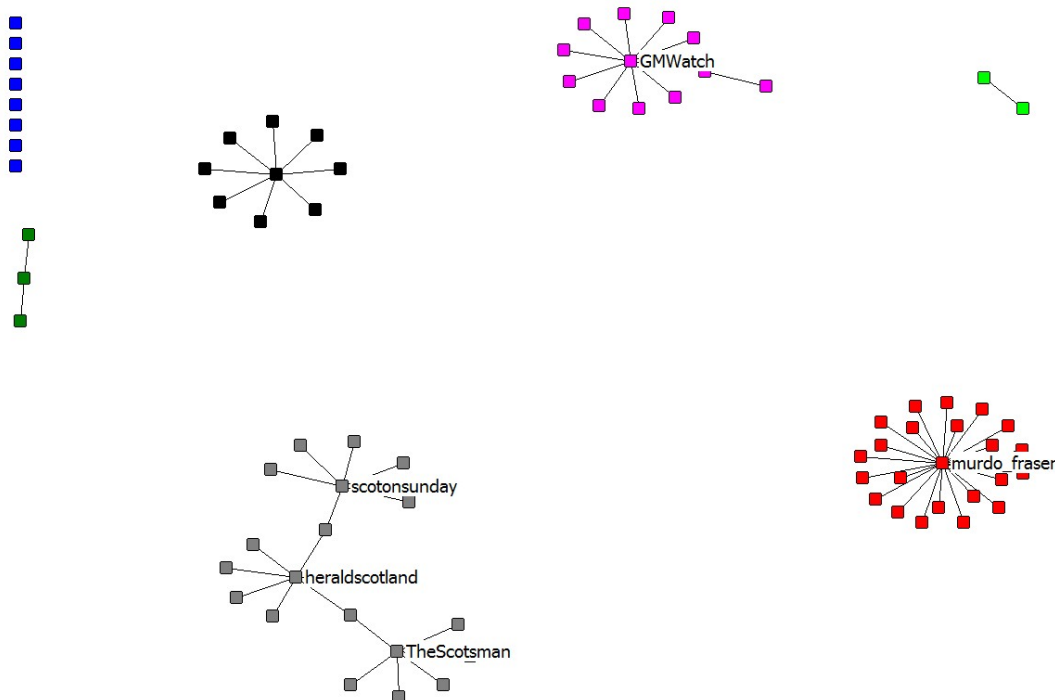
Figure 5.4 *shows a visualisation of connections amongst users mentioning the Scotsman article, the Herald article or both news pieces. In red are users belonging to the main component of the network which has a Scottish conservative politician at its centre. Notably, Scottish news outlets seem to be active on Twitter in disseminating this piece of news, though not as prominently as Murdo Fraser.*

5.2.4. AnonHQ

The last example of an ego network that was extrapolated from the Twitter dataset were the tweets sharing the news article from @AnonHQ on GMO labelling in the United States (figure 5.5). This network comprised 71 nodes, with 57 isolates, one component of 6 nodes and a main component of 8 nodes with the official @anonhq account at its centre. Amongst the ego networks analysed, this is the least dense ego network (Table 5.2), because most users tweeted about this article directly from the external source, without interacting with other twitter users. The main component had the official @AnonHQ account at its centre, not dissimilar to what was found for other news outlets present on the Twitter platform. Interestingly, however, the smaller component featured Joanna Blythman. Upon further investigation, she was mentioned in a few private individual's tweets discussing the article. Although the exact connection between the two topics is not discernible from the limited information we have about users, we know that the two news items were not tweeted very far apart in time (figure 5.1). Therefore,

it is possible that the journalist gained popularity in the broader anti-GMO community and was thus considered a relevant voice to be included in the debate. It needs to be noted that the main component of this ego network with @AnonHQ at its centre will remain completely separate from the rest of the users in the network even in the whole network analysis, as will be seen in the next section.

Figure 5.5 Network visualisation of alters mentioning the AnonHQ.com article
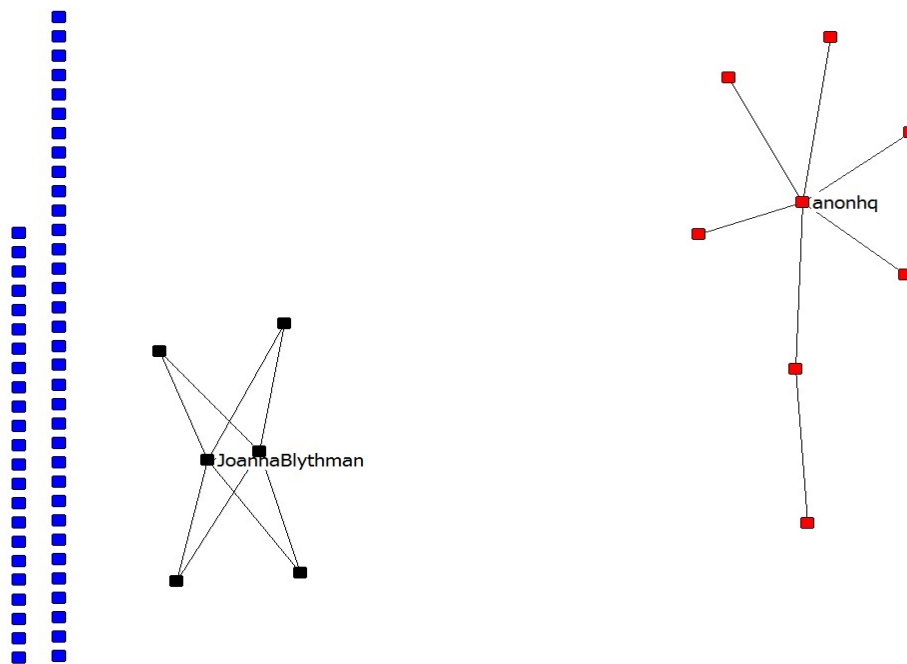
Figure 5.5 shows a network representation of connections amongst users who have tweeted about an article by AnonHQ.com on GMO labelling regulation in the USA. Shown in blue are the network isolates. Shown in red are nodes belonging to the main component of the network. Shown in black is the secondary component containing Joanna Blythman.

Table 5.2 Social network parameters

Network type	Network name	No. of users	No. of isolates	No. of ties	No. of components	No. of users in main component	Network density
EGO	Chlorinated chicken	104	32	178	45	42	0.017
EGO	Michael Gove	107	34	148	46		0.013
EGO	Herald	38	6	54	11	10	0.038
EGO	Scotsman	43	2	74	6	23	0.041
EGO	AnonHQ	71	57	32	59	8	0.006

Whole network	Twitter users mentioning GMOs and Brexit	3828	418	13324	623	2686	0.001

Table 5.2 *summarises the main characteristics of the networks analysed in this chapter. Namely the number of users in each network, the number of unconnected users (isolates), the total number of connections (ties), the number of groups of connected users (number of components), the number of users in the biggest component in the network (main component) and, finally, the density coefficient (network density). Note how, amongst the EGO networks, the Scotsman network presents the least amount of isolates and is the most dense.*

The analysis of ego networks carried out in this chapter highlighted how, although news outlets intervened in the dissemination of their respective news items, they did not gain great traction. In contrast, journalists such as Joanna Blythman were shown to be more central in the absorption of news on Twitter. Furthermore, accounts with a vested interest in the discussion of GMO related news seemed to take part in the news debate on the platform. Examples of these were NGOs such as GMWatch but also specialised magazines such as The Ecologist. Lastly, the analysis of news dissemination also revealed two different roles for politicians in the news commentary on Twitter: on the one hand, active politicians did not interact with the news piece, but rather shared a link to a government website, like Fergus Ewing and Alyn Smith did. On the other hand, government officials did not participate in the news debate, rather they were tagged by private individuals to incite a conversation, but this invitation to interact was unmet.

5.3. Whole network analysis of Twitter users discussing GMOs and Brexit in 2017

This section will discuss results from the analysis of relational data regarding Twitter users. Taking all connections in this dataset into consideration, different components of the network can be identified, highlighting groups of users that are not connected. This section will also discuss the role of key accounts for the diffusion of the discourse to a broad audience.

5.3.1. Overview

The whole network analysis considered all users that are present in the corpus, including those actively tweeting, those retweeting, being retweeted and/or mentioned in tweets. The entire network of these users is much larger compared to the small ego networks presented above. The entire network contained 3,828 users, 418 of which were isolates. It contained 572 components, of which the main component had 2686 nodes. Except for the main component,

no other group of users surpassed 27 nodes. Figure 5.6 shows a network visualisation of all components with more than one user (i.e. without isolates). Upon a superficial analysis of the network visualisation, it becomes evident that a high number of users represents a pendant node in the network, meaning they only interacted with one user. As also found in the ego networks, this often indicates either a single retweet, or a single mention. The high number of pendant nodes meant that the network is not very dense; in other words, the number of ties is far from the potential number of ties within the network. As hinted to in the methodology, this is common for large networks (Himelboim *et al.*, 2017) and is not surprising given the high amount of retweeted content, as opposed to original content.

Figure 5.6 Whole network visualisation
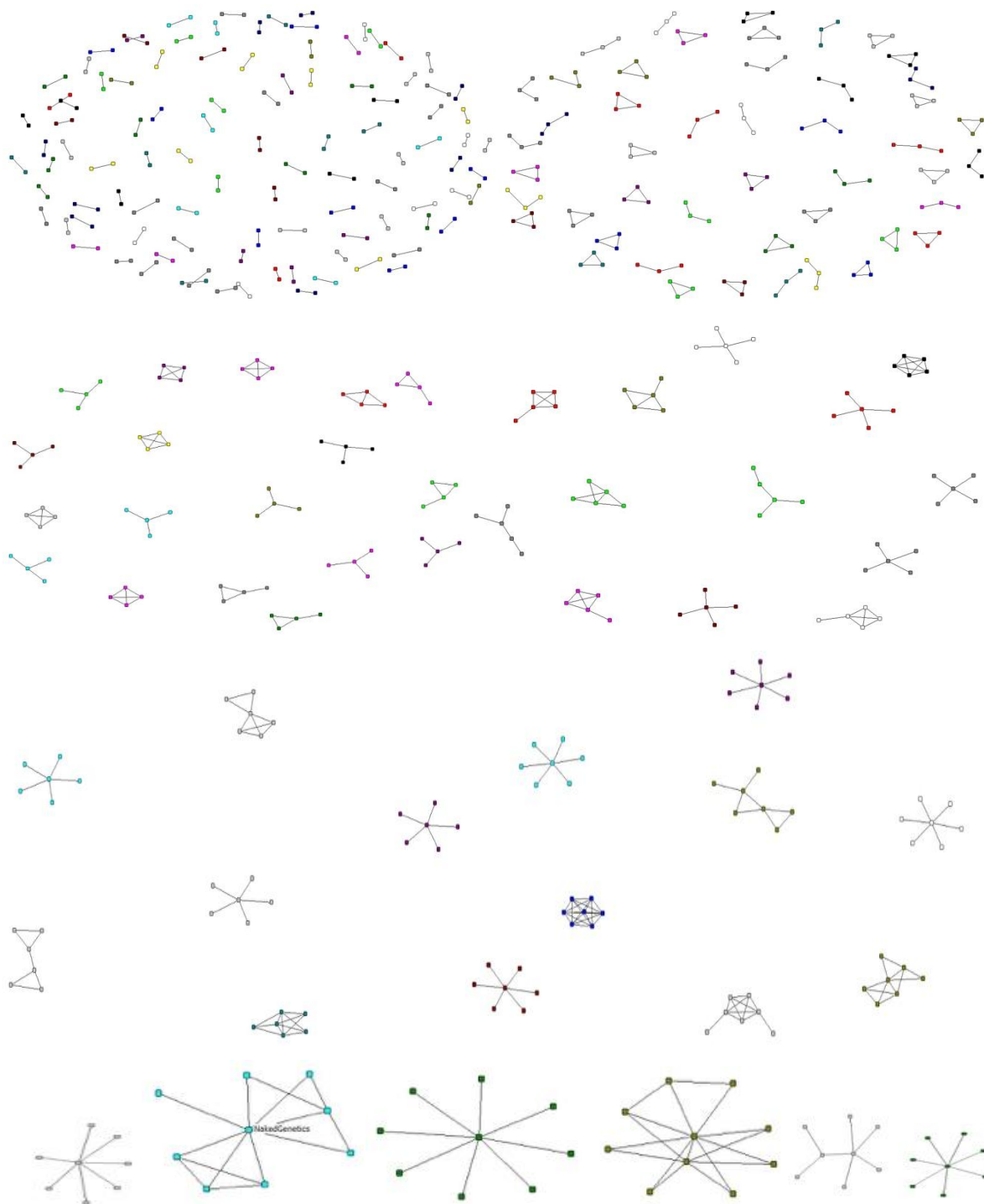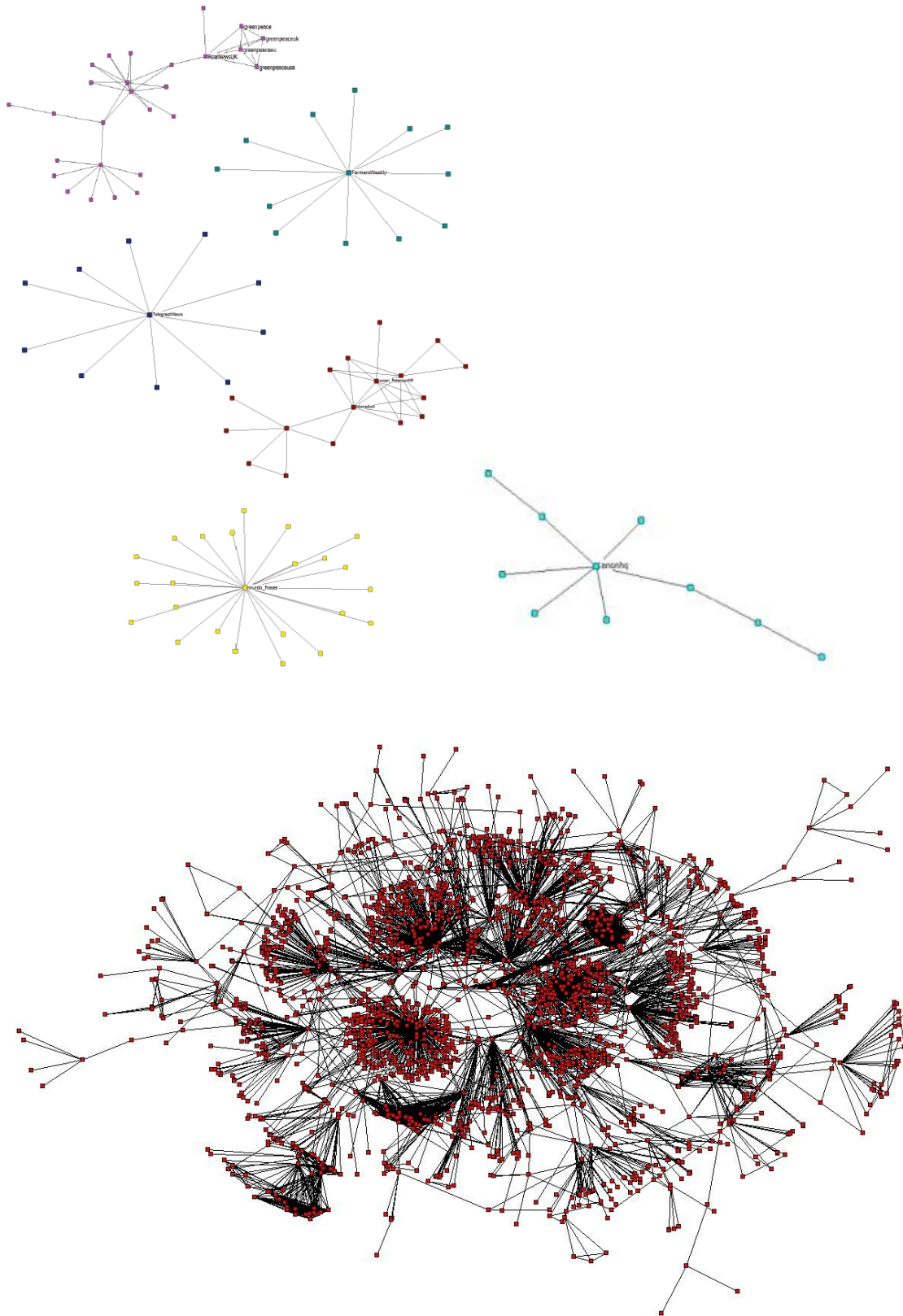
Figure 5.6 *shows a visualisation of the entire network of users discussing GMOs and Brexit. The network also included 418 isolates that are not represented in this figure.*

As hinted in the previous section, it is notable that 3 components emerging from the ego network analyses remained unchanged within the whole network: the AnonHQ component, the Telegraph News component and the Scottish conservative component. There were, however, other emerging groups of nodes with a single central user and a number of pendant nodes, such as those clustered around @FarmersWeekly which comprised 13 nodes and linked to the sharing and retweeting of two news item from the Farmers Weekly website regarding princess Anne and prince Charles' opinion on GM crops and political support for GM maize respectively. These are exemplified by tweet [42] and [43] below.

[42] Princess Anne disagrees with Prince Charles and backs GM crops and livestock https://t.co/eWEPbBGhQO #GMcrops #foodsecurity #Brexit

[43] Could GMs be grown in UK after #Brexit? Defra ministers show support for biotech maize in #EU vote https://t.co/ccd3OZ4WsR #GMcrops #GMO

As was previously the case for Murdo Fraser's tweet on the purportedly unscientific nature of Scottish regulation, these two tweets advertise a view that is different from the more prominent anti-GMO/anti-Brexit stance and users interacting with this content were not party to the larger political discourse on chlorinated chicken and other US import.

Lastly, there were two further components, which comprised several public accounts but that were not part of the main cluster. One was a component debating Owen Paterson's interview to BBC radio 4 regarding GM crops. The other was a cluster of private individuals and strongly anti-GMO/anti-Brexit accounts, including @RealNewsUK, a Twitter account that has currently been suspended by Twitter for violating the platform's guidelines. Frequent in tweets by this cluster were comments about the Michael Gove article, mentioning Monsanto and strong negative hyperbolic language towards GMOs as exemplified by tweet [44].

[44] Poisonous GMOs can kill animals and harm humans #Monsanto https://...

The case of Real News UK was not the only instance of a suspended account. In fact, some strongly anti-GMO tweets were created by private individuals who, upon verification resulted suspended. The same held true for the Twitter account associated with No GMOs Verified. This is interesting in the light of the fact that there are a few reasons for Twitter to suspend accounts and, amongst them, is misinformation (Twitter Help Centre, 2021). Although it is

difficult to know exactly when the accounts were suspended, the gathering of users around alternative news source such as Real News UK and the fact that this was a separate component in the network suggest there were small pockets of misinformation within the GMO/Brexit debate (Xu *et al.*, 2020).

5.3.2. The main component

The main component in the network, as seen in figure 5.6 presents many pendant nodes, especially in correspondence of highly retweeted accounts which make it difficult to visualise connections amongst central users. Therefore, to obtain a better visualisation of the central nodes within this network, the pendant nodes were removed, and the size of the nodes was increased based on degree centrality. This new visualisation is presented in figure 5.7.

Figure 5.7 Network visualisation of the main component and degree centrality
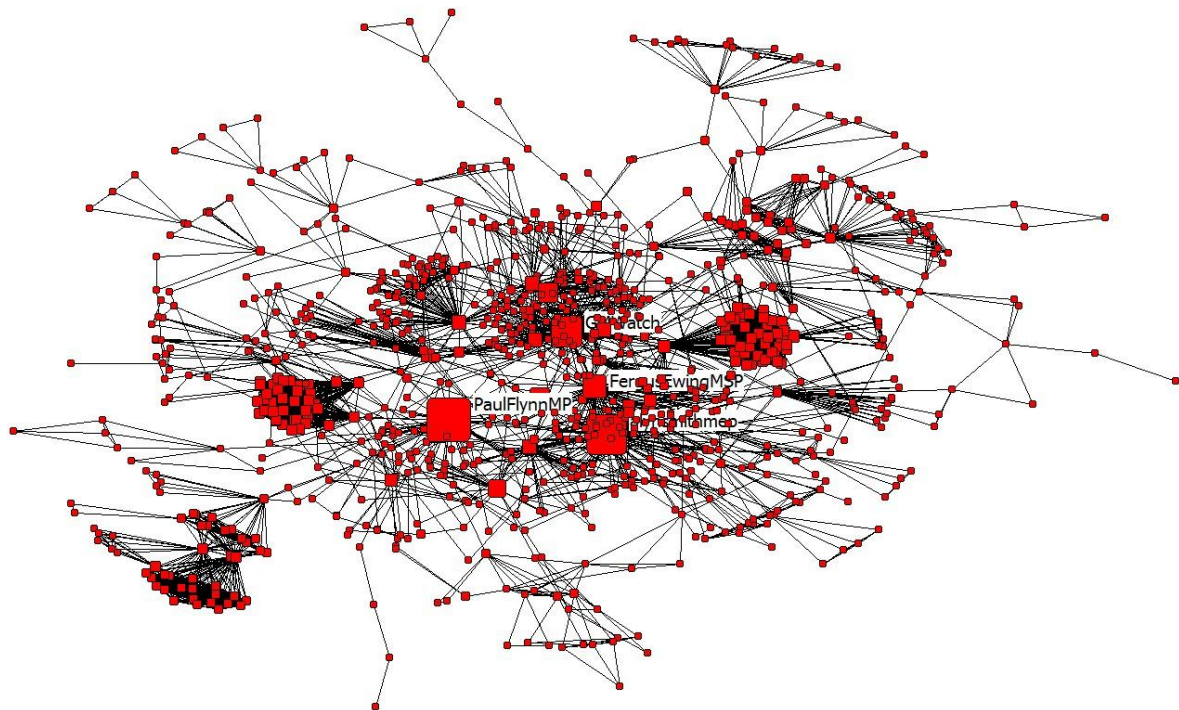
Figure 5.7 shows a visualisation of the main component within the entire network, which is depleted of pendant nodes. The size of nodes in the diagram is a measure of degree centrality. Nodes with the highest degree centrality are @PaulFlynnMP, @alynsmithmep, @GMWatch and @FergusEwingMSP.

It is evident that there are groups of nodes within this simplified component with similar high degrees of centrality. These were users that were often mentioned in the same tweet, which was then retweeted many times, thereby reinforcing the connection between these users by account of the number of occurrences. Nevertheless, it is clear that the core of the network

revolves around a few highly central users. Namely, in order of decreasing centrality, Alyn Smith, Paul Flynn, GM Watch, and Fergus Ewing, followed by a series of highly retweeted private individuals. At first glance, this does not seem surprising, considering the popularity of these users (chapter 4) and the fact that the degree centrality measures the number of ties. However, when considering the betweenness parameter, the GMWatch becomes the most crucial node in the network. It should be noted that betweenness is a measure of how important a node is in bridging groups of nodes that would otherwise not be connected (Grassi *et al.*, 2019). The importance of the GMWatch in the dissemination of news items was already highlighted in the previous chapter by the fact that @GMWatch is very active in tweeting about breaking news and retweeting relevant discussions. This centre-stage activity becomes even more apparent if we consider the GMWatch's ego network (Figure 5.8). The visual representation shows that the organisation's Twitter account not only had a broad reach in the GMO/Brexit discourse (the ego network included 480 ties with an alters' network density = 0,008), but that it also tweeted in concert with other activist groups, thereby amplifying their reciprocal exposure in the corpus. This behaviour was in stark contrast to Alyn Smith's ego network (Figure 5.9), who's Twitter account produced only one single popular tweet and who's alters are not very well connected with each other (the ego network includes 16 ties with an alters' network density < 0,001), as seen in Figure 5.9.

Figure 5.8 Visualisation of @GMWatch's ego network
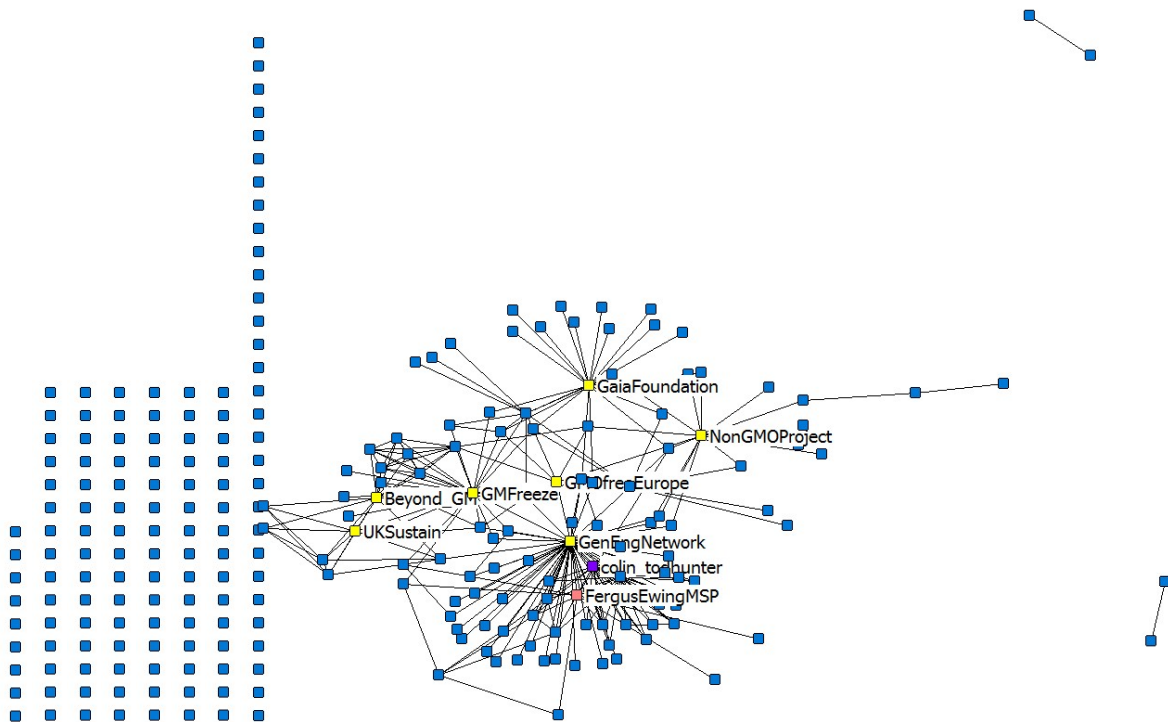
Figure 5.8 *shows a visual representation of the GMWatch's ego network. All the users in this network have at least one connection to @GMWatch in the discourse. This visualisation shows that many of these users (alters) also have connections other than to the GM Watch (alter-alter ties).*

Figure 5.9 Visualisation of @alynsmith's ego network
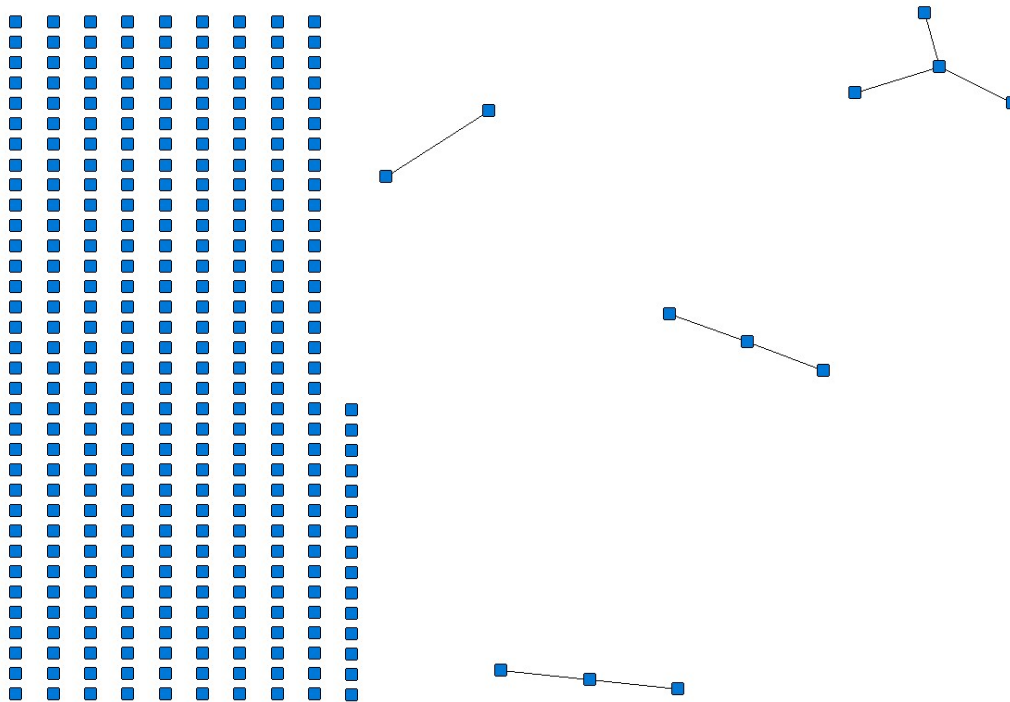
Figure 5.9 shows a visual representation of Alyn Smith's EGO network. All the users in this network have at least one connection to @alynsmithmep in the discourse. This visualisation shows that not many of these users (alters) have connections other than to the ego in the network.

The whole network analysis of the Brexit/GMO discourse on Twitter in 2017 showed the heart of the user network is represented by well-connected NGOs some of which were highly retweeted such as GMWatch and GM Freeze. The latter, together with SustainUK, the Gaia Foundation, the Genetic Engineering Network and many more, constituted a cluster of influential social actors. The cohesion of these users was unlike any other in the network and contributed to their ability to amplify each other's content and increase their reach (Himelboim, Mccreery and Smith, 2013). Furthermore, the whole network analysis revealed the presence of pro-GMO content separately from the main discourse suggesting some Twitter users preferentially retweeted content that aligned with a pro-GMO/pro-Brexit stance (Morgan, Shafiq and Lampe, 2013).

5.4. Chapter summary

The overarching objective of this chapter was to obtain a better understanding of how news travelled on social media, and to verify whether Twitter users in the debate were effectively connected and engaging in a conversation about GMOs and Brexit. Results from 3 out of 4 ego

network analyses about popular news items showed a high number of isolated individuals tweeting about the news. This suggests that users often tweeted a news item directly from the source and did not interact with other users, who might have had a similar interest. However, there were instances where a newspaper account, a private individual or an activist group would act as a broadcasting platform for selected news items, which would then be disseminated and retweeted more, thanks to the reach of these specific accounts. The main examples of this newscasting behaviour were Joanna Blythman who was important in the dissemination o of her own news piece, news accounts such as the Scotsman, the Herald and Farmers Weekly who tweeted about specific articles and gained some traction on the network. Lastly anti-GMO groups were ubiquitous in the sharing and dissemination of relevant news and contributed to the creation of debate-stimulating content.

When it comes to news sharing on social media and to Twitter as a breaking news outlet, one needs to be reminded that just because something is being shared, it does not mean that all individuals will be exposed to it in equal measures. In fact, many users in this analysis have proven to be occasional tweeters or re-tweeters with one single interaction in the debate, for the entire duration of the analysis. Despite this being the main trend for many Twitter users within the corpus, there were users who take a more active role in setting the agenda and purposefully shared and retweet content to make sure a certain viewpoint reached as many people as possible. This was the case for the GMWatch and other activist groups. The way these accounts were supporting each other's content could be assimilated to what in SNA is called a *clique*, in that they are a group of nodes who are highly connected and amongst which there is a reliable and efficient flow of information. This is in line with the history of the anti-biotechnology lobby in the UK, in the sense that, for many years, there has been a strong cohesive group of anti-GMO stakeholders with an active role in the political debate on GM crops and food (Montpetit, Rothmayr and Varone, 2007). This is interesting if one considers that there is no recognisable support network amongst the very few and far apart individuals who advocate for a different point of view. Furthermore, on the basis of content alone, some of these NGOs' accounts seemed use Twitter as an opportunity to discredit users with diverging opinions (see the discrediting article on Jonathan Jones shared by the GMWatch) however, this was not reflected in the relational data provided by SNA. On the contrary, each side of the network appears to launch one sided *attacks* and criticise other voices in the debate, as seen in the case of Murdo Fraser. However, they are seldom interacting.

6. General discussion: why are GMOs inherently bad?

6.1. Summary of results

The research presented in my PhD thesis has addressed the link between Brexit and GMOs within UK digital news outlets and social media throughout the year 2017. The work presents evidence that the subject of GMOs co-occurred with mentions of Brexit within both media. A critical discourse analysis of news revealed that there was a place for discussions on GMOs within the broader discourse on Brexit negotiations, policy and trade (sections 3.2 and 3.4) However, where GMOs were the main focus in digital media, Brexit was often only mentioned in passing (section 3.5.3). Interestingly, this difference in the prominence of either topic was not discernible on the Twitter platform. Nevertheless, further analysis of news dissemination on Twitter revealed that most tweets discussed the same themes to those reported in the digital media (section 4.4), which suggests a similar framing in both media types for GMOs within Brexit negotiations. Overall, the research identified the following thematic macro-areas (sections 3.4 and 4.4):

- POLICY, with a particular focus on food, animal welfare, environment and safety standards
- Trade, particularly trade between the UK and the USA and between the UK and the EU
- Food, with frequent mentions of GMOs and chlorinated chicken
- Farming, with a focus on the use of hormones in cattle rearing, pesticide use and subsidies.

There were also a few mentions of the science behind GMOs with analysis of risks and benefits of the technology and a few instances of discussions on societal issues such as poverty or social justice. Finally, on Twitter, other thematic areas were found, namely mentions of miscellaneous small thematic areas such as human health, cancer and conspiracy theories.

Negative stance towards GMOs was positively correlated with a negative stance towards Brexit and *vice versa* meaning that, in the UK news media, if an article was against Brexit, it was also likely to be anti-GMO (section 4.3). Within the negative framing of Brexit, GMOs were portrayed negatively by being placed side by side with other notoriously controversial food technologies (e.g. chlorinated chicken) and poor-quality standards (section 3.5.1). In these instances, the controversial nature of GMOs was used as a scaremongering tactic, with the aid of negative hyperbolic language, to discredit statements within the pro-Brexit agenda. By contrast, in pro-Brexit news items, GMOs were seldomly mentioned and often replaced by

mentions of gene editing, ailed as an innovative technology and portrayed in a non-problematic way (3.5.1).

These tendencies were also found on Twitter (section 4.3), although the discourse on both GMOs and Brexit was overall more negative than in UK digital newspapers, which had more room for more in-depth and balanced discussions. The complexity of the journalistic prose was often lost due to the short nature of tweets despite the latter often including references to the analysed press. A few news items from the online national press were frequently incorporated in tweets (section 4.2.) as shown by the prevalence of news-sharing and news-commenting tweets (section 4.2.1) but they were rarely long-lasting and mentioned throughout the entire year, thus not setting the tone for the discourse (section 5.1.1).

The most central users in the Twitter debate were anti-GMO interest groups, who produced the most original tweets and who were central not only in amplifying content echoing their beliefs, but also in challenging the views of prominent voices on the opposite side of the debate (section 5.3). Other anti-GMO influential voices were found amongst political figures, who had remained unnoticed in the national press and who gained traction on Twitter (section 5.3.2), although typically only for brief amounts of time.

6.2. Incidental or intentional? The presence of GMOs in the Brexit debate

Results from this analysis showed that, in the UK news media, although there were a few articles discussing GMOs in depth, most of the news pieces mentioned the technology in passing within the broader frame of Brexit. The articles corresponding to the most intensely covered discussion on GMOs in the Brexit context were found in correspondence of statements from political figures regarding trade and controversial import of chlorinated chicken, hormone-beef and GMOs. However, the inclusion of GMOs within the Brexit debate often seemed **incidental**. Despite the fact that 'chlorinated chicken' became the centre of the US imports controversy, making headlines several times in the digital press, GMOs remained marginal to the broader trade discussion in the news.

By contrast, the hashtag #GMO featured heavily in the Twitter corpus, which was amplified by an already established network of anti-GMO stakeholders. The placement of GMOs alongside Brexit within the Twitter discourse appears much more **intentional**. Moreover, some of the media coverage trickled down to Twitter where chlorinated chicken, hormone beef and GMOs often became the *main focus* of tweets. The persistence of this triad on Twitter throughout 2017 suggests that these purportedly horrifying foods resonated with Twitter users,

who cherry picked them from various news sources despite them being mere mentions in the national press with lasting effects on the Twitter discourse (Valenzuela, Piña and Ramírez, 2017). This is also corroborated by the fact that the social network of users in the discourse has low density; in other words, many individuals tweeting about the Joanna Blythman article on chlorinated chicken and other national news pieces often did so of their own accord, linking directly from the digital news source. So, one could argue that GMOs, though very marginal in the Brexit discourse, were chosen to be discussed on Twitter, because they felt relevant to a number of Twitter users.

This has important methodological implications. In fact, frequently, in media studies, articles where a topic under analysis is only briefly mentioned are discarded as noise (Xiong *et al.*, 2006). Given the resonance that these *merely mentioned* issues had on Twitter, this study suggests that adopting such an approach would have overlooked a significant subset of the digital media debate and, in turn, would have ignored an invested readership who in turn, played a significant part in amplifying the political debate on GMOs on Twitter.

6.3. Pathos vs logos: a battle between emotions and reason?

It appears that the use of controversial foods as a discursive strategy to discredit the pro-Brexit agenda was effective in gaining traction in both the digital media and on Twitter. But why would political figures and journalists want to construct a negative critique of Brexit based on mentions of these foods? And why was this discursive representation of the US as inherently bad so successful? The answer might be linked to history, anchoring, and emotional triggers.

As mentioned in the introduction, chlorinated chicken, hormone beef and GMOs all have a controversial history in the EU, especially in the international trade landscape. Though these products are widely adopted in the USA and have been deemed safe by international authorities, most European countries still did not accept their importation within the EU, thus causing intense international disputes. Research from different countries across the EU about the discursive representations of GMOs show that the issue involved food culture and national identity more than the technology itself (Heller, 2002; Sato, 2013). Furthermore, GMOs were themselves used as emotional triggers within the US food import discourse, which is anchored to their controversial history. The fact that GMOs are portrayed as alien, processed, unsafe, abiding to sloppier standards (sections 3.5 and 4.5.2), and being overall unhealthy, does not necessarily speak of the safety of GMO technology, but it links them to a variety of practices

and cultural stereotypes associated with it. This point is evidenced by the frequent mentioning of *US-style chlorinated chicken*.

In the digital media, multiple social actors took the opportunity of relevant reporters' questions to express aversion over US food imports. For instance, Jamie Oliver was reported wording his rejection as *we don't want any of their gear*. Similar sentiment was widespread across Twitter, with expressions of disgust and appeals from private individuals and organisations to lobby prominent political figures to stop these imports. This associating of GMOs with US food practices effectively othered them, making them appear as alien in opposition to the portrayed high quality of British Food. Such process of othering is not new in the GMO debate (Zajc and Erjavec, 2014), but it is interesting that it was exploited to drive the anti-Brexit agenda in light of the fact that, the use of othering strategies was common in the leave campaign, especially in the discursive representation of immigrants (Koller, Kopf and Miglbauer, 2019).

In the anti-Brexit discursive representation of GMOs, a negative connotation was already assumed. Stating that Brexit will mean that GMOs will line supermarket shelves is suggestive and sparks two main ideas: i) GMOs are just as controversial and just as purportedly unsafe as chlorinated chicken and hormones in beef and ii) there is an assumption that the word 'GMOs' by itself is a valid way of describing US food products.

In fact, in the anti-Brexit/anti-GMO articles and tweets, the demonisation of GMOs was not argued, but used as a matter of fact and listed as a disadvantage of Brexit. There is no space to debate why GMOs are bad, while there are ample arguments about the disadvantages of Brexit.

6.4. Who will speak for GMOs?

The fact that there was often no room given for statements that could justify this portrayal is in line with the presence throughout this research of a predominantly political framing, as opposed to a more scientific focus on GMOs. In fact, themes such as *science* did not feature heavily in the press or on Twitter, confirming that GMOs were embedded in a prevalently political debate around Brexit and not *vice versa* (Ruan, Yang and Jin, 2019).

This is in line with previous research showing practices in political reporting can differ largely from those of science reporters (Russell, 2010). A science correspondent might be asked to have researchers weigh in on an issue and to also interview someone of diverging opinions (Nelkin, 1995). This was true for articles discussing GMOs in depth. However, in

these, the balance was only superficially obtained given the nature of the language used and the narrative construction of anti-GMO voices (Boykoff and Boykoff, 2004) thus showing that the democratising effects of having multiple sources in a debate (Maeseele, 2015) could be skewed by the hyperbolic use of language (C. Mcinerney, Bird and Nucci, 2004).

Outside of attempts to narrate a balanced discussion in GMO focussed articles, in most news items and tweets, virtually no scientist was asked to intervene on the GMOs or to comment on the safety of other imports from the USA, because the article/tweet was not about science. Frequently mentioned public figures were politicians and, sometimes, celebrities. In the digital media, journalists asked public figures about their opinions and, in these instances, politicians themselves were found having to defend the safety of chlorinated chicken and/or GMOs. Some of them did so in the media, as happened during question time with Theresa May, in a press conference with Liam Fox, or at a conference with Michael Gove. The presence of political figures is unextraordinary in risk reporting (Cho, Reimer and McComas, 2015). However, the frustration of these social actors in having to express opinions about such issues is of interest in the GMO-Brexit discourse. That is because none of the aforementioned politicians, despite them all having a Twitter account, were found to intervene in the Twitter debate when asked the same questions, nor did they actively partake in the conversation by creating original content. Thus, while scientists were largely absent in the media discourse on Brexit and made sparse appearances on Twitter, government officials were highly cited within the debate in the news media but did not make individual contributions in Twitter.

6.5. The discourse failure

In addition to the framing of GMOs in context of food imports from the USA, there is a complementary discursive representation of GMOs, which entails the mentioning of highly emotional triggers, such as corporate greed, environmental degradation, pesticide use and cancer. This negative portrayal of GMOs entailed complex and articulated arguments other than the cultural dislike of food imports. In fact, this framing was more centred around the opinion of GMOs being a 'techno-fix'.

In the digital media, this term was reported used by Liz O'Neill from the GM Freeze and entailed a critique of biotechnology as being a narrow scientific solution failing to address systemic problems. This ideology appeared to include a politicised view of science, asserting the latter should be held accountable for its connections to agri-tech corporate power, unsustainable farming practices and an overall lack of appreciation for the complexity of

certain environmental and societal issues (Devos *et al.*, 2008). This sentiment is in line with what has been defined by Lang and Heasman as an ecologically integrated paradigm (Lang and Heasman, 2015, page 35), which encompasses a more holistic view of science and the development of scientific solutions to complex societal problems. However, in the news media analysed in this corpus, when activists advocated for a focus on social justice and long-term sustainability, scientists have often countered these points with the potential for productivity increases and short-term economic benefits to farmers.

The arguments brought forward within the anti-GMO/anti-Brexit discursive representation of GMOs ask scientists to reflect on the implications of scientific innovations beyond the boundaries of their field (Maeseele, 2009). This sentiment, heralded by anti-GMO groups and anti-Brexit politicians in both the media and Twitter, resonated with other political figures and journalists. The Scottish GMO ban is an example of this with the rejection of corporate America to preserve local traditional food and small business owners. However, this was an argument of a social-behavioural nature and not necessarily involving considerations about biology, genetics or agricultural sciences. Thus, in the rare instances of a response to these views, these arguments were often met with condescendence and minimised as ignorant, obsessive, luddite or anti-science, as exemplified by a tweet by conservative politician Murdo Fraser.

So, it seems as though both in the media and on Twitter there are missed opportunities for debate because activists and scientists are speaking different languages and are concerned about different issues in their argumentations against or in favour of GM crops. This paradox is indicative of a what has been called a 'paradigm shift' from a life science approach to science and food production to an ecologically integrated one (Lang and Heasman, 2015, page 38). What Lang and Heasman mean by paradigm shift, is that over the last few years the focus of science-driven policies has been changing from problem-specific solutions towards an interdisciplinary *system* approach to granting the resilience of the food system in the wake of a changing climate (POST, 2020). Therefore, although it is undeniable that agri-tech research has played a large role in securing a reliable food supply, there are those who argue it will not be sufficient unless it is accompanied by societal change. A great example of the successes and pitfalls of agricultural sciences was the Green Revolution (as presented in section 1.2.1) which, though saving billions of lives, has had long term effects that have repercussions to this day (Pingali, 2012). Furthermore, although there are numerous GMO crops being developed to face a changing climate, at the present time, most products of biotechnology available on the market are pest resistant and herbicide resistant crops tied to large corporations.

In the way that providing scientific knowledge is often not enough to increase technology acceptance and adoption (Mielby, Sandoe and Lassen, 2013) I would suggest that just because the scientific community agrees a technology will benefit the future of food security, it does not imply it will gain public support.

6.6. The nuisance and the novel technology: discursive representations of GMOs and gene editing in pro-Brexit arguments.

As previously mentioned, political figures aligning with the pro-Brexit ideology, often tended to avoid the issue when asked about GMOs in news reporting or Twitter. To them, 'GMOs' was not only a undesirable term, but it was also a nuisance, especially when flanked by chlorinated chicken, a topic the media was *obsessed with* according to Liam Fox. With a few rare exceptions, the term 'GMOs' was not used by pro-Brexit stakeholders to describe the opportunities presented by Brexit. Instead, the pro-Brexit argument often mentioned 'biotechnology', 'genetic engineering' and, most frequently, 'gene editing'. While the term 'GMOs' did not have a dedicated place in the discursive representation of the pro-Brexit agenda, pro-Brexit statements often mentioned that the potential of gene editing would unleash great technological development for the country. It almost appears as though Brexiteers knew of the emotionally triggering nature of the term and purposefully avoided the 'GMOs' buzzword.

The duality between political opposition to GMOs on the anti-Brexit side and favour for the technology on the pro-GMO side is new. Historically, both progressive green politicians and conservative politicians have disliked GMOs, although for different reasons. On the one hand, green environmentalists tend to believe in the benevolence of nature (McCright *et al.*, 2013) and the need for humankind to be in harmony with it without disrupting its balance. Thus, in this view, scientists can be ideologically associated with Frankenstein, and GMOs with his monster (Holmgreen, 2008). On the other hand, the more conservative side of the political spectrum often aligned with the belief that producing GMOs would mean playing God, meaning the argument discouraging GMO use was fought on moral and sometimes religious grounds (Holmgreen, 2008). However, the overall lack of pro-Brexit articles and tweets that were against GMOs showed that this conservative discursive representation of the two issues was not used by conservative politicians. So, a potential reason for them avoiding using the term *GMOs*, could be because it could elicit negative reactions amongst conservative voters. Despite this *fear of the word*, during the political debate about the implementation of

Brexit in 2017, the UK biotechnology sector was narratively placed amongst *production sciences* (McCright *et al.*, 2013), meaning those technological advancements that could have an economic relevance in post-Brexit UK.

The only remnant of the *traditional* anti-GMO view seems to be personified by Michael Gove. Although his reported dislike of GMOs and chlorinated chicken has been reported as an opportunistic attempt to appeal to a more environmentally conscious segment of the British electorate, I would argue his statements were an attempt to maintain the support and avoid uproar amongst those who voted for Brexit but disliked GMOs on a fundamental level. However, it should be noted that shortly after the period of data collection for this study, Michael Gove was reported expressing positive views on gene editing: *Gene editing allows us to give mother nature a helping hand* (David Brown, 2018).

6.7. Ill defined: is *GMO* the new *Frankenfood?*

At the beginning of this thesis, I mentioned how some would argue that humanity has been genetically modifying organisms since the domestication of food crops in the first agricultural revolution. This sentiment was exemplified by princess Anne who reportedly said in her interview "*Most of us would argue we have been genetically modifying food since man started to be agrarian, but everybody would say it doesn't happen so quickly via conventional selective breeding*". This is in line with another corollary to this argument: the view that products legally defined as GMOs are in fact not so different from foods considered *natural* and GMO-free today, because the latter are almost all the result of 20th century scientific research and technology.

Those agreeing with these statements often argue that there are issues with the scientific validity of the word 'GMOs' itself. For instance, the FDA does not recommend using the acronym in food labelling (FDA and HHS, 2019) and the debate over regulation of gene editing techniques in the EU suggests the legal definition used to define the products of genetic engineering is, in fact, not scientifically appropriate anymore due to the new developments in the technology (Hartung and Schiemann, 2014). Some argue the word is ill-defined (Jiang *et al.*, 2018); however, the term was widely used in social media and digital newspapers where the words 'GMOs', 'GM crops' and 'GM food', or '#GMO' were the preferred ways journalists and Twitter users referred to products of biotechnology Most interestingly, data from this analysis show the term GMO appeared frequently tied to anti-GMO/anti-Brexit arguments on both platforms and, in fact is part of anti-GMO groups' names such as 'GM Watch', 'GM

Freeze', and 'No GMOs Verified'. Furthermore, as seen in both the discourse analysis of digital media and the analysis of tweets, the term was often used without a description, suggesting that those mentioning GMOs might be aware of its inherently bad connotation and used it as a scaremongering buzzword. However, in the construction of pro-Brexit narratives, gene editing was front and centre. Therefore, there is a question to be asked: will the term 'GMO' fall out of use in post-Brexit positive representations of the technology? In other words, has 'GMO' become the new 'Frankenfood'? Based on what found in this research, I would argue that these are realistic possibilities. However, in the light of historical occurrences in the UK GMO debate after 1990s food scares and in light of upcoming trends in the value placed on supply chain transparency (Astill *et al.*, 2019), I would also argue that GMOs should not become taboo, especially because it would ultimately be counterintuitive to the ideals of science communication and public participation in policy making.

6.8. Limitations

The research described in this PhD thesis has generated a deeper understanding of the portrayal of biotechnology within the political discourse. Particularly, it showed how the politicisation of controversial issues such as GMOs often prevailed in both digital media and Twitter where built upon the othering of GM foods and the portrayal of the EU as a protector. By using discursive strategies such as hyperbolic language and anchoring to emotional triggers anti-GMO arguments on both digital media and Twitter were made more compelling, eclipsing a less politicised portrayal of the technology throughout 2017 Brexit negotiations. The Brexit discourse and negotiations proved to be a crucial *discursive moment* which created an opportunity to analyse the GM debate in the light of an evolving political landscape. However, the research is not without limitations.

Firstly, this work only comprised what could be considered news sources of national relevance whereas, whereas, seen the regulatory contentions amongst different nations of the UK, it might have been appropriate to look into regional and local online press. Furthermore, as shown in the analysis of URLs on Twitter, blogs and alternative news websites could have been a complementary source of discourse on GMOs. Examples of these were websites such as David Icke's blog, specialised magazines like Farmers Weekly, activist groups websites such as the one from GM Watch or GM Freeze, or even science focussed news outlets such as the Genetic Literacy Project. An alternative strategy of exploring the discourse would be to examine the comment section in news websites, thus gaining immediate insight into the

readership of digital newspapers. There are various creative approaches to the data collection for the critical analysis of discourse that could have provided valuable insights into the broader discourse. However, with the tools available and a limited timeframe, the digital media and Twitter were selected not only to pair and contrast the two media environments, but also to investigate the direct uptake of news items on the social media platform.

The need to restrict data to a short framework meant that data collection was limited to 2017. In doing so, there is a possibility that part of the relevant discourse was left out due to the arbitrary time delimitations, especially seen as the discursive representations of the UK's exit from the EU stretched from 1972 to the present. However, 2017 was a crucial year in the debate, marking the time between the referendum and the triggering of article 50 in a moment where the terms of Brexit had not yet been defined.

Other than a longitudinal limitation to this research, there is also a clear limit to the depth of the analysis. When imagining the different layers of the discourse, Carvalho's approach suggests CDA would be more complete if it took into consideration the underlying ideologies of social actors laying outside of the discourse, such as journalists and the general public. These aspects were only partially addressed in this research by considering the different newspapers stances on Brexit and GMOs (openly declared or otherwise) and by glimpsing into the popular Twitter discourse. However, within the limits of the PhD, it was not possible to delve into the power exercised over the discourse *in the newsroom* with editorial choices or the impact of specific news items on public perception of GMOs and Brexit. From that perspective, it would be interesting to carry out in depth interviews or focus groups with journalists (such as Joanna Blythman, seen the agenda setting nature of her work), NGOs or the general public to investigate the shaping factors during news production and gain information into stakeholder and public perceptions respectively. However, the identification of the Brexit discursive moment and the narrowing of the scope of this work happened later in the research timeline, meaning it was not feasible to develop a cross-section approach *a-posteriori*.

Regarding the Twitter discourse, one of the main limitations lies in the fact that the presence of interactions between users in the Twitter corpus is limited by their use of both GMOs and Brexit in their tweets. If the PhD had been focussed solely on the GMO and Brexit discourse, it could have been possible to start with a broad analysis of the discourse on the two issues individually, as was done for the GMO discourse in the media. To solve this problem, contextualisation of the Brexit/GMO discourse was achieved by reviewing supplementary literature.

Another limitation relating to the data collection via the Twitter API was that there is no information about users following each other on Twitter or not. Thus, the inter-relational data used for the social network analysis was only based on mentions and retweets amongst users. Furthermore, because of the limitations in the construction of the adjacency matrix, the ties do not have a direction or weight. This is a limitation to the richness of the analysis that could have otherwise been done using network data. On the one hand, direction could have aided in the quicker identification of the channels of news dissemination in the ego networks while weighted ties would have provided information on the strength of social media relationships. However, due to limitations in the computing capacity caused by the COVID-19 lockdown, a more detailed analysis had to be sacrificed to be able to carry out the whole network analysis.

6.9. Implications and future prospects

The findings of this study have value for future policy making and science communication about agricultural applications of biotechnology in the UK. Particularly, there is an argument to be made about the fact that the opposing sides of the debate are not talking about the same issues and are heralding two different approaches to address global food sustainability. I would also argue that this continuous lack of dialogue and dismissal of ethical and environmental concerns as *anti-science* would only reinforce the already cohesive and well-established anti-GMO side of the debate and generate more controversy and contention because, despite possible considerations on the validity of arguments on either side of the debate, the framing and narrative representation of biotechnology in the anti-GMO discourse is, in the end, more compelling due to its value based arguments and emotionally charged language (Mallinson *et al.*, 2018).

In many cases, the controversy surrounding GMOs was actually *piggybacking* on more systemic controversies. For instance, it is undeniable that the majority of the GM crop market is tied to international agri-businesses. So, to those opposed to the ethical value set of corporate America, it is reasonable to question whether it is worth supporting the industry. Signalling an anti-GMOs stance has become a way to oppose capitalism and careless farming and husbandry practices. Perhaps one way forward is for the scientific community to build a more constructive dialogue with stakeholders and contextualise scientific research and its implications on society. This would entail accounting for ecological and cultural impacts of technologies, especially in cases where new discoveries challenge the status quo and pre-existing ethical boundaries or when they involve issues of great cultural value such as food.

This PhD research also reinforces the notion that scientific progress is not exempt from scrutiny by society, even years after adoption of the technology. Therefore, failing to address cultural factors and ethical concerns both in policy and in science in the early stages of adoption can generate a long-lasting backlash. Furthermore, although this research shows there are discursive implications to the political framing of biotechnology, I argue it is risky to remove science from the political narrative. In fact, one runs the risk of being carried by the media current in whichever direction they consider to be the most newsworthy. It might be too late to mend the disagreements over *traditional* GMOs, but there might still be time for scientists, politicians and NGOs to have a constructive debate on gene editing that is not only informed by genetic and biological evidence, but also by social sciences. Also, the lack of representation of the scientific community in the Brexit debate suggests there might be a need for change in the way political reporting on new technologies is carried out (Russell, 2010) to provide the public with a sensible but still reasoned view of science (Devos *et al.*, 2008).

In the future, more research should be carried out on media and social media representations of gene editing to inform science communication in the field of biotechnology. Furthermore, research should be done on effective ways in which a more productive discourse can be encouraged amongst political figures, scientists and other stakeholders in the debate, especially now that Brexit has been finalised and the UK political landscape on GMOs and gene editing might be subject to change.

6.10.   Original contributions

This body of work constitutes an original contribution to contemporary literature in three main ways. It provides a novel application of a known methodological approach, it contributes to the socio-political debate about the role of science in policy and society and, lastly, it enriches the body of knowledge about the intersection between online debates on GMO and Brexit.

Regarding its methodological contributions, this thesis has shown that Carvalho's approach developed for CDA of conventional media (as shown in chapter 3) can be tailored to CDA of social media (as demonstrated in chapter 4). This enabled me to compare discourses unfolding in both media environments (section 4.5). In fact, the coding framework developed to analyse online news (appendix C) only required small adaptations to classify tweets (section 4.2) and was otherwise successfully applied to Twitter texts (tweets) suggesting there are similar power dynamics in the different discursive domains. Moreover, Social Network Analysis (chapter 5) applied to the use of URLs allowed me to draw *news sharing maps* (section 5.1) and provided

novel insight into the relational aspect of the discourse (Moser, Groenewegen and Huysman, 2013), something that would have otherwise been difficult to extricate from the analysis of tweets only. Also, SNA allowed me to identify users' collaborative efforts to amplify ally voices on Twitter. However, exposing the relationship between opinions on GMOs with political agendas was only possible through CDA. The two approaches worked in concert to not only uncover the *full picture* of GMOs and Brexit representation in online media environments, but also to understand who the *painters* are. Lastly, the *vertical analysis* carried out with this work proved valid to create an accurate cross-section of how the media environment influenced discourses on social media.

On a conceptual level, this thesis has contributed to the ongoing socio-political debates over the de/politicisation of science and the role of science in society (McFadden, 2016). In regard to the politicisation debate, it corroborates earlier findings by Maeseele (Maeseele *et al.*, 2015) revealing an underlying drive for the depoliticisation of new technologies, including GMOs, (sections 3.3 and 4.3) and a political framing of innovation as *production science* (McCright *et al.*, 2013). This framing overlapped with positive views on Brexit and, as illustrated by the Michael Gove case (section 4.5.2), revealed a shift in political agenda from a predominantly conservative view (dislike of GMOs) to a more neoliberal standing (praise of gene editing) (Cornelissen, 2021), as reported in section 4.5.2. However, statements in favour of scientific progress were met with strong pushback based on arguments about ethical responsibility, environmentalism and, more broadly, accountability in science. This push for the politicisation of innovation and advocacy to *look at the bigger picture* fits well with two pre-existing conceptual frameworks referenced in this work. The first is that it supports the paradigm shift suggested by Lang and Heasman (Lang and Heasman, 2015), implying that policy making around food is shifting towards an ecologically integrated and holistic approach to address problems in the food system (POST, 2020). The second is that it confirms findings by Helliwell et al. (2019) regarding the interdisciplinarity of anti-GMOs motives, which appear to go beyond simply contesting the safety and instead express convoluted arguments about ethics, food culture, social values and corporate responsibility (Helliwell, Hartley and Pearce, 2019).

The portrayal of GMOs in media and social media has been investigated by scholars and was already mentioned in this thesis' introduction (sections 1.5 and 1.7). However, the GMO/Brexit combination represented a new research focus yet to be explored by discourse analysts at the time of data collection (2017). Since then, various research papers have been published investigating the issue of food in the Brexit trade debate both as analyses of media messages

(Downes, 2020) or as reflections on the socio-economic impact of Brexit on the food system (Lang, 2017; Lang and Millstone, 2019; Millstone, Lang and Marsden, 2019). Furthermore, scholars globally have started to reflect on media portrayal (Marcon *et al.*, 2019) and public perception of gene editing (Shew *et al.*, 2016) in light of the rapid development of the technology. Moreover, some studies have looked into gaining a better understanding of the anti-GMO side of the debate in the UK addressing specifically NGOs (Helliwell, Hartley and Pearce, 2019). However, to my best knowledge, this thesis provides novel in-depth insights into the discursive intersection between GMOs and Brexit at a time in which the UK was transitioning towards a future outside the EU.

Having this new data on GMOs portrayal in the light of Brexit will allow future scholars to gain a better understanding of the socio-political relevance of debates about GMOs. In addition, it can help to expose how past media conversations about GMOs have shaped the present and how they can be of relevance in post-Brexit UK. Looking at the discourse and its social actors has revealed how sentiments about GMOs intersected with political arguments around Brexit, while also demonstrating that GMOs are rarely discussed in context of science policy. Although scientific facts were sometimes mentioned, powerful messages often bypassed science entirely. There was a scarcity of scientists in both the media and social media political discourses on GMOs and Brexit, even when the issue could have called for opinions from scientific experts (section 3.4.2.2). Furthermore, the results have shown how the assumed negative connotation associated with GMOs was wielded as an argument against Brexit. Even though the argument of '*GMOs are junk food*' is not novel (Sato, 2013), its presence in the Brexit debate shows a reprisal of its use as a political strategy for emotional anchoring. This result provides further insight into the socially constructed meaning of GMOs in the UK, and its relationship with the cultural attachment to food in light of decision-making processes. As such, it demonstrates how a controversial topic such as GMOs may be used to gain political advantage within another debate. In so doing, the controversy of GMOs was often reduced to populist arguments and scientific opinion was removed.

Similarly, this thesis brought to light the early stages of a political debate on gene editing, which at the time of writing (November 2021), is close to a new public consultation in the UK (Reuters, 2021). It has shown that gene editing as a GMO technology has been exploited by pro-Brexit politicians as part of the post-Brexit science and innovation agenda. Despite the positive framing of gene editing, this thesis revealed that strong negative opinions persist in

the printed media about Brexit and in some anti-GMOs circles on social media, hinting to the fundamental issues that might arise in the process of regulating genetic engineering in the UK.

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Appendixes

A. Python script for Twitter data collection

 # Script to collect tweets using the Twitter Developers API
 # It is an adaptation of the one found in the book "Python for social media analytics" and is
specific to twitter REST API data collection
 # It is an example of a request

```
import requests
import json
from requests_oauthlib import OAuth1
```

 # define q.
 # "q" is the query containing the keywords to be searched.
 # Contains the relevant operations.
 # In this case "OR" is the main operation but you can also find "-" to eliminate words
 # Example:"genetically" -identical
 # There is a limited number of characters per query based on what Twitter developers
subscription

```
# # #Query
q = ('gmos "Brexit" OR GMO "Brexit" OR "GM food" "Brexit" OR "GMfood" "Brexit" OR
"GM crops" "Brexit" OR "gmcrops" "Brexit" OR CRISPR "Brexit" OR "gene editing" "Brexit"
OR "geneediting" "Brexit" OR "genetically -blessed" "Brexit" OR "genetically -inherited"
"Brexit" OR "genetically -identical" "Brexit" OR "genetically modified" "Brexit" OR
"genetically" "Brexit" OR "frankenfood" "Brexit" lang:en')
```

```
# # # define endpoint
```

```
# defining endpoint connects spyder (Python) with the Twitter API
# and the specific app I created in Twitter developers, specifically the paid subscription
```

```
url = 'https://api.twitter.com/1.1/tweets/search/fullarchive/HistoricalGMO.json'

# define parameters of the query (request)
# use "next" code if search results exceed 500 tweets
# remember it's a string

#page 1
pms = {'query' : q, 'maxResults' : 500 , 'fromDate': 201701010000, 'toDate' : 201712312359,
'next': 'eyJt…'}

params = {
  'app_key': 'Sk9y…',
   'app_secret': 'Pe3X…',
   'oauth_token': '7807…',
   'oauth_token_secret': '9xyT…'
 }

auth = OAuth1 (
 params ['app_key'],
    params ['app_secret'],
    params ['oauth_token'],
    params ['oauth_token_secret']
 )

#formulate request referring to the previously set variables and export them in json format

#formulate request
br_2017_4 = requests.get(url, params = pms, auth = auth).json()

# write results into json file #in this case the file is called br_res.json

with open('br_2017_4.json', 'w') as f:
   json.dump(br_2017_4, f, indent=4)
```

```python
#print results to see that it worked in Spyder
print (br_2017_4)
```

B. Python script for Twitter data collection

Article title	Author	Date	Newspaper section	Source name	On Twitter
The public is finally coming round to GM crops - The i newspaper online iNews	Tom Bawden	02/01/2017	Unassigned	i News	NO
After Brexit: What happens next for the UK's farmers?	Jamie Robertson	05/01/2017	Business	BBC news	NO
Freedom to Farm | Comment | The Times	Not Applicable	05/01/2017	Comment	The Times	NO
Farmers could 'reap a post-Brexit bonus when Britain leaves the EU' - The i newspaper online iNews	Nigel Morris	06/01/2017	Unassigned	i News	NO
Farming revolution in a post-Brexit Britain | Comment | The Times	Not Applicable	07/01/2017	Comment	The Times	NO
As talks loom, 'hard Brexit' option raises fear of tariffs	Associated press	13/01/2017	wires	Daily mail.com	NO
A UK trade deal with Trump~ Be careful what you wish for ~ Politics ~ The Guardian	**Dan Roberts**	**16/01/2017**	**Politics**	**The Guardian**	**YES**
Reality Check: Can there be a quick UK-USA trade deal? - BBC News	Jonty Bloom, business correspondent	16/01/2017	Reality check	BBC news	NO
What Trump means for trade – and for Britain | Letters | US news | The Guardian	Not Applicable	17/01/2017	letters - US news	The Guardian	NO
Jamie Oliver fears Brexit could force down food and farming standards - The i newspaper online iNews	Sally Guyoncourt	18/01/2017	Politics	i News	NO
Quick trade deal 'is not high priority for US companies' | News | The Times	Rhys Blakely, Henry Zeffman, Lucy Fisher	24/01/2017	News	The Times	NO
Redefining a 'special relationship': Trump and May to talk trade	Reuters	25/01/2017	wires	Daily mail.com	NO
Theresa May refuses to rule out private US firms taking over NHS services | The Independent	**Rob Merrick**	**25/01/2017**	**Unassigned**	**Indipendent**	**YES**
Trader Trump ups his steak - BBC News	Douglas Fraser Business-economy editor	25/01/2017	Unassigned	BBC news	NO
'Opposites attract,' UK PM calls on Trump to renew special relationship	Elizabeth Piper	26/01/2017	wires	Daily mail.com	NO
May and Trump talks likely to reveal cracks in 'special relationship' ~ US news ~ The Guardian	Dan Roberts	26/01/2017	US news	The Guardian	NO
May-Trump meeting to test UK-US 'special relationship'	Associated press	26/01/2017	wires	Daily mail.com	NO

On her flight May should read Trump's book: the other guy is always shafted | Polly Toynbee | Opinion | The Guardian	polly Toynbee	26/01/2017	Opinion	The Guardian	NO
At last we can negotiate trade on our terms	Liam Halligan	28/01/2017	Business	Telegraph	NO
MATT ROBERTS. How to lose 7 stone but avoid getting saggy skin as a result	Matt Roberts	28/01/2017	Health	Daily mail.com	NO
Chlorinated chicken and acid-washed meat could soon be sold in British supermarkets - Mirror Online	Joshua Barrie	29/01/2017	Unassigned	Mirror Online	NO
Is chlorinated chicken about to hit our shelves after new US trade deal? | Environment | The Guardian	**Joanna Blythman**	**29/01/2017**	**Environment**	**The Guardian**	**NO**
New 'super yield' GM wheat trial gets go-ahead - BBC News	Matt McGrath Environment correspondent	01/02/2017	Unassigned	BBC news	NO
US trade deal with the UK 'could take place in the next two years'	Ruth Sherlock	01/02/2017	Unassigned	Telegraph	NO
GM 'superwheat' trial will start in the spring ~ News ~ The Times & The Sunday Times	**Ben Webster**	**02/02/2017**	**News**	**The Times**	**YES**
May and Trump could launch UK-US trade deal within '90 DAYS' of Brexit | World | News | Express.co.uk	Aletha Adu	02/02/2017	News	Express	NO
Flood of American food will damage health and ruin farms | the big issue | News | The Guardian	Not Applicable	05/02/2017	News	The Guardian	NO
We can survive outside of the EU when it comes to trade – the shipment of Californian lettuces prove this | The Independent	Sean O'Grady	06/02/2017	Unassigned	Indipendent	NO
A 'green guarantee' could stop Brexit ruining our environment | Caroline Lucas | Opinion | The Guardian	Caroline Lucas	13/02/2017	Environment	The Guardian	NO
UK unprepared for exiting Europe's green legislation, says Lucas | Environment | The Guardian	**peter walker**	**13/02/2017**	**Environment**	**The Guardian**	**YES**
Brussels 'will block' GM food from Britain | News | The Times & The Sunday Times	**Ben Webster**	**17/02/2017**	**News**	**The Times**	**YES**
Food standards could be weakened after Brexit leaving consumers with chlorine-washed chicken, warn environmentalists | The Independent	Tom Batchelor	22/02/2017	Unassigned	Indipendent	NO
Mohsin Hamid on the dangers of nostalgia: we need to imagine a brighter future | Books | The Guardian	Mohsin Hamid	25/02/2017	Books	The Guardian	NO
FREXIT~ Marine Le Pen will 'free French farmers from EU straitjacket' ~ World ~ News ~ Express.co.uk	Vickiie Oliphant	26/02/	World	Express	NO

		20 17			
UK business leader warns over Brexit's 'worst-case scenario'	Associated press	02/ 03/ 20 17	wires	Daily mail. com	NO
Brexit Britain is forging ahead with scientific research and discovery	Sarah Knapton	03/ 03/ 20 17	News	Teleg raph	NO
UK looks to supercharge EU trade deals post-Brexit	Tim Wallace	12/ 03/ 20 17	Business	Teleg raph	NO
**Brexit-proof the UK economy with more R&D, say employers	Business	The Guardian**	Katie Allen	20/ 03/ 20 17	Business	The Guar dian	NO
'One of thoe things that devides people'Princess anne speaks out in favour of gm crops	Thea De Gallier	22/ 03/ 20 17	Royal	Expr ess	NO
Charles and Anne at odds over GM crops? Princess Royal says she would be happy to grow them on her estate	Hannah Furness	22/ 03/ 20 17	News	Teleg raph	NO
Genetically-modified crops have benefits - Princess Anne - BBC News	**Not Applicable**	**22/ 03/ 20 17**	**Unassign ed**	BBC news	**YE S**
**Princess Anne backs GM crops and livestock – unlike Prince Charles	Environment	The Guardian**	Damian Carrington	22/ 03/ 20 17	Environm ent	The Guar dian	NO
Princess Anne open to growing GM crops on her land (From Epsom Guardian)	Press Association	22/ 03/ 20 17	wires	Daily mail. com	NO
Princess Anne says genetically modified food has 'real benefits' despite brother Prince Charles being a fierce critic	Sun reporter	22/ 03/ 20 17	News	The Sun	NO
**UK royals' sibling rivalry? Princess Anne says GMO crops have benefits	Reuters**	Not Applicable	22/ 03/ 20 17	Science news	Reute rs	NO
Tory voters want environmental regulations mantained after brexit	**Peter Walker**	**04/ 04/ 20 17**	**Environ ment**	**The Guar dian**	**YE S**
**Meet Tom Hunt - the food sustainability visonary	The Independent**	Casper Hughes	07/ 04/ 20 17	Unassigne d	Indip ende nt	NO
**Post-Brexit Britain: This is what taking your country back looks like	The Independent**	Youssef El-Gingihy	11/ 04/ 20 17	Unassigne d	Indip ende nt	NO
**Europe's age of unreason harms its wildlife	Comment	The Times**	Matt Ridley	17/ 04/ 20 17	Comment	The Time s	NO
What will happen to farmers like me when brexit turns our industry upside down	Edward Barker	09/ 05/ 20 17	Opinion	The Guar dian	NO

Fear takes root after ban on sale of GM orange petunias | News | The Times	Ben Webster	10/05/2017	Unassigned	The Times	NO
Greens restore environment to heart of election campaign as others 'wilfully ignore' the issue | The Independent	Ian Johnston	11/05/2017	Unassigned	Indipendent	NO
France sees ties with Germany key for post-brexit eu farm policy	Sybille de La Hamaide Gus Trompiz and Yves Clarisse	01/06/2017	wires	Daily mail.com	NO
Martians under the surface of Mars. Lab-grown bacon sarnies. A career in politics! The nation's favourite science boffin (and his brainy new partner) flick the switch on a revamped Tomorrow's World	Cole Moreton	03/06/2017	Celebrities, culture and the critics	Daily mail.com	NO
Brexit 'will enhance' UK wildlife laws - Gove - BBC News	Roger Harrabin	19/06/2017	Science and Environment	BBC news	NO
Gove needs to watch out for the green lobby | Comment | The Times	Matt Ridley	19/06/2017	Comment	The Times	NO
Oh do stop whingeing Harry	Max Hastings	22/06/2017	Max Hastings	Daily mail.com	NO
forget chlorine washed chicken - What this piece of prime British beef tells you about America's real view of free trade	Sir Peter Westmacott	29/06/2017	Right Minds	Daily mail.com	NO
We can call the shots! Diplomat hits back at team Juncker and predicts golden UK future	Nick Gutteridge	29/06/2017	Politics	Express	NO
Brexit: Liam Fox says talks on a UK-US trade deal will begin on 24 July | The Independent	Tom Batchelor	30/06/2017	Unassigned	Indipendent	NO
How the left is winning the war of words | Comment | The Times	Matt Ridley	03/07/2017	Comment	The Times	NO
We must pull economy back from the brink | Scotland | The Times	Magnus Linklater	03/07/2017	Comment	The Times	NO
As world trade struggles, Trump offers us a deal | Comment | The Sunday Times	Unassigned	09/07/2017	leading article	The Sunday Times	NO
Ken Thompson: how did orange petunias escape from the lab? | The Telegraph	Ken Thompson	09/07/2017	lifestyle	Telegraph	NO
Trump's cheap words cannot hide the costly truth about trade talks | Business | The Times	Philip Aldrick	11/07/2017	Comment	The Times	NO
Our politicians would be to blame for a post-Brexit food price fiasco	Ryan Bourne	13/07/2017	Business	Telegraph	NO
Animal experiments spark outrag as the UK sees almost 5,000 dogs tested on | Nature | News | Express.co.uk	Unassigned	14/07/	News	Express	NO

		20 17			
There will be no easy trade deals for Britain | Comment | The Times	Ed Conway	14/ 07/ 20 17	Comment	The Time s	NO
British biotech Horizon buys General Electric's gene editing business	Tom Rees	19/ 07/ 20 17	Business	Teleg raph	NO
We'll survive without an EU deal, insists Liam Fox | News | The Times	Henry Zeffman, Dominic Kennedy	21/ 07/ 20 17	News	The Time s	NO
The Guardian view on Brexit and farming: outlook unsettled | Editorial | Opinion | The Guardian	Not Applicable	23/ 07/ 20 17	Opinion	The Guar dian	NO
Why US trade deal could hinge on Britons eating chlorinated chickens	**Gordon Rayner**	**23/ 07/ 20 17**	**News**	**Teleg raph**	**YE S**
Brexit: Theresa May refuses to rule out weakening of food standards in trade deal with US	**Rob Merrick**	**24/ 07/ 20 17**	**News**	**Indip ende nt**	**YE S**
Fox admits UK unlikely to finalise free trade deal with EU before Brexit - Politics live | Politics | The Guardian	Andrew Sparrow	24/ 07/ 20 17	Politics live	The Guar dian	NO
Hard Brexit to swallow as trade deals could crush our farmers and force us to eat junk food - Voice of the Mirror - Mirror Online	Voice of the Mirror	24/ 07/ 20 17	Voice of the Mirror	Mirro r Onlin e	NO
Liam Fox begins talks over trade deal with US as he warns Brexit won't be thwarted'	Laura Hughes	24/ 07/ 20 17	News	Teleg raph	NO
Liam Fox mocks concerns over chlorine-washed chicken and insists it is just 'detail' of trade deal with US	Nick Allen, Steven Swinford	24/ 07/ 20 17	News	Teleg raph	NO
Liam Fox mocks fears about the sale of chlorine-soaked chickens in Britain after Brexit – describing it as 'a detail' | The Independent	Rob Merrick	24/ 07/ 20 17	Unassigne d	Indip ende nt	NO
No chlorinated American chicken can rival the sheer existential horror of a Scotch egg	Tanya Gold	24/ 07/ 20 17	News	Teleg raph	NO
'Hogwash!' Americans blast suggestion US is trying to 'poison the UK' with hormone-treated beef	Laura Hughes	25/ 07/ 20 17	News	Teleg raph	NO
Brexit: Theresa May warned that slashing food standards to win US trade deal could spell disaster for farmers	Rob Merrick	25/ 07/ 20 17	UK politics	Indip ende nt	NO
Donald Trump promises 'very big and exciting' trade deal with the UK after Brexit	Tom Batchelor	25/ 07/ 20 17	US politics	Indip ende nt	NO
Labour should exploit the Tories' disarray on Europe, not copy it	polly Toynbee	25/ 07/ 20 17	Opinion	The Guar dian	NO

Title	Author	Date	Section	Publication	
Post-Brexit trade deals 'threaten UK's animal welfare standards'	Fiona Harvey	25/07/2017	Politics	The Guardian	NO
The US-UK trade deal will leave a bad taste in British mouths	Not Applicable	25/07/2017	Editorials	Independent	NO
Thirteen Bangladeshi children died from controversial insecticide only recently banned by US	Tom Batchelor	25/07/2017	News	Independent	NO
Tory Liam Fox is 'open' to importing cheap chlorine chicken to the UK in desperate bid for Trump trade deal	Mikey Smith	25/07/2017	Politics	Mirror Online	NO
Chlorination Chicken	Not Applicable	26/07/2017	Comment	The Times	NO
What is chlorine washed chicken? This video shows you how it works	Chris Campbell	26/07/2017	News	Express	NO
Chloe Green's Mr Wrong is a tawdry lesson of our times	Jan Moir	27/07/2017	Jan Moir	Daily mail.com	NO
Dancing with Trump and his chlorinated chicken will come at a huge expense	Jude Kirton-Darling	27/07/2017	The blog	Huffington Post	NO
Brexit: Access to cheap American produce will BENEFIT Brits, says TIM NEWARK	Tim Newark	28/07/2017	Comment	Express	NO
Review: Land of Plenty: A Journey Through the Fields and Foods of Modern Britain by Charlie Pye-Smith	CLIVE ASLET	29/07/2017	Review	The Times	NO
Will US chlorinated chickens come home to roost in Britain?	**James Dean**	**29/07/2017**	**Business**	**The Times**	**YES**
Gove fattens up a moral myth in the henhouse	Dominic Lawson	30/07/2017	Comment	The Times	NO
EU Migrants Can Enter UK Without Border Checks After Brexit, Government Confirms	Owen Bennet	16/08/2017	Politics	Huffington Post	NO
Liam Fox tries to bypass scots and welsh in bid for brexit trade deals	**Sam Coates, Hamish McDonnell**	**19/08/2017**	**News**	**The Times**	**YES**
Why we need an agriculture GCSE	Clive Aslet	14/09/2017	Education	Telegraph	NO
Scottish and Welsh government propose joint amendments to EU withdrawal bill	Severin Carrell	19/09/2017	Politics live	The Guardian	NO
Scottish and Welsh governments set out brexit bill amendments	Not Applicable	19/09/	Scotland	BBC news	NO

		20 17			
Scottish and Welsh leaders seek to ward off Westminster 'hijack' of powers	Steven Morris and Severin Carrell	19/ 09/ 20 17	Politics	The Guar dian	NO
Lab notes~ everyone's gone totally lunar over space travel	Tash Reith-Banks	29/ 09/ 20 17	Science	The Guar dian	NO
Pesticides that pose threat to humans and bees found in honey	John Von Radowitz	05/ 10/ 20 17	Environm ent	Indip ende nt	NO
Platell's peple: from little big lies to broadchurch and doctor foster to fearless, whi do the makers of tv drama hate men?	Amanda Platell	06/ 10/ 20 17	Amanda Platell	Daily mail. com	NO
How Brexit could force uk farmers to lower standards to compete with US meat market	Kathryn Snowdon	07/ 10/ 20 17	Unassigne d	Huffi ngton Post	NO
Flip-flop Phil gets his spreadsheets in a twist	Dominic Lawson	15/ 10/ 20 17	Comment	The Time s	NO
Innovation can give farming a bright future	Not Applicable	23/ 10/ 20 17	Scotland	The Time s	NO
EU on brink of historic decision on pervasive glyphosate weedkiller	Arthur Neslen	24/ 10/ 20 17	Environm ent	The Guar dian	NO
Farms could become a wasteland in just 30 years, says Gove	Colin Fernandez	24/ 10/ 20 17	News	Daily mail. com	NO
Thursday briefing: chinese know trump is a two faced man	Warren Murray	26/ 10/ 20 17	World news	The Guar dian	NO
Britain must scrap EU rules and allow chlorine-washed chicken if it wants post-Brexit trade deal with US, Trump adviser says	**Josie Cox**	**06/ 11/ 20 17**	**Business**	**Indip ende nt**	**YE S**
Don't let the EU dictate Brexit if you want a speedy US trade deal, Trump adviser warns UK	Ambrose Evans-Pritchard	06/ 11/ 20 17	Business	Teleg raph	NO
Priti Patel reprimanded in person by Theresa May over Israel visit, No 10 reveals	Andrew Sparrow	06/ 11/ 20 17	Politics	The Guar dian	NO
Trump's secretary hopes US will be UK's NUMBER ONE trading partner	Simon Osborne	06/ 11/ 20 17	News	Expr ess	NO
Brexit weekly briefing: UK business leaders fret over lack of progress	Jon Henley and Peter Walker	07/ 11/ 20 17	Brexit weekly briefing	The Guar dian	NO
Exclusive poll shows public has lost faith in Theresa May's handling of Brexit negotiations	Kate McCann, Ashley Kirk	07/ 11/ 20 17	News	Teleg raph	NO

Fox DENIES free trade deal with US after Brexit will mean lower food standards as he unveils legislation to copy 40 existing EU agreements	James Tapsfield	07/11/2017	News	Daily mail.com	NO
Free us from brussels rules, says liam fox: minister calls for liberal and open arrangement to help secure trade deals with other countries	Jack Doyle	07/11/2017	News	Daily mail.com	NO
Brexit: Euro will plummet in 2018 and leaving will be a success, claims psychic	Matt Drake	12/11/2017	News	Express	NO
Brexit trade deal talks as Liam Fox meets US negotiators	Mark Chandler	14/11/2017	Unassigned	Express	NO
Brexit Britain needs a new innovation culture, not just investment, in order to take off	Alan Mak	21/11/2017	News	Telegraph	NO
i Recognised twice at FPA awards	i Team	21/11/2017	Media	i News	NO
Is Ireland really willing to put watchtowers on our border to inspect a few milk churns?	Juliet Samuel	26/11/2017	News	Telegraph	NO
GM crops will continue to be banned in Britain after Brexit says Michael Gove in blow to UK/US trade deal	**Christopher Hope**	**28/11/2017**	**News**	**Telegraph**	**YES**
Letters: How can Archbishop Welby leave Bishop Bell's name under a cloud?	Mike Ostick	19/12/2017	Opinion	Telegraph	NO
Brexit could see chlorine-washed meat in the UK	paul gallagher and sally guyoncourt	20/12/2017	News	i News	NO
Michael gove would scupper US trade deal over chlorinated chicken	Richard Vaughan	20/12/2017	Politics	i News	NO
MPs can block post-Brexit trade deal with US if it will damage animal welfare standards, Michael Gove says	Rob Merrick	20/12/2017	UK politics	Indipendent	NO
Inside the Cabinet Brexit ding-dong as the main players turn up the heat and fight for Mrs May's ear	James Forsyth	23/12/2017	Unassigned	The Sun	NO
The Boxing Day bumper quiz of 2017	Olav Bjortomt	26/12/2017	Politics	The Times	NO
Does Europe have what it takes to create the next Google	Eric Auchard	30/11/3017	News	Reuters	NO

C. Coding framework for the critical discourse analysis of news articles and tweets.

STANCE	
BREXIT STANCE	
1) Strongly pro Brexit	
2) Cautiously pro Brexit	
3) Neutral-Undecided-Non specified (Brexit)	
4) Cautiously anti Brexit	
5) Strongly anti Brexit	
GMO STANCE	
1) Strongly pro GMO	
2) Cautiously pro GMO	
3) Neutral-Undecided-Non specified (GM)	
4) Cautiously anti GMO	
5) Strongly anti GMO	
MAGNITUDE OF COVERAGE	
PREVALENCE BR	
BR Main	
BR Mention	
BR Sub topic	
PREVALENCE GM	
GM Main	
GM Mention	
GM Sub topic	
TOPICS	
BREXIT	
GMOs	
Animals	
As a metaphor	
Crops	
Feed	
Maize-corn	
Seeds	
Flowers	
Food	
Cereals	
Fruit	
apple	
Ingredients	
vegetables	
Gene editing	
People	
TWEET	
IRRELEVANT TWEETS	
IS A RETWEET	
IS AN ORIGINAL TWEET	
TYPE	
Call to action or appeal	

Event focussed	
Interactions	
News comment	
News reporting	
Singleton	

THEMATIC MACRO-AREAS
ECONOMICS
Country
EU
France
Germany
Ireland
Non EU
China
Commonwealth
Russia
Thailand
UK
Scotland
USA
Funding-investments
Academia
Charity
International organisations
Private
Public-government
Ideology
Colonialism-Imperialism
Free trade
Globalisation
Green economy
Growth-progress
Lobbying-manipulation
Localism
Power inbalance
Protectionism
Inflation-fall of the pound
Labour
Tariffs
Trade
Agreements, deals, negotiations
Disputes
Import-export
EXPORT from UK
IMPORT to UK
FARMING
Country
EU
UK
Northern Irish
Scotland
USA
Ideology

pesticides
Herbicides
Glyphosate
Insecticides
Neonicotinoids
modern pesticides
Size
Big scale
Medium
Small scale
Time scale
Long term
Short term
FOOD
Ideology
Artificial food
Big Food
Fast food
Food scares
Food "scandals"
Free from...
Local food
Regional specialties
Natural food
Organic food
Processed food
Junk food
Slow food
Veganism-vegetarianism
Issues
Aesthetics
Crisis
Environmental impact
Ethics
food shortages
Health
Hygiene
Labelling
Nutritional value
Price
Cheap
Expensive
Production efficiency
Quality
Safety
Sanctity
Security
Shelf life
Standards

War			
wikileaks			
REGULATION			
Body			
	EU		
		EC	
		ECHA	
		EEA	
		EFSA	
	UK		
		DEFRA	
		England	
		FSA	
		Northern Ireland	
		Scotland	
		Wales	
	USA		
		FDA	
		USDA	
	WTO		
Ideologies-agendas			
	Control-sovereignty		
	Corruption		
	Euroskepticism		
	Freedom		
	Geopolitical hegemony		
	Greens		
	labour		
	left wing		
	Liberal-neoliberal		
	Nationalism		
	new world order		
	Political parties		
		Political alliances	
			conservative
			Tory
			ukip
		Political opposition	
	Populism		
	Precautionary principle		
		Farm to fork	
	Reform		
	Safeguard		
	Scottish independence		
	Transparency		
Subject of regulation			
	Agricultural policy and farming		
		Crop rotation	
		Organic farming-food	

air pollution

Animal welfare

Badger culling

Consumers

Environmental policy

  Wildlife and biodiversity

Food

Foreign policy

GMOs

Health

  NHS

independence referendum - scotland

Natural justice-law-law of the land

Patent

Pesticides-chemicals

privacy

Risk assessment

Risk management

Safety

Scientific research

SDGs

Standards

  High standards

Type of action-inaction

  Approval

  Ban - restrictions

  Change

  De facto moratorium

  Enforcement

  Evidence based

  GRAS principle

  Harmonisation

    An even playing field

  Innovation

  Lawsuit

  opt-out

  Patent debating

    Patent infringment

  Public good

  Standards

    Lowering standards-regulations

    Maintaining high standards

    Unchanged

SCIENCE

  Body

    Academia

    Companies

    Experts

    Research institutes

Explanation of the science
Ideology
Anti-science
Bias
breeding=GM
Deficit model
Dystopia
Evidence
Burden of proof
Feeding the planet
GM different from GE
Holistic approach
Independent science
neophobia
Politicised science
Scientific collaboration
Issue
Advantages - benefits
Animal welfare - survivability
Economic
Yield
Environment
Reduce pesticide use
Reduced fertiliser use
Health and nutrition
Cancel genetic diseases
safety
Animal testing
controversial studies
Efficiency
Field or clinical trials
history
New technologies
AI - automation
Financial technology
Gene editing-crispr
Medical
germline editing
Non medical
Synthetic Biology
Transport innovation
Patent
Privacy
Progress-Innovation
Risks-concerns-disadvantages
Animal welfare
Biohacking
Biological weapons
Cross contamination