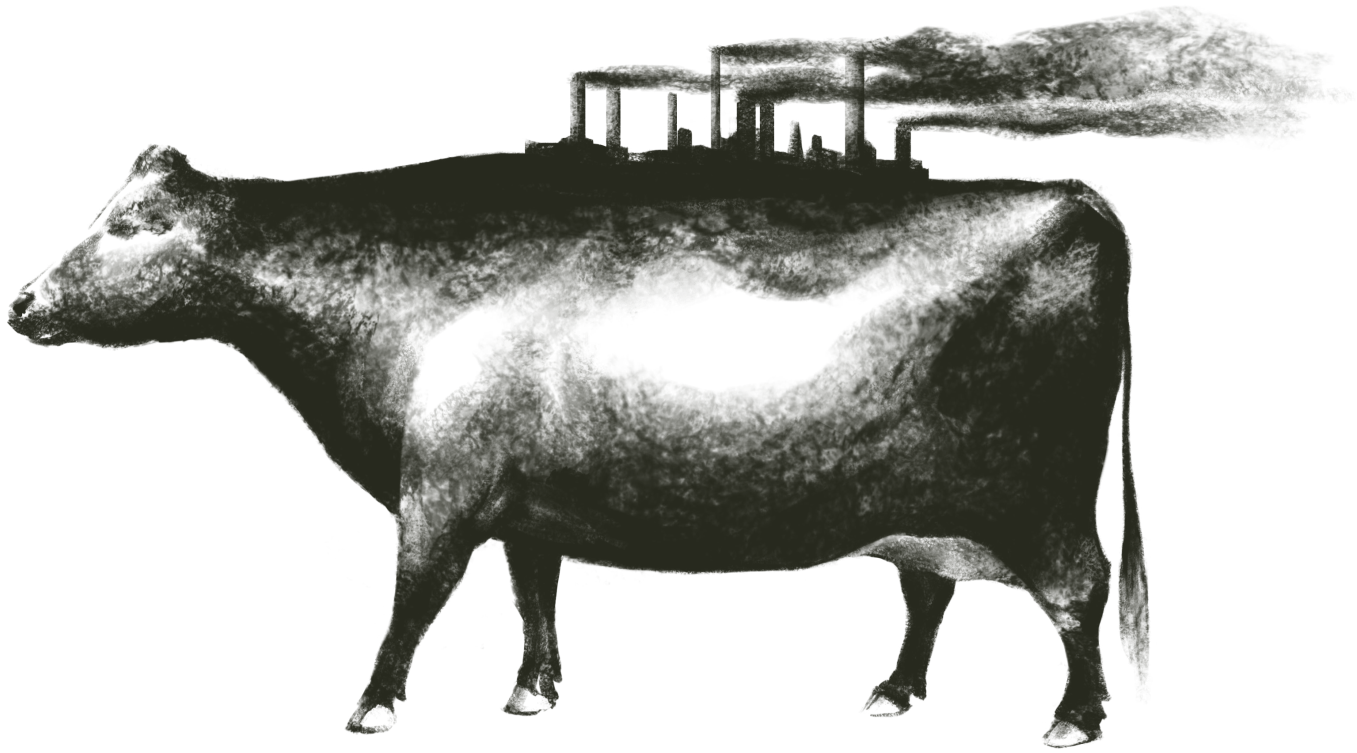
Data Humanism

Examining how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996



A Master of Design Thesis by

FENG YUAN

Data Humanism: Examining how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996

By

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ABSTRACT

Data Humanism: Examining how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996

Master of Design 2019

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Digital Futures

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This research examines the use of data visualization not only to inform audiences about a particular event but mainly to humanize data and uncover the missing content and hidden stories. This research uses digital storytelling as an engaging tool to represent how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986 to 1996. By incorporating a set of recent theories, such as thick data, local data and feminist data visualization, this research emphasizes the need to contextualize data so that these theories can help to fill the context-loss gap generated in standard data analysis. Employing the mixed methodologies of practice-based research, mapping as research, and research through design, this thesis comprises: 1) a written document stating the research process; 2) a series of iterations leading to an interactive web-based data story. The final storytelling aims to answer the questions of how we might represent the British Mad Cow Disease Crisis from 1986 to 1996 using a digital technique to approach different understandings of this historical event and how digital technologies and media benefit users and evoke their emotions.

Keywords*: data visualization, thick data, data humanism, digital storytelling, quantitative analysis, qualitative analysis, mad cow disease, the Guardian, British newspaper*

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"Data visualization will inevitably be all about personalization."

- Giorgia Lupi

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1. Introduction

The motivation for my research topic comes from my interest in data analytics and information visualization. I love digging the story behind the data and using visual language to make the data more "human." However, before reading the theory of Georgia Lupi, I didn't realize this passion and interests would link to a brand-new world: data humanism. Giorgia Lupi and Stefanie Posavec's book, *Dear Data*, presents the possibility that data visualization can be personalized, and can build an intimate relationship between the designer, the viewer and the dataset. In this book, they stated, "Data can describe the hidden patterns found in every aspect of our lives, from our digital existence to the natural world around us." Moreover, they described *Dear Data* as a "personal documentary" rather than a quantified-self project. In this book, they illustrated a way that data can be used to become more humane and to connect with ourselves and others at a deeper level. This work led me to Giorgia Lupi's theory - data humanism. In her theory, data humanism is a theoretical concept that proposes using data visualization as the communication tool to unveil the hidden human-related information. Through reading her work, I realized data humanism can be a powerful approach to enhance the comprehension of information, especially in human-related data research. That is where my research starts.

The principal objective of this thesis project is to argue that the more information from various perspectives, the more comprehensive understanding we will obtain. In this research, I analyze how the British newspaper, *The Guardian*, represents and introduces Mad Cow Disease

to the British public in the period from 1986 to 1996. All articles[1] about Mad Cow Disease or bovine spongiform encephalopathy (BSE) in that period are collected as the data. Through a series of analysis, I achieve a holistic understanding of how *The Guardian* depicts this historical event and the selected insights are visually represented on the final web-based data visualization. By analyzing how *The Guardian* depicts the British Mad Cow Disease Crisis from 1986 to 1996 as a lens, I intend to get an answer to my research questions:

- How might we represent the British Mad Cow Disease Crisis from 1986 to 1996 using an interactive storytelling to approach different understandings of this historical event?
- How does the interactive storytelling help users to discover hidden stories and missing content?

During my research, I didn't find any previous work translating the data of this historical event into a novel visual representation. In general, data visualization helps communicate complex information in clear and meaningful ways. My goal is to create a data visualization of the British Mad Cow Disease Crisis that will make this complex history simple and easy to understand. In this case, the final prototype will contribute to enhancing the audience's understanding of this historical event. This research itself is also a process to gather a deeper understanding of data humanism. More important than the dataset, in this case, the British Mad Cow Disease Crisis, is the medium I chose for exploring ways to humanize the data in practice.

This document starts with a literature review including an explanation of important concepts on data visualization, and previous research and artworks about data humanism. This chapter explains the decision to apply data humanism in this research. As a communication

[1] *Article* in this research refers to the appearance on *The Guardian* when Mad Cow Disease or Bovine Spongiform Encephalopathy (BSE) was mentioned, including the advertisement, letter to editor and also article.

approach, information visualization can help viewers interpret a large volume of information. By understanding thick data and data humanism, a data visualization of how *The Guardian* depicted Mad Cow Disease outbreak from 1986 to 1996 was generated, as well as an analysis of the articles themselves and of the linkage between news reports and social situations. This understanding impacted the methodology and methods chosen, which is detailed in the Methodologies and Methods chapter. The Case Study: Data chapter focuses on introducing what is British Mad Cow Disease, how the Mad Cow Disease Crisis expanded in Britain from 1986 to 1996 and its influence, and the British news media and *The Guardian* more specifically. This chapter explains the case I chose to use for my research. Because of my interest and the accessibility of the dataset, this research analyzes *The Guardian's* article in which Mad Cow Disease is mentioned. The Methodologies and Methods chapter explains how a mixture of methodologies and methods is integrated into the process of research and creation. This thesis engages Practice-based Research supported with self-study and Research through Design structured by iterative design. Also, Mapping as Research supported with visualization and sketching methods help this research understand the datasets and discover potential patterns, relationships and linkages of data. Finally, the Case Study: Prototype chapter details the design process of the final iteration. The Prototype One experiments with the interaction design of data visualization and Prototype Two organizes all insights achieved through data analysis and expresses these insights via an appropriate narrative form. This chapter also details the reflection obtained through user testing and offers insight into how visualization and interaction leverage information communication and mentions the room left for improvement. The other research insights of this project can be found in the Appendices, including several tables generated through data analysis and a timeline of British Mad Cow Disease from 1986 to 1996.

2. Literature Review

This literature review outlines recent literatures on data visualization, thick data, data humanism and related artists' works, and explains the main concepts that have influenced this research. The first and second sections start by identifying the concept of data visualization and thick data, and then addresses the advantage of using visualization tools to represent the British Mad Cow Disease data. The third section then focuses on the theory of data humanism, while the fourth section presents a few related works of data humanism. The content in the third section explains the vital power of data humanism on representing a human-related event and this explanation is then supported by the fourth section. The final section focuses on different ways that knowledge is digested and assimilated in different information processing stages. This section explores how visualizing data will leverage the knowledge digestion and assimilation. Also provided are theoretical explanations for why data visualization can help to generate a comprehensive understanding of British Mad Cow Disease. These five sections outline the theoretical framework of the research presented in this paper.

2.1 Data Visualization Overview

Data visualization is often viewed as a communication tool for data exploration which involves the study and creation of the visual representation. It has a long history, and its "earliest seeds arose in geometric diagrams and in the making of maps to aid in navigation and exploration" (Friendly, "Milestones In", 1). In his research, Friendly states that with the rapid development of techniques and instruments for precise observation and measurement by the 16th

century, data visualization welcomed the beginnings of the husbandry of visualization. Then, in the 17th century, the rise of analytic geometry, theories of errors of measurement, the birth of probability theory, and the beginnings of demographic statistics and "political arithmetic" led to the growth of data visualization in theory and the dawn of practice. In the next century, with the development of statistical theory and the growing interest in data analysis, "the idea of graphic representation at least somewhat established" and relevant research expanded into new domains and new graphic forms (Friendly, "A Brief", 7). At that time, cartographers began to present more than just geographical position on a map. As a result, more forms of data representations were invented, such as isolines and contours. The origin of thematic mapping of physical quantities also comes from this period. Some novel visual forms were invented in this century to portray the data. In summary, the 18th century was the first time when "data could 'speak to the eyes'" (Friendly, "Milestones In", 11).

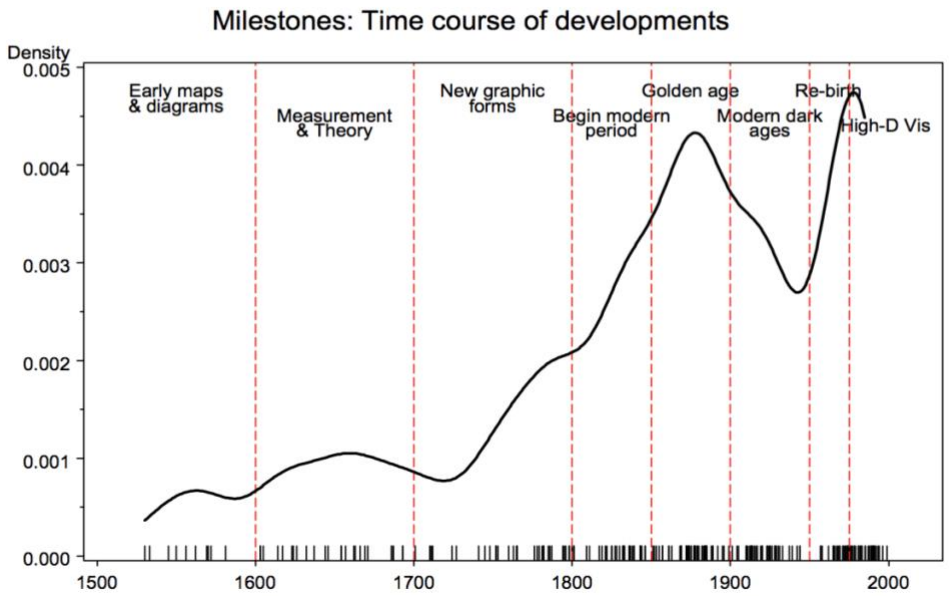


Fig. 1. Friendly, Michael, Matthew Sigal, and Derek Harnanansingh. "The Milestones Project: a database for the history of data visualization." *Visible Numbers: The History of data Visualization. Ashgate Press, London* (2012).

The period from 1850 to 1900 was called the Golden Age of statistical graphic (see Fig. 1) (Friendly, Sigal, and Derek). In this period, all conditions for the rapid growth of visualization had been established and the importance of numerical information was recognized worldwide. Later in the 20th century, data visualization welcomed another significant growth in the mid-1960s (Friendly, "Milestones In", 32). John Wilder Tukey, an American mathematician, suggested the recognition of data analysis as a legitimate branch of statistics distinct from mathematical statistics in *The Future of Data Analysis*, published in 1962. He also invented a series of novel and useful visual displays, and his works began to draw people's attention to how to make graphical data analysis interesting and respectable (Friendly, "Milestones In", 32). Moreover, Jacques Bertin's work *Semiologie Graphique* systematically organized the visual and perceptual elements of graphics and became a monumental work of data visualization. At the same time, computer techniques began to be applied to data processing, and extended the possibility of building different visuals. All these developments led to explosive growth in new visualization methods and techniques and improved visual representation to convey data better. More recently, the rise of computer graphics and open data sources on the Internet have made a significant impact on data visualization (Viégas, 1).

Throughout the history of data visualization, the development of technology has greatly stimulated the development of data visualization. Despite this growth, the increased understanding of the advantages of visualization also led to the application of data visualization to various subjects. Numerous studies on human visual system have also supported the prominent role of visualization in information dissemination.

In *Information Visualization: Perception for Design*, Colin Ware explains that rather than merely constructing an image in the mind, the visualization is "a graphical representation of data

or concepts from an internal construct of the mind to an external artifact supporting decision making" (1). James Gibson stated in his Affordance Theory that people perceive in order to operate on the environment. In short, perception is designed for action (Gibson, 22). The research of Lawrence G. Appelbaum and Anthony M. Norcia centers on the brain mechanisms underlying visual perception and addresses visual perception, executive function, decision making, and learning/expertise. In their article "Attentive and pre-attentive aspects of figural processing," Appelbaum and Norcia stated that human vision could extract information from each item's basic visual features in the early pre-attentive visual process (Appelbaum and Norcia, 1). That makes human vision a powerful tool for analyzing and interpreting data.

In *Readings in Information Visualization, Using Vision to Think*, Card defined visualization as computer-supported, interactive, visual representations of data to amplify cognition, so that the eventual goal of visualization is achieving insights to discover knowledge, make decisions and explain thoughts (Card, 6). More specifically, *information visualization* is "the explicit attempt to design external representations to amplify cognition" (Card, 10). In her book, *Visualization Analysis and Design*, Tamara Munzner suggested that compared with other sensory modalities, the visual system is better suited for information transmission (7). By viewing carefully designed visualization, which is often used as a form of external representation or so-called external memory, the visual system allows viewers to "offload internal cognition and memory usage to the perceptual system" (Munzner, 6).

Ware discussed in his research that perception and cognition are often closely interrelated at a higher information processing level because "the eye and visual cortex of the brain form a massively parallel processor that provides the highest bandwidth channel into human cognitive centers" ("Perception & Data", 92). Munzner also explained that "a significant amount of visual

information processing occurs in parallel at the preconscious level" (7). Data visualization organizes information by spatial location to provide the possibility of accelerating both search and recognition (Munzner, 6). In this case, the visual system can process information effectively and quickly.

In this research, Data Humanism: Examining how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996, data was a collection of *The Guardian*'s articles in which Mad Cow Disease was mentioned. In the analysis process, a series of quantitative data and qualitative data needed to be collected. The dataset types are various, including tables about how many cases of bovine spongiform encephalopathy (BSE) were reported in the United Kingdom, how many of *The Guardian*'s articles in which "mad cow disease" or "bovine spongiform encephalopathy (BSE)" was mentioned occurred in each section, and also a timeline of a series of policy responses to the Mad Cow Disease outbreak from 1986 to 1996 (see Appendix E). This research aims to use data visualization as a communication approach to tie these multiple datasets together and express insights about the British Mad Cow Disease outbreak. The reason for combining multiple datasets is explained in the following sections, and the techniques and methods applied in this research is described in the Methodologies and Methods chapter.

2.2 Thick Data

Thick data, a term created by ethnographers and anthropologists, refers to "the qualitative information that provides insights into the everyday emotional lives" of a considered population (Cook). Thick data is a method created to fill the gap of context-loss generated in big data analysis. Based on the definition of tech ethnographer Tricia Wang, thick data is "the opposite of

Big Data, which is quantitative data at a large scale that involves new technologies around capturing, storing, and analyzing" and "is data brought to light using qualitative, ethnographic research methods that uncover people's emotions, stories, and models of their world" ("Why Big Data"). Because of the correlation between big data and thick data, my research must clarify what big data means before discussing thick data further.

2.2.1 What Is Big Data?

Big data is a phenomenon revealing the necessity and desirability of unlocking information hidden within it (Diebold, 1). It was originally associated with three key concepts: volume, variety, and velocity (Laney). This ubiquitous term attracted intense focus by scientific groups and referred to data sets that were too large or too complex for traditional data processing application software (Breur). On August 2012, the American Statistical Association and Royal Statistical Society published a joint publication, *Big Data Special Issue*, which raised discussion points about this phenomenon (Diebold, 2).

Big data plays a key role in simplifying data volumes and reducing the complexity of big data applications. The analyzing process of big data generally includes sample capture, storage, analysis, curation, searching, sharing, transferring, visualizing, querying, and updating. The results are mainly used in predictive analytics, user behaviour analytics, or certain particular data analytics reasons. The economist, Andrew McAfee, commented in his article "Big Data: The Management Revolution" that big data could help business managers measure their business and directly obtain knowledge. He concluded that in this way, big data can improve business managers' decision making and performance (4).

However, the disadvantages of big data are also very obvious. With the wide application of big data in various fields, scholars began to question whether solely relying on the quantity of data and ignoring the detailed analysis of individual data can lead the analysis to become inaccurate.

With the integration of diverse data sources, analytical challenges appear in the sorting and analyzing process. In her article "Privacy and Publicity in the Context of Big Data," researcher danah boyd expressed her concerns that huge amounts of data as a representative sample may lead to biased results. Both, boyd and Kate Crawford agreed that "working with Big Data is still subjective, and what it quantifies does not necessarily have a closer claim on objective truth" (667). In their article "Critical Questions for Big Data," boyd and Crawford pointed out that all data researchers are "interpreters of data." They borrowed Gitelman's explanation, that the interpretation of data is a necessary research base, to further conclude that the design decision made in interpretation makes some of the data unneutral (667-668). Just as Bollier in the article "The Promise and Peril of Big Data" questioned whether "the data [can] represent an 'objective truth' or is any interpretation necessarily biased by some subjective filter or the way that data is 'cleaned'?" (13), another key question of big data relates to data errors. Big data is not whole data. The huge amount of data coming from the Internet also has outages and losses. Therefore, "regardless of the size of a data, it is subject to limitation and bias" (boyd and Crawford, 668).

2.2.2 Then, What Is Thick Data?

In this case, thick data assists with the analysis bias caused by big data analytics. Thick data is an interdisciplinary research subject, which often contains knowledge from data science

and anthropology. The term of thick data was first coined in the literature in the 1990s. Clifford Geertz described it as a method associated with a detailed and dense description of cultural practices. A decade later, Madeleine Leininger pointed out that through his observations, thick data in ethnography shared a similar meaning with "in-depth data" and "rich data" (104). This referred to qualitative research which "corresponded to data that are detailed and complete enough to maximize the ability to find meaning" (Sloan and Quan-Haase, 201). Recently, Wang started to use the term *thick data*. As mentioned above, she described the concept of thick data to include an anthropological research methodology, "thick description," into the data analysis process. Unlike earlier scholars, Wang's definition suggested that thick data can be a small amount of data which still offers in-depth meanings and stories of human activities (Sloan and Quan-Haase, 201). With this concept, Wang positioned "the value of ethnographic work in the context of Big Data" and uncovered the information behind big data analysis.

Unlike big data which requires that the data must be normalized, standardized, defined, and clustered, thick data is the opposite and must keep the context and stories of the data. "Thick data is simply the idea that numbers alone are not enough. To understand data, you often need to consider things like human emotion, which is rarely data-driven" (Cassidy). This view rescued big data analysis from a loss of context. This method mainly relies on human understanding and learning of data. In this case, accepting and revealing the complexity of social and cultural contexts hidden in data become possible. "Thick Data is data brought to light using qualitative, ethnographic research methods that uncover people's emotions, stories, and models of their world" (Wang).

Nokia was cited as an example of over-reliance on big data analysis. In 2009, Tricia Wang pointed out in her report to Nokia that the Chinese market was ready to accept the mid-

and high-priced smartphones. Her conclusion was based on her ethnographic work in China from living with migrants to working as a street vendor and living in internet cafes. However, Nokia's policymakers took the results of the big data analysis and chose to continue the marketing strategy of low-priced phones (Wang). As it turned out, Nokia's judgment on the market was indeed wrong, and its over-reliance on market data delayed innovation and put the overall strategy in a bind. Nokia is not the only example of this error in judgment, but many companies also face similar challenges.

By contrast, Samsung accepted thick data as a research approach to analyzing its next-generation product concept. Samsung did not rely solely on the result of big data analytics but tried to obtain an in-depth understanding of the customers' behaviour by monitoring, observation and interview (Shacklett). The knowledge behind Samsung's research, which mixes big data and thick data, is an understanding that sole dependence on numerics and algorithms is impossible for adequately summarizing the human activities and unveiling the relationships behind the data (Shacklett).

Thick data is the best method for collecting and analyzing human stories and generating insights. The emotional context hidden in stories can be a useful and powerful tool to bond the connection between organization and stakeholders. It is also a type of information that researchers cannot obtain only from numbers. "Numbers alone do not respond to the emotions of everyday life: trust, vulnerability, fear, greed, lust, security, love, and intimacy" (Wang). In fact, the analysis of thick data can lead data scientists to deeper insights into people's inner world. Ultimately, the information reflected by thick data analysis will be emotional, not rational.

2.2.3 Thick data in the context of this research

This research worked with the dataset from the British Mad Cow Disease crisis from 1986 to 1996 and attempted to reveal some hidden connections and stories behind the data. British Mad Cow Disease was not only an outbreak of a pandemic disease but also a profoundly important social and political crisis in British history. For such a specific social event, it is not enough to rely on a standard statistical analytic method. As mentioned above, the emphasis of thick data analysis is on exploring the meanings and stories behind the data. Therefore, thick data analysis is a more conducive method for this research. Understanding thick data impacted the determinations made in conducting this project. I report on this in greater detail in the Methodologies and Methods chapter.

While attention on thick data is increasing, data scientists as well as artists have also explored how to use visualization to express information related to human emotional, historical, cultural, and social contexts. The terms "humanizing data" and "data humanism" are increasingly mentioned and discussed. The next section examines how data humanism explores human-related data and contributes to a more in-depth understanding of what is data humanism.

2.3 Data Humanism and Other Related Theories

Data humanism is a theory proposed by Giorgia Lupi, who referred to it as a big revolution of data visualization, by which "data visualization will inevitably be all about personalization" (Lupi, "Data Humanism"). Similar to thick data, data humanism also mixes the idea of grasping the overall trend through quantitative analysis; meanwhile, it emphasizes revealing the human stories hidden in the data. In this case, data humanism also can pack up non-

quantitative information. However, in Lupi's description, humanizing data does not limit visualization to hard numbers, but looks at numbers in a more human understanding way.

Data visualization should translate numbers into what they stand for knowledge, behaviours, and people (Lupi, "Data Humanism"). The research results are also not limited to a description and understanding of human activities and behaviour, but also an emotional connection. In the book *Dear Data*, Giorgia Lupi and Stefanie Posavec documented a laborious project. They sent each other one self-created postcard a week. On each postcard, they presented their system for displaying data on some item they tracked over the week. In this way, these two data visualization designers not only exchanged the data but also built an intimate communication.

In another project "Bruises—The Data We Don't See," Lupi explained her theory further that data visualization can be considered a self-discovery tool to achieve a better understanding of human nature and a self-expression medium to narrate the discovery. In the book *Infographic Designers' Sketchbooks*, Steven Heller noted in the introduction that "Making enticingly accurate infographics requires more than a computer drafting program or cut-and-paste template, the art of information display is every bit as artful as any other type of design or illustration, with the notable exception that it must tell a factual or linear story". By applying Lupi's theory to practice, data visualization should be a visual result that explores both quantitative and qualitative data sources and combines the information into an elaborate visual narrative. Scientific accuracy is not the only goal of Lupi's visualization; she also seeks to explore how to "convey knowledge and inspire feelings simultaneously with data" (Lupi, "Data Humanism").

It is not hard to find that Lupi's data humanism intends to combine visualization with analysis and intuition, logic and beauty, numbers and illustrations. In addition, the visual results are always "very human" and tell an intuitive and intimate story.

Steven Maxwell stated that "People are getting caught up on the quantity side of the equation rather than the quality of the business insights that analytics can unearth". Giorgia Lupi is not the only scholar who found that more numbers do not necessarily produce more insights. Catherine D'Ignazio and Lauren F. Klein applied feminist theory to information visualization research and questioned who was included in dominant ways of producing and communicating knowledge and whose perspectives were marginalized. Yanni Loukissas pointed out the concept of local data to emphasize the necessity of considering the origin of data. Although these scholars described their theories and thoughts in various terms, they all were concerned with the connection between two areas of work: data analysis and data visualization. Moreover, they all tried to solve the problem of content-loss and bias in data representation. The latter two theories cover the deficiencies of Lupi's study of data humanism. For this reason, clarifying what feminist data visualization and local data are is very important for this research.

2.3.1 Local Data

Loukissas suggested that all data is local. In his article, "Taking Big Data Apart: Local Readings of Composite Media Collections," he stated that big data has often been analyzed independently without discussing the local sites of production and use, and in this article, he also attempted to call attention to the necessity of local data. Here, *local* is a relative term and indicates a relative location from which the data comes. Loukissas noted that data is "made by people and their dutiful machines, at a time, in a place, with the instruments at hand, in existing

organizations, with limited resources, for disciplined audiences" (651). By answering the two questions he listed—namely, "Where do Big Data come from?" and "How do the local conditions of their creation shape subsequent research and practice?"—researchers can achieve an understanding of data's location and condition. Localizing data offers a chance for scholars to "to learn about varied cultures of data collection brought together in Big Data" and leads to "new forms of social advocacy around Big Data" (652).

2.3.2 Feminist Data Visualization

In "Feminist Data Visualization", D'lgnazio and Klein pointed out that data visualizations may exclude the perspectives of oppressed groups, such as female, minorities and so on. "As data visualization becomes a mainstream technique for making meaning and creating stories about the world, questions of inclusion, authorship, framing, reception, and social impact will become increasingly important" (4). They suggested that feminist data visualization can provide a responsible solution for research bias in the data analysis process. By applying feminist theory to information visualization research and practice, D'lgnazio and Klein outlined preliminary principles for feminist data visualization. Similar to Loukissas, these researchers also discussed the importance of localizing data in their context section. They mentioned that "a central premise of feminist theory is that all knowledge is situated, where 'situated' refers to the particular social, cultural, and material context in which that knowledge is produced" (3). Therefore, they suggested that data visualization needs to consider fully the diverse context and the data's particular visual output (3). Applying this technique with a human-centered design and participatory design methods, a designer can obtain more understanding about a user's culture, history, circumstances, and worldviews, and create a more informative and humanizing

visualization design. In addition, D'lgnazio and Klein also tried to use feminist data visualization as an approach to discuss the importance of leveraging embodied and affective experience to enhance visualization design and engage users. According to feminist theory, embodied and affective experiences are ways of "knowing on par with more quantitative methods of knowing and experiencing the world" (3). Hence, the design of embodiment and affect, an emotional bond with a story or an impressive visual design, can evaluate data visualization.

In conclusion, Lupi's theory served as the beginning and inspiration for this research. It introduces data humanism as an approach to represent the human story vividly behind the quantitative and qualitative data. Feminist data visualization and local data offer a further understanding of the necessities of context analysis and the design of embodiment and affect. These two theories assisted me in shaping the knowledge of data humanism—an attitude of data visualization designers that not only focuses on numerics but also analyzes all related context, an approach to represent data with an emotional story and intuitive visual design. In short, data humanism is an understanding that data is not simply numbers, but numbers associated with people, society, and culture.

The study of Mad Cow Disease inevitably involves the consideration of human participation and an analysis of culture and society. In this case, this research must work with multiple data sources, both quantitative and qualitative. As the theoretical foundation of my research, data humanism has led me to explore the most appropriate methods, as demonstrated in the fourth chapter Methodologies and Methods. This theory also inspired me to convey the information through elaborate novel visuals. The next section is a review of various design works related to data humanism. Through reviewing the related works of data humanism, I

further strengthened my understanding of data humanism, and gained enlightenment about its final manifestation.

2.4 Related Works

In this section, I choose two relevant projects: “We Feel Fine” by Sep Kamvar and Jonathan Harris, and Giorgia Lupi’s “Data ITEMS.” We Feel Fine is an early web-based project that aimed to reveal dynamic stories of human emotion. It preceded the concept of data humanism and provided rich soil on how to design a web-based interface to carry various data visualizations. Another selected work in this section is Data ITEMS, developed by Giorgia Lupi, who develops the theory of data humanism to address the use of data visualization to reveal hidden human stories. Although this work, Data ITEMS, keeps her usual hand-sketching style, the research and creation process illustrate how to apply the sketching as an analysis technique in a data humanism project. In short, We Feel Fine helped me to think about how to use interaction design for this project, while Data ITEMS helps this research optimize the research and design process.

These two projects were delivered as different forms: We Feel Fine is an interactive web-based data visualization, and Data ITEMS is a static hand-sketching style visualization. However, both of them present the beauty of data humanism —deeply mining the context of the data and exploring hidden stories. The following content will focus on discussing how these two works serve this research.

We Feel Fine is a data-driven project created in 2005 summer (see Fig. 2). This project includes an interactive website and a documentary book to document, highlight, and visualize emotional data. It comes from an idea of Sep Kamvar and Jonathan Harris “to make something

that could distill the beauty, the humanity, and complexity" that they saw in the web (16). This project searched the internet every 10 minutes for expressions of human emotion on blogs and then displayed the results in several visually-rich dynamic representations. By collecting the world's newly posted blog entries for occurrences of the phrases "I feel" and "I am feeling," this project sorted the data recording the full sentence and context in which the phrase occurred into various polarities (happy, sad, depressed, etc.). By using "I feel" and "I am feeling," these emotional tags bond strange people very closely and reveal the beauty in the everyday ups-and-downs of life.

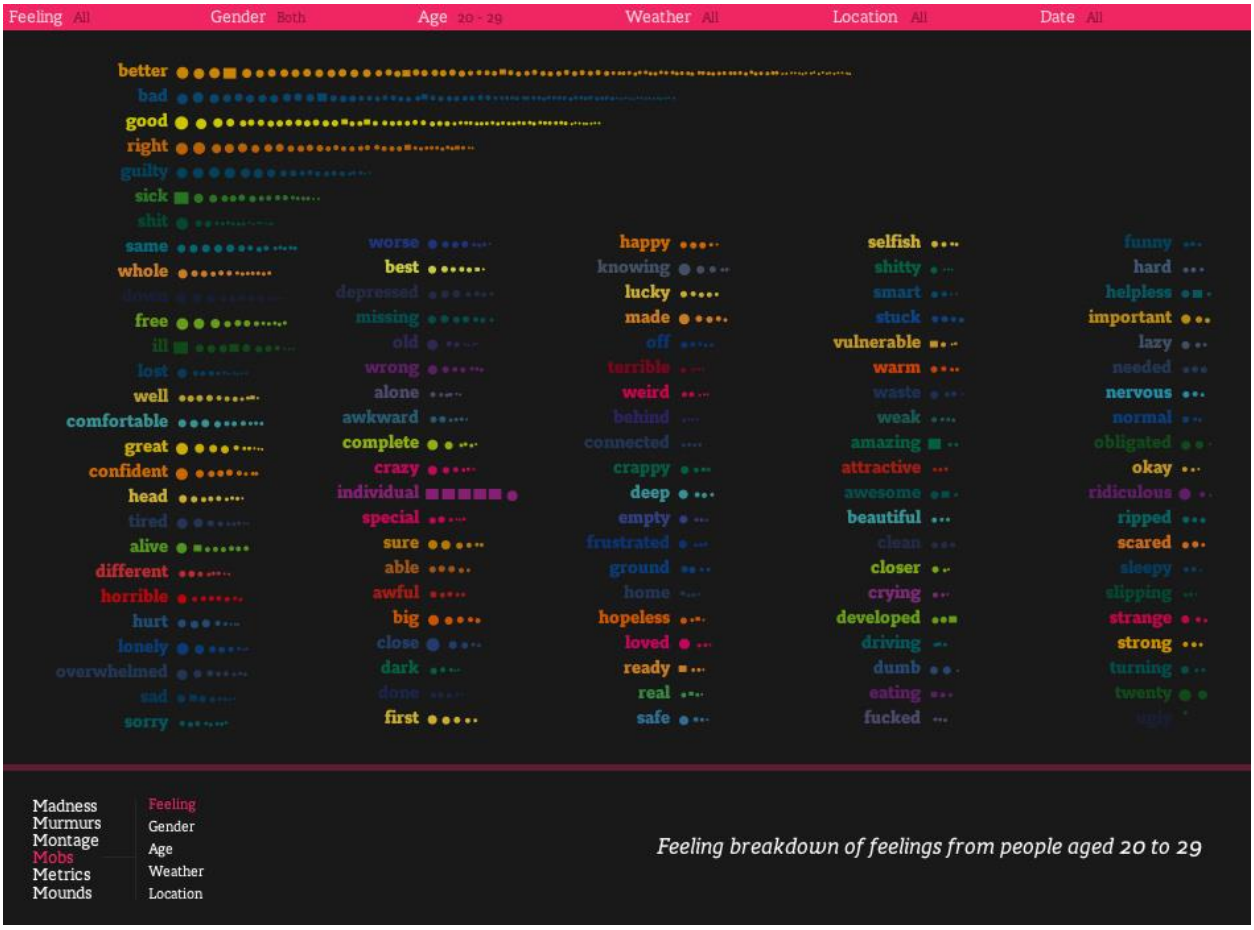


Fig. 2. Mobs, the fourth visualization of We Feel Fine. Kamvar, Sep, and Jonathan Harris. "We Feel Fine." *We Feel Fine / Movements*, 2006, wefeelfine.org/movements.html (accessed on March 2019).

We Feel Fine was started in summer of 2005 and was launched in 2006. It existed earlier than when Giorgia Lupi started to use data humanism to describe her project. However, as an early online data visualization artwork, We Feel Fine presented different data visualization to reveal various aspects of human emotion. The interface to this emotional data is "a self-organizing particle system, where each particle represents a single feeling posted by a single individual" (Harris, "We Feel Fine"). The color, size, shape and opacity of the particles indicate different properties of the feeling. Moreover, these particles can help to visualize various human emotions because they are self-organized along any number of axes. In this way, this project painted various pictures of human emotion in six precise movements titled: Madness, Murmurs, Montage, Mobs, Metrics, and Mounds. The visitor could experience various emotional visuals by visiting We Feel Fine's six playful interfaces to achieve specific questions, such as: Do Europeans feel sad more often than Americans? Do women feel fat more often than men? Does rainy weather affect how we feel? In Fig. 2, they presented how to utilizes a self-organizing particle system to express the different zeitgeists of feeling, gender, age, weather, and geographical location. By clicking each particle, the viewer can review more context about these feelings, like who has them and in what conditions generate them. Through viewing this online project, it is possible to see the emotional stories that the strangers are sharing. These stories cannot always be presented clearly to the audience through standard visual representations like static bar and pie graphs, because the context is missing, and the stories are hidden. Instead, an interactive visualization can improve the level of information transition.

When the researchers of We Feel Fine were asked if the findings of this project were scientific, their answer was yes and no. They described the result as a piece of exploratory data analysis that was the beginning of a scientific conversation (Kamvar and Harris, 23). For this

purpose, they skipped some steps of scientific study, such as a validation of hypotheses. The goal of We Feel Fine is not the argument of hypotheses, but the artistic expression of the data and the freedom for the audience to interpret the information.

This understanding also impacted me to design my final deliverable prototype as a web-based data visualization story. I use D3.js and JavaScript to create an interactive data visualization to bring new understanding to a historical event. I report more details about the design process in a later chapter. By interacting with my prototype, the audience will gain an understanding of my topic through their own experience. This understanding may be one-sided and imperfect due to using only *The Guardian* articles, but my hope is to help provide them with further context to this historical event.

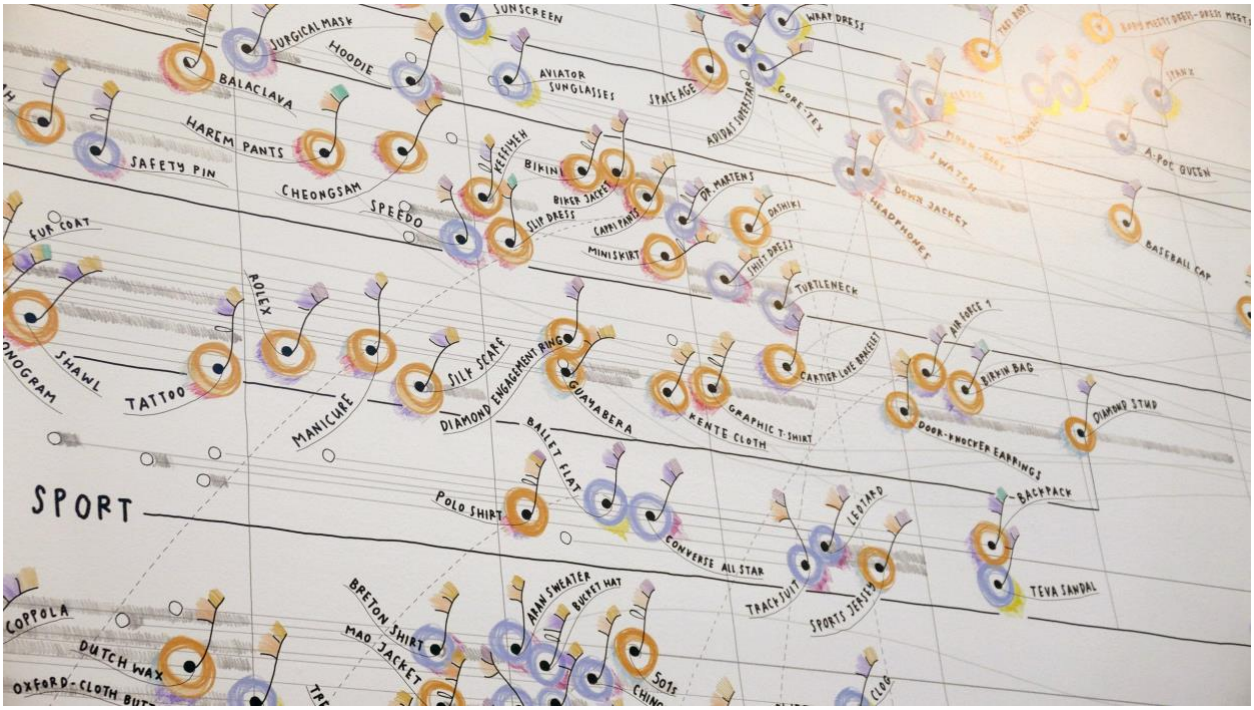


Fig. 3. Lupi, Giorgia. "Data ITEMS: Exploring the Power and Depth of Soft Data for the Museum of Modern Art." *Medium.com*, Medium, 2 Oct. 2017, medium.com/@giorgialupi/data-items-exploring-the-power-and-depth-of-soft-data-for-the-museum-of-modern-art- e5e5f40a82943 (accessed on March 2019).

In addition to the above, I also found visualization and sketch to be the main methods employed in the research of data humanism. For instance, in creating the project "Data ITEMS: A Fashion Landscape," Giorgia Lupi and her team investigated the hidden stories of 111 iconic fashion objects and translated their research and discovery into visuals (see Fig. 3). By visualizing the highlighted items, they built a reconnection to the items' backstage stories (their commercial lifecycle, design process, production, marketing, distribution, and recycling). This project analyzed and collected the data from some materials in which "you don't immediately see numbers" (Lupi, "Data ITEMS"). By digging into the stories behind theses 111 items and documenting the background research, Lupi and her team conceived a set of questions to analyze each item and explore both quantitative and qualitative information. In her research process, visualization is not only the final delivery, but also a method to analyze data collection and discover the internal connection between each item. Learning from this project, I decided to embody the concept of mapping as research as one of my main methodologies, and employed Lupi's methods, such as sketching and visualization, to analyze data.

The above successful cases used different types of data and interacted with various audiences, but they all explored the human-related information hidden within numeric data. Data encodes the stories of our lives, capturing not only our tastes and interests but also our hopes and fears (Thorp). Through reprocessing this human-related information, the visual expressions become soft and convincing so that the information receiver (audiences) can achieve a strongly empathetic resonance. In this way, the quality and level of information communication are further deepened.

In the previous sections, terms such as *understanding*, *information* and *data* were repeatedly mentioned. The identification of these terms needs a greater understanding of the

Data-Information-Knowledge-Wisdom hierarchy. In the next section, I explain the difference between data, information, and knowledge. By differentiating among these three concepts, the reason and method of deepening an understanding of data will be discussed.

2.5 Data, Information, and Knowledge

In visualization, data, information, and knowledge are three terms used extensively. They often have a similar context but refer to different understandings of fact. Data, information, and knowledge can all be output and input in an analysis. Russell Ackoff is often cited as the initiator of the DIKW (Data-Information-Knowledge-Wisdom) hierarchy. Based on his hierarchy, data, information, and knowledge are classified into different human understanding levels in perceptual and cognitive space (see Fig. 4).

Fig. 4. Bernstein, Jay H. "The data-information-knowledge-wisdom hierarchy and its antithesis." 2009.

Based on Applehans' definition in *Managing Knowledge: A Practical Web-Based Approach*, data is a series of facts collected from the external environment, such as unprocessed numbers, words, sounds, images, and so on. In this hierarchy, data is the source of information, knowledge, and wisdom. Ackoff suggested that information is the human understanding which is

generated in the process of analyzing the raw data. Information is meaningful, logical, processed. Because it can help people answer the questions of 'who,' 'what,' 'where,' and 'when,' it is valuable for decision making. Harris defined knowledge as a combination of information, cultural context, and experience. It is the product generated from the analysis of simple and abstract information. Moreover, knowledge can be extensively and deeply tested in practice.

It is not difficult to realize that the process from data to knowledge is a process of progressively deepening the understanding of information. Leveraging the understanding of data corresponds to this process. In this research, the term *information* refers to the information people can directly receive from the project, while the terms *understanding* and *knowledge* are usually used to describe the knowledge an audience can obtain after experiencing the project.

In conclusion, the content of this chapter discusses the significance of using visuals to humanize data and tell the human-related stories behind it. As a method, data humanism offers designers an opportunity to process and represent complex datasets. This method strengthens the connection between people and data visualization and can inspire an audience to gain more in-depth understanding of the data representation. This context review also shows various methods for creating a data visualization of a human-related dataset. Specifically, Mad Cow Disease in Britain is a vast subject. Relevant data includes medical data, government policies, changes in the British economy, and so on. The next section will illustrate how I conducted a series of data searches to find the data, as well as the specific details of this data.

3. Case Study: Data

This research analyzes the data of how a British newspaper, *The Guardian*, reported the Mad Cow Disease outbreak from 1986 to 1996. As an infectious disease that caused a significant impact on British history, Mad Cow Disease has so many mysteries. Until today, scientists have no clear understanding of what the origin of the disease and the transmission mechanism between species is. All these unknowns have always fascinated me and made me eager to research more deeply into this subject. Also, I am not the only one who has considerable interest in this disease. There has been a lot of related research and discussion about this disease over the past decades. Theses related materials greatly helped this research and provided a lot of accessible data.

British Mad Cow Disease outbreak is not a singular case. Similar infectious disease outbreaks have happened a lot recently. Between November 2002 and July 2002, an outbreak of severe acute respiratory syndrome (SARS) in southern China caused an eventual 8,098 cases, resulting in 774 deaths (Smith). Ebola virus disease (EVD) is a severe, often fatal illness in humans and is transmitted to people from wild animals and spreads in the human population through human-to-human transmission. In the period from 2014 to 2016, Ebola virus disease outbreak spread between African countries and caused 28,712 cases resulting in 11372 deaths (WHO). Because of the limited time, this research only focuses on a small portion of the BSE outbreak: how *The Guardian* newspaper reported this crisis in 1986 to 1996. Still, this research can help to study how to apply data visualization to communicate these types of crises and may offer some insights for related research.

3.1 The British mad cow disease, A Social Crisis

Mad Cow Disease, which is also called BSE (bovine spongiform encephalopathy), is a slowly progressing, fatal nervous disorder of adult cattle that causes a characteristic staggering gait and is similar to a handful of rare, neurological diseases that affect humans and other animals (Powell, 3). The most common of these diseases is scrapie, which causes sheep compulsively to scratch themselves on fence posts or whatever is available (Leiss, 4). Until March 1996, the relevant research revealed that this disease is due to an infection by misfolded protein, known as prion. This disease passed to cattle after they were given infected feed made from the remains of other cattle who spontaneously developed the disease or scrapie-infected sheep products (Brookes, 253). This disease was first identified in 1986, and today's researchers call it classic bovine spongiform encephalopathy (C-BSE) to distinguish with other new forms of BSE. Even today, there is no clear understanding of how BSE-infected meat transferred the disease to humans, relevant researchers described the spatiotemporal correlation of C-BSE to the variant Creutzfeldt-Jakob disease (vCJD), "which led to the classification of BSE as a zoonotic disease (and the "cause" of vCJD) in 1996" (Casalone and James, 121). In this case, Creutzfeldt-Jakob disease (CJD) is considered to be the human equivalent of scrapie or BSE and occurs in about one-person-per-million every year throughout the world (Powell, 3).

CJD is not a new disease and was first identified in 1920 by two German neuroscientists, Drs. Hans Gerhard Creutzfeldt and Alfons Jakob. Kate O'Neill stated in her research, "A Vital Fluid: Risk, Controversy and the Politics of Blood Donation in the Era of 'Mad Cow Disease'," CJD is occasionally inherited via a genetic mutation and also transmitted through the use of infected human brain tissue (362). As the new strain of CJD, vCJD differs in its molecular structure from the older form of CJD, resembling more closely BSE, and associates with eating

meat from BSE-afflicted cattle (O'Neill, 362). "All of these ailments (BSE, CJD, vCJD and sheep scrapie) have long incubation times, from two to seven years in cattle and up to 30 years in humans, but once symptoms appear, the victim rapidly degenerates. There is no known treatment" (Powell, 3).

In the era of BSE outbreak in Britain, "the prevailing theory is that the carcasses of sheep afflicted with scrapie —also in the general class of TSEs— were rendered into bone meal and subsequently fed to beef cattle, transmitting the disease along the food chain to humans who consumed the tainted beef" (O'Neill, 362). At that time, the outbreak of bovine spongiform encephalopathy (BSE) in the United Kingdom continued to concern beef and dairy producers and customers. And this concern had increased because of the continued spread of the disease on the European continent. In 1986, BSE was first discovered among Britain's cattle. In June 1988, the U.K. government made BSE a reportable disease and by July had instituted a ban on ruminant offal in cattle feed (Powell, 3). The U.K. government decided to slaughter and incinerate all suspected cows and provide compensation to farmers at 50% of the animal's estimated worth (Powell, 4). Although the number of new cases of BSE dropped dramatically after the ban was imposed, over a period of decade up to March of 1997, 168,382 cases of BSE at more than 32,400 British farms had been reported in total (IFST).

United Kingdom news media started to promptly report the news about BSE in the mid-1980s, and in 1990 the North American newspaper coverage began. The U.S banned British beef imports in 1989, and Canada subsequently executed the beef import ban in 1990. While the U.K. official insisted there was no scientific proof of BSE transmitted through the spice barriers, questions continued to be raised by the scientific community, the British public, and trading partners (Powell, 3). In that 9 years period, up until Christmas 1995, beef consumption in the

U.K. fell 20% and 1.4 million British households stopped buying beef (Leiss, 11). Because of the concern from parents and the public, a lot of British schools took beef off their menu (Cook). Beef consumption across the European Union dropped 11 percent in 1996, and the BSE crisis cost the E.U 5 billion U.S dollar in subsidies to the beef industry. At end of 1996, the compensation paid to farmers for destroyed cattle was £553 million and abattoirs cost £162 million in total (Leiss, 5). BSE crisis contributed to devastating economic and social effects in Britain.

In this crisis, the British press played a subtle role. In his work "Trust, Emotion, Sex, Politics, and Science: Surveying the Risk Assessment Battlefield," Paul Slovic mentioned that, "we live in a world in which information, acting in concert with the vagaries of human perception and cognition, has reduced our vulnerability to pandemics of disease at the cost of increasing our vulnerability to social and economic catastrophes of unprecedented scale. The challenge before us is to learn how to manage stigma and reduce the vulnerability of important products, industries, and institutions to its effects, without suppressing the proper communication of risk information to the public" (59). There are many researches discussing how the U.K government and industry didn't manage the risk of BSE and vCJD properly. The British government insisted to comfort the public with "no-risk" message and underestimated the public's capacity to deal with the risk, even a few of vCJD (a similar malady in human beings) cases were found on March 1996 (Powell, 6). Scientific uncertainty, public suspicion, and an obstinate government which refused any public inquiries fed the media mill and helped accelerate the social amplification of risk (Kasperson et al, 180).

3.2 The British newspaper and BSE crisis

Journalism and newspaper editing have a long history in Great Britain. The history of the British newspaper dates back to the 17th century, when the newspaper became the primary medium of information (Copeland et al, 89). In order to understand the influence of the news media in the British BSE crisis, this research studies the mechanism of newspaper reporting about BSE.

In Blumler's words, the media provides "the informational building blocks to structure views of the world from which may stem a range of actions" (Blumler, 24). Although these informational building blocks combine with a multiplicity of political and social functions to direct an individual's action, they do determine the limits of his or her knowledge as well as perceptions of events and their causes (Kopytowska, 74).

The news media's attention is also influenced by multiple factors:

> Journalists knowledge, (some journalists shy away from stories where they have difficulty understanding the issues); news values and the need for 'real events' to serve as news hooks; the human interest factor (what they call the "it could be you/it could be me" factor); the self-referential media momentum, where once a story becomes newsworthy, other media outlets start to address it; and the amount of associated activity by pressure groups, professional bodies, politicians etc (Washer, 3).

Except for the above factors, the public's understanding and reactions of the media message is another factor impacting the attitude of how news media pick up (and drop) the reporting (Washer, 4). Based on all these factors, it could be argued that the British media do not simply and transparently report events but select "newsworthy" events for reporting in the period from 1986 to 1996.

Although the first case was reported when it happened in 1986, it was only after May 1990 that there was higher media interest in the BSE story. This was mainly due to the story of the first cat that died from feline spongiform encephalopathy (FSE), indicating that BSE could jump the species barrier. This was a particularly significant event and the government had to reassure the public following the media interest it generated. Greg Philo said in "Bias in the Media" that "news is not found or even gathered so much as made." When the British press expressed more interest to report the suspected human-related stories, its role ranged "from a fairly neutral observer to an active participant" (Kopytowska,75). However, because of the uncertainty of ongoing scientific work and the governmental official silence or inaction, the BSE posed a serious hazard.

3.3 The Guardian

In this research, I examine the reporting of Bovine Spongiform Encephalopathy (BSE) in the British newspaper. The UK newspaper, *The Guardian*, was chosen as the sample. The reason for the choice was partly pragmatic: All the archives (over the period from 1986 to 1996) of *The Guardian* is consistently available online as scanned digital copy via Newspaper.com subscriber service.

The Guardian is a daily newspaper founded in 1821. Its original name is *The Manchester Guardian*. In 1959, the name was changed to *The Guardian*. As a leading British news media, *The Guardian* is considered to be linked to the Labour party. However, based on the self-description on *The Guardian's* own page, it is still factual information that utilizes loaded words (wording that attempts to influence an audience by using appeal to emotion to stereotypes) to

favour liberal causes. On the Scott Trust[2]: values and history page, one core purpose of the trust is "to secure the financial and editorial independence of *The Guardian* in perpetuity: as a quality national newspaper without party affiliation; remaining faithful to its liberal tradition."

Founded by the cotton merchant John Edward Taylor, the majority of its readership is the middle class with a left political orientation (Engels, 68). Traditionally, British newspapers are divided into two distinct categories: broadsheets and tabloids. Broadsheets are often considered intellectual and serious in the matter they look into. Because of this, broadsheets newspapers are also called "quality press." On the other hand, tabloids usually refer to papers tending to focus on celebrity news, gossip and coverage of human interest rather than politics, overseas news etc. As a broadsheet newspaper, the readership of *The Guardian* is holding views of such people as middle class, earnest and politically correct. However, the separation between the tabloid and broadsheet is not absolute. "There are self-referential feedback mechanisms between two" (Washer, 9).

Because of limited time, this research used only *The Guardian* as the source to examine British news media with the understanding that it would restrict the results. *The Guardian* is a paper on the left of the political spectrum, which prevents this research to offer a broad range of political shades of opinion on this issue. However, this broader view can be examined in future research. I describe my research process of examining all *Guardian* articles in which Mad Cow Disease/ BSE is mentioned in the next chapter.

[2] The Scott Trust was the British company that had owned *The Guardian* from 1936 to 2008. It was replaced by the Scott Trust Limited that owns Guardian Media Group in 2008.

4. Methodologies and Methods

This research engages Practice-based Research supported with self-study, Research through Design structured by iterative design and Mapping as Research supported with visualization and sketching methods. These mixed methodologies build a solid foundation for this research.

4.1 Practice-based Research

Practice-based Research is an original investigation undertaken in order to gain new knowledge partly by means of practice and the outcomes of that practice (Candy, "Practice Based", 3). In the article "Practice-based Research in the Creative Arts: Foundation and Futures from the Front Line," Linda Candy and Ernest Edmonds stated that a basic principle of practice-based research is that not only is practice embedded in the research process but research questions arise from the process of practice, and the answers of research questions are directed toward enlightening and enhancing practice (63). Candy and colleagues suggested that "the central practice is primarily directed toward making artifacts" and these artifacts provide the basis of research (68). Researchers referenced Scrivener's argument that artworks offer perspectives or ways of seeing, and "'new knowledge' can be understood within the context of any particular discipline" (Candy et al, 66). This means the research results need to be understood and communicated and raise the significance of the practice in the research process. Researchers concluded that "it is equally important to recognize that practice-based research is research and not practice alone" (Candy et al, 68).

Since my research will include the use of digital technology, practice-based research is similar to other forms of research but has different needs brought by the nature of digital media and its interactivity. This approach falls into two areas: research about how to design and implement the technologies involved, and research about understanding how the audience responds to the interactive experience (Candy, "Research And", 2). The approach of practice-based research embodied in my own study includes taking online courses of D3.js and creating demos with a sample dataset where I obtained the first-hand experience with D3.js. Except for self-learning D3.js and programming, the practice-based research is also embodied in the creation of several iterations and the reflection collected through user testing. My research is also informed by reading related articles and studying these techniques. A series of practice help me to understand the advantage of interaction design in data visualization. Finally, the development of the prototypes engages iterative design including practice-based prototyping and programming.

4.2 Mapping as Research

One of the goals of this research is to use data visualization as a way to represent an event that involves humans which led to a range of complicated consequences and responses. As such, gathering and organizing data in a mapping practice can help this research to deal with the representation of multiple datasets. In the article "Mapping as Assemblage for Cultural Research," the researchers state that mapping is a practice of:

> Interpretation that engages the mapmaker in the process of decision-making about what is included (and thus excluded). The map as a communication artifact is produced through a process of selection of data territories that engaged with generally pre-

> determined forms of knowledge (legal, proprietary, technical, scientific, theoretical, esoteric, communal, archaic, personal, emotional etc.) (Schumack & Tuckwell, 4).

They suggested that mapping can be a research process rather than a practice. As a practical approach, this methodology emphasizes "process (i.e. the performance of mapping itself), rather than the map as an artefact" (Schumack and Tuckwell, 3). By involving Deleuze and Guattari's description of rhizomatic thinking styles (which is a radical thought model described as a form of network that cuts across different categorical borders), the mapping can be defined as a pragmatic methodology of collecting information. In *A Thousand Plateaus*, Deleuze and Guattari introduce the notion of relations of exteriority, which characterize wholes they called assemblages. Based on this work, a theoretical framework of assemblage emphasizes fluidity, exchangeability and multiple functionalities. Applying to this theory of mapping as research, a methodology of mapping should focus more on the study of the data flow, not the single nodal data. It not only visualizes how the researcher is conceiving the data but also emphasizes the flows and networks of data which precede them. Mapping is a technique of "connecting and observing patterns of movement, force and effect across very diverse formal and disciplinary divides" (Schumack and Tuckwell, 5). Following the idea of Schumack and Tuckwell, when I outlined the narrative content of the final prototype, I sketched a map (see Fig. 5) including all the datasets surrounded by the variables for each table. As the below image shows, mapping as a methodology led me to discover the potential linkages of all my datasets and organize these datasets with various scales in a proper way.

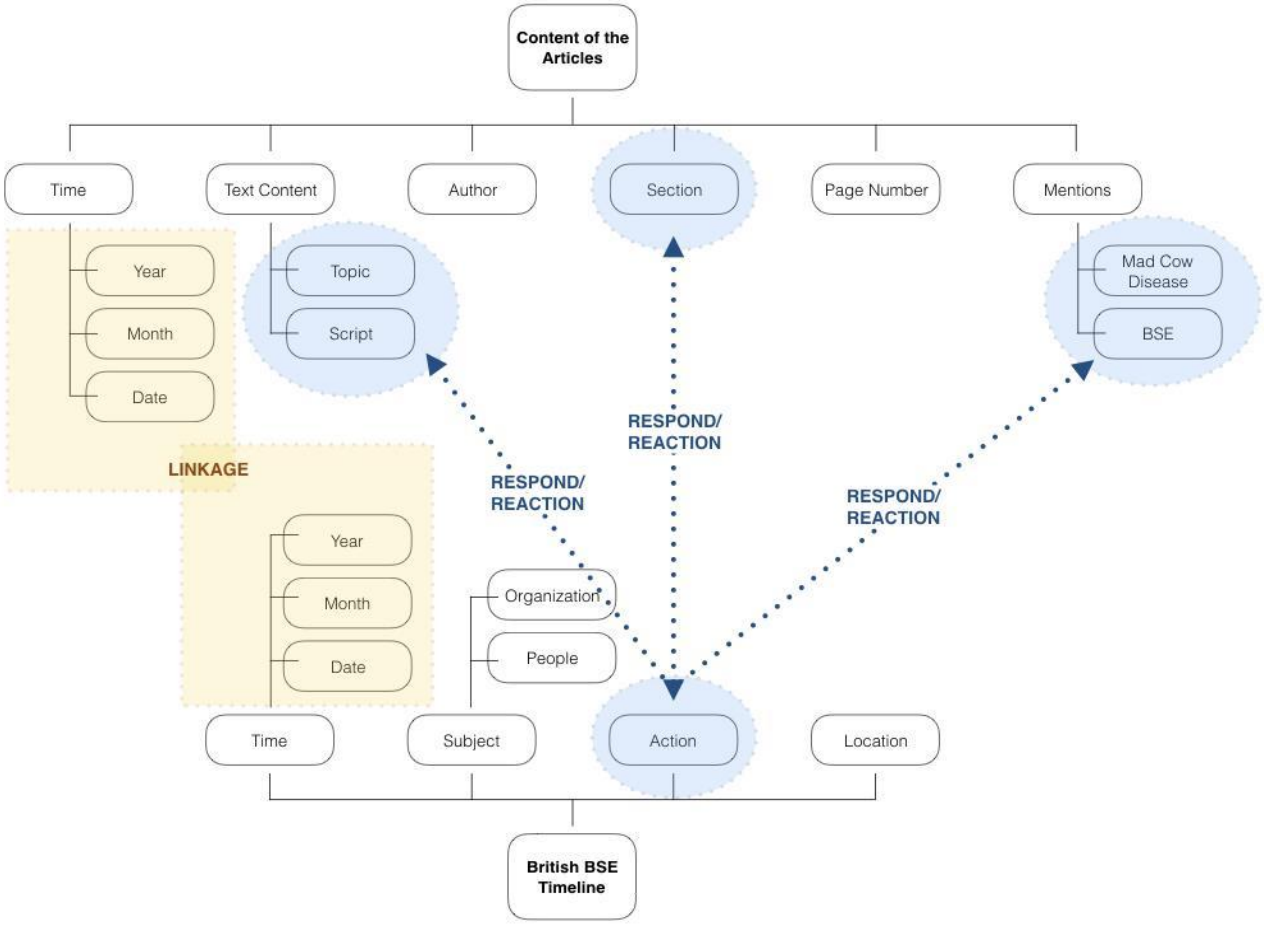


Fig. 5. This diagram shows how I use mapping as research to discover the linkage between multiple datasets (Image produced by the author).

4.3 Research through Design

Research through Design is one type of design research (Frayling, 5). Research through Design is "an approach to research that leverages the design process of repeated problem reframing as a method of scholarly inquiry" (Forlizzi et al, 6). The goal of RtD is not the design outcome, but design as a way of thinking and an approach to answering the design question. "Research is guided through design process logic and design is supported/driven by phases of

scientific research and inquiry" (Jonas, "Research Through", 1378). In Wolfgang Jonas's article "Design Research and Its Meaning to the Methodological Development of the Discipline," he stated that:

> Design through research assumes that the "swampy lowlands" of uncertainty will be subsequently replaced by well-grounded knowledge. But exclusively scientific research is unable fully to recognize the implications of acting in a space of imagination and projection. The "knowledge base position" needs to be complemented by the "unknowledge base position" or by the competencies to deal with not-knowing (202).

In the article "From Design Research to Theory: Evidence of a Maturing Field," researchers discussed that theoretical payoffs often come after a project or a design is finished, allowing for "reflection on a project with backward thinking" (289). As an approach, RtD allows researchers to focus on a future state and engage with wicked problems. In this case, RtD "allows researchers to become active constructors of possible futures" (Forlizzi et al. 289).

As a common methodology used in practise-based research, in this research it will be applied no differently than other art and design projects. Applying the methodology of RtD as an approach to my research, I create several iterations which all focus on particular design questions. Reflecting on each iteration will provide a possible solution to those challenges and lead to the next iteration.

4.4 Methods: Quantitative and qualitative data analysis

Quantitative data is identified as data which can be measured and numerically manipulated (Meirelles, 205). The analysis result of quantitative data usually leads to an answer to "how much/many". Quantitative data analysis is a process of seeking insights by analyzing mathematical and statistical modelling, measurement and research. As a research method,

quantitative analysis provides analysts with a tool to examine and analyze any subject involving numbers. The analysis result reveals insight of past, current, and anticipated future events. "Statistics help us turn quantitative data into useful information" (McLeod, 66). In my research, this technique was employed to explore the patterns, relationships and connections of the dataset. I researched *The Guardian* newspaper from 1986-1996 for mentions of Mad Cow Disease. For example, I learned there were 382 news articles which included all types of news (i.e political, economic, social and scientific, etc.). These articles accounted for 68.95% of the total 554 articles in which Mad Cow Disease/BSE is mentioned in that period. Moreover, I also discovered that 1990 and 1996 were two peaks in which there were the most articles about Mad Cow Disease in *The Guardian* (see Table 4.1). This is just one of the analysis insights I obtained through my research. More analysis tables can be seen in the Appendices E. Also, all these insights are organized together to compose the narrative of the final prototype.

	News	Opinion	Sport	Culture	Lifestyle	Ads	**Total Per Year**
1986	0	0	0	0	0	0	**0**
1987	0	0	0	0	0	0	**0**
1988	0	0	0	0	0	0	**0**
1989	10	3	0	0	0	0	**13**
1990	109	26	0	16	6	2	**159**
1991	23	1	0	2	3	2	**31**
1992	21	1	0	9	1	0	**32**
1993	14	2	0	0	0	0	**16**
1994	54	12	0	9	3	2	**80**
1995	37	10	0	5	6	6	**64**
1996	114	30	0	4	7	4	**159**
Total Per Section	**382**	**85**	**0**	**45**	**26**	**16**	**554**

Table. 1. Number of cases of bovine spongiform encephalopathy (BSE) reported in the United Kingdom, by World Organization for Animal Health, http://www.oie.int/animal-health-in-the-world/bse-situation-in-the-world-and-annual-incidence-rate/number-of-cases-in-the-united-kingdom/#Royaume-Uni (Accessed in March 2019).

On the other hand, qualitative data is usually collected through methods of observations, interview and other qualitative research methods. Qualitative research is empirical research where the data are not in the form of numbers (Punch, 4). "Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (Denzin and Lincoln, 2). In the article "Qualitative vs. Quantitative Research," Saul McLeod states various techniques engaged in the process of qualitative research. Content analysis is one of them and also used in the process of data preparation. In this research, I reviewed *The Guardian* for every page that mentions Mad Cow Disease, which is about 554 articles across hundreds of topics. I excluded all unrelated data points and sorted all related articles into six sections.

The above two methods: quantitative research, that engages the use of statistics, and qualitative research, that is supported with content analysis, are used together, especially in the stage of data preparation.

My data preparation includes three steps: data collecting, data editing and data analysis. In the first step: collecting data, I first chose Newspaper.com as the data resource used in this research. Newspapers.com is one of the largest online newspaper archives. This online resource consists of more than 471 million pages of historical newspapers from about 11,500 newspapers.

It covers all British mainstream newspapers as far back as 1700. Moreover, all these historical newspapers can be saved and printed as high-quality digital images easily and conveniently. Then, I determined to narrow the scope of this research to the articles in *The Guardian*. The more specific explanation about this determination is made in the Case Study: Data chapter. After saving all articles that mentioned "mad cow disease" and "Bovine Spongiform Encephalopathy (BSE)" as digital images, I reviewed this research data to identify and clear out any data points that may hamper the accuracy of the results. For example, when searching for "mad cow disease" on Newspaper.com, the search results showed each word as a separate occurrence in the text which was unrelated to my research. In this case, I excluded them from the exact phrase results to keep the accuracy of the results. In the end, the step of data analysis, quantitative analysis and qualitative analysis are both engaged to gather integrated analytical insights. Using context review as a technique for qualitative analysis, I reviewed all the articles in my dataset and sorted these articles into six sections: news, opinion, sport, culture, lifestyle and advertising. All these sections are defined based on *The Guardian*'s categories. Also, by using quantitative analysis, I gathered data about how many articles about BSE were published each year in the period from 1986 to 1996, how many times "mad cow disease" and Bovine spongiform encephalopathy (BSE) are mentioned in these articles, how many articles in each section, and other quantitative data from the dataset.

4.5 Method: Visualization

In this research, visualization is used as a graphical method to communicate the potential patterns, connections and relationships in my data set. I made two visuals to represent the historical event, the British Mad Cow Disease Crisis from 1986 to 1996. The goal for these

visuals is to examine the level of interest in Mad Cow Disease by the general public viewing my visualizations. Through these two visuals, I gathered knowledge about the following questions:

- How did my classmates respond to the sample story I provided in this data set? Did this story about Mad Cow Disease Crisis trigger their interest? What contemporary relevance (a political issue, an economic issue, the human-self, or even ecosystem) could my tester possibly obtain from this testing?
- Did the visualization provide a better understanding of the topic? If not, what suggestion might the participants make to improve this research?
- How could I combine the quantitative data and qualitative data in the process of creating/structuring this information graphic?

4.5.1 Visualization I

I created a set of two visualizations. The first visual (see Fig. 6) was an infographic about the UK Mad Cow Disease Crisis in the period of 18th century to 1992. The goal of the first was to answer my first questions: "How did my classmates respond to the sample story I provided in this data set? Did this story about Mad Cow Disease Crisis trigger their interest? What contemporary relevance (a political issue, an economic issue, the human-self, or even ecosystem) could my tester possibly obtain from this testing?" This graph contained three parts. In the first part, there are two curves presenting the public's emotional reflection on the British Mad Cow Disease in that period. One of these curves was designed to present the public's fear of this disease. Another one expressed the development of the "green industry." The second part presented the timeline from the 18th century to 1992. It contained information of when Mad Cow

Disease started and ended. The last part contained the responses made by the British government and the European Union.

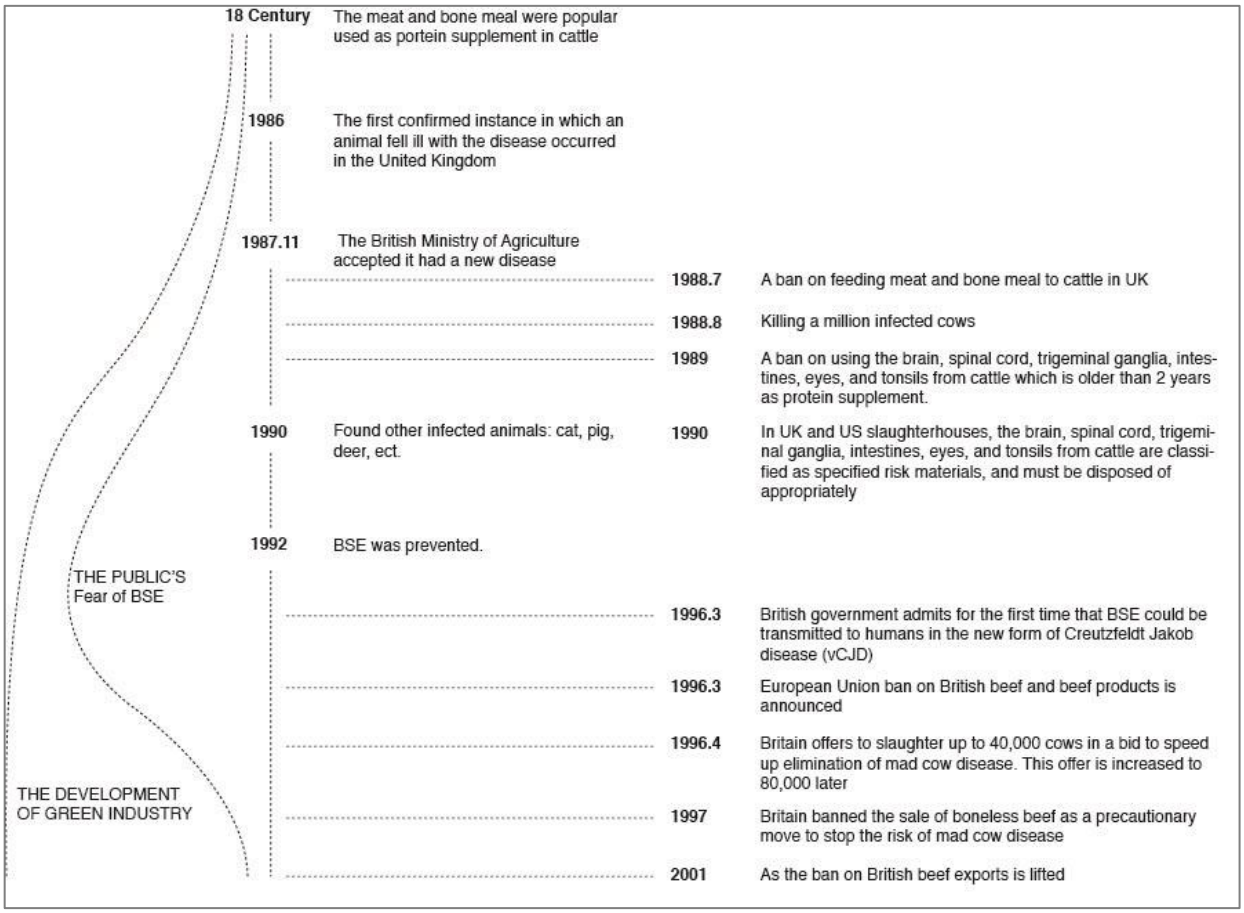


Fig. 6. The first visualization presents a timeline about British Mad Cow Disease Crisis from 18 century to 2001 (Image produced by the author).

This visualization brought an open discussion of what contemporary relevance the audience might obtain from this research and received a positive response. At the beginning of the research, I was worried that the audience was not interested in a data visualization about a historical event. However, to my surprise, the reflection on the choice of topic was quite positive. Most of my colleagues showed interest and linked this research with current global-warming,

over-industrialization, media bias and risk management. Their response helped answer my question of "How did the test subjects respond to the sample story I provide in this data set?" and "Did this story about the Mad Cow Disease Crisis trigger their interest?" The discussion about contemporary relevance also provided a lot of exciting topics and future research angles.

In addition, in the first visualization design, I mainly used text to express information. Through the discussion with my classmates and instructors, I learned that a purely textual expression required the audience to spend more time reading and understanding the information, which is contrary to the original intention of this research. During this information digestion process, the audience's attention is easily lost. At the same time, the color choice of black and white left the audience with a solemn and rigid impression which did not enhance the audience's participation. Therefore, in the next visualization, I decided to involve more interesting visual expressions.

4.5.2 Visualization II

Based on the reflection of the first visualization, more novel visual expressions were engaged in the second visualization (see Fig. 7). This time, the timeline was placed horizontally at the middle of the image. The timeline started from 18th Century to 2001. Each red cow icon stood for 100,000 infected cattle, and each blue cow stood for 100,000 killed cattle. The purple gradient area stood for the public's fear of Mad Cow Disease, and the green area is for the development of "green industry." This visualization emphasized exploring what type of diagrams could be applied to this research and how intuitive and novel visuals could enhance the audience's interest in this project. It should be noted that the data used in this visualization was

sample data which was not thoroughly verified for scientific rigour. This sample data was not fully used in the subsequent studies until its scientific rigour was verified.

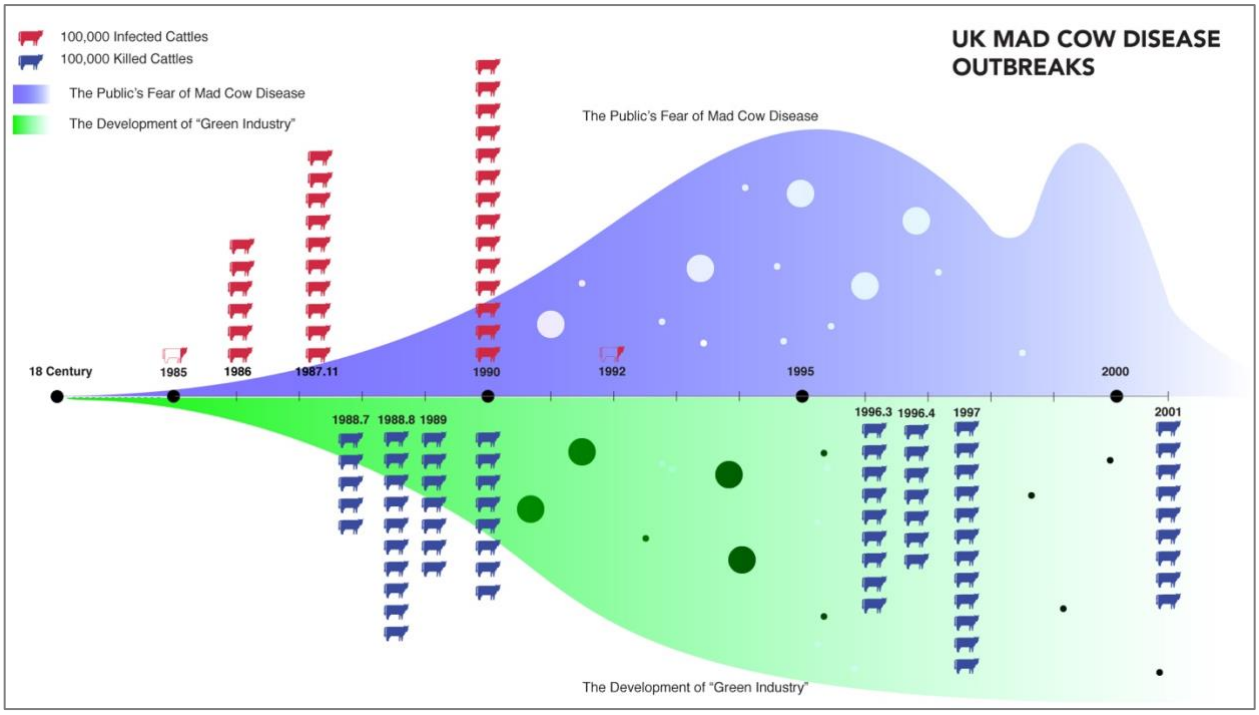


Fig. 7. In the second visual, I added more visual representations to enhance the audience's experience (Image produced by the author using Adobe Illustrator).

The second visual design responded to my other questions, "Was the purpose of "deepening" the knowledge of the data accomplished through testing? If not, what suggestion might the test subjects make to improve this research?" and "How could I combine the quantitative data and also qualitative data in the process of creating/structuring this information graphic?" When sharing my second visual design in the class, my classmates responded that this visual expression was easier to understand, and the information representation was more

intuitive. Besides, I learned that data visualization was not always about presenting all data points, but selectively presenting data. For example, in the second visual, I did not give a specific number of killed cattle and infected cattle each year. The audience could only obtain an approximate value through legend. However, the approximate number did not harm the power of storytelling in this visual.

In conclusion, these two visuals provided me with a lot of useful reflections, including what contemporary relevance this research could have and how visualization as an approach could represent a historical event. These visualizations also led me to explore the appropriate tools and techniques and to discover the best narrative and narrative angle for this research.

Except for static visualization, interactive visuals generated by coding are also another way for me to explore the dataset visually. In order to represent the visualization interactively and dynamically, I decide to use D3.js and CSS animation to create a web-based data visualization. D3.js is a JavaScript library for manipulating documents based on data. It can be used to produce dynamic, interactive data visualizations in web browsers. This library provides me with an approach to attach the data to DOM (Document Object Model) elements. Then I can use my coding skills of CSS, Html, and SVG to showcase this data. D3.js also provides the functions of data-driven transformations and transitions. In this case, making interaction with the data becomes possible.

4.6 Method: User Testing

User testing was used as an approach in this research to gather reflection about whether the functionality and accessibility of the prototype work. The purpose of user testing is to observe the research participants' reaction and gather their critical feedback. After gaining

approval from OCAD University's Research and Ethics Board, I proceeded to invite research participants. All their response contributed to insights into what could be changed or improved and improve this research further.

The user-testing consisted of two sections, each with three different participants. Each user-testing took approximately 40–60 minutes of each participant 's time. Participants first received information about the project and the consent form. Then they received a set of activities to perform in addition to being able to freely explore the prototype. While participants were using the prototype, I observed and took notes. Once participants finished the exploratory phase, they used an online questionnaire to answer as many questions as they are capable of. Once they finished answering the questionnaire, I informally chatted with them to see if they have additional questions about the task they had just performed. As with any design project, what I learned during user-testing was used to revise and refine the prototype. Later, I again invited other participants to user-test the revised prototype.

5. Case Study: Prototype

5.1 Prototype One

My first prototype is a web-based data viz of how *The Guardian* represented and identified mad cow disease from 1986 to 1996. This prototype is the first iteration using a full dataset which includes 554 articles sorted into six sections. After collecting all *The Guardian*'s articles about Mad Cow Disease and BSE through Newspapers.com, I sorted these articles into six categories based on the section to which each article belonged. The sections were news, opinion, sport, culture, lifestyle, and advertisement. The graph I present in this mockup represents the analysis results. It is a streamgraph generated by a D3.js function (see Fig. 8). The streamgraph shows the trend of how many articles for each section mentioned Mad Cow Disease. Hovering on each section of the graph, some detailed info, including a bar chart below the streamgraph, will show how many articles in this section were published in each year (see Fig. 9). The bar chart consists of the articles' titles.

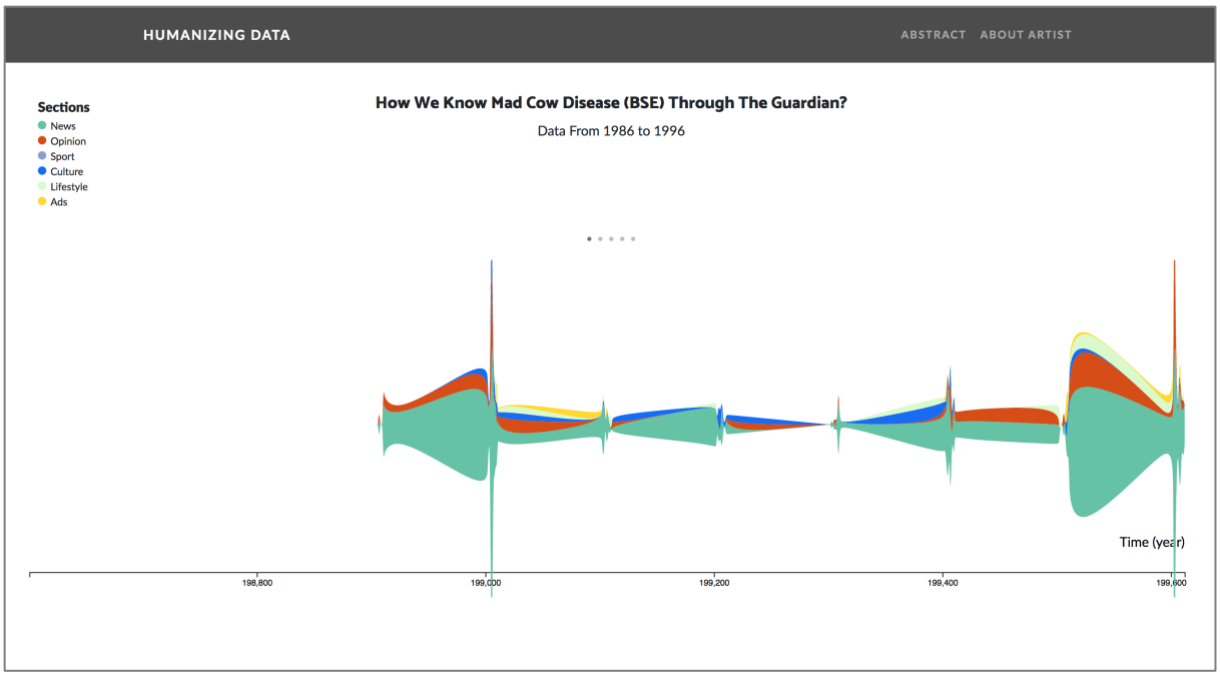


Fig. 8. The interface of the first prototype presents an overview of the data (Image produced by the author using D3.js).

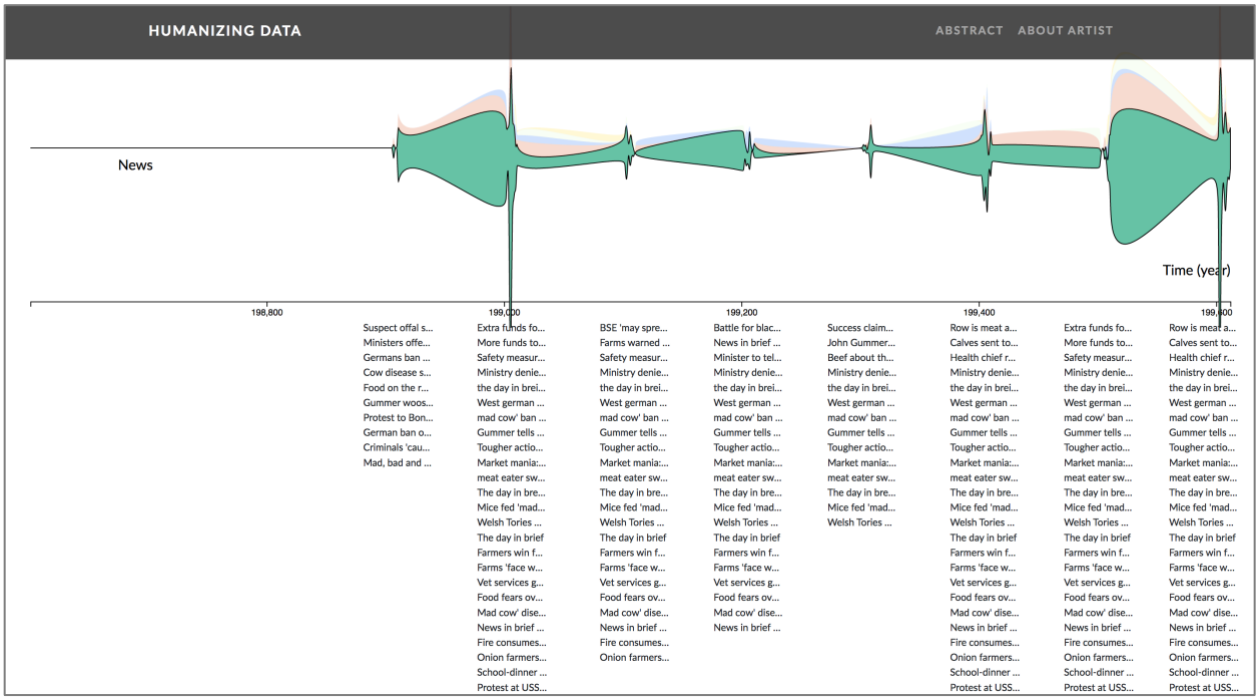


Fig. 9. The text bar chart of this section appears after hovering the cursor on each section of the graph (Image produced by the author using D3.js).

When I presented this prototype to my classmates, I received much useful feedback. The first main response focused on the narrative presented in this demo. Prototype one was designed as an overview of my data collection. It presents an overview glance at the dataset during the period 1986 to 1996. However, this view misses the interesting data point found in the process of analysis. For instance, some food advertisements mentioned Mad Cow Disease and BSE in order to sell products. Another interesting finding from the data analysis was how often Mad Cow Disease and BSE were mentioned in the articles of lifestyle and culture sections. All these articles unveiled the fact that this disease was becoming a popular term in the culture of the time. To highlight these interesting moments, I needed to explore the appropriate layout to wrap multiple stories together on the website. This will be the primary goal to accomplish in the next iteration.

In addition, the process of design and coding this prototype allow me to realize the necessity of improving the visual design for this website. An important comment I received was the suggestion to make the visual design/visual features somehow "connect" with the case study of this research. In other words, an appropriate visual metaphor can be the bridge between this research and the theme (Mad Cow Disease and British newspaper). This would enhance the audience's comprehension of this research by visually building a connection between Mad Cow Disease and the British news media.

The findings led me to a clear direction for the next iteration. In Prototype two, I will explore the best way to organize all the information I want to present on this website and adjust

my design style so that it can fit into the theme of this research—Mad Cow Disease and the British newspaper.

5.2 Prototype Two

5.2.1 Narrative and Scrollytelling

Based on the reflection on the previous prototype, this prototype aims to discover the appropriate narrative to structure all insights I achieved from the process of analyzing the data. Inspired by the pudding.com, I decided to pack up all my data graphs to a one-page scrollytelling website. Scrollytelling is a technique by which more content can be revealed as the user scrolls down the page, and it is also popular in web-based data visualization. Based on Doris Seyser and Michael Zeiller's definition, scrollytelling is a type of storytelling "[using] long, narrative types of text (e.g., report, feature) to tell complex stories. Scrollytelling articles published online often use multimedia content, especially information graphics which is a powerful tool to communicate complex information" (401). Seyser and Zeiller also discussed that scrollytelling articles have an advantage in explaining new insights and clarifying facts since it is an appropriate way of telling complex stories based on large amounts of retrieved data (401).

The narrative form of the final prototype needs to deal with various types of information. For instance, I obtained information about how many reports mentioning BSE were published every day in *The Guardian* from 1986 to 1996, and also how many infected cattle were reported every year from 1988 to 2016. The period of these two datasets is different, as is the unit. The unit of *The Guardian* reports is per day, while the unit of infected cattle is per year. Because of the complexity of the datasets, they cannot be simply mixed. In this case, scrollytelling became

the best option to deal with these two types of data. The text description and charts can coexist. Also, multiple data sources can be presented according to the narrative. Audiences can view the story section by section while scrolling down. In this way, I can easily handle the flow of the whole narrative from overview information to detailed information.

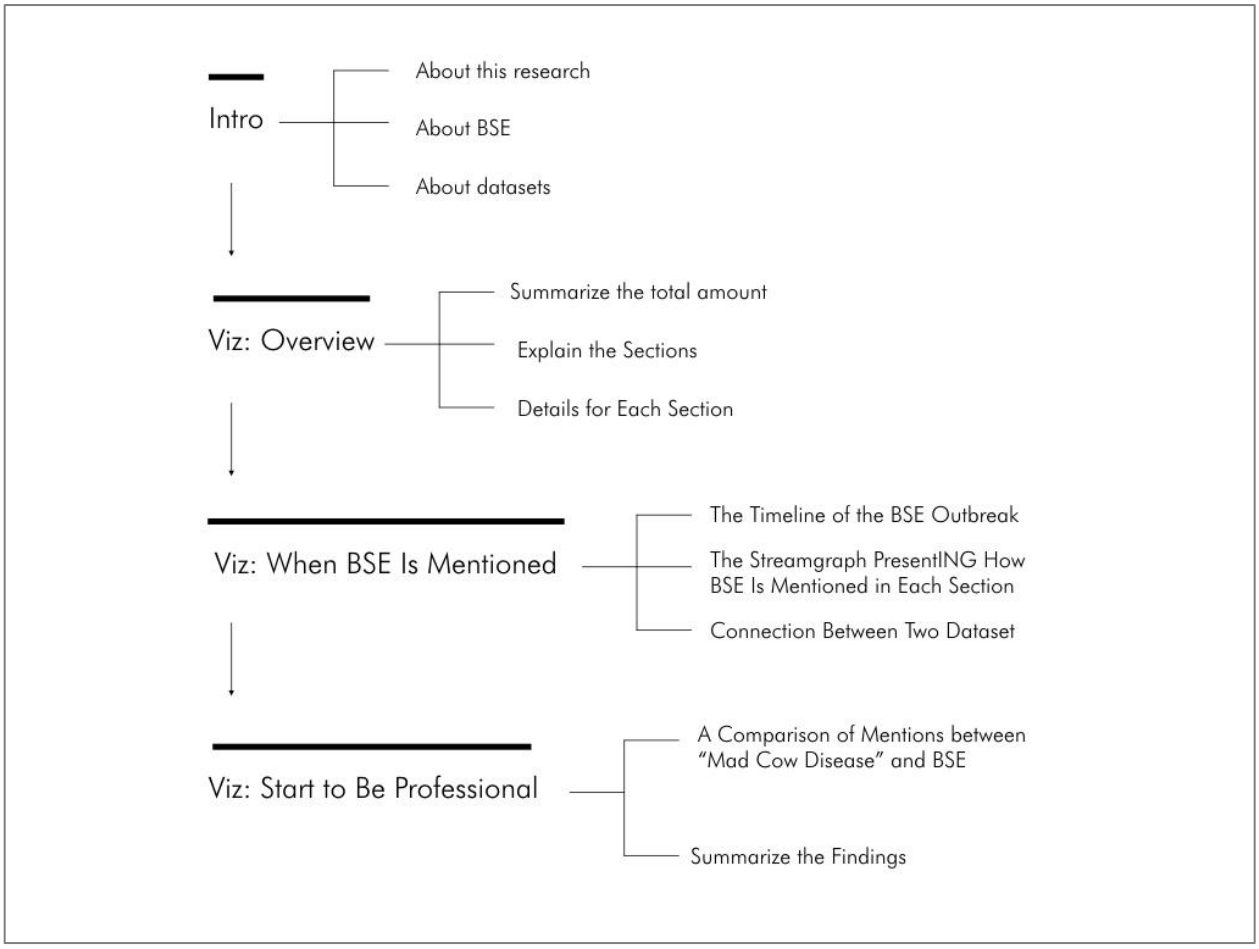


Fig. 10. The narrative flow of the website (Image produced by the author).

Fig. 10 is the narrative outline. The first part is the introduction which gives audiences a brief overview of this research. This section focuses on answering three questions: 1) What is this research? 2) What is Mad Cow Disease? And 3) What data will be represented in this research? By answering these questions, this section introduces the audience to a basic understanding of this research so they can gradually become familiar with the topic.

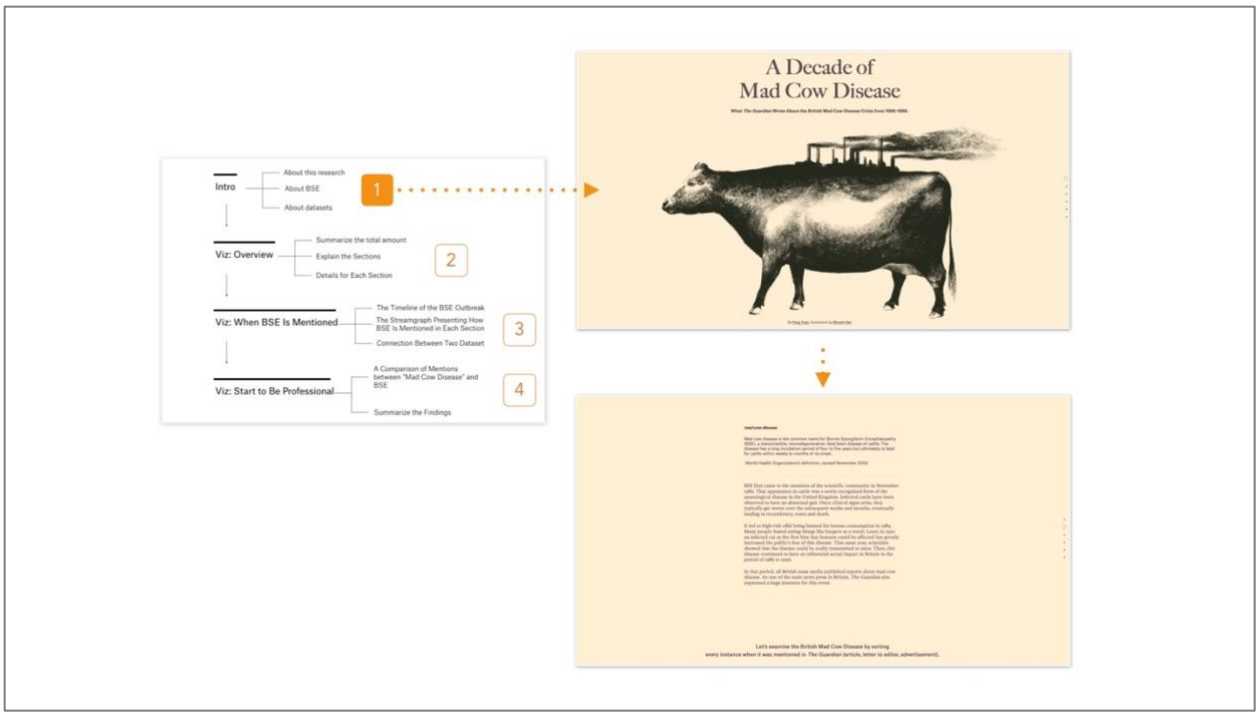


Fig. 11. This image presents the design of the first and second sections for the first part of the narrative outline (Image produced by the author).

The second part provides information about how many articles in *The Guardian* were collected and how many reports about this disease appeared in each category. At the same time, this part mentions some highlight insights achieved from the process of analysis, such as how the advertisers of food books mentioned Mad Cow Disease to stimulate consumers' concerns about the food environment.

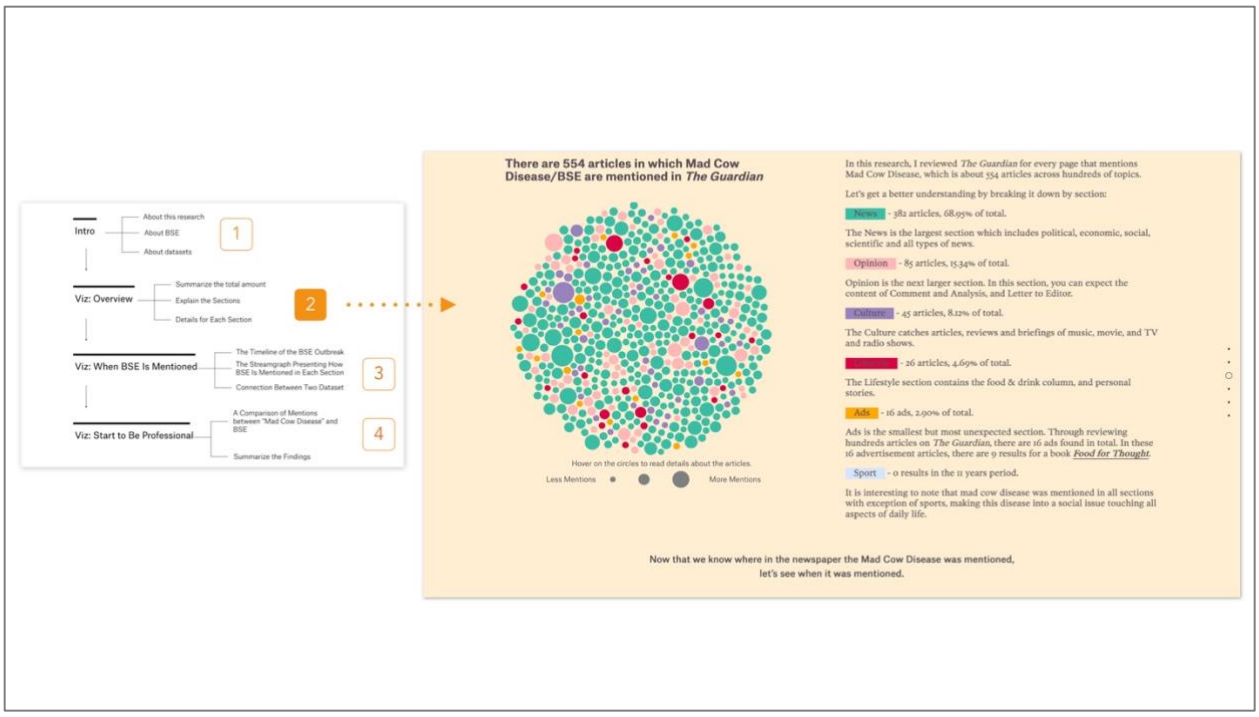


Fig. 12. This image presents how the third section was designed for the second part of narrative outline (Image produced by the author).

The third part of the narrative lists more detailed analysis of *The Guardian* articles. In this part, I present an area graph of how BSE was mentioned in each section on each day between 1986 to 1996. Because the British Mad Cow Disease caused a significant impact on politics and the economy, the policy made by the British government during the outbreak is also included in this prototype. By comparing the streamgraph and the timeline of the British government's response to this crisis, viewers can observe this event from different perspectives and intuitively gain understanding. In this way, this prototype can lead the audience to consider the possible subtle connections between the media reports, the disease outbreak, and the government's crisis management.

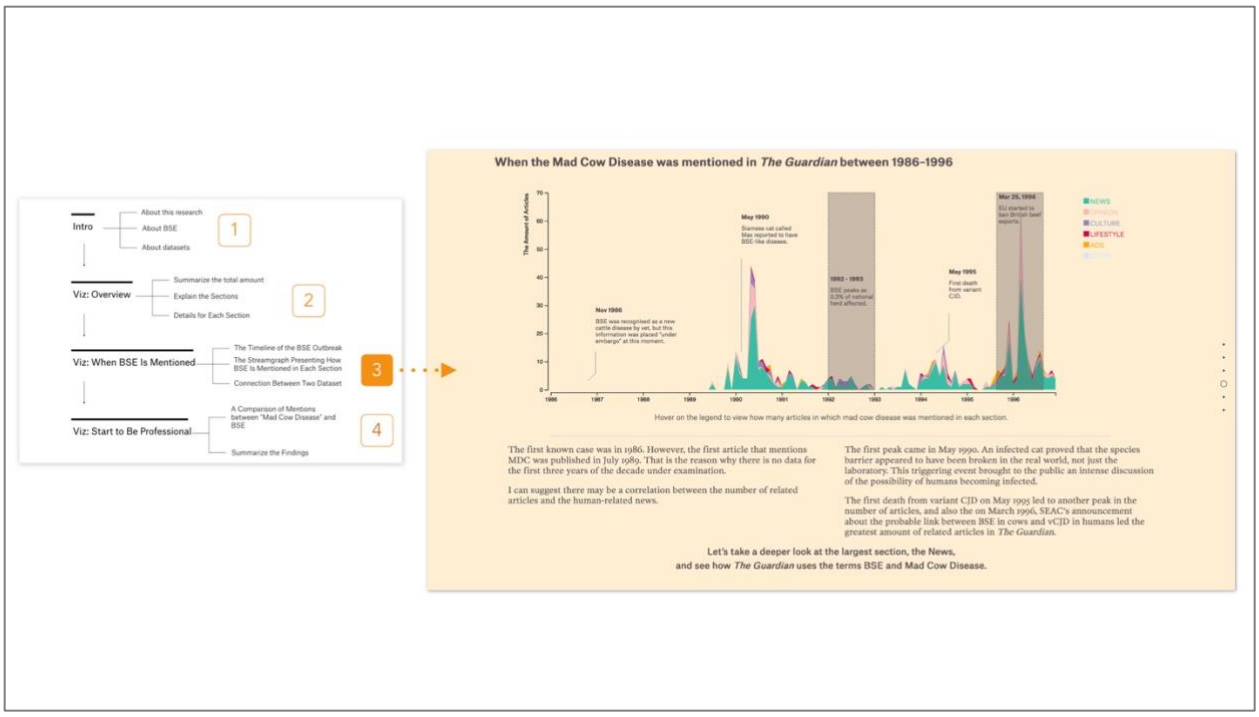


Fig. 13. This image presents how the fourth section was designed for the third part of narrative outline (Image produced by the author).

The fourth part depicts which words refer to Mad Cow Disease in news articles. Through the analysis, I made a comparison of the term usage frequency of BSE and Mad Cow Disease. Although BSE and Mad Cow Disease refer to the same disease, BSE is more scientific and rigorous than Mad Cow Disease. The choice of using BSE more often revealed that this scientific term and the disease's scientific explanation had started to be accepted by the public.

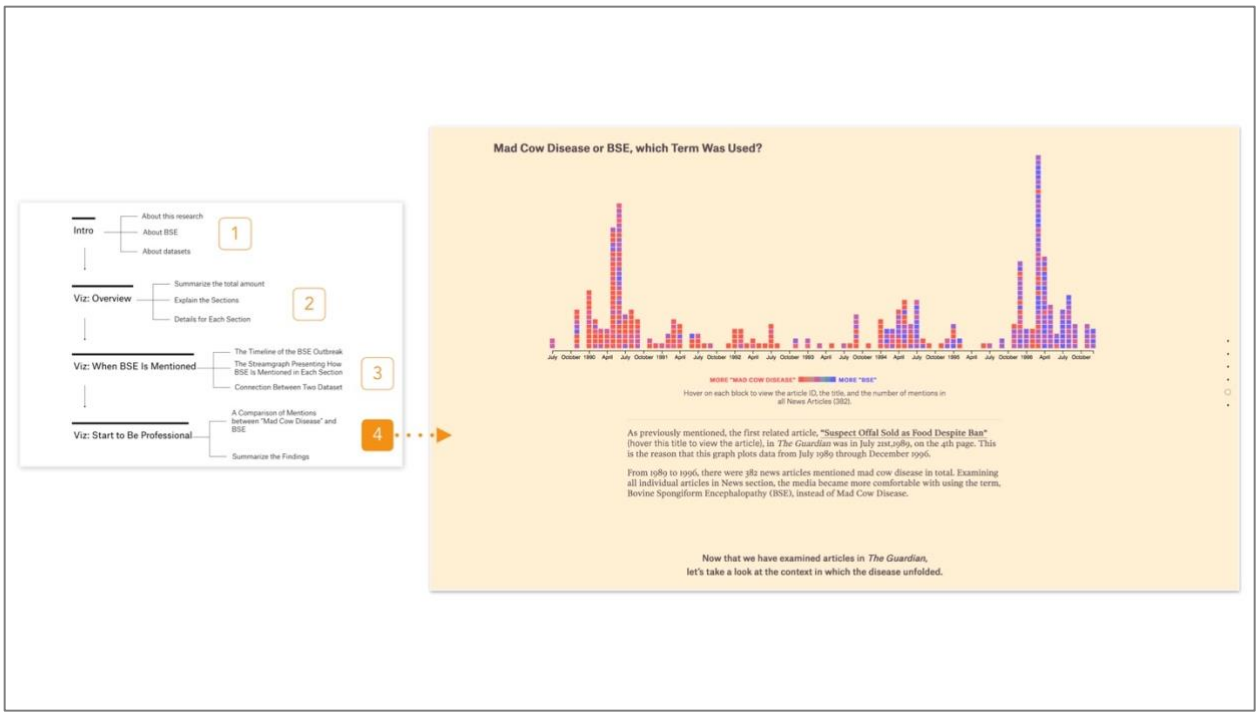


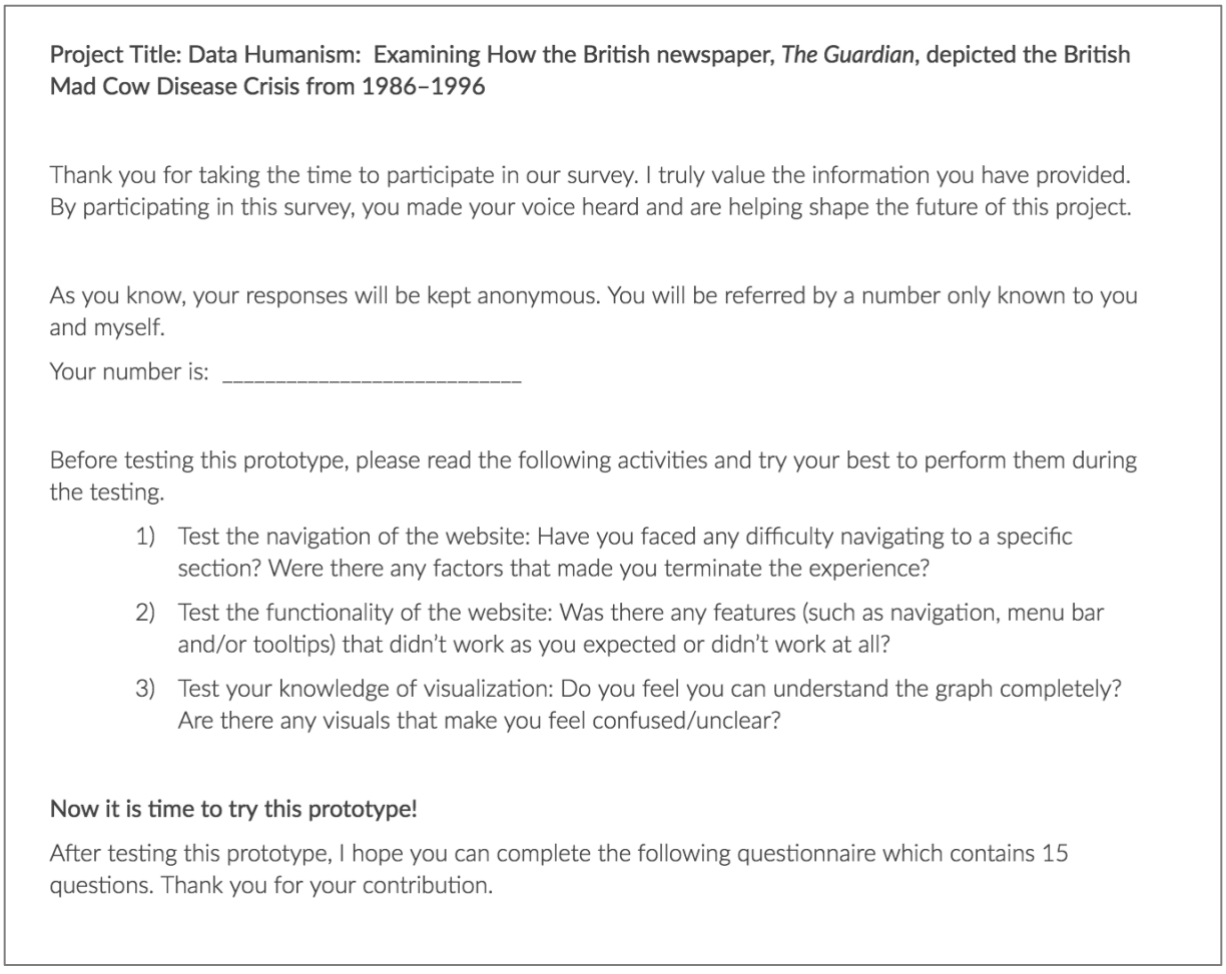
Fig. 14. This image presents how the fifth section was designed for the fourth part of narrative outline (Image produced by the author).

Through these four parts, this website guides the audience step by step to view the insights I achieved during the research. At the end of this visual presentation, I show the actual number of infected cattle and the executed cattle during the 11 years. This prototype provides an opportunity for the audience to think of what led to the gradual expansive influence of this crisis. According to the narrative structure, I created the web wireframe for the final prototype (see Appendix F).

5.2.2 User Testing

This user testing mainly focused on exploring whether the layout of the web pages is reasonable, whether the narrative provides enough information, and whether the visual

representation effectively conveys the information. Therefore, the questions in the questionnaire mainly focused on discussing the accessibility and usability of the web pages (see Appendix D). The details of how to select the participants and conduct the user testing are described in the Methodologies and Methods chapter. Six anonymous participants were invited to this user testing. At the beginning of this test, all the participants were asked to sign the consent form and read the first page of the questionnaire (see Fig. 15). On this page, I listed the main focus questions to help the testers understand the main purpose of this testing. After reading through these questions, testers started to experiment with this prototype. The testers completed the questionnaire after they finished their experience.



Project Title: Data Humanism: Examining How the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996

Thank you for taking the time to participate in our survey. I truly value the information you have provided. By participating in this survey, you made your voice heard and are helping shape the future of this project.

As you know, your responses will be kept anonymous. You will be referred by a number only known to you and myself.

Your number is: _____

Before testing this prototype, please read the following activities and try your best to perform them during the testing.

1) Test the navigation of the website: Have you faced any difficulty navigating to a specific section? Were there any factors that made you terminate the experience?
2) Test the functionality of the website: Was there any features (such as navigation, menu bar and/or tooltips) that didn't work as you expected or didn't work at all?
3) Test your knowledge of visualization: Do you feel you can understand the graph completely? Are there any visuals that make you feel confused/unclear?

Now it is time to try this prototype!

After testing this prototype, I hope you can complete the following questionnaire which contains 15 questions. Thank you for your contribution.

Fig. 15. The first page of the questionnaire.

5.2.3 Reflection

The process of designing the prototype and executing the user testing presents challenges and directions for future research. Deciding who the participants would be was the first challenge. In this user testing, all participants were recruited from OCAD University, and their age was mainly between 23 to 30 years old. However, because of the difference in their nationality and actual age, they presented different degrees of interest in and understanding of the topic of British Mad Cow Disease. For instance, a student from Europe was much more sympathetic to this topic and-also willing to spend more time reading the text carefully.

Meanwhile, the students who were nearly 30 years old already had some understanding of what Mad Cow Disease was and the impact caused by its outbreak because their birth were relatively close to the British Mad Cow Disease outbreak. Conversely, younger participants, such as students aged between 23 to 25, showed less knowledge of the British BSE crisis. Most of them required more background information at the beginning of the test. This finding suggests that future research should carefully consider who the participants are and how their perspectives might shape the outcome. The future iteration will include more participants with various cultural backgrounds and different ages.

Another challenge involved when and where to design an interaction in the prototype. As an important narrative technique, interactive design can affect the mode and rhythm of the narrative. In this test, participants expressed a strong interest in the interactive design of this prototype. After analyzing the content of the questionnaire, almost all participants expressed that the interaction made them willing to spend more time on reading the information. The interactive design of the tooltip in the bubble cluster graph was the best example (see Fig. 16). In this

testing, all participants spent a significant amount of time checking the information of each "bubble" one by one. The feedback about interactive design also provided thoughts on how to include more detail information in this layout design. For example, in Fig. 16, the tooltip contains information on the article name, the publication year, and how many times BSE was mentioned in the article. Participants expressed willingness to view more information on this tooltip.

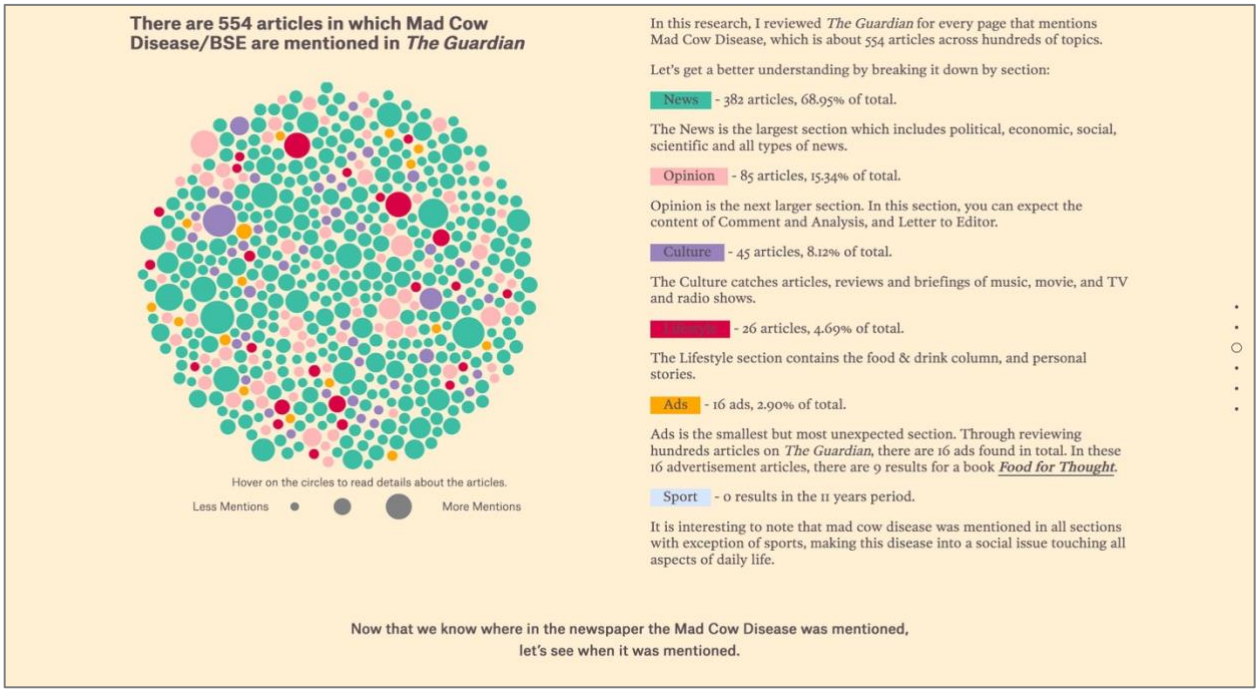


Fig. 16. The bubble cluster presents how many articles in The Guardian mention BSE (Image produced by the author using D3.js).

The third challenge was finding the appropriate visual metaphor and visual design style. Although this user testing did not focus on testing whether the design style was appropriate, audiences still mentioned that they hoped the visual design (illustration, logo design, color and typeface choice, etc.) could be relevant to the topic of this research: "Britain," "mad cow

disease" or "historical newspaper." Through their feedback, I learned the importance of proper visual design. A good visual design can grab the audience's attention and leverage its understanding of the information.

6. Conclusions and Future Work

In this document, each chapter pushes forward into the next and all these chapters work together to answer the research questions introduced at the beginning:

- How might we represent the British Mad Cow Disease Crisis from 1986 to 1996 using an interactive storytelling to approach different understandings of this historical event?
- How does the interactive storytelling help users to discover hidden stories and missing content?

The Literature Review chapter examined concepts of data visualization and relevant theories such as thick data, data humanism, local data, and feminist data visualization. All these theories worked together to describe the advantage of representing data with visual language as well as the necessity of keeping the dataset's context and origin to avoid context-loss in data analysis. The topic of this research is how *The Guardian* depicted the British Mad Cow Disease crisis from 1986 to 1996. The Literature Review chapter built a solid theoretical foundation for this research. As part of the research, the Case Study: Data chapter introduced the process of determining the datasets and the mixed methodologies and methods helped to conduct research and achieve knowledge and insight about this historical event.

A series of prototypes were built step by step in the research process. A web-based interactive storytelling and a static data visualization poster were conceptualized and built as the final delivery for this research. Based on the narrative flow, I designed an online interactive storytelling titled "A Decade of Mad Cow Disease: What *The Guardian* Wrote About the British Mad Cow Disease Crisis from 1986-1996" (see Appendix G). In addition to this, I designed a

data visualization poster with the same title (see Appendix H). In the exhibition, I also present the visualization poster which represents the same data, but in a more artistic way (see Fig. 17).

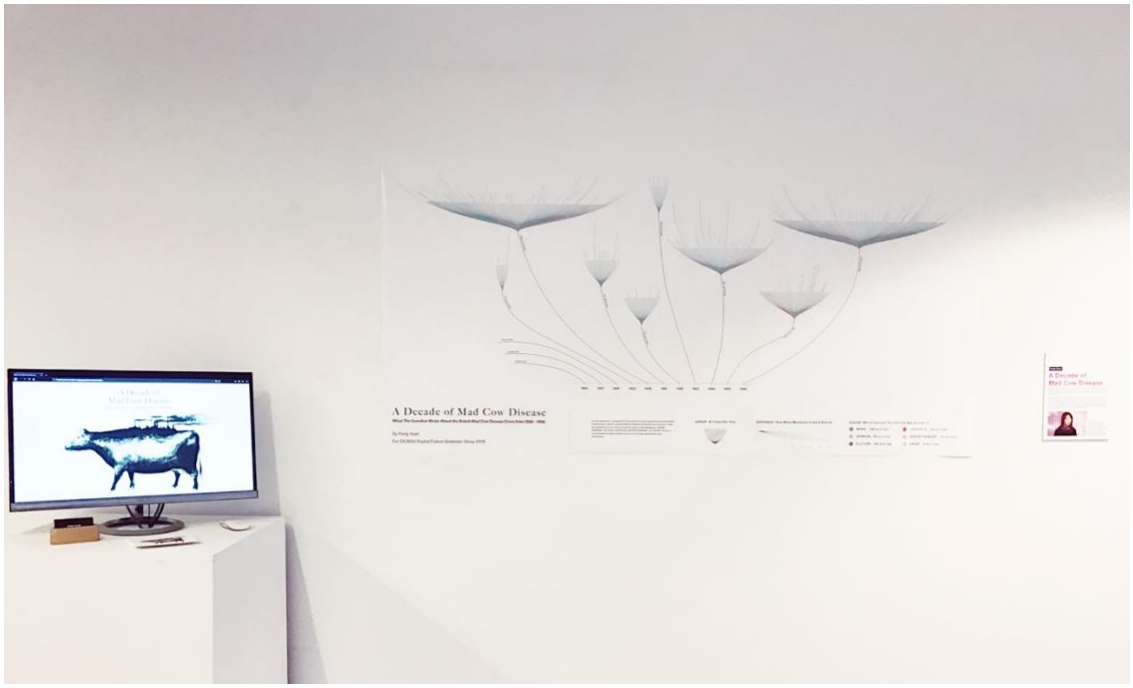


Fig. 17. Installation image at TMAC (Image taken by the author).

In the online interactive storytelling, I revealed a few stories discovered in the process of research. For example, I unexpectedly found there were 16 advertisements in which mad cow disease was mentioned. Most of these advertisements mentioned mad cow disease to stimulate people's fear and concerns about food safety and eating habits so that these advertisements could promote their products.

Also, I presented more stories in the fourth section, where I designed an area graph to present how many related articles were published in each month during that period, in addition to annotations showing the timeline of the British mad cow disease crisis. In this graph, I show that the first known mad cow disease case was in 1986. However, from 1986 to 1988, no articles

mentioned mad cow disease. I suggest the main reason for the lack of articles is because the related information was placed “under embargo”. In this graph, I show that the first peak happened when an infected cat was found. This event triggered an intense discussion of the possibility of humans becoming infected. Then, the first death from variant CJD on May 1995 led to another peak in the number of articles. Again, on March 1996, the SEAC's announcement about the probable link between BSE in cows and vCJD in humans led to the largest number of related articles in *The Guardian*. Through these stories, it is not difficult to find that only when an event appears to be related to human beings, do people show interest and attention to it.

The above is just a small sample of the hidden stories I uncovered in this project. By experiencing my project, more stories can be found. However, these stories only represent a small part of this event. As I discussed in the literature review chapter, we can always discover more stories through an in-depth analysis of the data context.

During the research, I felt the unique charm of studying data under the theory of humanized data—specifically, how the process of humanizing data makes researchers embrace the imperfections of data, as Lupi wrote in her article. Both feminist and localized data theories discussed that in the process of data analysis and data reproduction, the result of data visualization may generate errors and biases due to the position of the analyst, data collection means, and other factors.

Observing audiences interact with my project during the exhibition also helped me find answers to my research questions:

- Wrapping the visual graphs with text descriptions in the online interactive storytelling helped provide context to the data. Audiences were able to view the data from various perspectives and approach the topic with different understandings.

- A visual appealing design can catch the audiences' attention and increase their interest in a topic. By presenting the context of data in an online interactive storytelling, users' interests and passion about this topic can be increased further. The appealing visuals in both the static and the interactive design of the storytelling eventually encouraged audiences to learn more information about this topic.

The idea of data humanism requires researchers to examine the origin of data and continuously analyze the context of data. To achieve a comprehensive understanding and different insights about how *The Guardian* reported Mad Cow Disease between 1986 to 1996, a data study including statics and text review was engaged in this research. This theory helps this research emphasize the needs of digging the contexts and stories of data. Also, this theoretical framework leads scholars to embrace the potential of expanding knowledge and insights generated in research.

This paper only scratched the surface of humanizing data about how the British newspaper reported the historical event, the Mad Cow Disease crisis, from 1986 to 1996. Future research can probe more deeply to include more data sources. In the Case Study: Data chapter, I stated that due to limited time, only one British newspaper, *The Guardian*, was selected as the dataset in this research. Although the British media maintain a neutral point of view, they still have a subtle political bias. At the same time, different news media have different groups of readers. In future studies, more data of British news media can be added to obtain more comprehensive analysis results by comparing the data of various media.

In this research, I found that in the period of the British Mad Cow Disease outbreak, television had entered British people's lives and replaced the position of the newspaper. Also, radio was still part of British people's lives. In short, this was a time when newspapers,

television, and radio existed simultaneously. In future research, data on television and radio can be collected to cover reports by these two media on BSE events. Through analyzing and comparing these three media (newspaper, television, and radio), future research might result in more comprehensive insight into the British news media's reporting attitude toward the Mad Cow Disease outbreak. For instance, future research may find the answer to whether these three media reported the BSE outbreak in diverse ways.

The British Mad Cow Disease outbreak was international in scope and also lasted a long time. This event caused a direct impact on the development of British animal husbandry. The European Union, the United States, Canada, Japan, Australia, and other countries all issued bans on British beef meat and cattle products. In March 2006, the European Union lifted a decade-long beef export ban (Fickling). In future iterations, not limited to the British domestic news media, related reports from international news media can be collected to generate a more comprehensive insight.

During the time spent writing this document, anthropologist Wang and Data artist Lupi have been continuously publishing their works and making efforts in their own respective research fields to make data analysis content reflect more of human nature. Yanni Loukissas's book, *All Data Are Local: Thinking Critically in a Data-Driven Society*, and D'Ignazio's and Klein's book, *Data Feminism*, will also be published soon. More and more research on how to address the importance of analyzing the origin and context of data is constantly enriching the field of data humanism. This document demonstrated visualization as a method that can leverage the potential of information communication and data humanism. My hope is that this research will contribute to future scholarship in this area and help others find ways to use data humanization to both understand and represent these types of events.

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APPENDIX A: REB APPROVAL

The research methods used in this research were proposed before and then approved by The Research Ethics Board. The approved REB application (#101478) is dated Jan. 17, 2019 and is valid for one year, or until Jan. 16, 2019.

APPENDIX B: REB CONSENT FORM

Date: March 1, 2019
Project Title: Humanizing Data: British Mad Cow Disease Crisis from 1986 to 1996

PURPOSE

My research explores the possibilities of using data visualization and digital technology as engaging tools to represent a historical event and foster new understandings. The data set I chose to use is the representation of news media about the British Mad Cow Disease Crisis from 1986 to 1996. My focus and goal is to explore the use of data visualization not only to inform audiences about a particular event, the British Mad Cow Disease but mainly to humanize data and evoke emotions in the viewers.

In this case, I have the specific question focusing on my final project: Can a new approach to representing the British Mad Cow Disease Crisis from 1986 to 1996 foster new understandings of this historical event?

This study aims to get 6 participants in total. 3 people in each session of user testing. Participants will test the existing features of my prototype and answer a questionnaire about the aesthetics, functionality, and accessibility. Each session will be conducted in a different time and for a different stage in the research. Demographic characteristics are not required for this study.

Participants will be recruited from Art and Design undergraduate programs as well as Art and Design faculty members at OCAD University.

WHAT'S INVOLVED

As a participant, you will be asked to test existing features of my prototype (a web-based data visualization) and answer a questionnaire about the aesthetics, functionality, and accessibility. Participation is voluntary and will take approximately 40-60 minutes of your time. Demographic characteristics are not required for this study.

POTENTIAL BENEFITS

Possible benefits of participation include the opportunity to provide feedback, and to have an interesting experience with an interactive web-based data visualization about the British Mad Cow Disease Crisis from 1986 to 1996. Participants will also achieve a comprehensive understanding of the British Mad Cow Disease Crisis from 1986 to 1996.

POTENTIAL RISKS

There will be no known or anticipated risks associated with participation in this study.

CONFIDENTIALITY

[Confidential survey/questionnaire]

All the information you provide is considered confidential. All the data generated in this testing will be anonymous. You will not be identified individually in any way in written reports of this research.

Your name and email will be collected, but will not be used in this thesis document. You will be assigned an identification number which will be kept in case you would like to withdraw from the research. In this case, your associated data can be removed from the data collection. Your personal identifier will be stored on a password protected mac computer and a password protected hard drive in a reasonably secure location. Access to this data will be restricted to the researchers.

[Interview with Member Check]

There will be an informal conversation with you once you finish answering the questionnaire. This conversation will aim to see if you have additional questions about this project. All the information you provide will be kept confidential, i.e. your name will not appear in any thesis or report resulting from this study.

☐ *Yes, I would like to hear more about the study. You may reach me by (provide contact information):*

Email:

Post:

Phone:

(Advice to the researcher: specify manner of reaching the participant – email, post, last phone/address)

INCENTIVES FOR PARTICIPATION

The participant will not be paid to participate in this study.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study.

Further, you may decide to withdraw from this study at any time, or request withdrawal of your data prior to data analysis and you may do so without any penalty or loss of benefits to which you are entitled. Your choice of whether or not to participate will not influence your future relations with OCAD University or the investigators [Feng Yuan] involved in the research.

To withdraw from this study, let PI know at any point during the study or you may contact Feng Yuan by email at [redacted].

To withdraw your data from the study, please contact Feng Yuan by email at [redacted] no later than March 30th, 2019. Any data associated with the participant who chooses to withdraw will be fully deleted.

PUBLICATION OF RESULTS

Results of this study may be published in Feng Yuan's thesis written documentation. In any publication, data will be presented in aggregate forms. Quotations from interviews or surveys will be anonymous, and not be attributed to you personally.

Feedback about this study will be available after June 01, 2019. The participants will be informed of the thesis show date and a link to the thesis online documentation by requiring through email.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please ask. If you have questions later about the research, you may contact the Principal Investigator Feng Yuan or the Faculty Supervisor (Isabel Meirelles) using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University [#101478].

If you have questions regarding your rights as a participant in this study, please contact:
Research Ethics Board c/o Office of the Vice President, Research and Innovation
OCAD University
100 McCaul Street
Toronto, M5T1W1
[redacted]

AGREEMENT

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: _____

Signature: _____ Date: _____

Thank you for your assistance in this project. Please keep a copy of this form for your records.

APPENDIX C: LETTER OF INVITATION

Date: March 1, 2019

Project Title: Humanizing Data: British Mad Cow Disease Crisis from 1986 to 1996

You are invited to participate in a research study for Humanizing Data: British Mad Cow Disease Crisis from 1986 to 1996. The purpose of this study is to explore the possibilities of using data visualization and digital technology as engaging tools to represent a historical event and foster new understandings. The data set I chose to use is the representation of news media about the British Mad Cow Disease Crisis from 1986 to 1996. My focus and goal is to explore the use of data visualization not only to inform audiences about a particular event, the British Mad Cow Disease, but mainly to humanize data and evoke emotions in the viewers. In this case, I have the specific question focusing on my final project: Can a new approach to representing the British Mad Cow Disease Crisis from 1986 to 1996 foster new understandings of this historical event?

As a participant, you will be asked to test all the existing features of my prototype (a web-based data visualization) and answer a questionnaire about the aesthetics, functionality, and accessibility.

Participation is voluntary and will take approximately 40-60 minutes of your time.

Possible benefits of participation include the opportunity to provide feedback, and to have an interesting experience with an interactive web-based data visualization about the British Mad Cow Disease Crisis from 1986 to 1996. Participants will also achieve a comprehensive understanding of the British Mad Cow Disease Crisis from 1986 to 1996.

There will be no known or anticipated risks associated with participation in this study.

If you have any questions about this study or require further information, please contact the Principal Investigator Feng Yuan or the Faculty Supervisor Isabel Meirelles using the contact information provided below. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University [#101478]. If you have any comments or concerns, please contact the Research Ethics Office through [redacted].

APPENDIX D: QUESTIONNAIRE

Project Title: Data Humanism: Examining how the British newspaper, *The Guardian*, depicted the British Mad Cow Disease Crisis from 1986–1996

Thank you for taking the time to participate in our survey. I truly value the information you have provided. By participating in this survey, you made your voice heard and are helping shape the future of this project.

As you know, your responses will be kept anonymous. You will be referred by a number only known to you and myself.

Your number is: _____

Before testing this prototype, please read the following activities and try your best to perform them during the testing.

1) Test the navigation of the website: Have you faced any difficulty navigating to a specific section? Were there any factors that made you terminate the experience?
2) Test the functionality of the website: Was there any features (such as navigation, menu bar and/or tooltips) that didn't work as you expected or didn't work at all?
3) Test your knowledge of visualization: Do you feel you can understand the graph completely? Are there any visuals that make you feel confused/unclear?

Now it is time to try this prototype!

After testing this prototype, I hope you can complete the following questionnaire which contains 15 questions. Thank you for your contribution.

Rate the following from 10 to 1. 10 is very easy, 1 is very difficult	
How easy is the navigation/menu to use?	
How easy are the graphics to be understood?	
Rate the following as True or False	
The overall site is attractive.	
The graphics are pleasing.	
The site keeps a good balance of graphics versus text.	
The colors used throughout the site are attractive.	
The typography (lettering, headings, titles) suits the theme of the site.	
The introduction page's content makes me want to explore the project further.	
It is fun to explore the site.	
I can get to information quickly.	
Throughout design effectively communicates the project's idea.	
Which features of this project are most important to you?	
Which features of this project are least important to you?	
What do you like least/most about this project?	
If you have to review this site with a score out of 10, what score would you give?	

APPENDIX E: TABLES

Table. 2. Number of cases of bovine spongiform encephalopathy (BSE) reported in the United Kingdom, by World Organization for Animal Health, http://www.oie.int/animal-health-in-the-world/bse-situation-in-the-world-and-annual-incidence-rate/number-of-cases-in-the-united-kingdom/#Royaume-Uni (Accessed in March 2019).

	Alderney	Great Britain	Guernsey[3]	Isle of Man[4]	Jersey	Northern Ireland	**Total Number in United Kingdom**
1987 and before[5]	0.00	442.00	4.00	0.00	0.00	0.00	**446.00**
1988	0.00	2,469.00	34.00	6.00	1.00	4.00	**2,514.00**
1989	0.00	7,137.00	52.00	6.00	4.00	29.00	**7,228.00**
1990	0.00	14 181	83.00	22.00	8.00	113.00	**14,407.00**
1991	0.00	25 032	75.00	67.00	15.00	170.00	**25,359.00**
1992	0.00	36 682	92.00	109.00	23.00	374.00	**37,280.00**
1993	0.00	34 370	115.00	111.00	35.00	459.00	**35,090.00**
1994	2.00	23 945	69.00	55.00	22.00	345.00	**24,438.00**
1995	0.00	14 302	44.00	33.00	10.00	173.00	**14,562.00**

[3] In Guernsey BSE is generally confirmed on the basis of clinical signs only. To date, a total of 600 animals have been confirmed without laboratory examination.

[4] In the isle of Man BSE is confirmed on the basis of a laboratory examination of tissues for the first case on a farm and thereafter by clinical signs only. However, all cases in animals born after the introduction of the feed ban have been subjected to histopathological/scrapie-associated fibrils analysis. To date, a total of 277 animals have been confirmed on clinical grounds only.

[5] Cases prior to BSE being made notifiable are shown by year of report, apart from cases in Great Britain which are shown by year of clinical onset of disease.

1996	0.00	8 016	36.00	11.00	12.00	74.00	**8,149.00**
Total Number	**2.00**	**166,576.00**	**604.00**	**420.00**	**130.00**	**1,741.00**	**169,473.00**

Table. 3. Number of *The Guardian*'s articles in which "mad cow disease" or "bovine spongiform encephalopathy (BSE)" was mentioned in each section (Table produced by the author).

	News	Opinion	Sport	Culture	Lifestyle	Ads	**Total Per Year**
1986	0	0	0	0	0	0	**0**
1987	0	0	0	0	0	0	**0**
1988	0	0	0	0	0	0	**0**
1989	10	3	0	0	0	0	**13**
1990	109	26	0	16	6	2	**159**
1991	23	1	0	2	3	2	**31**
1992	21	1	0	9	1	0	**32**
1993	14	2	0	0	0	0	**16**
1994	54	12	0	9	3	2	**80**
1995	37	10	0	5	6	6	**64**
1996	114	30	0	4	7	4	**159**
Total Per Section	**382**	**85**	**0**	**45**	**26**	**16**	**554**

Table. 4. *The Guardian*'s articles in which "mad cow disease" or "bovine spongiform encephalopathy (BSE)" was mentioned (Table produced by the author).

Date	Page	Title	Section	Frequency	BSE Mentions
1989.07.21	4	Suspect offal sold as food despite ban	News	2	1
1989.07.28	2	Ministers offer limited menu on food safety	News	5	2
1989.07.29	22	A generous dollop of pap	Opinion	1	1
1989.11.01	1	Germans ban British beef	News	9	4
1989.11.02	3	Cow disease stand defended	News	4	0
1989.11.03	25	Food on the rack	News	1	0
	3	Gummer woos consumer with new food safety post	News	1	2
1989.11.04	3	Protest to Bonn over beef ban	News	3	2
1989.11.07	2	German ban on 'suspect' UK beef is confirmed	News	4	2
1989.11.09	20	Criminals 'caused lead-in-milk outbreak'	News	1	0
1989.11.10	29	Mad, bad and dangerous?	News	20	2
1989.11.16	3	£300m cuts fuel attack on industry policy	Opinion	1	1
1989.11.22	8	Gummer to lift ban on irradiation	Opinion	1	1
1990.01.10	3	Extra funds for mad cow research	News	11	7
1990.01.11	2	More funds to research 'mad cow disease'	News	3	0
1990.01.13	3	Safety measure on cattle brains overruled	News	5	3
1990.01.16	2	Ministry denies 'mad cow' ban	News	2	0
	6	The day in brief	News	1	0
1990.01.18	3	West german ban on British beef stand as deal fails	News	4	2

1990.01.19	2	mad cow' ban by EC on live British cattle	News	9	3
1990.01.23	4	Gummer tells Germans to lift beef ban	News	6	2
1990.01.24	3	Tougher action on British beef	News	2	0
1990.01.27	9	Market mania: when a mad cow gets the wind up . .	News	2	0
1990.01.29	3	meat eater swallow food poison risk	News	5	1
	18	Food for more than thought	Opinion	1	0
1990.01.30	5	The day in brief	News	1	0
1990.01.31	6	Sounds of disorder down Mexico way	Opinion	1	0
1990.02.02	2	Mice fed 'mad cow' brains developed fatal disease	News	11	5
1990.02.05	20	The time-bomb on out plates	Opinion	4	0
	4	Welsh Tories mobilise to unseat Silent Knight	News	1	0
1990.02.09	6	The day in brief	News	1	0
1990.02.14	2	Farmers win full cash for 'mad cows'	News	6	1
1990.02.15	40	Television and Radio - BBC1 - 8.0 - Tomorrow's World	Culture	2	1
1990.02.26	38	Television and Radio - ITV London - 8.30 - World in Action	Culture	1	0
	4	Farms 'face worst slump in 50 years'	News	3	2
1990.02.27	2	Vet services go it alone	News	3	0
1990.03.06	3	Food fears over rise in 'mad cow'	News	6	3
1990.03.12	3	Mad cow' disease kills zoo antelopes	News	6	0
1990.03.20	3	News in brief - Disease 'complacency'	News	2	0
1990.03.23	2	Fire consumes the mad cows	News	9	3
1990.04.09	9	Onion farmers fall victim to Pakistan's poppy war	News	1	0
1990.04.11	2	School-dinner ban on 'mad cow' beef	News	8	3

1990.04.23	2	Protest at USSR 'mad cow' ban	News	4	0
1990.04.24	4	Cow disease fear prompts human study	News	17	8
1990.05.10	23	Blindness in Gaza	Culture	1	0
1990.05.11	24	Scientists confirm first case of 'mad cat disease'	News	14	2
1990.05.14	3	News in brief	News	1	0
1990.05.15	5	Ministers accused over 'mad cow' toll	News	8	1
	5	Death throes haunt victim's husband	News	4	1
	40	Television and radio	Culture	1	1
1990.05.16	19	A bareback Gummer in the mad cow rodeo	Opinion	15	5
	1	Mad cow' fear prompts ban on school beef	News	10	1
	13	Lord Hanson primed to do battle as the value of war chest swells to £6.4 billion	News	4	0
	18	Beefing	Opinion	3	2
	11	Eating-out habits change	News	1	0
1990.05.17	2	Meat industry faces confidence crisis	News	9	5
	18	Food for thought, Food for action	Opinion	7	0
	1	MPs snub Gummer with 'mad cow' disease inquiry	News	6	1
	19	Dairy	Opinion	1	0
	40	Television and Radio - ITV London - 8.30 - This week	Culture	2	1
1990.05.18	22	Ministers give consumers something to beef about	Opinion	15	8
	1	EC calves ruling ignored in British	News	3	0

	7	The day in brief - Next week in parliament	News	1	0
	6	Attack on 'alarmist' press over beef	Opinion	7	1
1990.05.19	2	Second dead cat tested for cow brain disease	News	8	0
	1	News in Brief - 'Mad Cat' Inquiry	News	1	0
	108	This week's TV highlights	Culture	2	1
	22	A history lesson for all those getting their teeth into beef problem	Opinion	7	5
1990.05.21	3	Farmers call for 'mad cow' reassurance	News	4	0
	18	Not so sweet now as it was before	Opinion	1	0
	40	Television and radio - BBC2 - 8.10 - Horizon: do cow make you mad?	Culture	2	1
1990.05.22	7	Tighter rules on food 'scrapped'	Opinion	11	4
	24	Second cat died of cow disease	News	10	4
	22	Animal feed for thought	Opinion	5	2
1990.05.23	10	Throwing caution to the electorate	News	2	0
1990.05.24	20	Gummer slips BSE hook	News	9	2
	17	Familiar Ring	Lifestyle	2	0
	19	Dairy	Opinion	1	0
1990.05.25	28	Intron - Space Odyssey	News	1	0
1990.05.26	3	Fourth cat tested for 'mad cow disease'	News	5	2
1990.05.28	1	News in brief - Cuts hit mad cow fight	News	2	0
	3	BSE fears on vet shortage	News	4	3

	18	Offal truth of cows' convenience food	Opinion	1	1
1990.05.29	19	Dairy	Opinion	1	0
1990.05.30	3	Austria bans British beef	News	7	5
	1	News in Brief - More beef banned	News	1	0
	16	More victims fall to a deadly 'mistake'	News	2	0
1990.05.31	20	French ban British beef over BSE fear	News	7	4
1990.06.01	20	British seek to end French ban on beef	News	5	1
	23	Render unto caesium 134	News	1	0
	34	The mad man disease	Opinion	2	1
1990.06.02	11	Why protectionist sleight of hand is the real beef...	News	5	3
1990.06.04	10	Saatchi grounded by debts	News	1	0
	9	Brussels ready to flex its newly found muscle	News	1	0
1990.06.05	20	EC proposes legal action on beef ban	News	4	3
1990.06.06	2	News in brief - BSE incinerator plan	News	1	0
	6	The day in brief	News	2	1
1990.06.07	18	The ammunition labour needs	Opinion	1	0
	7	Debate 'needed' on political union	News	2	0
	1	Italy joins ban on 'safe' UK beef	news	4	3
1990.06.08	2	Irish blame UK for disease spread threatening exports	News	5	2
	2	Germans favour tighter controls	News	3	0
	2	Computer hitch costs dear	Opinion	1	0

	2	Booming demand for poultry offset firms' losses on beef	Opinion	4	3
	1	EC safety deal ends beef ban	News	9	5
	22	The farce has some serious moments	Opinion	4	3
	23	Unhealthy state for a ministry	Opinion	1	0
	6	Minister hails 'success' on mad cow deal	News	3	2
1990.06.09	4	Beef uproar hides deeper crisis	News	1	1
	4	Sheep breeders face new clearance	News	12	9
	24	Farmer scorn beef export deal	News	6	4
1990.06.13	19	The Russian bear shuffle Westwards	News	2	0
1990.06.14	3	Research on BSE danger 'manipulated'	News	9	5
	1	News in brief - Research 'manipulated'	News	1	0
1990.06.15	8	Swiss ban British beef in dumping fear	News	6	4
	1	News in brief - Third BSE cat	News	2	1
1990.06.16	24	Minister withholds report on unhygienic abattoirs	News	3	2
1990.06.20	3	News in brief - 'Mad cow' advice	News	2	0
1990.06.21	3	Bankruptcy fear for beef industry	News	3	2
	13	Going Edwardian with Italian food has to be paste joke...	News	2	1
1990.06.23	48-49	Riding down to appleby fair	Lifestyle	1	0
1990.06.25	27	Between lines - Ted Fellows Farmers weekly	Culture	1	0
1990.06.26	5	Consumers demand tough 'mad cow' safeguards	News	5	1
1990.06.27	6	The day in brief	News	2	1

1990.06.28	6	Minister rejects breeding ban on offspring of 'mad cows'	News	7	4
	24	Three fish short of a lawnmower	Culture	1	0
1990.06.29	29	A business that stinks - Etiquette of the trough	News	4	1
1990.07.03	4	NFU seeks independent food agency	News	4	3
1990.07.04	5	Traumas for townies amid farmers' idyll	News	1	0
	19	Quote	Opinion	1	0
1990.07.07	3	Dementia report 'misleading'	News	9	2
1990.07.16	25	Mad cows and a pig's ear	Culture	16	9
1990.07.17	11	Surprises for the sceptical city	News	1	0
1990.07.20	27	Eco soundings	News	1	0
1990.07.27	24	The community consumed by fear	News	13	0
1990.07.28	3	News in brief - 'BSE' cat dies	News	3	2
	68	This week's TV highlights	Culture	3	1
1990.08.01	8	Meat war escalates as farmers ambush iorry	News	1	0
1990.08.02	38	Television and radio - Channel 4 - 11.35 - The mad cow mystery	Culture	2	0
1990.08.03	6	Doctors reject beef assurance	News	3	1
	28	Cheating heart settles score with highway ode	Culture	4	1
1990.08.04	38	All the food fit to eat	Lifestyle	20	15
1990.08.06	20	BSE cases top expected peak	News	16	6
1990.08.07	8	News in brief - More mad cats	News	1	0
1990.08.23	6	Cheap UK beef on 'Greater Iraq' menu	News	2	0
1990.08.25	3	Irish to legislate on beef industry crisis arising from Iraqi sales	News	1	0

1990.08.27	3	Hostage returns to his first taste of Guinness in freedom	News	1	0
1990.08.30	10	Saving time and serving time: a crucial lesson - Treble chance	News	1	0
1990.09.04	51	Food Scares	Lifestyle	3	1
1990.09.06	13	Wisdom of Solomon spurs Hillsdown's meteoric rise	News	2	1
1990.09.07	41	Something fishy in the Eskimo miracle cure	Lifestyle	4	0
	2	French kill hijacked lambs	News	2	1
1990.09.21	2	Health body backs eating red meat	News	3	1
1990.09.25	3	Pig with BSE sparks offal ban in feed	News	9	4
	1	News in brief - Mad cow disease in pig	News	2	0
1990.09.29	2	News in brief - £8m aid for farmers	News	1	0
1990.10.04	23	Once more in jugular vein	Culture	1	0
1990.10.05	2	Hill farmers put subsidy plea to Gummer	News	1	0
1990.10.11	2	Scares lower confidence in food industry and cut sales	News	2	0
1990.10.13	64	This week's TV highlights - Wednesday - Dispatches	Culture	1	0
1990.10.15	1	Inquiry into trade in unfit meat	News	1	0
1990.10.18	7	Etropolitan home	Ads	1	0
1990.10.23	21	Dairy	Opinion	2	0
1990.10.27	45	Etropolitan home	Ads	1	0
1990.10.29	4	Mad cow deaths at London Zoo	News	7	0
1990.11.02	22	Non to foxy lady	News	1	0
1990.11.22	9	Animal feed industry faces inquiry	News	5	2
1990.12.12	21	Cows that are left to rot in the fields	Opinion	8	1
1990.12.14	22	Antelope death widens mad cow disease fear	News	11	1

1990.12.22	50	The Answers - Why/Who or what were	Culture	2	1
1990.12.29	39	Good food for thought	Lifestyle	10	5
1990.12.31	28	Fear and lots of loathing	Opinion	2	0
1991.01.05	4	BSE 'may spread'	News	3	1
1991.01.15	21	The cerealisation of history	Ads	1	0
1991.02.01	6	Farms warned on 'mad cow' burials	News	6	2
1991.02.13	6	Farmers beset by 22pc income fall	News	1	0
1991.02.14	4	Farmers 'dumping bodies of disease livestock'	News	8	5
1991.03.02	8	Tesco 'natural beef' from Ireland angers farmers	News	4	1
1991.03.07	2	Government to close 'mad cow' livestock inspection centres	News	3	0
1991.03.11	13	Food groups beef up stock	News	1	0
1991.03.12	21	Top girl	Lifestyle	1	0
1991.03.27	12	'Mad cow' ban	News	2	0
1991.03.28	2	Mad calf' death widens BSE fears	News	11	5
1991.03.29	32	Secret agent for a baffling disease	News	25	3
1991.04.12	4	Government faces legal threat over growth drug deaths	News	1	0
1991.04.13	3	Mad cow campaigner unable to stomach menu	News	3	1
1991.04.26	5	Mad cow' findings revive safety fears	News	12	10
	38	Television and radio - ITV London - 9.0 The Chief	Culture	1	0
1991.04.27	4	Scientist ordered to halt 'mad cow' study	News	8	0
	1	News in brief - 'Mad cow' study halted	News	2	0
1991.06.03	4	If an animal has mad cow disease, where does it go for surgery?	Ads	8	3
1991.06.22	6	Mad cow disease scientist faces disciplinary tribunal	News	7	0

1991.06.25	6	The day in brief	News	3	0
1991.06.26	15	Firmer futures market and later flurry of interest helps lift index	News	1	1
1991.07.09	6	The day in brief	News	1	0
1991.07.12	31	Gasping for life-saving vaccine - Beyond belief	News	4	0
1991.07.30	2	MPs government of complacency over farm burials	News	3	1
1991.08.16	5	Gene labs caught over illegal tests	News	2	0
1991.09.06	31	Mad cow disease: the beef goes on	News	20	8
1991.09.12	37	Doonesbury	Lifestyle	1	0
1991.10.14	23	A healthy streak of subversion	Lifestyle	2	0
1991.11.12	27	Soundbites	Opinion	1	0
1991.12.13	23	Patriarchs of eternity	News	1	0
1991.12.28	35	Eat your words	Culture	1	0
1992.01.06	1	Battle for black sea fleet	News	1	0
1992.01.07	1	News in brief - Vet steps into beef row	News	1	0
1992.01.08	6	Minister to tell Russians that British beef is edible	News	3	0
1992.01.09	8	Yeltsin insists on allied control of black sea fleet	News	1	0
1992.02.13	4	BSE deaths rising among young cattle	News	10	5
	4	Farm couple count cost of disease	News	5	1
	1	News in brief - Mad cow worries	News	2	0
1992.02.14	23	Capitalism in the dark	News	1	0
1992.02.28	36	Listening brief	Culture	1	0
1992.03.18	12	Countryside is king where sheep outnumber the voters by 10-1	News	1	0
1992.04.03	3	New cases feared after six die from disease linked to growth treatment	News	4	1

1992.04.04	52	Down on the farm	Culture	7	2
1992.04.08	40	Television and radio - Channel 4 - 8.30 Food file	Culture	1	0
1992.04.28	20	In tomorrow's guardian	News	1	0
1992.05.19	22	Foreign office finds cartoonists' EC offerings no laughing matter	Culture	1	0
1992.05.21	4	Charity saves brain disease research	News	4	0
1992.05.30	112	Weekend television and radio	Culture	1	0
1992.06.01	36	The ups and downs of fluorescent acrylic	Culture	2	1
1992.06.02	3	News in brief - Mad cow disease call	News	2	0
1992.06.06	112	Sunday television - BBC1 - 9.10 Natural lies	Culture	1	0
1992.07.06	1	Parents sue over deaths from 'mad cow' growth drug	News	3	0
	2	Treatment turned son into 'vegetable'	News	3	0
1992.07.07	5	10p-a-gland trade spread mad cow bug	News	6	0
	7	Labour urges 'mad cow' rethink	News	5	2
1992.07.27	2	Growth aid was refused licence	News	4	0
1992.08.25	4	Fussy children spur research	News	1	0
1992.08.29	46	Beastly deeds	Culture	4	3
1992.10.16	55	Watching brief - Public eye	Culture	3	1
1992.11.09	5	Puma's 'mad cat' disease death casts doubt on Gummer claim	News	8	2
1992.11.16	6	Mad cow fear leads to stock rule breach	News	8	6
1992.12.03	25	Pass notes - No 39: John Gummer	Opinion	2	0
1992.12.24	45	Christmas quiz answers	Culture	1	0
1993.03.22	4	Success claimed on cow disease	News	7	3

1993.05.28	3	John Gummer: Surprise move puts him back into department where he helped launch poll tax	News	1	0
1993.06.02	19	Beef about the ozone layer	Opinion	1	0
1993.07.03	9	Mad cow disease 'still poses threat'	News	9	4
1993.08.07	9	Overseas disasters benefit producers	News	1	0
1993.09.01	3	News in brie - Alert over fertility treatment link with fatal brain disease	News	2	0
1993.09.02	3	Hunt to trace 300 women in killer disease alert	News	1	0
1993.09.06	4	Stockpiled beef 'predates BSE ban'	News	8	5
	1	News in brief - 'Mad cow' concern	News	2	0
1993.09.07	2	EC stores 'now hold no meat pre-dating rules to block BSE'	News	3	2
1993.09.10	3	Human form of cow disease kills second farmer	News	4	2
1993.09.23	24	One comrade one vote, urges Smith	Opinion	5	2
	4	Professor challenges claim of decline in 'mad cow' disease	News	8	4
1993.10.02	7	Mad cow figures 'massaged by back-dating dates of deaths'	News	4	1
1993.10.30	8	Research claims 1 in 10 could be at risk from beef-eating	News	9	5
1993.11.05	3	Verdict spurs claims over growth boost	News	2	0
1994.01.01	55-56	Gulps of disbelief	Lifestyle	10	2
1994.01.26	66	Watching brief - Dispatches	Culture	2	1
	1	News in brief - Mad cow fears	News	2	0
	4	Women's illness fans beef fears	News	5	2
1994.01.27	32	The silent teenager	Culture	3	1
	7	Health chief rejects 'scare stories' linking CJD and beef	News	2	1
1994.02.12	5	Ministry snubs expert advice to close abattoirs	News	10	3

	3	Gory Vidal takes bull by the bones in sex and death decomposition	News	1	1
1994.02.15	36	Fresh talent - Sheep, by Simon Maginn	Opinion	1	0
1994.02.26	3	Germany ready to ban British cattle over 'mad cow' fear	News	7	4
	2	In today's Guardian	News	1	1
1994.03.09	7	Safe' beef pledge fails to impress Germans	News	29	19
1994.03.21	61	Good food - Assistant Art Editor	Ads	1	0
1994.03.28	4	Commission backs UK over 'mad cow' row	News	4	1
1994.03.29	10	German scare 'costs British beef exporters million'	News	3	1
	30	French Cricket	Culture	1	0
1994.03.31	8	Britain blocks EU ban on beef	News	5	4
1994.04.14	18	Rate fears curb trading.	News	1	0
1994.04.20	3	Minister 'failed to act on mad cat disease'	News	4	0
1994.04.22	35	Eco soundings	News	3	2
1994.04.23	24	Mad cow of Tory dogma	Opinion	5	0
1994.04.26	7	Shephard retaliates in German meat market	News	7	6
	7	Safe-to-eat claims 'lack proof'	News	12	9
1994.04.27	7	German 'retreat' on British beef	News	4	2
	61	General Manager/Fundraising coordinator	Ads	3	1
	24	Pass the apple sauce, mein herr, the beef's off	News	3	2
	11	Rapprochement on EU expansion	News	1	0
1994.04.29	38-39	Mad cow and Englishman	Culture	28	23
1994.05.05	18	Tate & Lyle healthy on diet of substitutes	News	1	0

1994.05.10	1	Germany says no to British beef	News	7	5
1994.05.11	3	Germany to climb down on beef ban	News	4	4
1994.05.12	5	Bonn sets deadline in beef row	News	3	2
	22	Food chains deadly flaw	News	20	13
	1	News in brief - 'Mad cow' deadline	News	2	0
1994.05.13	6	Germans warn British host over mad cow disease	News	3	0
1994.05.25	21	A bug and a context	Opinion	1	0
1994.05.27	2	German retreat in beef row	News	1	1
	9	Peers seek to revive Commons campaign to ban tobacco ads	News	1	0
1994.05.31	3	Beef fear blamed on Bonn	News	2	0
1994.06.01	5	Fine tuning' fails to lift German beef ban threat	News	8	5
1994.06.10	4	Germans challenge EU with slaughter ban on British cattle	News	3	0
1994.06.21	3	Shepherd in U-turn to improve export animal's treatment	News	1	0
1994.06.29	24	UK to appeal over German ban on beef	News	6	3
1994.06.30	4	EU seeks expert mad cow ruling	News	4	2
1994.07.01	6	BSE controls stagger on reluctantly	News	27	18
	1	Calves hit by BSE minister admits	News	2	1
	12	Leadership row smoothed over	News	1	1
	55	Listening brief	Culture	1	0
1994.07.02	94	A thorn in the side	Culture	5	2
1994.07.04	19	Still no sign of method in ending this madness	Opinion	8	7
1994.07.05	24	French join moves to ban British beef	Opinion	7	6

1994.07.06	10	German plan to ban British beef illegal	News	4	3
1994.07.08	25	Public's right to know about food checks	Opinion	7	6
	4	German call for total ban on beef	News	2	2
1994.07.09	8	Beef deal still possible as Germans vote for ban	News	8	7
	8	Australians add fuel to hormone lawsuits	News	2	1
1994.07.16	5	News in brief - Mad cow curb tightened	News	3	2
	30	Sport for all - television	Culture	1	0
1994.07.19	24	Deal agreed on mad cow row	Opinion	6	3
1994.07.20	6	Germany 'very satisfied' at BSE measures	News	2	2
1994.07.22	5	Exports threatened by mad cow 'victory'	News	8	3
1994.08.01	18	Hunt is on for the smiling face of John Major	Opinion	1	0
	1	Mon dieu, now the minister's got it	News	5	4
1994.08.13	46	The seed of madness	Lifestyle	8	6
	144	Look	Lifestyle	20	11
1994.08.15	7	UN plays down fears of second Rwandan exodus	News	1	0
1994.08.18	21	Mad cow disease and pesticides	Opinion	6	2
1994.09.02	9	Growth hormone inquiry demand after scientist reveals 'lab risks'	News	1	0
1994.09.03	116	Music rock & pop - Review - Saturday 3 - Day of rock	Culture	1	0
1994.09.06	34	Mad cows and doctored dread	Opinion	4	1
1994.10.01	13	Europeans refused to be stampeded	News	2	0
1994.10.10	65	Carlton - 8.30 World in action	Culture	1	0
1994.10.14	16	Test to detect mad cow disease sends Proteus shares climbing	News	7	3

1994.10.15	36	Footsie retreats as buyers waver	News	1	0
1994.10.27	1	News in brief - 'Mad cow' death	News	2	0
	26	Inquiry call into hormone death	News	1	0
1994.10.29	48	Foreword - Digitations	News	1	0
1994.11.15	3	Ready-cooked meals 'account for 35pc of food bills'	News	2	0
1994.11.30	26	Dairy fresh madness	Opinion	13	7
1994.12.14	5	Vet sacked in 'BSE-free' cattle clash	News	10	8
1994.12.19	5	S Africa bans Jersey cattle	News	6	2
1994.12.31	55	July	Opinion	1	0
1995.01.10	3	Row is meat and drink to minister's village	News	1	0
	18	The case for killing the fatted calf	Opinion	1	0
1995.01.20	24-25	Fat of the land?	Opinion	5	0
1995.01.21	7	Calves sent to France via Ireland	News	2	0
1995.02.01	33 & 85	Hopes that died	Lifestyle	1	0
1995.02.09	12	Snapshots - Still in a beef over British cows	News	1	0
1995.02.18	7	Vets 'issue sham health certificates to livestock'	News	2	2
1995.02.22	38	A passion for science	Lifestyle	3	2
1995.03.25	76	Veal now bacon next	Lifestyle	1	1
1995.06.13	7	Mad cow scientist fight for job	News	2	0
1995.06.17	27	Hell for Shell as fury spills on to the forecourts	Opinion	1	1
1995.06.19	12	One nation facing catastrophe with quietude-and a pint in its hand	Opinion	1	1
1995.07.20	9	News in brief - Tougher rules for abattoirs	News	2	1
1995.08.14	59	Carlton - 8.30 World in action	Culture	2	1

1995.08.15	6	Government blocks 'mad cow' inquiry	News	5	2
1995.08.18	9	Food for Thought by Vernon Coleman	Ads	1	0
1995.08.31	39	Food for Thought by Vernon Coleman	Ads	1	0
1995.09.08	45	Food for Thought by Vernon Coleman	Ads	1	0
1995.09.16	6	BSE' scientist loses dismissal case	News	3	2
1995.09.21	17	Food for Thought by Vernon Coleman	Ads	1	0
1995.09.23	250	Channel 4 - 9.0 Frontline	Culture	1	0
1995.09.27	46	Frontline	Culture	4	3
1995.09.30	7	BSE study after farmer dies	News	4	3
	26	Food for Thought by Vernon Coleman	Ads	1	0
1995.10.11	74	Eco soundings	News	1	1
1995.10.17	16	A British Perot	Lifestyle	1	0
1995.10.24	8	BSE fears over fourth sick farmer	News	10	8
1995.10.25	7	Two more CJD victims	News	1	0
1995.10.26	50	Kamikaze cattle	News	1	0
1995.10.27	4	Brain disease victims	News	4	3
1995.11.06	4	Woman 'died of CJD disease'	News	2	1
1995.11.07	17	Dairy	Opinion	2	1
	40	Food for Thought by Vernon Coleman	Ads	1	0
1995.11.10	4	Mad cow warning by ministry	News	3	1
1995.11.11	253	Carlton - 8.30 World in action	Culture	1	0
1995.11.13	7	Beef eating fear leads to boycott	News	7	4
	59	Carlton - 8.30 World in action	Culture	1	0

1995.11.16	11	Majority of Britons 'will eat BSE meat by 2001'	News	15	10
1995.11.27	4	Mother dies as doctors suspect new case of CJD	News	3	0
1995.12.05	6	Schools take beef off the menu	News	5	3
1995.12.06	5	Nutrition specialist warns against 'BSE beef products'	News	5	5
1995.12.07	1	Schools told to ban beef	News	4	2
	20	Mr. Hogg in a beef stew	Opinion	7	4
	21	Dairy	Opinion	2	1
	2	Mad cow mystery persists	News	20	13
1995.12.08	3	Major stops short of endorsing 'safe' beef	News	8	1
	18	Mad cow and Englishman	News	16	7
1995.12.09	7	BSE expert calls for clam	News	10	5
	7	Ministry's emergency advisers	News	1	0
	7	Beef scare threatens smallholders	News	3	3
	23	Where's the truth serum?	Opinion	4	0
1995.12.11	28	Peter, the great bear	News	1	0
1995.12.12	9	BSE fears lift venison sales	News	3	2
1995.12.14	32	Talking dirty	Lifestyle	1	0
1995.12.15	4	All-out offensive to quell 'needless' public fears over mad cow disease	News	8	6
1995.12.19	3	Scientists scale down BSE link	News	8	5
1995.12.21	33-34	Real scientist eat beef	News	7	5
1995.12.22	6	Abattoir worker's illness adds to alarm over mad cow disease	News	4	2
	13	Dairy	Opinion	1	0

1995.12.23	29	Snow joke as FTSE rallies for yuletide	News	1	0
1995.12.28	14	Price-moving fantasy a seasonal risk	News	1	1
1995.12.29	5	Mad cow disease scare causes 15pc decline in sale of beef	News	3	2
1995.12.30	63-64	December	Opinion	4	3
	66-67	What's eating Britain?	Lifestyle	1	0
1996.01.06	72-73	Cheshire gorge	Lifestyle	1	0
1996.01.09	17	AIM wins higher profile with own FTSE index	News	1	1
1996.01.10	7	Death is suspected CJD	News	1	0
1996.02.05	14	Germans head for showdown over British beef imports	News	1	0
1996.02.07	1	Food for Thought by Vernon Coleman	Ads	1	0
1996.02.08	6	Europe challenges German beef ban	News	1	0
1996.02.10	70	Brave moo world	Lifestyle	2	1
1996.02.14	6	Germany told to end ban on British beef	News	2	1
1996.02.15	10	Mad cow disease 'kills man'	News	2	0
1996.02.19	13	Food for Thought by Vernon Coleman	Ads	1	0
1996.03.20	26-27	Pots and fans	News	1	0
	5	Dorrel 'to admit mad cow risk'	News	2	1
1996.03.22	17	The diet of words	Opinion	7	4
	16	Beef, politics and a question of trust	News	7	4
	16	Mr Dorrell's bad science	Opinion	8	8
	21	Steak-holders stampede from market	News	2	1
	7	Sifting facts and theory at boundary of knowledge	News	5	0

	1	The crisis ministers ignored	News	15	9
1996.03.23	5	Ministers weigh options in face of political fall-out	News	2	1
	26	Too many cooks made this rotten beef stew	Opinion	12	10
	4	Stores set to replace British beef with imports	News	4	3
	4	Household fetish turns into Trojan horse	News	1	1
	4	Crisis halts live export	News	1	1
	4	Problems face litigants	News	3	3
	8	In Tuesday's Guardian Education	News	1	0
	36	Gossip helps Smith shares defy gravity	News	1	1
1996.03.25	1	Cabinet considers plan to slaughter 4m cattle	News	3	1
	10	Cheap food for thought	News	1	0
	10	Let's try a new menu tonight	Opinion	6	6
	26	World in action	Culture	1	0
1996.03.26	52	In a stew about beef	News	22	15
	7	US wanted of imminent mad cow disease threat	News	13	7
	7	Husband of CJD victim denounces Government	News	6	4
	7	Seriously ill 'suspects' studied	News	6	3
	15	Dairy	Opinion	1	0
	15	A butcher's hook at the Government	Opinion	6	5
	15	Nature bites back	Opinion	2	2

	1	Ministers defy beef outcry	News	5	2
	34	It's the couch potato charter	News	7	6
	2	Tory petulance leaves bad taste	News	3	2
	32	Review: Afghan whigs	Culture	1	0
	14	Hard facts for farmers to digest	Opinion	6	5
	14	Hiding behind experts	News	4	4
	28	Mad cable disease	Opinion	4	4
1996.03.27	44	Lies of the land	News	12	7
	44	Sacrificed on the hi-tech altar	News	2	1
	6	Countrywide slaughter is only answer, say farmers	News	2	2
	6	MPs savour safe steak from duke's guaranteed disease-free Scottish herd	News	2	2
	6	Wily Sir Leon fails to halt EU ban	News	1	1
	6	Ministers' record in the scare	News	4	3
	33	I have a list...Quite a long list'	Culture	1	0
	17	Dairy	Opinion	1	0
	17	A mad way to run a country	Opinion	2	2
	17	Sir Robert Peel keeps an eye on the contest	Opinion	1	1
	16	Euro-cash for cows	News	3	2
	16	Further serving of bovine material to tempt your appetite	Opinion	6	6

	29	The archbishop makes Jeremiah look jolly	Lifestyle	1	1
1996.03.28	5	Europe pledges aid to beef farmers	News	19	14
	50	BSE outbreak on the Net	News	15	14
	1	Beef crisis threatens EU summit	News	1	0
	19	Out of the melting-pot comes a new mosaic	Opinion	1	0
	19	The unbearable of smugness of being vegetarian	Opinion	2	2
	48-49	Playing with numbers	News	9	8
	18	Charitable look at cruelty	Opinion	1	1
	18	A recipe for the consumer to become a steak-holder	Opinion	3	3
1996.03.29	31	Mad about my cow	News	3	2
	7	Europe braces for slaughter	News	3	3
	7	Labour claims 1989 BSE export warning	News	4	4
	7	Doctors fear CJD victim may have had new strain	News	2	2
1996.03.30	4	Beef sales collapse costs 6,000 jobs	News	7	5
	27	Taking the bull by the horns	Culture	1	1
	6	Party faithful strip offal from Labour policies	News	3	2
1996.04.01	14	Putting Europe back to work	Opinion	2	1
	14	Beef evidence salted away	Opinion	2	2
	14	Beef as barometer of the national psyche	News	2	2
1996.04.02	49	Milk product	News	8	5

1996.04.03	16	Mad cows and Europhiles	News	5	3
1996.04.04	10	Hogg's mission ends in a humiliating defeat	News	4	4
	10	Penned in by dead market	News	4	4
	10	Firms only 'days away' from disaster, warm landowners	News	7	5
	2	EU snubs Hogg over beef	News	3	2
1996.04.06	6	French CJD case 'has mad cow link'	News	4	1
	6	Stores re-label to sell beef	News	7	7
	37	Straight-faced bureaucrats exploit BSE scare to ban winkle treatment	News	3	2
1996.04.11	5	EU remains firm on beef export ban	News	6	3
	5	Supermarket price cuts bring increased sales	News	5	4
	5	Fish will face a tasty temptation as anglers swallow cheap bait	News	1	1
1996.04.15	2	MPs angry at EC beef admission	News	2	1
1996.04.17	8	Beef exports 'will take five years to recover'	News	7	7
	8	Minister fails to lift gloomy farmers	News	3	3
	8	CJD deaths from hormone 'were avoidable'	News	1	0
	16	Mad cow syndrome subsides	News	1	1
1996.04.22	3	Right urges tougher line on beef ban	News	2	1
1996.05.01	19	Food industry sinks its teeth into beef alternative	News	6	4
1996.05.02	4	Tories round on Hogg for failing to win beef pledge	News	2	1
1996.05.03	19	Brussels beef ban forces Unilever to dump £ 15m of Birds Eye burgers	News	4	3
1996.05.15	5	CJD victims' family seeks legal aid to sue ministers	News	4	2

1996.05.18	4	Hogg offers to double cow cull	News	6	5
1996.05.22	4	Fear outweighs science as distrust clogs EU diplomacy on beef	News	11	6
1996.05.23	18	Europe's meaty debate	Opinion	7	6
	18	Hogg's ham tactics over beef	News	8	7
1996.05.29	19	Be very afraid	Opinion	2	2
	1	Wrapped in the futile flag	News	8	4
1996.05.31	10	Hopes rise for end to byproducts ban	News	2	1
1996.06.04	19	Dalgety fears £25m profit drop in wake of BSE scare	News	4	1
1996.06.14	2	Tests link BSE to humans	News	5	5
1996.06.18	13	Sweetly mad	Lifestyle	2	1
1996.06.19	4	EU deal on offer it Major co-operates	News	3	2
1996.06.25	30-31	Throwing the book at the Internet	Lifestyle	2	1
1996.07.04	57	BSE: is British science to blame?	Culture	12	12
1996.07.06	8	Flaw' in BSE cull rules	News	1	1
1996.07.20	27	Shaming scandal of CJD	News	3	2
1996.07.22	3	Irish police keep out British's mad cows	News	2	2
1996.07.23	1	Hogg bows to EU sheep ban	News	13	11
1996.07.24	4	EU seeks to allay sheep meat fears	News	6	6
	4	Beef, lamb and a pig's ear	News	17	15
	4	Holistic chef wants to eat inside and outside	News	3	2
	14	No need for a sacrificial lamb	News	5	4
1996.07.25	15	Dairy	Opinion	1	0

	15	Food for Thought by Vernon Coleman	Ads	1	0
1996.08.05	5	Germany fuels BSE crisis	News	9	6
1996.08.06	5	Germany raises stake on cow cull	News	13	11
1996.08.15	23-25	Man with a mission	Life Style	22	15
1996.08.17	8	Cash now halts Ulster BSE cull	News	9	5
1996.08.20	1	Coroner links death to 'mad cow' beef	News	11	5
	15	Shaggy dog takes taxi to Cotswolds	Opinion	3	1
1996.08.23	1	UK evaded BSE checks on cattle for Europe	News	10	8
1996.08.29	6	700,000 BSE cattle 'fed to humans'	News	19	18
1996.08.30	2	Bullish farmers march their cows to Paris	News	2	1
	2	Rethink on cattle cull	News	4	2
	2	Fourth British farmer dies from CJD strain	News	4	3
1996.08.31	7	Alarm over BSE meat in baby foods	News	6	5
	7	Calves brought in for EU subsidy	News	3	3
1996.09.06	20	Hillsdown spells out BSE cost in red and white	News	3	2
1996.09.07	67	Disease and the Mother of all Mad Cow	Ads	2	1
1996.09.09	13	Dangers in this drive for food profits	Opinion	2	0
1996.09.11	1	Ministrers signal cattle cull retreat	News	3	1
1996.09.12	2	Ministers to agree cut in BSE cull	News	8	6
1996.09.20	5	Prince hits at farming's 'unnatural' methods	News	4	3
1996.09.26	2	Americans devise BSE test	News	5	3
1996.10.10	11	Perils of Gulf pesticides 'unheeded by MoD'	News	2	1

1996.10.11	1	Fridge ship to store culled cows	News	4	3
1996.10.21	13	Tell us the worst-we need to know	Opinion	3	2
1996.10.24	2	Scientists find human BSE link	News	6	4
1996.10.29	64	Don's delight	News	7	6
1996.11.01	9	Blair points to beef botch	News	4	2
1996.11.09	23	Bears begin to emerge from woods	News	2	1
1996.11.16	9	Children taking drugs used to kill BSE cattle	News	4	3
	290	Preview: Horizon BSE	Lifestyle	2	1
1996.11.26	6	BSE 'to kill hundreds'	News	4	3
1996.11.27	2	BSE epidemic 'could be over by mid-1998'	News	17	10
1996.11.29	21	The Booker Man-a cult for our time	Opinion	1	1
1996.12.09	6	CJD compensation claim	News	3	2
1996.12.17	9	Cull retreat fails to ease beef ban	News	2	2
	1	Test votevictory for Tories	News	2	1
1996.12.18	46	Eco soundings	News	1	1

APPENDIX F: WIREFRAME

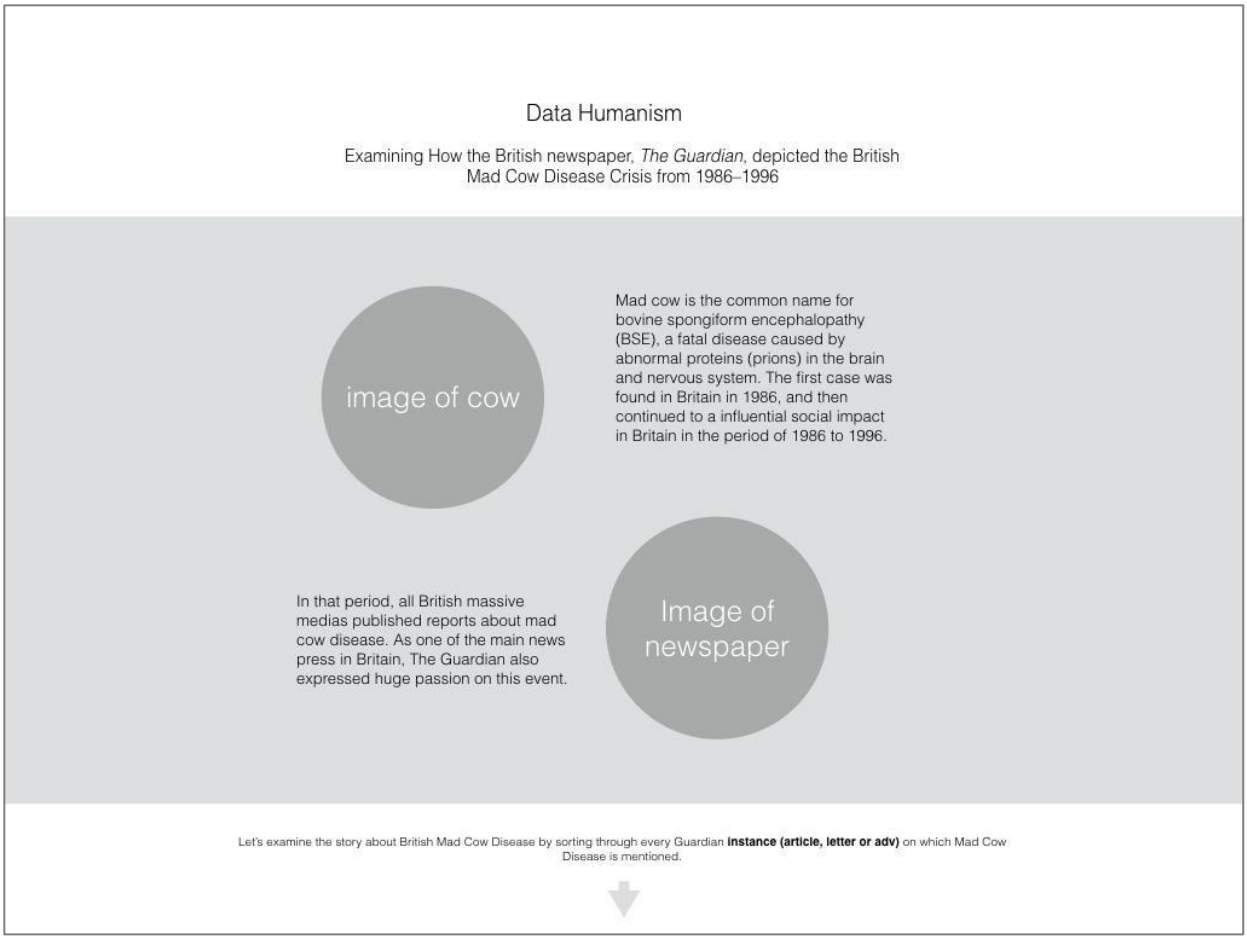

Fig. 18. Wireframe design: First section introduces the topic of the research (Data graph produced by the author using D3.js).

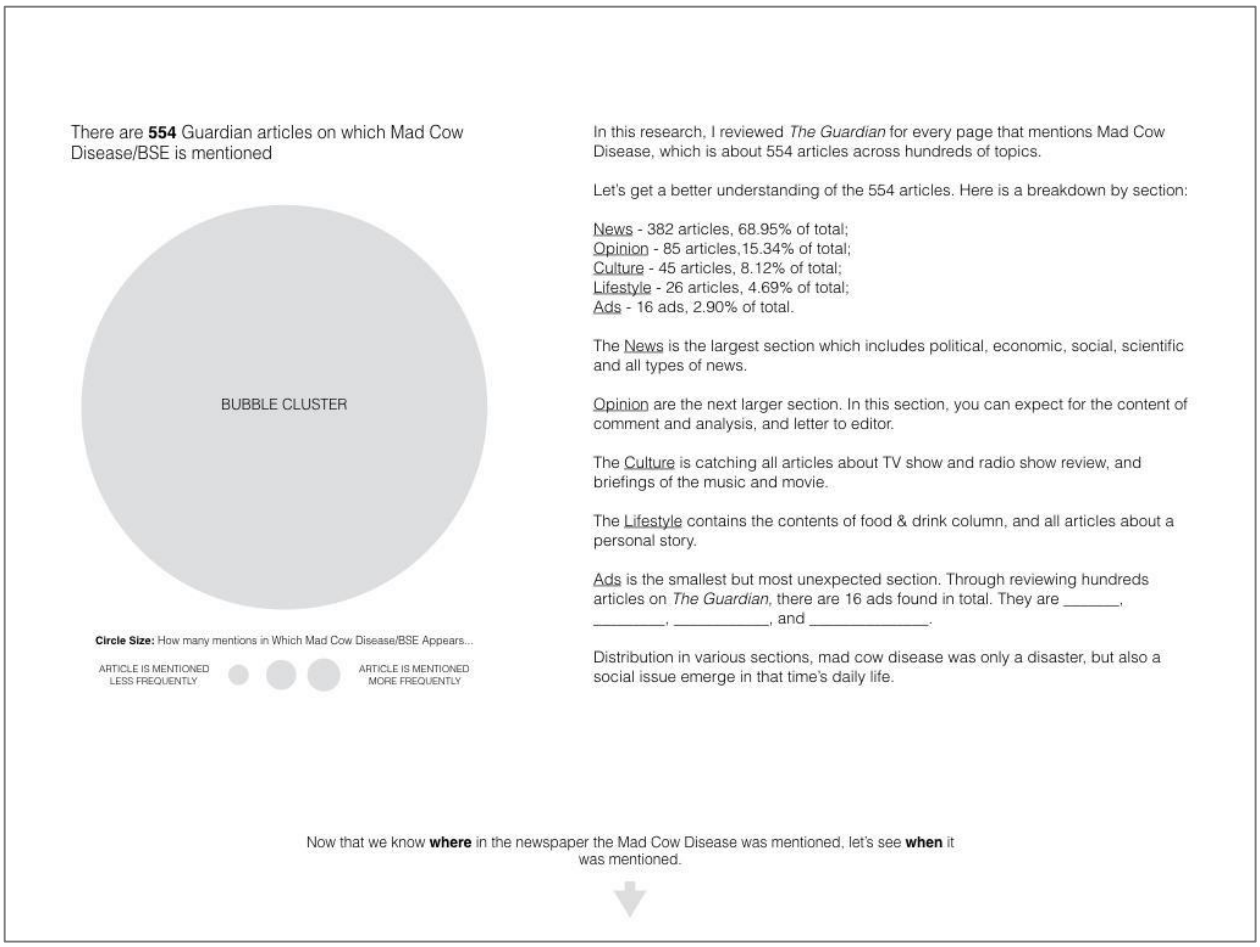

Fig. 19. Wireframe design: Second section presents a bubble cluster and the text description

(Data graph produced by the author using D3.js).

Fig. 20. Wireframe design: Third section presents a streamgraph and a timeline of British Mad Cow Disease outbreak (Data graph produced by the author using D3.js).

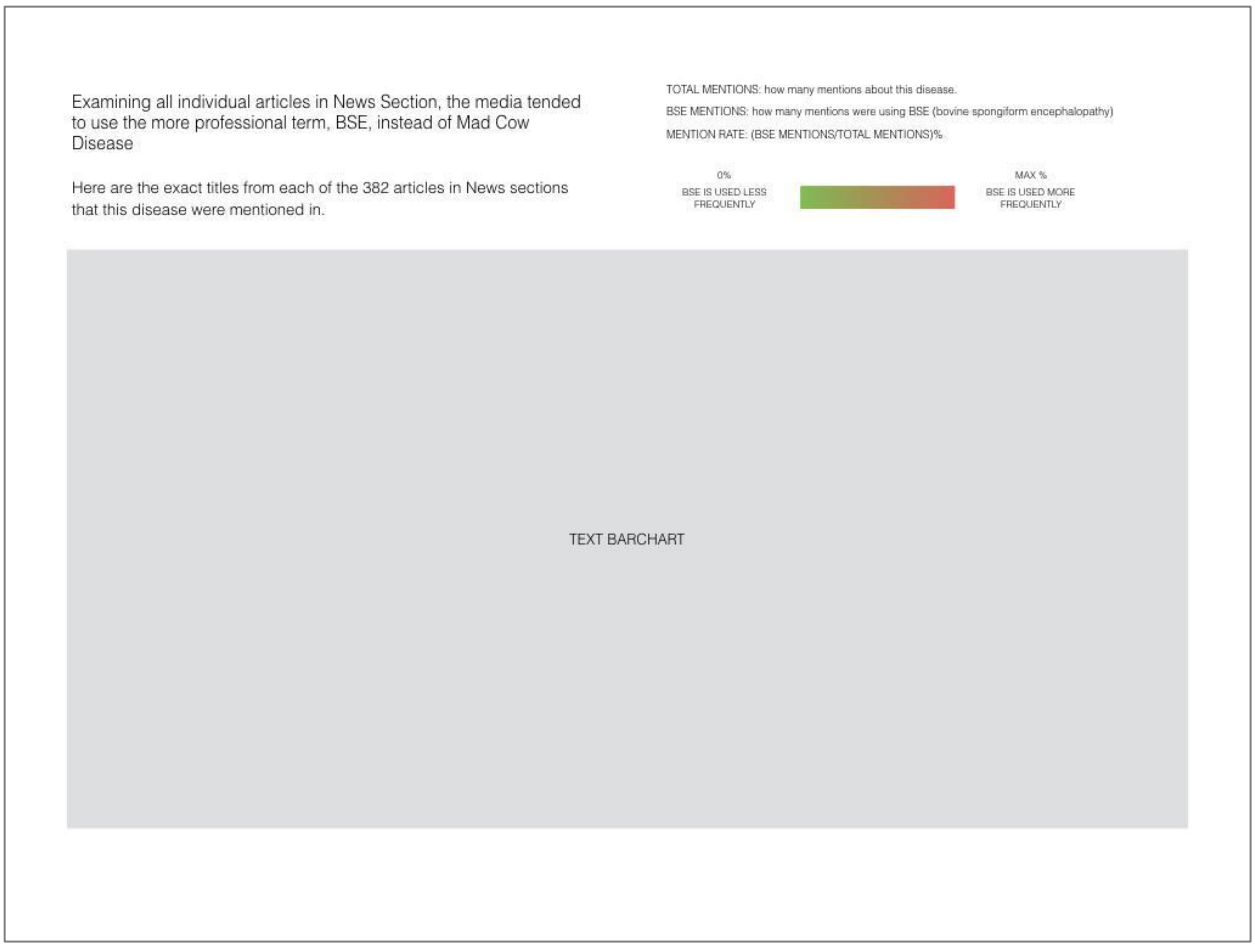

Fig. 21. Wireframe design: Fourth section presents a bar chart which examines how *The Guardian* tended to use a more professional term Bovine spongiform encephalopathy (BSE) instead of Mad Cow Disease (Data graph produced by the author using D3.js).

APPENDIX G: INTERACTIVE STORYTELLING DESIGN

The first section of the storytelling presents the project title (see Fig. 22). Then, in the second section, I briefly introduce this project and provide the WHO's definition of mad cow disease and the background history of the British mad cow disease crisis (see Fig. 23). The third section of the story gives audiences an overview of the data (see Fig. 24). In this section, I use a bubble cluster graph and a text description to present the 554 articles in which the mad cow disease crisis is mentioned in *the Guardian*. By grouping these 554 articles by section (News, Opinion, Culture, Lifestyle, Ads, and Sport), I provide audiences with a better understanding of the dataset by showing that mad cow disease was mentioned in all sections with exception of sports, making this disease into a social issue that touched all aspects of daily life.

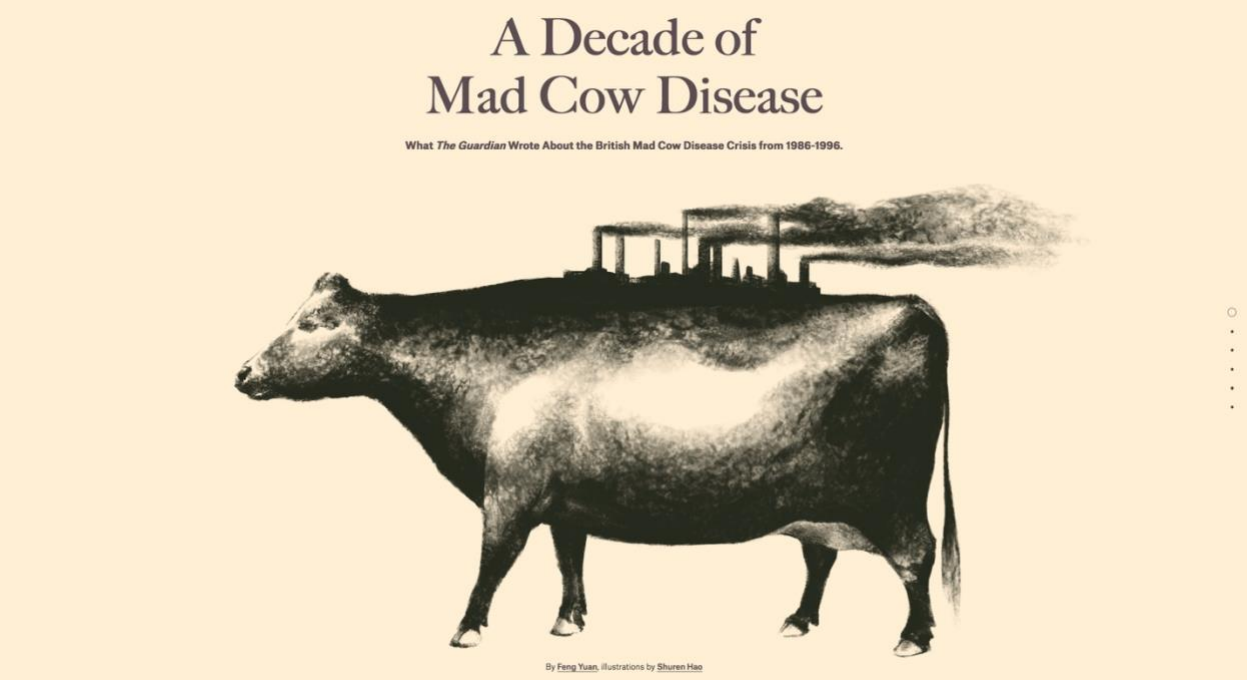

Fig. 22. Interactive storytelling: The first section presents the project name, author's name and a cover image.

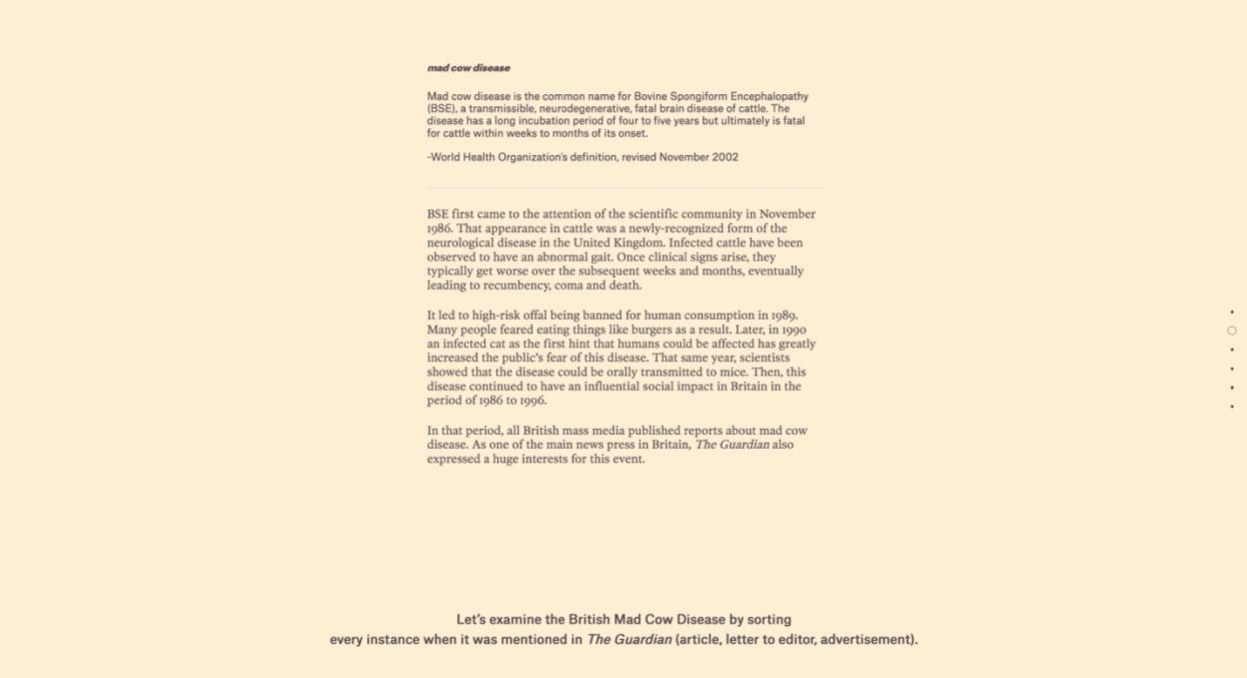

Fig. 23. Interactive storytelling: The second section presents the WHO's definition of mad cow disease and the background history about the British mad cow disease crisis.

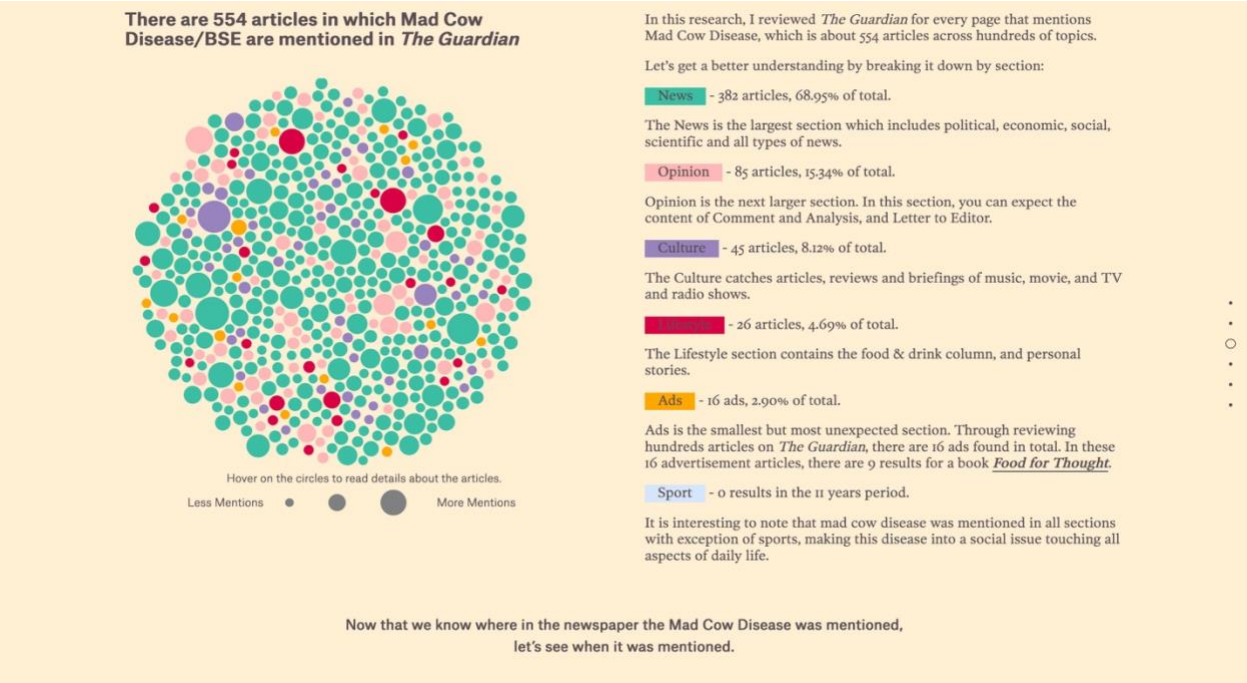

Fig. 24. Interactive storytelling: The third section (Data graph produced by the author using D3.js).

The fourth section discusses when the mad cow disease was mentioned in the Guardian between 1986–1996 (see Fig. 25) I use an area graph to present how many related articles were published in each month during that period, in addition to annotations showing the timeline of the British mad cow disease crisis. The text description provides audiences with possible connections between the number of related articles and the human-related news. The fifth section presents a deeper analysis

for the News section of the articles only (see Fig. 26). By examining all individual articles in the News section, I demonstrate that the media became more comfortable with using the term Bovine Spongiform Encephalopathy (BSE) instead of Mad Cow Disease. The last section is left open and invites the audience to think about what kinds of roles British newspapers played in this crisis (see Fig. 27).

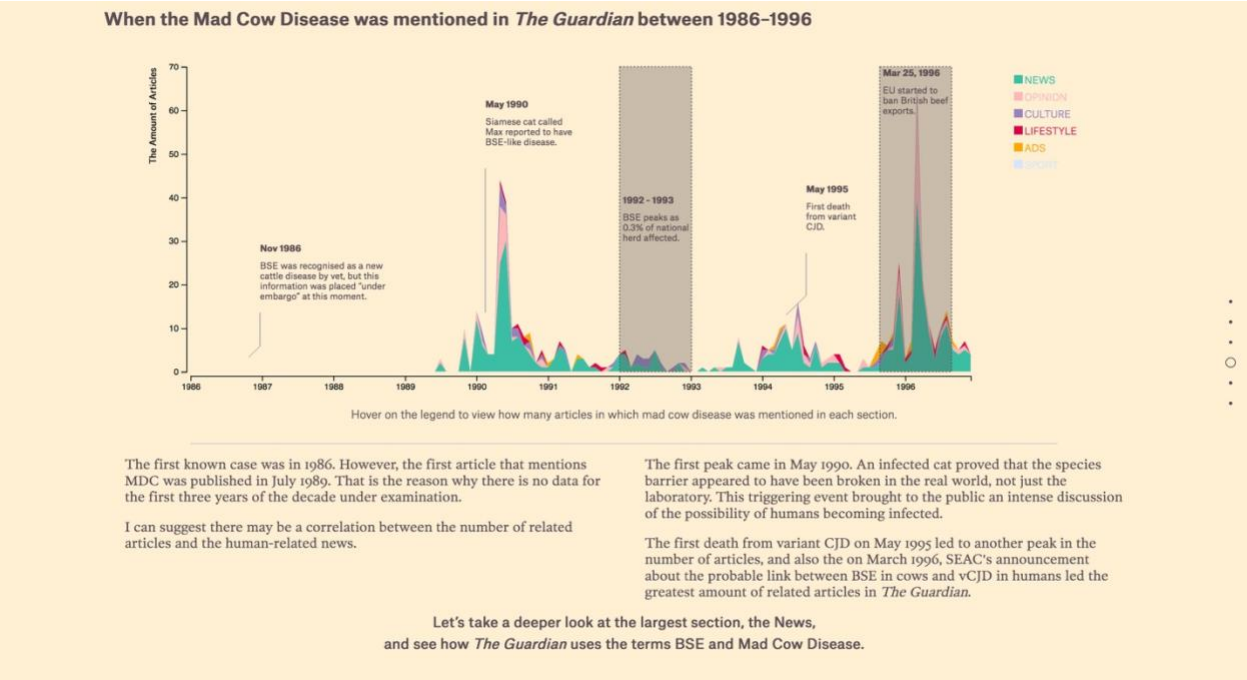

Fig. 25. Interactive storytelling: The fourth section (Data graph produced by the author using D3.js).

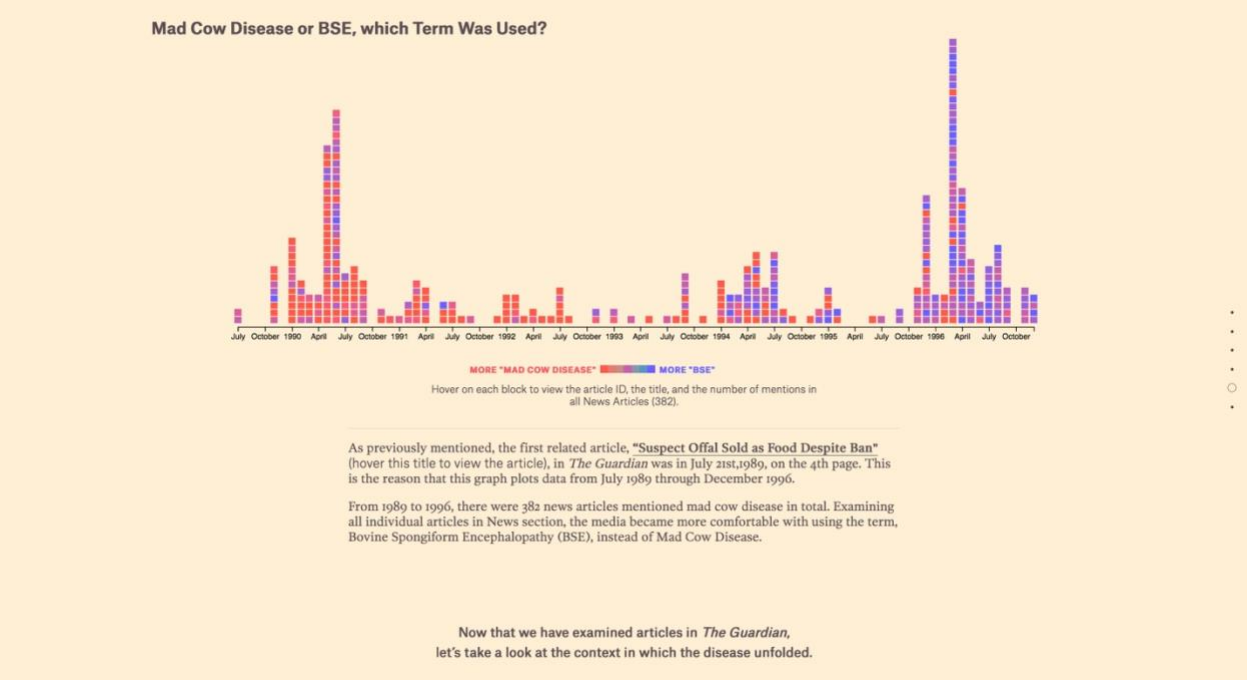

Fig. 26. Interactive storytelling: The fifth section. (Data graph produced by the author using D3.js).

Fig. 27. Interactive storytelling: The sixth section.

APPENDIX H: DATA VISUALIZATION POSTER DESIGN

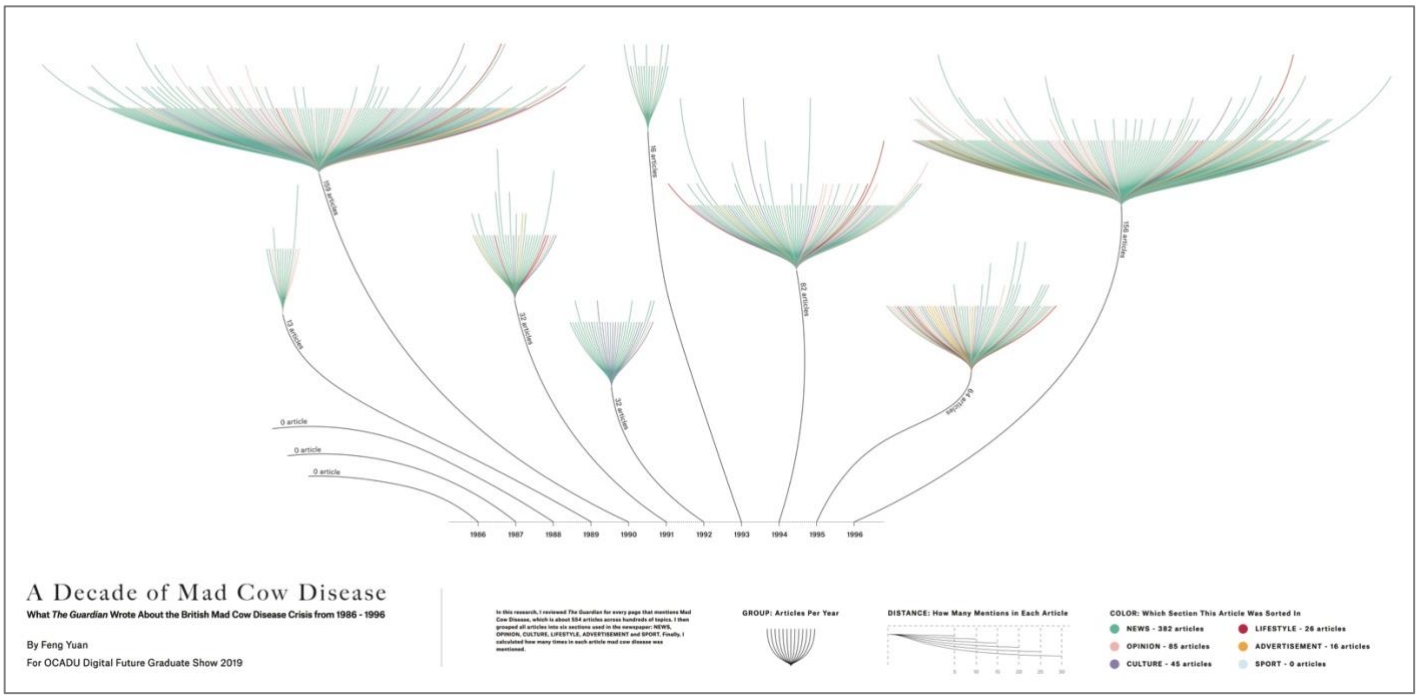

Fig. 28. A data visualization poster design presents the same dataset but in a more artistic style.