Do emotional responses to data visualisation mobilise people to act?

A case study of climate change visualisations in two national contexts

By:

Monika Fratczak

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

The University of Sheffield

Faculty of Social Sciences

Department of Sociological Studies

Submitted February 2022

Abstract

This study offers original insights into audiences' emotional responses to data visualisations or datavis (graphs, charts and maps) and how these responses play a role in mobilising participation in two different national contexts: Poland and the United Kingdom. Understanding the role emotions play in engagements with graphic representations of data is important, because there is an increased circulation of data through visual representations in everyday life, and because emotions are vital components for making sense of data and for eliciting engagement. Despite this, sociological research has yet to explore emotional experiences of datavis and where they can lead.

This thesis focuses on climate change datavis as a case study. It uses a comparative mixed qualitative methods approach, incorporating analysis of thirteen datavis about climate change, nine semi-structured interviews with ten data visualisation professionals from six organisations who design, commission and/or disseminate data visualisations about climate change, thirty-four semi-structured interviews and thirteen follow-up interviews with diverse audience participants from the United Kingdom and Poland who responded to these data visualisations on social media.

The thesis argues that datavis can be seen as what I have called an 'emotional repository' of dynamic and complex emotional experiences. Datavis can trigger multiple, simultaneous, and often contradictory emotions, relating mainly to the data that is the subject of the visualisation or aesthetic form. These emotions play an important role in mobilising audiences to participate in datafied democracies, more often on an individual and daily level, and less frequently on a collective and public scale; and they do so in different ways, depending on geographical context and demographic characteristics. The study offers an original contribution to the sociology of emotions, critical data studies and the limited existing research on datavis in society.

Key words: Data visualisation, emotions, participation, climate change, diversity

Acknowledgements

I feel privileged to have had the opportunity to conduct this research and I am genuinely honoured to have been able to listen to the stories that my participants were willing to share with me. As such, this thesis starts with an expression of my gratitude to each of the thirty-four participants who volunteered to speak with me: Adam, Alan, Aneta, Anjelo, Archibald, Aurora, Bill, Claire, Edo, Ewa, George, Hawa, Jacek, Jack, Jadwiga, Jan, Jess, Jo, Kate, Krzysztof, Lucyna, Maciej, Marek, Mariusz, Marjorie, Mark, Natalia, Nguyen, Peter, Rachel, Rita, Tom, Tony, and Vera; and to the six organisations that took part in the research: Carbon Brief UK, Nauka o klimacie Polska (Climate Science Poland), Greenpeace UK, Greenpeace Poland, WWF UK and WWF Poland. Thank you for taking the time to share your stories with me.

I want to thank my exceptional supervisors, Professor Helen Kennedy and Professor Sarah Neal. I have been incredibly lucky to have your insights, time, support and guidance throughout the course of this thesis. I could not have asked for kinder, wiser, and more inspiring mentors than the two of you.

Thank you to the other members of the Department of Sociological Studies who played an integral role in the completion of this PhD, and to the ESRC for funding this research.

I have made many friends while studying at Sheffield, and there are a few I want to thank in particular. I would like to thank Camille, Chris, Lauren, Liam, Lulu, Natalie, Ruth, Sharon – my PhD friends – thank you all for your help and our meetings; thank you Catherine for being a fantastic and supportive friend. I am lucky that I shared this adventure with all of you.

Last but certainly not least, I would like to thank my family, my mum Bozena, dad Grzegorz and sister Anna for always believing in me and for their unconditional love. Finally, thank you to my partner Michael for all the delicious dinners he cooked for me when things got busy, his humour, support and wisdom.

Declaration

I, Monika Fratczak, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not been previously presented for an award at this, or any other, university.

Contents

List of Figures

List of Tables

Chapter One:
Introduction

1.1 Introduction

> Although there is a top-down process from governments making the changes, we also need a bottom-up process to motivate governments, to take the decisions faster. And I think that's where the ShowYourStripes can come in, it can start those conversations at the local level by reaching different audiences and allowing a very simple way of communicating. (Ed Hawkins, University of Reading)

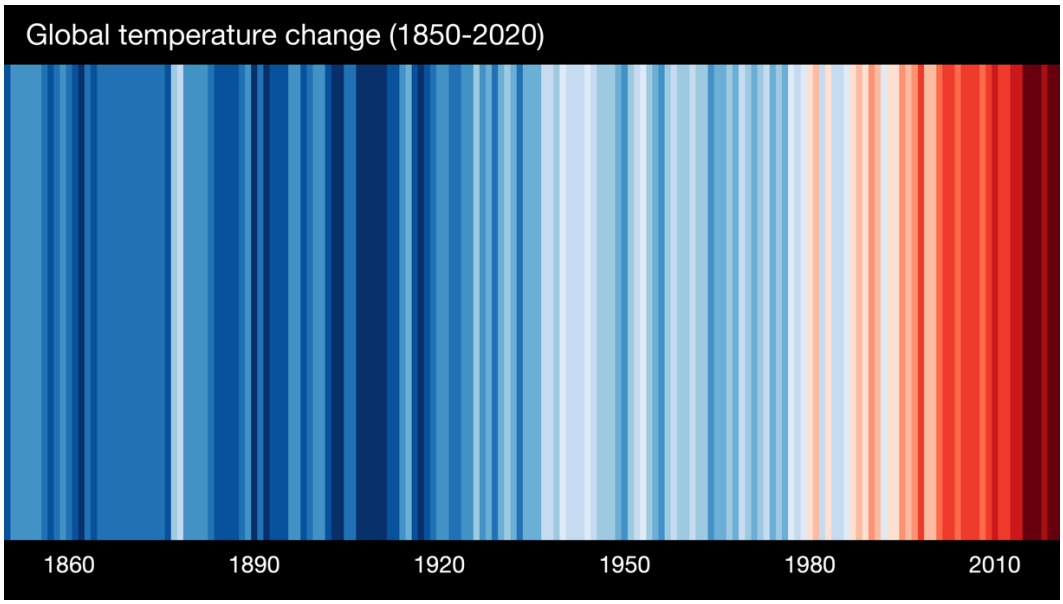


Figure 1: Data visualisation Warming stripes

Source: #showyourstripes, January 20202. Author: Ed Hawkins.

The statement above is taken from an interview (see Levantesi, 2021) with Professor Ed Hawkins, a British climatologist and Lead Author for the latest IPCC 2021 (Intergovernmental Panel on Climate Change) 6th Assessment Report. Hawkins talks about an interactive 'Warming Stripes' data visualisation (Figure 1) that he developed in 2017 "as means of displaying climate change in a "visual and accessible" manner" (BBC, 2021). When generated, it shows coloured blue and red stripes that represent the average temperature for individual years since 1850 and illustrates the rapid heating of our planet in recent decades. The visualisation is interactive and can be generated for individual countries and

regions around the world to present how temperatures have risen over the last 100+ years in the selected countries and locations.

Since 2017, the *Warming Stripes* data visualisations have been used worldwide, reaching a huge audience and becoming an international symbol of climate change. They became widely recognised and appeared on the front cover of *The Economist*; have been adapted for interactive light shows in Copenhagen, Berlin and Vienna; and hit the catwalk at the 2021 London Fashion Week. They have been shared not only by scientists but also by TV meteorologists, musicians, campaigners and activists, including Greta Thunberg. They have been displayed all around the world on protest signs, mugs, ties, shirts, dresses, trams and cars, and were widely used during the global climate change conference COP 26 (UN Climate Change Conference of the Parties) organised in 2021 in Scotland.

As can be seen in Hawkins' above statement, the *Warming Stripes* data visualisation is believed to be an effective tool for communicating climate change in a simple way to the public. Importantly for this thesis, Hawkins argues that it can start conversations about climate change at a local level among different audiences. Like other scientists (see for example, Climate Outreach, 2021), the meteorologist suggests that a bottom-up approach and individual actions can influence public opinion and subsequently help reduce climate change.

Warming Stripes is not the only data visualisation that is believed to be effective in conveying information and mobilising diverse audiences to action. In 2016, for example, during a 2016 EU referendum in the United Kingdom, the official Vote Leave campaign distributed pro-Brexit adverts targeted at UK voters. Millions of people received leaflets often driven by data and/or data visualisations and/or saw adverts on Facebook attacking immigration and promoting false claims including about how much money the United Kingdom sends to the European Union every week (see Figure 2). The claims were widely discredited (Channel 4, 2016), but some commentators (BBC, 2016) suggest they helped the political campaign group Leave.EU win the UK referendum and consequently the UK formally withdrew from the European Union on 31st January 2020.

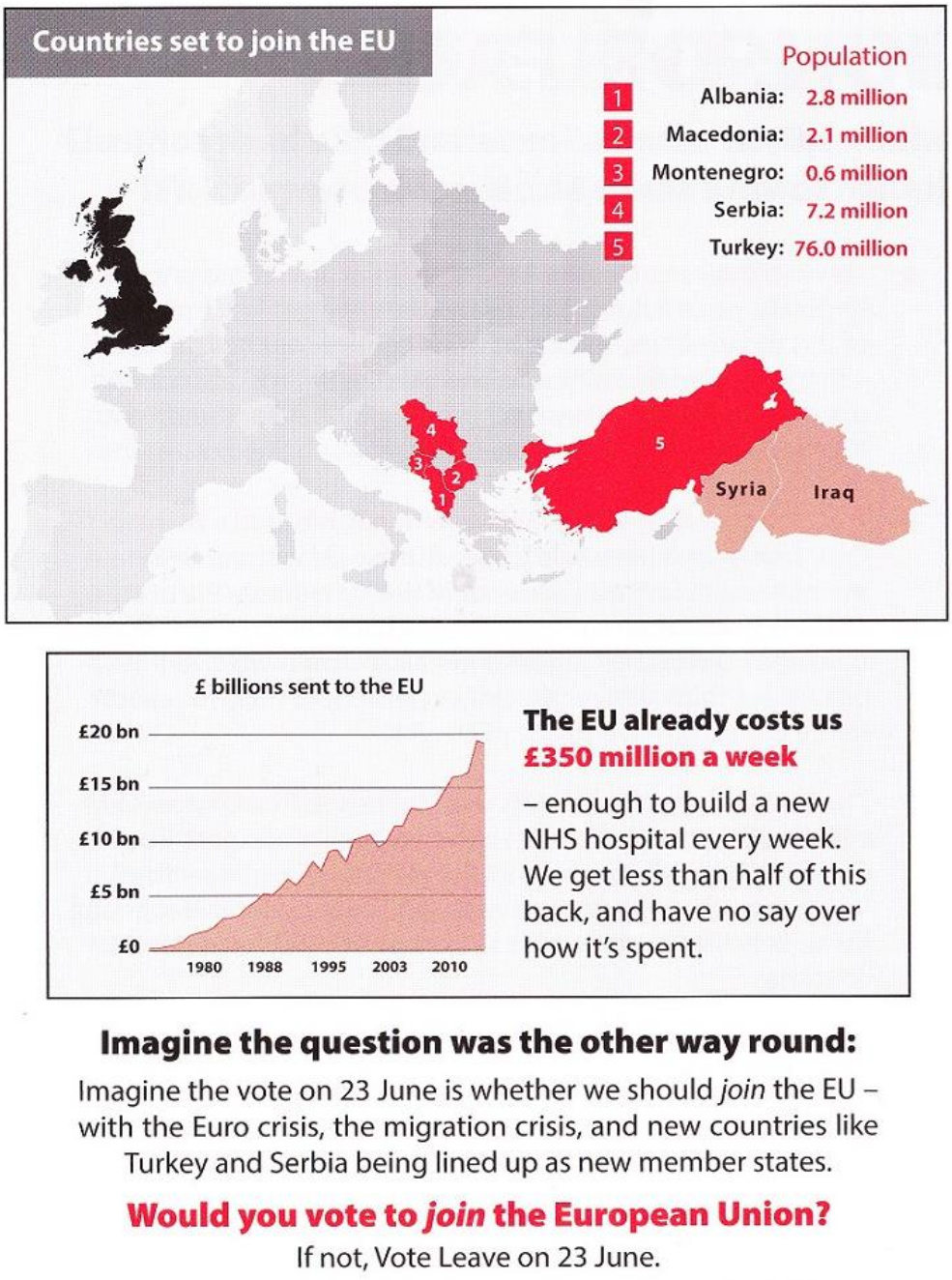


Figure 2: One of the leaflets distributed during the Vote Leave campaign

Source: Irish Election Literature, December 2019

Moreover, a study by King's College London, in partnership with Ipsos MORI and the UK in a Changing Europe, ran a major survey of over 2,200 people aged 18-75 in Great Britain on misperceptions of immigration and Brexit realities. The results (Duffy, 2018) show that 42% of people supporting different political parties believed the claim that the UK sends £350m

a week to the EU even though “the UK Statistics Authority judged this claim to be ‘misleading’ and a ‘clear misuse of statistics’” (Duffy, 2018), while just 36% thought it was false and 22% were unsure. Responding to these findings, the director of the King's College London policy institute points to the importance of emotions in decision making processes: “These misperceptions raise important questions about the basis of our decision making. But as I point out in our work on misperceptions, it’s not as simple as people just changing their minds if they had the correct facts – it’s more emotional than that” (Stone, 2018).

These visualisations represent two of the many widespread visualisations currently circulating in the media and other realms of life, and are introduced here for two reasons. First, to indicate the social and political significance of data visualisation, and second, to emphasise the role that emotional responses to them may play in sometimes manipulated data-driven processes and decision-making. Politicians, designers, activists and campaigners increasingly use datavis in topics ranging from climate change and elections to Covid-19 distribution and social inequalities, hoping that it is an effective tool not only in communicating information to the public and reaching a variety of recipients but also in mobilising them to undertake the actions they deem necessary.

Graphs, charts and maps are therefore used as a social, political and, in worst-case scenarios, ideological tool. They can help audiences access and understand key data and information, persuade or empower them in decision-making processes and prompt them to act. However, whether this happens has not been researched empirically. Little is known about the social impact of data visualisation, including audiences’ experiences of graphs, charts and maps and whether they can prompt mobilisation, political engagement and participation.

This thesis therefore offers original insight into how diverse audiences engage emotionally with data visualisations and what this means for mobilisation and political participation in datafied democracies in two different national contexts, the UK and Poland. This introductory chapter will familiarise the reader with the definition of data visualisation used in this study, background information to the research that is relevant to a full understanding

of the thesis argument, and a summary of the study itself. Finally, it will provide an outline of the thesis structure.

1.2 What is data visualisation?

Although it may appear so, data visualisation is not a recent phenomenon. Alternative traditions of datavis have a long history, particularly in relation to wider visualisations of weather conditions and astrology. Recent scholarship has sought to complicate and decentre narratives about the origins of datavis by placing them in longer historical contexts (Therrell and Trotter, 2011)

Many visualisation techniques were introduced in the 17th and 18th centuries (Friendly et al., 2008). However, the graphical representation of numeric information "grew in importance with the widespread use of data and statistics for planning and commerce in the nineteenth century" (Kennedy and Engebretsen, 2020, p.19). Otto and Marie Neurath, creators of a visual system known as Isotype (International System for Typographic Image Education) for presenting quantitative information to a wide, often uneducated audience through icons, played an important role here (Friendly et al., 2008). Their work gave rise to modern infographics and data visualisations. However, despite this long and rich history it is difficult to point to a single and commonly accepted understanding or definition of data visualisation (also called datavis, DV, or simply visualisation). There are several different ways to describe it depending on who is using it and for what purpose. For example, in a broad sense, data visualisation can be understood as multimodal (Ledin and Machin, 2018). It consists of multiple modes of communication which contribute to meaning making and experiences of visualisations by recipients. In this approach, visual communication with datavis is never just simply visual since other semiotic resources, including titles and annotations, also influence interpretations and meanings of datavis (van Leeuwen, 2005; Kress and van Leeuwen, 2006; Kress, 2009).

In a narrower sense, according to datavis practitioner Andy Kirk (2012), data visualisation is "the representation and presentation of data that exploits our visual perception abilities in order to amplify cognition" (p.17). However, a closer look at the key elements of this

definition may not result in an unequivocal understanding of its meaning, which, as the author points out, is due to the dynamics of this changing field, and its “unique conjunction of art and science shaping its practice” (Kirk, 2012, p.17).

Recognizing this ambiguity about what datavis is and its dynamics, in this thesis I follow the definition given by Kennedy and Engebretsen (2020) where:

> Data visualisations are understood as graphical representations of data which are primarily, but not solely, numeric. What’s more, they are abstractions and reductions of the world, the result of human choices, social conventions, and technological processes and affordances, relating to generating, filtering, analysing, selecting, visualizing, and presenting data. Data visualisations (also called datavis or DV) are created to ‘facilitate understanding’, to use Kirk’s term (2016, p.19; see also Borgo et al., 2013; Cairo, 2013), but they also facilitate documentation, persuasion, and manipulation.

Although seemingly complex, I refer to this understanding since it offers three important points for consideration in my work. Firstly, this definition draws the boundaries between datavis and other visual forms which appeal to the sight but do not have data at their heart, including photographs, word clouds, infographics or information visualisations. Secondly, this definition emphasises that data visualisation does not have to be solely numeric. As Kennedy and Engebretsen (2020) suggest, qualitative data can also be visualised. Finally, it acknowledges that publishing and sharing datavis has various purposes, including facilitating persuasion and manipulation, which is also important in my considerations, as explained above. As such, this definition is most appropriate for the purpose of this thesis.

However, due to the possible ambiguity in understanding what data visualisation is, the phrase "graphs, charts and maps” or the expression “visual representation of data in graphs, charts and maps” is also adopted in this research. The phrases were used especially when

communicating with audience participants who may be more familiar with them and thus may find them easier to understand.

As the definition and understanding of datavis in this thesis have been introduced, it is now possible to offer an overview of background information to the research. In the next section, I provide some context to the study and identify the knowledge gap.

1.3 Background to the study

There has been a huge rise in the visual communication of data and information in the form of data visualisation in everyday social life. As Kennedy and Engebretsen (2020) point out, the graphical representation of numeric information dates to the 19th century, but it has never been as powerful as it is today. Datavis are widely used to engage publics in different topics and consequently people encounter them with growing frequency (Kennedy and Engebretsen, 2020). They have entered the mainstream as a tool that can help to acquire knowledge about important social and political issues and increase understanding of abstract numeric information (Alamalhodaei et al., 2020), but as noted in the previous sections, they can also facilitate persuasion or manipulation (Kennedy and Engebretsen, 2020).

For these reasons, data visualisation and experiences of data "from the bottom up" (Couldry and Powell, 2014) are gaining importance as research subjects. Throughout the social science literature, it is agreed that alongside reason, emotions should be considered as an important factor while studying engagement with datavis (see Kennedy and Hill, 2017; Gray, 2020; Simpson, 2020; D'Ignazio and Bhargava, 2020). This is because firstly, emotions are considered to be vital components for making sense of visualisations (Kennedy and Hill, 2017, p.); and secondly, they can elicit political engagement (Nærland, 2020).

Despite this, some scholars (Kennedy et al., 2016b; Kennedy and Engebretsen, 2020) claim that until recently there has been little sociological contribution to the understanding of experiences of datavis (see exception Kennedy and Hill, 2017) and where these can lead. Existing studies of the perceptions of datavis have mostly been carried out from a computer

science or psychological perspective, often failing to recognise the social aspects of engagements with datavis (Kennedy et al., 2016b). While much of this work has focused on the capacity of data visualisation to convey information (Harold et al., 2020) or persuade audiences (Pandey et al., 2014), little has been done to empirically explore its emotional impact. This may be due to an assumption that data and thus datavis are objective reflections of knowledge and do not make much of an emotional impact.

Furthermore, as Kennedy and colleagues (2016b) argue, in such approaches, data visualisation is seen as an isolated and independent text and researchers often do not provide much information about participants. They overlook socio-cultural contexts and individual factors, such as who engages with datavis and where, whether the person is alone or with others, time and attention and technological devices used (Kennedy et al., 2016b). In this thesis, I consider all these factors as together they present a more complete picture of an audience's perspective and the phenomena under investigation. As several scholars (Kennedy et al., 2020; Peck et al., 2019) suggest, differences between people matter when it comes to engaging with datavis, as these differences may lead to unequal experiences of data and data visualisations. Despite this, sociological research has also yet to explore the role that these differences play in experiences of datavis. Moreover, Milan and Treré (2019) call for "a de-Westernization of critical data studies" suggesting that data universalism "tends to assimilate the heterogeneity of diverse contexts and to gloss over differences and cultural specificities" (p. 324). By comparing two different national contexts in this study, Poland and the United Kingdom, my work will add to these debates exploring what role, if any, do national contexts play in audiences' engagements with datavis and what this means for mobilisation and political participation.

To address these gaps, my study goes beyond what Kennedy and others (2017; 2020) and Nærland (2020) have done. It explores diverse Polish and British audiences' emotional responses to data visualisations through a sociological lens and considers whether and how these emotional responses may subsequently prompt political participation in two different national contexts. It focuses on climate change as a case study, investigating data produced or disseminated by six climate and environmental organisations from the UK and Poland

(including Carbon Brief UK, Climate Science Poland (Nauka o klimacie Polska), Greenpeace UK, Greenpeace Poland, WWF UK and WWF Poland) to answer the research questions:

1. How and in what ways does data visualisation convey and evoke emotional responses?
2. To what extent do those experiences relate to people's (potential) political participation?
3. What role, if any, do national and demographic differences play in these processes?

The research considers emotions as a central aspect of social and political experience (Ahmed, 2004; Wahl-Jorgensen, 2018) and a vital aspect of diverse audiences' engagements with data visualisation (as seen in Kennedy and Hill, 2017). It is therefore based on three assumptions. Firstly, on the empirical argument that engaging with datavis not only concerns reason, but also emotions (Kennedy and Hill, 2017). Secondly, on the claim that datavis can enable and mobilise people to function as citizens (Nærland, 2020). This is a conceptual statement that needs to be examined empirically because empirical research on data visualisations, emotions, and political engagement has not yet been undertaken. Thirdly, on the argument put forward by Milan and Treré (2019) about data universalism being asocial and ahistorical and operating outside of specific socio- political, cultural, and economic contexts. Finally, the research is based on the proposition that civic practices and political participation are the results of certain emotions and feelings which motivate people to act, as well as rational judgements (Coleman, 2013; Nærland, 2020).

1.4 The study

This study employs mixed qualitative research methods. It draws upon analysis of 13 selected data visualisations about climate change; nine semi-structured interviews with 10 data visualisation professionals who design, commission and/or disseminate data visualisations about climate change; and 34 semi-structured interviews and 13 follow-up interviews with diverse audience participants from the United Kingdom and Poland who responded to these data visualisations on social media. Semi-structured interviews with professionals, lasting between one to two hours (averaging one hour each) were conducted

in various locations across England and Poland with professional participants who were aged between 24 and 47 years. Semi-structured interviews with audiences, lasting 40 minutes to almost two hours (averaging about fifty minutes each) were conducted online with participants aged between 19 and 72 years.

Responding to the limited academic empirical interest in audiences' experiences of data visualisation and recognising the significance of this for political participation, the primary aim of this research is to learn more about diverse audiences' emotional responses to datavis and what they mean for mobilisation and political participation in a datafied democracy. As indicated previously, computer science and psychological research into non-experts' perceptions and experiences of datavis is dominant within academia. Therefore, a secondary aim of this study is to develop a sociological understanding of datavis experiences – one which emphasises the social aspects and significance of these experiences. To meet these objectives, a set of research questions, listed in the previous section, was devised and an appropriate literature review was carried out.

The literature drawn upon throughout the thesis comes from a broad range of fields and brings together four core bodies of research, relating to the emerging field of critical data studies and the limited existing research on datavis in society (Kennedy et al., 2016b; Kennedy and Hill, 2017; Nærland, 2020); sociological perspectives on emotions (Hochschild, 1989; Ahmed, 2004; Burkitt, 2014); political participation and emotions in political communication and social movements (Ekman and Amnå, 2012; Coleman, 2013; Lamprianou, 2013; Flam and Doerr, 2015; Wahl-Jorgensen, 2019); and diversity and inequality issues in data studies (D'Ignazio and Klein, 2016; Peck et al., 2019; D'Ignazio and Bhargava 2020). The literature review is therefore split into four sections.

Bringing the literature together in this way positions uniquely the study at a cross-section between sociology and critical data studies to extend current understandings of each. Furthermore, drawing upon this and other literature and original data, this thesis demonstrates that emotional engagements with datavis are social experiences, heavily embedded in the social and political contexts and relationships with others. It highlights the

complexities of these engagements and explores the consequences of the emotional experiences of datavis for the ways people make decisions and participate in data-driven societies. Finally, the thesis shows that national and other demographic differences between participants may play an important role in these processes.

This approach to understanding of the emotional significance of data visualisation aims to advance and transform the sociological understandings of how publics engage with datavis and where it can lead.

1.5 Structure of the thesis

This thesis is organised into eight chapters. Following this introduction, Chapter Two provides a review of the literature relevant to this thesis. It is divided into five sections. Following an introduction, sections 2.2: 'Data visualisation in society' and 2.3: 'Sociological perspectives on emotions' situate data visualisation and emotions within the context of social theory. They explore why they matter for social science and the relationship between them. Section 2.4: 'Conceptualising political participation' outlines and evaluates the definitions of political participation and explains how this term is understood and defined in this study. It distinguishes between political participation and civil (latent political) participation and considers the relationship between these two, in terms of emotions and visuals. Finally, Section 2.5: 'The importance of differences' engages with narratives of currently available studies on national and demographic differences in engagements with data and datavis, before introducing the two national contexts I compare in the study, Poland and the United Kingdom. While detailing what is currently known, Chapter Two sets the conceptual framework for the thesis. It shows where there are gaps in knowledge and explains how this research fits into those gaps. Finally, it concludes by reviewing the research questions.

Chapter Three provides a detailed description of the methods employed in this study. Section 3.2 makes clear why qualitative research using semi-structured interviews was the most suitable for studying emotions and datavis in this project. Next, it turns to other aspects of the research design, covering recruitment/sampling, the data collection process

and overviews of the research participants. For ease of understanding and a more coherent narrative, this part of the chapter is divided into three sections for each of the three datasets: Section 3.3: 'Data visualisations and social semiotics approach', Section 3.4: 'Professionals' and Section 3.5: Audiences'. Following on from that, in Section 3.6 'Interview reflections' more information is provided about the interviews, including the visual elicitation method used, the role of the interviewer in qualitative research, and language and translational approaches. The chapter then turns to considerations about ethical issues in Section 3.7 and the data analysis process in Section 3.8. Finally, Section 3.9 discusses the researcher's positionality and researcher effects.

What follows are four empirical chapters which address my research questions. The central themes of emotional experiences of data visualisations, potential political participation, and the importance of national and demographic differences between my audience participants are outlined in turn. Chapters Four and Five build upon existing knowledge of the emotional experiences of datavis by providing an empirical examination of the ways in which different emotions play a significant role in datavis design and engagements with datavis. These ideas are considered through the lens of climate change, recognising the social nature of datavis.

Chapter Four introduces the six environmental and climate organisations that took part in the study. It considers the motivations and perspectives of the datavis professionals on datavis produced and/or disseminated by them and introduces 13 datavis from the sample. Following an introduction, Section 4.2 begins with an exploration of the environmental campaigning organisations and their datavis. Section 4.3 turns to information-providing organisations and datavis designed and/or disseminated by them. Finally, Section 4.4: 'Producing data visualisations to evoke emotions' engages with narratives of professionals about what they think about emotive potential of datavis and how they design datavis to evoke emotions.

Chapter Five: 'Audiences' emotional responses to data visualisations' examines audience experiences about datavis produced or disseminated by climate and environmental organisations. Section 5.2 examines the importance of socio-cultural factors and contexts in

emotional engagements with datavis. Consideration is given here to proximity techniques. Section 5.3 expands upon Kennedy and Hill's (2017) study of emotional responses to datavis by identifying which of the emotive factors in datavis are most likely to stimulate an emotional engagement among audiences, what kind of engagement that might be, as well as its consequences. Section 5.4 reveals the tension amongst the three most emotional factors in datavis by identifying contradictory positive and negative emotional responses to them. The section considers the *'*feeling rules' and 'emotion management*'* (Hochschild, 1989) and how these concepts extend to datavis. Finally, the narratives provided by audience participants in Section 5.5 show the emotive potential of visual form and particular datavis features.

Chapter Six continues to emphasise the social nature of datavis, but it moves onto mobilisation and (potential) political participation prompted by datavis. Drawing upon the sociological theorisations of political participation, it seeks to explore how the emotional experiences of datavis discussed in Chapter Five relate to people's mobilisation and political participation. The chapter empirically interrogates Nærland's (2020) conceptual statement and argues that datavis can mobilise people to act on many different levels. It develops a typology of participatory responses and political activities influenced by data visualisations from the micro/informal to the meso/semi formal and the macro/formal. It does this in several ways. Section 6.2 draws on Ekman and Amnå's (2012) understanding of political participation, arguing that sharing datavis with others and informal talks that people undertake as part of their daily lives can be seen as 'pre-political'. Section 6.3 uses Marres's (2016) ideas of approaching long-term everyday individual practices as a distinctive form of material participation. Finally, Section 6.4 draws upon Lamprianou's (2013) understanding of conventional (more formal and organized) and unconventional political participation. The three sections reveal that different categories of mobilisation triggered by various data visualisations are intertwined, overlap and exist across public and private, formal and informal, or online and offline spaces.

Chapter Seven outlines the roles that national and other demographic characteristics may play in emotional engagements with datavis and its ability to mobilise people to act. Section

7.2 explores national differences and similarities in datavis production and reception. It highlights how national and socio-political contexts play an important role in emotional experiences of datavis. Throughout this discussion, it is made clear that national differences can shape unequal access to and experiences of datavis and therefore mobilisation and political participation prompted by it, or lack thereof. In Section 7.3, consideration is given to other demographic differences, including age, education, ethnicity and race, gender, occupation and political affiliation. The section explores how different demographic groups engage emotionally with datavis and reveals that these differences may lead to unequal emotional experiences of datavis and consequently audiences' mobilisation or lack thereof.

Finally, Chapter Eight concludes the thesis by returning to the three research questions and reviewing the main findings and academic contributions for key substantive areas of the research. An analysis from across the four empirical chapters is brought together to present a coherent narrative of ideas. Key findings are presented within each theme of 'Emotions', 'Participation' and 'National and demographic differences.' I emphasise the importance of datavis as a topic worthy of sociological research, and why the sociology of emotions provides an important framework for it. Following this, the chapter acknowledges the limitations of the project and reflects on several suggestions for possible future studies. Finally, the chapter concludes with some final reflections and concluding thoughts.

Chapter Two:
Literature Review

2.1 Introduction

As explained in the introduction, in this thesis I develop a framework for understanding the role of data visualisation in enabling political participation and the roles that emotions and national and demographic differences play in these processes. I do this by bringing together four core bodies of literature and research, relating to data visualisation in society (Kress, 2009; Kennedy et al., 2016a, 2016b; Kennedy and Hill, 2017; Feigenbaum and Alamalhodaei, 2020; Nærland, 2020); sociological perspectives on emotions (Hochschild, 1989; Ahmed, 2004; Burkitt, 2014); political participation, social movements and emotions (Ekman and Amnå, 2009; Coleman, 2013; Lamprianou, 2013; Flam and Doerr, 2015; Wahl-Jorgensen, 2019); and diversity and inequality issues in data studies (D'Ignazio and Klein, 2016; Peck et al., 2019; D'Ignazio and Bhargava, 2020). As my focus is sociological, wider interdisciplinary scholarship on datavis (e.g. Tufte, 2001; Kirk, 2012 and 2016; Kosara and Mackinlay, 2013; Cairo, 2016 and 2020; Rosling et al., 2018; D'Ignazio and Klein, 2020) will not be included in my literature review and my analysis due to slightly different epistemological assumptions. My literature review is split into four corresponding sections.

I begin by exploring sociological approaches to datavis (Section 2.2) and emotions (Section 2.3), why they matter for social science, and the relationship between them. I do this to understand the place of datavis and emotions in social theory today and to situate my research within these debates. The chapter then proceeds to Section 2.4 to conceptualise political participation and explain how it is understood in this study. I distinguish between political participation and civil (latent political) participation and consider the relationship between these two, in terms of emotions and visuals. In the final section, 2.5, I first explain why national and demographic differences matter in data studies and why I consider them important in my project. I then introduce the two countries I compare in the study: Poland and the United Kingdom. In the conclusion of the chapter, each of these knowledge bases will be interlinked to show how I will answer my research questions and address the overall research aim.

2.2 Data visualisation in society

2.2.1 Sociological importance of data visualisation

There has been a rapid popularization and huge rise in the visual communication of information in the form of visualisation in everyday social life in the last decade. Data and datavis are ubiquitous and people "encounter them with growing frequency" (Kennedy and Engebretsen, 2020, p.24). There are several factors that have influenced this. Many aspects of social life have been transformed into online quantified data, including health, politics, casual conversations, and emotional responses (van Dijck, 2014). This process of quantifying the world is called datafication (Mayer-Schönberger and Cukier, 2013) and has grown over the past decade to become "an accepted new paradigm for understanding sociality and social behaviour" (van Dijck, 2014, p.198). New digital tools allow people to generate, process, analyse, visualise and spread a massive amount of data, while open data initiatives and online networks make it more accessible not only for big companies but also for ordinary citizens (Kennedy and Engebretsen, 2020) to participate in data-driven societies more fully. Datavis is based on data, statistics, or numbers, and therefore it appears objective (Beer, 2016; van Dijck, 2014), offering an illusion of "total knowledge" (Rettberg, 2020). Since many people access data mainly through data visualisation, the "desire for numbers" (Kennedy, 2016) and objective knowledge leads to more datavis.

For these reasons, many scholars (including D'Ignazio and Klein, 2016; Kennedy et al., 2016b; Kennedy and Hill, 2017; Kennedy and Engebretsen, 2020; Nærland, 2020) consider not only data but also datavis to be an important sociological phenomenon. Some suggest that it is a powerful social and political tool that not only facilitates access to information but can also empower citizens in decision-making processes (see Kennedy and Engebretsen, 2020; Nærland, 2020). It is suggested that the effective use of datavis can increase understanding of abstract numeric information by ordinary people, especially in terms of low literacy and vulnerable audiences (Alamalhodaei et al., 2020).

However, data visualisations have different purposes depending on, among other reasons, who produces them. They can empower understanding, but they can also facilitate persuasion or manipulation, consolidate existing power relationships, and create new ones

(Kennedy and Hill, 2017). For these reasons, in data-driven societies (Pentland, 2013), providing data through visual representations is useful not only for citizens, but also for the politicians and activists who use them, in some cases, to influence the public, as seen in the previously mentioned data visualisation in Figure 3. The line graph was used in the campaign for the Leave vote in the EU Referendum that took place on 23rd June 2016 in the UK.

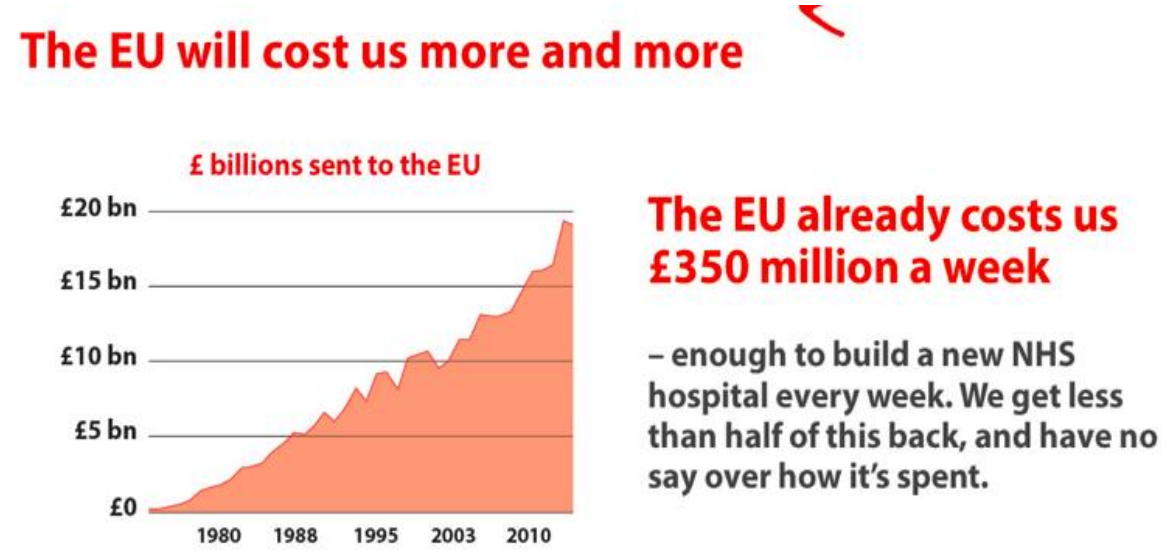


Figure 3: One of the ads distributed during the Vote Leave campaign

Source: Vote Leave: Thank You, December 2019

Despite this growing social and political significance of data visualisation, there remains little bottom-up research on non-experts' (or audiences') engagements with and perceptions of data visualisation. Until recently, when such a study has taken place, it has often been carried out from a computer science perspective in the controlled conditions of the laboratory, examining data visualisation effectiveness (Haroz and Whitney, 2012), memorability (Haroz et al., 2015) and data visualisation recognition and recall (Borkin et al., 2015), or from a psychological perspective through cognition of data visualisations (Harold et al., 2020).

In those cases, data visualisation was seen as an isolated and independent text. Researchers did not comment on engagements with datavis outside of the laboratory, and they often did

not provide much information about the study participants. As Kennedy and colleagues argue (2016b), such studies overlook socio-cultural context, history and individual factors, such as: who engages with datavis and where; whether the person is alone or with others; and the time, attention and technological devices used. In my study, I consider all these factors as important as, together, they may present a complete picture of the audiences' perspectives and the phenomena I am investigating.

Moreover, I argue that datavis is located in wider social and cultural contexts (Kennedy et al., 2016b) and cannot be treated and analysed simply as visual text. It is often produced to communicate and privilege certain perspectives and should be contextualised in social and power dynamics. Therefore, for the purposes of this thesis, I adopt Kress's (2009) approach to visual communication: social semiotics, which "is concerned with meaning making and meaning makers" (Jewitt and Henriksen, 2016, p.145) and posits that meaning is always formed and shaped by social processes. I discuss this approach in more detail in Chapter Three.

However, despite the dominance of research that often does not take into account social contexts and factors, there are a few important exceptions that provide insight into experiences and perceptions of data visualisation from a social science, qualitative perspective (see Kennedy et al., 2016b; Kennedy and Hill, 2017; Peck et al., 2019). Kennedy and others (2016b) identify six socio-cultural factors that affect engagements with visualisations including subject matter; source/media location; beliefs and opinions; time; emotions; and confidence and skills. The authors build on methods from media audience research and suggest that socio-cultural factors and differences amongst users matter and affect engagement with datavis. They should therefore be taken into account by visualisation producers "in order to generate data visualizations that reflect the highly contextualised and mediated character of everyday engagements with them" (Kennedy et al., 2016b, p.18).

Peck and colleagues (2019) focus on factors that may drive attention to and trust in datavis among rural populations in Pennsylvania (USA) with diverse economic and educational

backgrounds. Forty-two semi-structured interviews suggest that a complex set of factors, including education, political affiliation and personal experience, inform attitudes and perceptions about data visualisation. The authors argue that "for people to engage with data, it may be necessary to not only provide mechanism that allow people to explore personal dimensions of data, but to make sure those personal dimensions are front-and-centre in first encounters with a visualization" (p.10).

Finally, Kennedy and Hill (2017) investigate emotional responses to a number of factors related to datavis, which are discussed later in this chapter, and argue that emotions play an important role in engagements with datavis. Moreover, based on their findings the researchers acknowledge that "datafication is not constituted solely through data structures; rather, it is lived and experienced at the level of the everyday" (Kennedy and Hill, 2017, p.11). These projects suggest that it is important to engage with datavis through a qualitative sociological lens and view datavis "as objects for critical consideration, not just as a tool which can communicate data" (Kennedy et al., 2016b, p.1) because contexts and who engages with datavis matter and can influence perceptions and experiences of datavis.

Some authors (Kennedy and Engebretsen, 2020; Nærland, 2020) have further developed this debate. Kennedy and Engebretsen (2020) suggest that emotional engagement with datavis is related to their visual aspects and their "ability to elicit social engagement" (p.11). In his work on the political significance of data visualisation, Nærland (2020) goes further and suggests that visualisation might mobilise people to act as citizens and take part in political debates or activities. He understands people's engagement with political issues to be a result of not only "rational judgements and uptake of factual information" (p.44) but also certain "feelings and belongings" which can motivate people to act as citizens, including "sympathies, antipathies, identifications, passions, and so on" (p.44).

These statements of Kennedy and Engebretsen (2020) and Nærland (2020) are significant for my research and suggest that emotional engagement with data visualisation may mobilise people to act and have an impact on their political participation. However, these

issues have not been researched empirically and little is known about the nuances and relationship between datavis, mobilisation and the role of emotions in these processes.

Acknowledging these debates and research, I hypothesise that due to the aforementioned features of datavis – its availability, sophistication, impression of being objective, and its knowledge-giving, persuasive and emotive characteristics – engaging with datavis may have an emotional impact on people's political participation. I understand engagement as "the processes of looking, reading, interpreting and thinking that take place when people cast their eyes on data visualisations and try to make sense of them" (Kennedy et al., 2016 cited in Kennedy and Engebretsen, 2020, p.12).

I will analyse three layers of engagement as outlined by Kennedy and Engebretsen, as each interrelates with all the others. The first layer refers "to the actual interaction with a datavis and being engaged with it"; the second, "to emotional and practical responses and getting engaged by it"; while the last layer relates "to broader audience responses, for example the ways in which data visualisations are mobilised to prompt political engagement" (Kennedy and Engebretsen, 2020, p.12).

2.2.2 Emotional experiences of data visualisations

As discussed in the previous chapter and above, most studies in areas such as science communication have focused to date on the capacity of data visualisation to convey knowledge, its efficiency, or comprehension (see Haroz and Whitney, 2012; Haroz et al., 2015; Borkin et al., 2015; Harold et al., 2020). This may be related to the belief that data, statistics, and therefore datavis do not have a large emotional impact on audiences, unlike other visuals, for example emotive images (see for example, project and research Climate Outreach, 2021). Therefore, the purpose of datavis can be seen by many mainly as a tool allowing a recipient to independently explore data and draw empirical conclusions. In these processes, emotions do not play a significant role.

This debate about the effectiveness of datavis in conveying knowledge and data was initiated by Otto and Marie Neurath in the 19th century. They invented the visual language

Isotype which main aim was to display rational empirical-based quantitative information through graphics to facilitate understanding "across barriers of class, culture and education" (Nikolow, 2013, p.85). Otto Neurath himself commented on the importance of emotions, or rather the lack of them, in his work, juxtaposing it with the written words:

> Finally it should be noted that the picture education, especially the pictorial statistics, are of international importance. Words carry more emotional elements than set pictures, which can be observed by people of different countries, different parties without any protest; Words divide, pictures unite (Nikolow, 2013, p.85).

However, with the growing popularity of data visualisation as an increasingly important means of communicating information to publics and its ubiquitous presence in the media, visualisation designers began to acknowledge the importance of 'emotional design' (Kennedy and Hill, 2017) and to deliberately use or talk about emotions in their work (e.g. Chalabi, 2016; Kirk, 2016; Lupi, 2017; Rosling et al., 2018; Cairo, 2019).

For example, prominent datavis designer Giorgia Lupi (2017) suggests that data visualisation can transform and simplify (usually quantitative) data into something that can not only be seen, but also felt and reconnected to people's lives. Some other datavis professionals discussed this emotional dimension of visualisation during the 'S-H-O-W conference on datavis and information design' in 2019 in Utrecht. The conference organisers suggested in the invitation to the event several reasons why emotions in visualisation design might be important:

> Data is numbers, facts, true, bold. When we communicate data to an audience in a visual way, we need to add an emotional layer of design to convince the audience, to guide them, to attract them, to make them click. How can design choices help to add emotion to raw data? How do we bring the story across? How can we feel the numbers? (S-H-O-W, 2019)

Other datavis experts in the Tableau community, Kosara, Phillips, and Misner, also discussed ways to tell emotional stories that audiences can personally relate to through datavis. Finally, in 2016 in her talk at the OpenVisCon, data journalist Mona Chalabi suggested that "there is no such thing as an emotionless data visualisation" (Chalabi, 2016). As she explained, data visualisation always has an emotive charge because the person who designs it has emotions and feelings about the presented information and these emotions and feelings are often, consciously or not, embedded in their visual design decisions.

Nevertheless, the use of emotions in visualisation is not always obvious. When commenting on the Periscopic's data visualisation 'U.S. Gun Deaths', journalist and designer Alberto Cairo (2013) contrasted quantitative data with emotions and argued that for historical reasons people assume the former to be objective, while the latter are the source of cognitive biases. He explained that while emotions are messy and may lead to deviation from rational thinking and judgements, 'the proper handling of data' is the most reliable antidote to this deviation.

Eventually, Cairo changed his mind, influenced by Alberto Lucas's data visualisation (Figure 4) published in *National Geographic* magazine. The cut-out visualisation presents the countries with the highest percentage of children under five suffering from malnutrition. It includes a mid-upper-arm circumference called the MUAC bracelet (on the right), which is used to help assess the malnourishment level of children from the six selected countries.

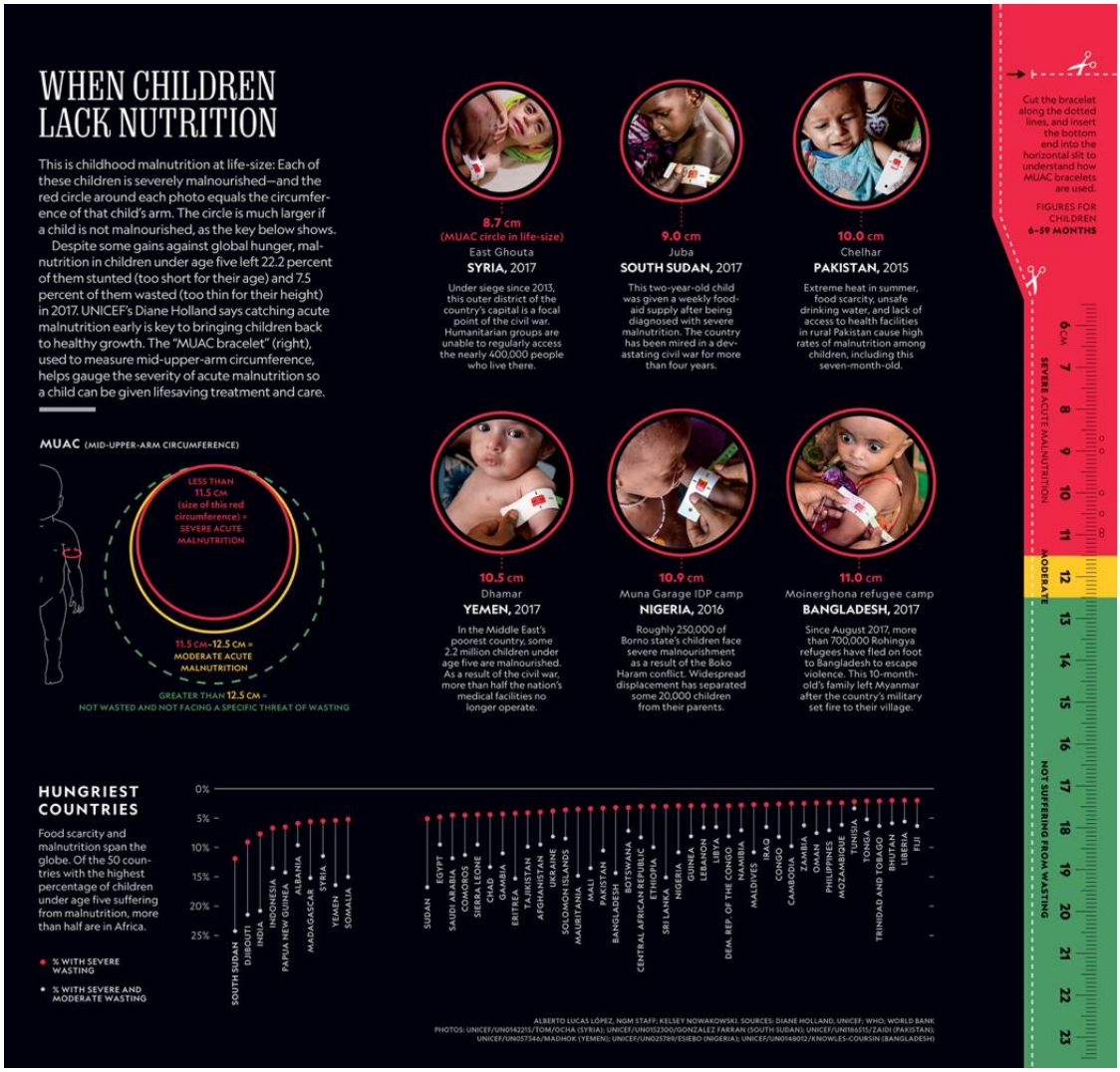


Figure 4: Cut-out data visualisation: When Children Lack Nutrition

Source: *Information is Beautiful* awards, March 2020. Author: Alberto Lucas López. How to use this cut-out datavis can be found here.

Affected by the strong message of this project, Cairo admitted that datavis can convey empathy in the sense of "sharing another person's emotions or feelings": "Once I realized that the size of the red circles is the actual circumference of those children's upper arms, I felt my stomach tighten. I didn't even need to see the children's photographs to feel uneasy and worried" (Cairo, 2019). However, the designer did not acknowledge that people can have more emotions of their own than just the feeling of empathy he mentioned, which in my understanding is a limited way of thinking about the emotions and datavis relationships.

In the limited social science literature on people's experiences of datavis, it is also agreed that individuals respond to datavis emotionally as well as rationally and therefore emotions should be considered as an important factor while studying engagement with datavis (see Kennedy and Hill, 2017; D'Ignazio and Bhargava, 2020; Gray, 2020; Simpson, 2020). Despite the indicators that emotions might matter in datavis, until recently, the affective dimensions of visualisation have been under-explored (D'Ignazio and Klein, 2016).

One exception to this is the work of Kennedy and others (2015; 2016b) on the Seeing Data project. The project used mixed qualitative methods and aimed to understand how non-experts make sense of data visualisations. The main findings show that engaging with statistics not only involves reason and cognition, but also emotions. Based on this study, Kennedy and Hill (2017) identified emotional responses to a number of factors related to datavis, including "visualisations in general; represented data; visual style; the subject of data visualisations; the source or original location of visualisations; and skill levels for making sense of visualisations" (p.5). The researchers noticed strong feelings in relation to those factors, such as "pleasure, anger, sadness, guilt, shame, relief, worry, love, empathy, excitement, offence" (Kennedy and Hill, 2017, p.6). As they point out, it was much easier for people to engage with data when they felt confident about their skills, which means that feelings play an essential role in audiences' experiences and understanding of data and their visualisation. This research took a first step in acknowledging that emotions play a role in engaging with datavis, sparking a scholarly debate.

Some authors (D'Ignazio and Bhargava, 2020; Gray, 2020; Simpson, 2020) have further developed understandings about the emotionalization of datavis. D'Ignazio and Bhargava (2020) argue in their work on data visualisation literacy that an emotional connection to datavis is crucial in the learning processes. Gray (2020) explores the "techniques and politics of producing aesthetics of distance" (p.220) in two 'cinematic data visualisations' created by Neil Halloran: 'The Fallen of World War II' and 'The Shadow Peace: The Nuclear Threat'. Gray examines "how data visualisations can articulate not just "ways of knowing" but also "ways of feeling" with data" (p.210) and suggests that those techniques and politics "may be relevant in relation to narrating and making sense of other complex and transnational

issues such as climate change, migration, and inequality" (p.220). Simpson (2019), on the other hand, discusses her subjective emotions about the design and circulation of her hand-drawn, small-data visualisation based on her own experience with Obsessive Compulsive Disorder.

While the work of these scholars has started a debate there remain several knowledge gaps to examine. Therefore, I go beyond what Kennedy, Hill and others have done, and building on their work, I focus on the following concerns: how and what different kinds of emotions do different datavis evoke; which of them dominate; and where can it lead? Before discussing literature related to political participation and why national and demographic differences matter in my study, I will explore sociological understandings of emotions to understand the place of emotions in social theory today and to situate my research within these debates.

2.3 Sociological perspective on emotions

2.3.1 Historical background

The study of emotions goes back to the late 19th century (see James, 1884; Lange, 1885). In Western capitalist societies, emotions have historically been considered in opposition to rationality. "Love, hatred, and all purely personal, irrational, and emotional elements which escape calculation" (Weber, 1946, p.216) were expected to be managed in a personal manner. Emotionality has been associated with the irrational, the natural, the private, and the female, whereas rationality has been associated with the rational, the cultural, the public, and the male (Jaggar, 1989).

Turner (2009) asks why such an essential part of daily life that impacts society on both the micro and the macro level was not "central to sociology's mission from the very beginnings of the discipline" (p.340). He suggests two main reasons: first, "early sociology was decidedly macro in its concerns with societies as a whole"; second, "foundational work of George Herbert Mead (1934) on micro social processes was, surprisingly, devoid of a conceptualization of emotions" (Turner, 2009, p.340).

The sociological focus on emotions has expanded since the 1970s when related theories and studies began to be developed in the areas of gender, class, politics, work, and family (see for example, Hochschild, 1989; Jaggar, 1989; Kemper, 1978; Thoits, 1990). Researchers began to discuss emotions and develop research on emotions to gain a deeper understanding of their socio-cultural dimensions. Emotions began to be treated as social processes, not just unconscious, biological, physiological or psychological ones.

Kemper (1978) emphasises the social aspect of emotions and mostly focuses on shame and pride. Jaggar (1989) claims that emotions are socially constructed and depend on how people perceive the situation, as well on how they have learned or decided to respond to them. Hochschild is more empirical. She is the founder of theories of 'feeling rules', 'emotional labour' and 'emotional work', which are based mainly on her original research in the airline industry. Her pioneering work was published in 1979 and since that time it has influenced many social scientists. I believe that her work makes the most significant contribution to the study of emotions and my research. Therefore, I will discuss her work in more detail below and focus on this framework due to its importance as empirically grounded sociological research.

Although the sociology of emotions is a fast-evolving field, little work has been done to define the concept of 'emotion'. Thoits (1990) offers a list of the components that sociologists use to explain this phenomenon, such as: appraisals of a situational stimulus or context, changes in physiological or bodily sensations, "the free or inhibited display of expressive gestures, and a cultural label applied to specific constellations of one or more of the first three components" (p.318). Emotions are understood here as something more than a biological and mental state. They are a relationship between cultural context, social situation, biological internal bodily responses, and visible external behaviour.

More recently, significant progress has been made in understanding emotional dynamics in their sociocultural context. Turner and Stets (2011) explore "how the study of emotions has added new insight into other subfields within sociology", including "the study of the workplace, health, and social movements" (p.4). The authors discuss specific emotions

including love, jealousy, envy, empathy, anger, and grief (Turner and Stets, 2011). They argue that these emotions drive human behaviour, interaction, and social organisation. Since 2000, many studies of emotion have been carried out in the fields of politics, education and family (e.g. Ahmed, 2004; Burkitt, 2014; Hochschild, 2016). Also, new theoretical and research fora have emerged, such as the 'Emotion, Space and Society' network in 2008 or the *Emotions and Society* journal in 2019.

Having provided an overview of the history, key ideas and theories within the sociology of emotion, I now turn to focus on specific authors – Hochschild (1989), Ahmed (2004) and Burkitt (2014) – and to thoughts essential to my research. I first point out the main challenges and issues that remain problematic or unclear within the sociology of emotion, including the degree to which emotions are biologically based, and in doing so situate my research within these debates.

2.3.2 Biologically based or socially constructed?

Two fundamental models have dominated discussions about emotions. According to Hochschild (1989) for organismic theorists, emotions are mainly a biological process, and therefore different categories of people have basic emotions that are similar and linked to their bodies. Interactionists, on the other hand, say that emotions are not only bodily and argue that social factors shape them. Hochschild (1989) acknowledges both ideas and explains her position with reference to her empirical work on managing emotions. She argues that emotions originate inside the body, but they always depend on the particular situation and are therefore both biological and social (p.x). Feelings, on the other hand, are social expressions of the emotional state of the individual (Hochschild, 1989). I follow this understanding in my work and do not use the terms emotions and feelings interchangeably.

Burkitt (2014) also argues that feelings and emotions must be considered as part of a broader socio-cultural context. They are "bodily sensations that result from some change in the organism as it consciously orientates itself to situations and their likely outcomes" (Burkitt, 2014, p.6). The way we perceive the world and our past experiences matter because they create patterns of our relationships with others and within these patterns,

emotions and feelings arise. In other words, emotions and feelings are always related to a particular situation and are therefore fundamentally social and not biological in an asocial sense (Burkitt, 2014). Moreover, they are defined through relationships with others, and this therefore makes them of sociological significance (Burkitt, 2014).

Ahmed (2004) raises this same point differently. She addresses the question of 'what do emotions do?' by describing them as performative. They circulate and produce a relationship between the individual and the social and this circulation allows us to think about the "sociality of emotion" (Ahmed, 2004, p.8). Furthermore, emotion is irreducible to the biological origin and bodily sensation because it "always involves appraisals, judgments, attitudes or a 'specific manner of apprehending the world'" (Ahmed, 2004, p.194). Ahmed and Burkitt (2004; 2014) agree that one of the main obstacles in understanding the social aspect of emotions is the language we use to express them. For example, when we ask; 'how do I feel right now' we always look inside ourselves because "everyday language of emotion is based on the presumption of interiority" (Ahmed, 2004, p.8). Furthermore, emotions are something 'we have' and so are considered as an 'object' that arises and is registered in our body or mind (Burkitt, 2014). This explains why emotions have been associated with psychology and individual mental states in everyday language and life. In this personal model, "I have feelings, and they are mine" (Ahmed, 2004, p.8). However, as Ahmed, Burkitt and Hochschild argue, this explanation is not enough.

The authors discussed above argue that emotions originate neither exclusively in the body nor in the brain but arise from a context, circumstances and relationships with others and things, which gives them sociological significance. In this context, it is necessary to discuss the distinction between emotion and affect. Some scholars maintain that this distinction is not significant, and use affect to describe anything related to emotions, while others recognize and consider the distinction to be significant. For example, Wahl-Jorgensen (2019) claims that emotion cannot be seen as an internal and individual, while affect is "a bodily sensation in an individual, a reaction to stimuli characterized by intensity and energy, but without a conscious orientation and interpretation" (p.7). I acknowledge that these debates exist, but they are not relevant to my work. In this thesis, I use the language of emotions,

not the language of affect. I argue that emotions should be perceived as a comprehensive phenomenon, not solely social, psychological or biological. They are "best seen as complexes of different feelings and bodily sensations that are organised within local cultures at specific historical times and places and thereby given a meaning" (Burkitt, 2014, p.2). They circulate in the body and mind but also in social networks and relationships with others, things and the world (Ahmed, 2004).

I have tried to show above that emotions do not originate exclusively in the body or the brain. I view them as bodily and social and consider them through relationships with others (Hochschild, 1989), which gives them sociological and political significance (Ahmed, 2004). Therefore, the importance of context, in a cultural, historical and personal sense, cannot be ignored. In this thesis, I use this sociological understanding of emotion and explore how emotions are created in social relations and circulate in relationships between people and data visualisations, which gives them sociological significance (Burkitt, 2014). I focus mainly on Hochschild's (1989) work as it is the most empirical and her arguments about emotion management are highly relevant to my study. In the next subsection, I explore her main concepts and research on emotions that I will use in my research.

2.3.3 Emotional work and feeling rules

As indicated previously, Hochschild (1989) states that emotions have a biological basis, but people contribute to the creation of feelings while they manage emotions. Moreover, the researcher shows how individuals regulate their emotions internally or externally to conform to what is socially appropriate and to fit in with the norms of the situation and context in which they find themselves.

Hochschild (1989) argues that 'emotional labour' occurs when people have to manage their emotions in paid work because they are asked to do so, while 'emotional work' is when people are expected to manage their feelings in other areas of life. Both terms point to the conflict between the feelings that a person has and feelings that are appropriate to the situation, cultural and social patterns, norms and expectations. Hochschild describes these patterns, norms and expectations as 'feeling rules' and argues that they guide emotional

work. Moreover, Hochschild (1989) argues that people do emotional work and try to fit in with feeling rules not only internally but also externally by creating an expected publicly observable facial and bodily display, and therefore, as the researcher argues, emotion management is a social act, never a private one.

According to Hochschild (1989), people can regulate emotions in two ways, through surface or deep acting. In the first case, changes occur at the level of the body language and appearance. People pretend to look a certain way, for example happy or sad, but these emotions are not experienced by them. In deep acting, people also change on a mental level. They not only try to seem happy or sad, but also deceive themselves that they really feel that way. In both cases "the actor has learned to intervene – either in creating the inner shape of a feeling or in shaping the outward appearance of one" (Hochschild, 1989, p.35). Feelings do not erupt spontaneously but are displayed by the social actors who evoke, suppress or allow emotions to surface. They can "squash their anger down or try hard not to feel disappointed" (Hochschild, 1989, p.39).

The above considerations indicate that emotions are socially mediated and constructed and should be interpreted in the context of the situation in which they exist. In my work, I focus on the 'feeling rules' that individuals learn through the process of socialization, and that can mean they behave in a certain way. I will mobilise this concept to answer one of my research questions: how and in what ways does data visualisation convey and evoke emotional responses? I consider emotions to be a central aspect of social and political experience and therefore a vital aspect of my research on data visualisation (as seen in Kennedy and Hill, 2017) and democratic participation (Nærland, 2012). To link to these debates, in the next section, I provide an overview of the literature that defines the concept of political participation and highlights the role emotions play in politics, social movements and political participation. I do this to explain how I understand participation in terms of this thesis and to make a link between political participation, emotions, and data visualisation.

2.4 Conceptualising political participation

2.4.1 Political participation and civil (latent political) participation

There is no universally accepted definition of political participation. Most conceptual frameworks are broad and refer to the ways in which people engage in public affairs or politics, or to what extent they do so. A traditional and more established understanding refers to "a set of rights and duties that involve formally organized civic and political activities" (Lamprianou, 2013, p.22, referencing Riley et al., 2010), but political participation can also be defined "in terms of the degree to which citizens are exercising their right to engage in political activities" (Lamprianou, 2013, p.22).

Furthermore, many political and social scientists (Coleman and Blumler, 2009; Dalton, 2008; Warren, 2002) argue that most people in Western societies identify democracy with regular elections, and therefore political participation is historically understood as limited to the act of voting. Nevertheless, democracy is something more than that: it is also the freedom to speak or organize for opposition to the government; the government's responsibility towards public opinion; and the existence of a civil society sector free from state or market control (Coleman and Blumler, 2009). The degree to which these conditions occur and are practised by the government and citizens indicates the level and type of democracy in a given country. For example, in an elite-dominated democracy, citizens may have limited and occasional impact on power while in the case of more inclusive democracies, public debate, deliberation and political participation can influence decisions made by the government (Coleman and Blumler, 2009).

Many social and political scientists (Dalton, 2008; Bang, 2009; Lamprianou, 2013) argue that political participation takes on extremely diverse forms, including voting in elections and being a member of a political party or civic organisation; but also supporting public interest lobbies, direct contact with politicians or signing petitions. Lamprianou (2013) points to two types of participation – conventional and unconventional – arguing at the same time that this distinction is to a certain extent artificial and elusive. In this division conventional forms are usually structured and normally lawful, for example "being a member of a political party, voting, lobbying, campaigning, attending political meetings, contacting officials, etc."

(Lamprianou, 2013, p.25). Unconventional forms, on the other hand, are less traditional and mostly lawful but more and more popular nowadays, such as participating in protest marches, signing petitions, boycotting products, demonstrations, barricading a community, blogging and using social commentaries on talk radio (Lamprianou, 2013).

Furthermore, some authors discuss new unconventional types of activities that are enabled by digital media and based on growing digital social networks, such as online petitions or participating in political groups on Facebook (van Deth, 2016), and argue that new media and the Internet have changed the landscape of political participation by moving civic action away from traditional institutions (Bimber, 2002). The boundary between the private and public spheres is blurring and the importance of government and politics in everyday life is growing, some commentators claim (van Deth, 2016). Therefore, some researchers suggest that it is necessary to rethink what political participation in the current political age means, while taking into account digital and social media, social movements and collective actions (see for example, Bennett and Segerberg, 2014; Coleman, 2017; Gerbaudo, 2018).

For the purpose of this thesis, I suggest that the division between conventional and unconventional political participation or online and offline political participation is unhelpful. Moreover, I believe that new models of civic engagement can improve the quantity and quality of democratic processes (Dalton, 2008; Bang, 2009; Coleman and Blumler, 2009; Warren, 2002). I bring these perspectives together in this thesis, arguing that people participate "in political life in a number of ways that [often] do not formally relate to the political (parliamentary) domain" (Ekman and Amnå, 2012, p.291) and the traditional understanding of political participation.

I use Ekman and Amnå's (2012) distinction (see Table 1) between actual (manifest) political participation, understood as all goal-orientated "actions directed towards influencing governmental decisions and political outcomes" (p.289), and civil (latent political) participation, which refers to involvement and civic engagement that intends to "influence circumstances in society that is of relevance to others, outside the own family and circle of close friends" (Adler and Goggin, 2005, quoted in Ekman and Amnå, 2012, p.291). In both

cases, these can be individual or collective and online or offline actions. I agree with Ekman and Amnå (2012), that taking into account *latent* forms of political participation is necessary to understand new forms of political behaviour, including online participation.

Civil participation (latent political participation)		Manifest political participation		
Involvement (attention)	**Civic engagement (action)**	**Formal political participation**	**Activism (extra-parliamentary participation)**	
			Legal	**Illegal**
Individual forms				
Personal interest in politics and societal issues Attentiveness to political issues	Activities based on personal interest in and attention to politics and societal issues	Electoral participation and contact activities	Extra-parliamentary forms of participation: to make once voice heard or to make a difference by individual means (e.g. signing petitions, political consumption)	Politically motivated unlawful acts on an individual basis
Collective forms				
A sense of belonging to a group or a collective with a distinct political profile or agenda Life-style related politics (e.g. identity, clothes, music, food, values)	Voluntary work to improve conditions in the local community, for charity, or to help others (outside the own family and circle of friends)	Organized political participation: membership in conventional political parties, trade unions and organizations	Loosely organized forms or network-based political participation: new social movements, demonstrations, strikes, and protests	Illegal and violent activities and protests: demonstrations, riots, squatting buildings, damaging property, confrontations with the police or political opponents

Table 1: Ekman and Amnå's understanding of latent political participation and manifest political participation.

Source: Reprinted from "Political participation and civic engagement: Towards a new typology" by Ekman and Amnå (2012), Human Affairs, 22 (3), p.292.

In the case of actual (manifest) political participation, as in Lamprianou's (2013) division discussed above, there are both more formal (conventional) forms of participation – such as voting, being a member of a political party, campaigning or contacting officials – and less formal forms of activism, described by Ekman and Amnå (2012) as extra-parliamentary participation or "new" forms of political participation, including taking part in demonstrations or strikes, engaging in political protests, boycotting and political consumption or signing petitions. On the other hand, civil (latent political) participation

takes into account all the other ways in which people engage in political life that do not aim directly at any specific actor, such as discussing politics, following political issues, writing to editors, donating money, volunteering to help others or solve local problems, or recycling for environmental reasons (Ekman and Amnå, 2012).

This understanding of civil participation covers involvement, decisions, acts and practices that people undertake as part of their daily lives that do not formally relate to the political domain but can be seen as 'pre-political' (Ekman and Amnå, 2012). Like Dahlgren (2002), I understand (online and offline) communicative interaction among citizens, which starts with informal everyday conversation, as a central element of democracy and politics and an expression of political participation. Barber (1984) argues that such informal, mundane, everyday conversation makes collective actions and political participation possible by enabling individuals to make connections between their private lives and their sense of belonging. It also reflects the kind of society citizens may wish to create and live in.

Moreover, I refer in my work to a distinctive form of material participation discussed by Marres (2016) in her work, which occurs with everyday material things, not just with words. The author argues that material participation "occur primarily on the level of practice" (p.xii) and that material objects including environmental devices "are explicitly ascribed the capacity to enable political participation: they are deliberately invested with the ability to render complex public problems such as climate change available for practical intervention by everyday people" (p.xii). Following Marres (2016), I therefore suggest that material practices and 'small changes' in everyday routines "can offer a far more effective approach to societal and environmental change than more comprehensive efforts to change society" (p.xiv).

Adopting this bottom-up, grounded approach to understanding political participation enables me to identify and recognize a broad range of audiences' political engagements and practices with datavis and the paths that lead to them. In this thesis, I use the notion of a continuum of political practices which implies a progression from individual political engagement in the private sphere to various types of political participation on a more public

and collective scale (Ekman and Amnå, 2012). Importantly, I understand political participation as a result of not only rational judgements but also of certain feelings which can motivate people to participate in public life, since a number of scholars argue that emotions have to be considered as being integral to politics (Ahmed, 2004; Coleman, 2013; Wahl-Jorgensen, 2018; Nærland, 2019). Therefore, in the following subsection, I map out some links between political participation, such as social movements and collective action, emotions and visuals, taking into account the impact of the Internet and digital media.

2.4.2 Links between participation, emotions and visuals

Along with the affective turn, many scholars in the field of political communication have moved their attention to emotions (see Coleman, 2013; Papacharissi, 2015; Boczkowski and Papacharissi, 2018; Wahl-Jorgensen, 2019). Wahl-Jorgensen (2018) argues that emotions must be considered as integral to politics, and it is necessary to discuss citizens' emotions currently, not only because emotions shape power relations and social meanings, but because emotions are also shaped by them. She states that there is no such thing as the dispassionate citizen because "a political brain is not a dispassionate calculating machine, objectively searching for the right facts, figures and policies to make a reasoned decision" (Wahl-Jorgenson, 2018, p.27). In other words, "the political brain is an emotional brain" (Wahl-Jorgenson, 2018, p.27) and therefore civic involvement or political participation is a result of not only rational judgements but also of certain feelings which motivate people to participate in public life.

Coleman's (2013) research on voting, based on a series of interviews with voters and non-voters in the UK, demonstrates that through political participation individuals show who they are and what they feel. He discusses the emotional experiences of democratic participation and argues that people often 'go with their guts' when voting, even though they are well-informed because "what democracy does and how democracy feels are not separable considerations" (Coleman, 2013, p.191). He describes this as democratic sensibility, or "ways of being attuned to the world, intellectually, emotionally and physiologically" (Coleman, 2013, p.192). This sensibility highlights the importance of emotions in decision making and political participation. Coleman (2013) suggests that

emotion should not be positioned against reason while discussing civic engagement or participation. His research is one of the foundations for my project as it shows that citizens' emotional engagement in politics is a commonplace occurrence that challenges the distinction between rationality and emotions in politics and political participation.

As noted in the previous chapter, many scholars agree that the emergence of digital technologies has influenced political participation (e.g. Bennett and Segerberg, 2014; van Deth, 2016; Coleman, 2017). Most people have access to a vast number of opinions online; they comment, produce, and (re)distribute news and information (Boczkowski and Papacharissi, 2018, p.26). Social media has created spaces where individuals can communicate by sharing not only opinions but also emotions in order to deliberate about the common good. Many people express themselves on these platforms because they care about an issue, or they are affected by it (Boczkowski and Papacharissi, 2018, p.79).

Some researchers have emphasised this connection between social media platforms and emotions (see for example, Papacharissi, 2015; Gerbaudo, 2016). In relation to social movements and collective actions, Boczkowski and Papacharissi (2018) argue that social media have a strong emotional aspect and can empower hate groups that use anger to spread and legitimate their ideas. Nevertheless, anger, most visible currently in the public sphere, "at the same time can be vital to energizing and shaping the activities of activists representing groups that might otherwise be disempowered or marginalized" (Wahl-Jorgensen, 2018, p.12). Positive emotions like love, on the other hand, "can foster the conditions for compassion with others who might be very distant and different from us" (Wahl-Jorgensen, 2018, p.14).

Much literature on new social movements and political participation emphasises the role of emotions in protests and attracting or persuading potential members (see Jasper, 1998; Goodwin et al., 2001; Flam and Doerr, 2015). This literature claims that protests are built on strong emotions and that social movements often use images to invoke 'moral shock' to recruit uninvolved citizens. The shock can include anger and indignation, fear and disgust, joy, love" (Goodwin et al., 2001, p.2), and occurs "when an unexpected event or piece of

information raises such a sense of outrage in a person that she becomes inclined toward political action" (Goodwin et al., 2001, p.16).

Activists recognize emotions as one of three elements of persuasion which are often used together to mobilise people to act. The first element, rational argument, is used to provide facts. The second, moral element appeals "to people's values and attempts to awaken their sense of justice" (Collective, 2014, p.7). Finally, emotional argument is considered to be the most powerful of the three appeals, seeking "to stir people's empathy and compassion regardless of underlying social norms and personal notions of justice" (Collective, 2014, p.7). According to Goodwin and colleagues (2001), activists often try to create moral anger to spur participation by weaving together a moral, cognitive, and emotional arguments.

Some studies (e.g. Doerr, 2010; Flam and Doerr, 2015) show that activists generate specific visuals to impose particular feeling rules on their viewers. Flam and Doerr (2015), for example, demonstrate how right-wing activists in different European countries use visual images to mobilise hatred and fear against immigrants. Flam and Doer (2015) use Jasper and Poulsen's work (1995) on moral shocks to argue that "images should be seen as an organisational resource that helps to connect formerly unlinked people, even more so in the contemporary media environment that facilitates such connections through computer-mediated social networks" (p.11).

The above considerations are important for my research because they show that both emotions and visuals have a significant impact both on how people participate and express themselves on social media, and on how activists attract and influence their potential audiences online and offline. I build on the above-mentioned findings to explore whether emotions play a role in mobilising people to act. In so doing, it is important to think about differences, and I turn to that issue next.

2.5 The importance of differences

2.5.1 Data and data visualisation research

It has been argued in the previous sections that data and thus datavis is neither neutral nor objective; they are shaped by and reflect social divisions and unequal social relations (D'Ignazio and Klein, 2020). Some critical data studies research highlights potential class, race and gender inequalities and discrimination which are reproduced by big data (see Eubanks, 2018; Noble, 2018). Research shows that big data and data practices are not without risks and threats but an "ideology" that can discriminate and therefore needs to be critically interrogated (van Dijck, 2014). Despite this data and discrimination scholarship focusing on structural inequalities, a number of practitioners argue (such as Kennedy et al., 2020; D'Ignazio and Klein, 2020) that there is still an absence of attention to diversity and inequality in research into audiences' perceptions of data and datavis. The exceptions to this are studies by Kennedy and colleagues (2016b); Peck and colleagues (2019); and D'Ignazio and Bhargava (2020), which acknowledge demographic differences and potential inequalities in their 'bottom up' understandings of data practices. These studies suggest that it is important to explore the experiences of different groups that may be affected by these structural inequalities to understand them fully.

The research by Kennedy and colleagues (2016b), already mentioned in this chapter, used various methods, including diary-keeping, focus groups and interviews, and focused on factors that affect engagement with various visualisations among participants from different organisations or social groups. The authors argue that acknowledging different socio-cultural factors and contexts in visualisation research can lead to a better understanding of how to think about datavis and its effectiveness. For example, some people in the study felt like they did not have the skills and knowledge to make sense of visualisations, which raised significant questions about how people make sense of datavis in order to participate in data-driven societies and why some of them feel they do not have the skills and knowledge to do so (Kennedy et al., 2016b).

Peck and colleagues (2019), on the other hand, focus on rural populations. They claim that "rural people are particularly vulnerable to information paucity due to economic and

infrastructure challenges" (p.1) and are at the same time largely under-represented in the visualisation literature. Their semi-structured interviews with participants with diverse economic and educational backgrounds were conducted in rural Pennsylvania in the USA. The authors found that a complex set of factors, including educational background, political affiliation, and personal experience, all informed participants' attitudes and perceptions about data visualisations.

Finally, the work of D'Ignazio and Klein (2016) and D'Ignazio and Bhargava (2020) suggest some structural reasons for inequalities in datavis perceptions and understandings. The authors criticize mainstream approaches to datavis teaching, arguing that data and the skills to work with it are not evenly distributed. Leading institutions that "have the resources to undertake this work" with data are mainly "corporations, governments, and elite universities" (D'Ignazio and Bhargava, 2020, p.130). The vast majority of those who do such work are wealthy, White, and male, who overly emphasise the technical approach to teaching and learning datavis.

Based on their research, D'Ignazio and Bhargava (2020) argue that a data literacy starting point should not be technical skills but rather "critical thinking and making skills that connect data back to the social and political reality" (p.131) in which data are collected and communicated. The authors propose the emancipatory approach to data visualisation literacy that "cultivates self-efficacy in women, people of color, and other marginalized groups" and "connects feminist theory to the design of data visualisations" (p.131). They offer principles for inclusive data visualisation, claiming that they do not underestimate the importance of technical skills but offer a new understanding of how audiences can be effectively involved in making sense of datavis in order to participate in data-driven societies.

Referring to the importance of the above debates and studies into inequalities in audiences' perceptions and experiences of data and datavis and little empirical research on the role that differences play in these processes, I will investigate whether, how and what national and demographic differences between participants in my research – including age,

education, ethnicity and race, gender, nationality and occupation and political affiliation – may lead to unequal emotional experiences of datavis. I begin these considerations by introducing in the next section two national contexts that I compare in this thesis. I return to other differences in the later empirical chapter (Section 7.3).

2.5.2 National differences: Poland and the United Kingdom

One of the main differences that is under-studied in data and datavis research is nationality. Although this is an important factor of engagements with datavis in the globalized context of digital worlds, there has been little research on the role of national contexts and national differences (and similarities) in relation to data visualisation experiences. Therefore, in this thesis, I compare two national contexts. They will be briefly introduced in this section to provide some background to my further considerations in the later empirical chapters.

In my study I focus on two different geo-historical, demographic and democratic contexts: the United Kingdom, with its long history of colonialism, migration and ethnic diversity, which is considered to be a "super-diverse" (Vertovec, 2007) with complex class divisions (Savage et al., 2013); and Poland, a post-socialist European society that is perceived as "relatively [ethnically] homogenous" (Mayblin et al., 2016). These two countries have very different histories and migration experiences, which are important for this thesis. As indicated previously, differences among study participants, including ethnicities, play an important role in this study and will be explored in more detail in the final empirical chapter.

As Vertovec (2007) argues, the UK's super-diversity emphasises complexity, including various ethnic groups, nationalities, religions, languages, and social classes. In opposition, after World War II and the communist regime, Poland became relatively homogenous. Nevertheless, both nations are becoming more diverse due to economic structure, international migration, residential mobility and lifestyle choices. In both societies, people are living alongside others who have different nationalities, languages, religions and cultures (Piekut et al., 2011).

Poland regained “independence as a democratic republic in 1918 after World War I” (Valentine et al., 2015, p.8) and more than 100 years of absence on the political map of Europe. About one-third of the population were religious and ethnic minorities at that time (Valentine et al., 2015). However, “as a result of the Holocaust, border changes and population exchanges”, the country “had become homogenous both ethnically (Poles) and religiously (Roman Catholic) after World War II” (Valentine et al., 2015, p.8). Even though ethnic and religious minorities were recognized during the socialist period (1945–1989), they were rather absent in public life (Valentine et al., 2015).

After the transformation of the political system in 1989, state borders were opened. Poles acquired freedom of expression and speech and equal treatment for all citizens (Piekut and Valentine, 2017). Parliament re-established the name of the country, the Republic of Poland, and the first free parliamentary and presidential elections since 1939 took place in 1989 and 1990. The strict censorship of the press in Poland, which lasted for four decades, also came to an end. To obtain accession to the European Union, Poland began to adopt “liberal laws on religious freedom, ethnic and national minorities” (Valentine et al., 2015, p.8). The character of migration flows changed rapidly (Valentine et al., 2015), and after 1989 Poland started to become relatively more multicultural again.

From 2010 to 2019, the number of foreigners with valid documents confirming their right to stay on the territory of Poland increased rapidly from 97,080 (Instat.gov.al., 2019) to 413,169 (Migracje.gov.pl, 2019). An analysis of trends in migration indicates that Poland is transforming from a typically emigrant country into an emigration and immigration country (Instat.gov.al., 2019, p.27). Although foreigners account for about 1% of the population today, Poland is still a relatively mono-ethnic “traditional society in which the Catholic Church has grown in influence since the end of the socialist period” (Valentine et al., 2015, p.8). Nevertheless, as researchers argue (Valentine et al., 2015), Polish society is “beginning to address the challenges of living with difference” (p.9).

The situation is very different in the UK, with its colonial history and a complex pattern of postcolonial, refugee and EU immigration throughout the 20th and 21st centuries, “resulting

in unprecedented diversity in which encountering difference in everyday public spaces has become normalised" (Valentine et al., 2015, p.8). The size of the foreign-born population in the UK nearly doubled from 2004 to 2017 from about 5.3 million to just under 9.4 million (Migration Observatory, 2018). The number of foreign citizens also increased from nearly 3 million to about 6.2 million. This means that the UK population was 14.4% foreign-born and 9.5% non-British citizens in 2017 (Migration Observatory, 2018). Migrants in the UK have had relative freedom "to define their own identities and to create their communities" (Valentine et al., 2015, p.12). Although the emphasis on the 'integration' of multicultural migrants has emerged in contemporary political discourse, until 2006 and the new regulations on the acquisition of citizenship, little attention was given to this issue (Valentine et al., 2015, p.12).

The processes "of de-traditionalization and individualisation are evident in the UK" (Valentine et al., 2015, p.12), such as the "decline in the influence of the Christian Church", "significant changes in gender roles", more diverse lifestyles, and the growing presence of the LGBTQI+ community in public discourse (Valentine et al., 2015, p.12). Valentine and colleagues (2015) suggest that the consequence of rapid increase in migration and population changes is a growing level "of intolerance towards minority groups and support for xenophobic and populist parties in some parts of the continent" (p.2). This may be the case in the UK (see Browning, 2019; Iakhnis et al., 2018), resulting in its withdrawal from the European Union in January 2020 following a UK referendum in June 2016, in which more than 50% voted in favour of leaving the EU.

These mechanisms may also apply to Poland (Jasiewicz, 2008; Owczarek, 2017; Pankowski, 2010). In recent years, there has been increasing activity among nationalist organisations and movements in Poland. Members of the National Movement are also represented in the Sejm of the Republic of Poland, the lower house of the bicameral parliament. The annual Polish far-right Independence Day march, organized by the nationalist milieu, turned out to be symbolically significant for making visible in the socio-cultural sphere new groups and associations promoting a nationalist and conservative vision of society. However, as

research conducted in 2019 (the Pew Research Center) shows, as much as 84% of Polish people hold strongly positive views of the EU and only 14% negative.

These significant political changes in the UK (its withdrawal from the European Union) and in Poland (the rise of the far-right) suggest that both countries, despite different geo-historical conditions, may experience the significant role that emotions play in political decision-making. Referring to this, different histories and migration experiences, and the ubiquity of data visualisation and emotions in politics and social life mentioned in the previous section, I consider it important to compare these two contexts with regard to the role of emotions evoked by data visualisation in political decision-making processes. I, therefore, undertake a comparative analysis to investigate how different histories and experiences with social diversity may influence data visualisation availability and exposure (who uses them; what kind of datavis are used; and what visual styles are produced); and whether datavis in consequence differently shapes political participation in Poland and the UK. To date, no such comparative study has been conducted focusing on emotional responses to datavis and political participation.

2.6 Conclusion

This literature review has drawn together work from a range of disciplines, including critical data studies and sociological subfields, to present an overview of the research that informs the analytical part of this thesis. I have shown how my research fits into the bigger picture of research on data visualisation, relating it to what has been done before including the work of Kennedy and colleagues (2016b; 2017; 2020); Peck and colleagues (2019); and Nærland (2020). Sociological and empirical research on data visualisation is a relatively new topic, and there is limited existing literature. Therefore, this chapter has provided an overview of key ideas and theories from other fields, including the sociology of emotions, political participation and emotions in social movements, and data-related inequalities. This provides a framework to understand the role of data visualisation in enabling participation in datafied democracies and the role that emotions play in this process.

In this literature review, it has been shown that there are several gaps in current sociological understandings of audiences' experiences and perceptions of datavis. This thesis will contribute by developing an understanding of emotional responses to datavis and where they can lead. This study will complement top-down, quantitative, or cognitive understandings of data and data visualisation by acknowledging non-experts' experiences, contexts in which audiences encounter datavis and how people are embedded in networks of relationships. These emotional experiences are therefore conceptualised in this thesis as highly relational, rather than psychological, processes. Moreover, similar to other studies focusing on emotions, this study intends to "redeem the epistemological value of emotions from the historical and widely criticised reason/emotion binary" (Bericat, 2016, quoted in Kennedy, 2020, p.1747). As such, it adopts a sociological framework which has rarely been applied within data studies before. The research questions, formulated with this conceptual framework in mind, are thus:

1. How and in what ways does data visualisation convey and evoke emotional responses?
2. To what extent do those experiences relate to people's (potential) political participation?

As explained in this chapter, differences matter when exploring audiences' engagements with and experiences of datavis. Therefore, the third and final research question is:

3. What role, if any, do national and demographic differences play in these processes?

In the next chapter, I explain how I designed and implemented my research to meet the research aim and answer my research questions in the most appropriate and effective way.

Chapter Three:
Methodology

3.1 Introduction

This chapter focuses on the methodological strategy of my study. First, it explains and examines the research approach and suitability of qualitative research methods for this research. Following this, the chapter is divided into three sections for each of the three key datasets (data visualisations; interviews with professionals; and interviews with audiences). Each section covers the account of recruitment/sampling and data collection. It includes the social semiotic approach introduced in the previous chapter and details the semi-structured interviews conducted with the two groups of participants (datavis audiences and datavis professionals) from Poland and the UK.

Specific considerations are given to follow-up interview sessions, online interviewing, visual elicitation, language and translational approaches and the role of the researcher in the interview process. After this, the chapter outlines ethical considerations before a reflection on the different stages and strategies of data analysis. It ends with a reflexive discussion of the researcher's own positioning.

3.2 Research approach – using qualitative methods

As indicated previously, the main discipline researching how users engage with visualisation is computer science (as noted by Kennedy et al., 2016b), which often focuses on the visual text and does not provide much information about the study participants. The primary purpose of these studies is to explore datavis effectiveness including memorability, recognition or recall of datavis (see Haroz and Whitney, 2012; Haroz et al., 2015; Borkin et al., 2015). Consequently, these research projects mostly try to quantitatively assess the effectiveness of datavis and its visual elements. However, Kennedy and colleagues (2016b) argue that due to the social nature of datavis, the "context of visualisation use and other factors outside the visualisation texts are also important in determining visualisation effectiveness" (p.4).

In contrast, qualitative sociological research can offer a counterbalance to these often quantitative and decontextualized studies. Sociological approaches take into account social factors outside the visualisation text, such as “who are the users and what are their circumstances” (Kennedy et al., 2016b, p.5), presenting a picture that is far more complex than other studies mentioned here can offer. Moreover, as Kennedy and colleagues (2016b) suggest, adopting a qualitative approach “can make it possible to identify new issues in research into visualisation use and engagement” (p.6). Indeed, the ability to ask follow-up questions, for example, is a vital advantage of some qualitative methods.

As indicated previously, my study aims to explore emotions, experiences and motivations of audiences. Here, qualitative methods can offer a broader and deeper understanding and insight into the different worlds of research participants than quantitative ones. Moreover, researching sensitive topics is also better suited to qualitative methods (Brewer, 2012) which is important to me as I research responses to the highly politicized topic of climate change. Unlike ‘closed questions’ in questionnaires, qualitative methods, such as an interview are more appropriate “for the complexity and subtlety of people’s responses or where evasion might be anticipated” (Brewer, 2012, p.69).

Moreover, according to Czarniawska (2015), traditional qualitative methodologies offer two pathways when researching emotions: “to ask people to describe their emotions or to deduce their emotions from their observable behaviour” (p.67). While interviews give participants the opportunity to speak about their own emotions in a detailed manner, deductions reached from observing other people’s emotions may not be correct or differ drastically from the interpretations of those who are observed (Czarniawska, 2015). On the other hand, using quantitative methods to, for example, analyse social media reactions to selected data visualisations including metrics of ‘likes’, ‘hates’, and ‘love’, as well as shares and comments to automatically measure emotion, would overlook the complexity of emotional responses and (political) contexts in which datavis are experienced (Kennedy, 2012).

For this research, interviews were deemed to be most beneficial since I wanted to gain access to a large number of emotions and motivations, and because observing emotional reactions of audiences to historical visualisations that the participants had seen some time before the interview would be difficult and might not have yielded rich data. Moreover, I use a semi-structured rather than structured interview technique because it assumes that "there is no fixed range of responses to each question" (Given, 2008). This allows me to explore the complexity of emotions, such as different emotional responses to different data visualisations, and understand how these experiences can relate to participants' (potential) political participation. Moreover, in terms of visual analysis of selected datavis, I was influenced by the previously introduced qualitative social semiotic approach, to "look systematically at how textual strategies are deployed to convey certain meanings" (Aiello, 2006, p.90).

For the above-mentioned reasons, adopting an inductive-qualitative approach is methodologically most appropriate to address this study's research questions, as semi-structured interviews and a social semiotic approach help to facilitate the generation of rich and strong datasets regarding ongoing processes of meaning-making. Moreover, this approach offers a contrasting insight into datavis experiences compared to those that are currently available.

Arguably, in terms of ontology, the entities being researched – emotional responses to data visualisations – are perceived as subjective rather than objective, although data and therefore datavis would seem to make claims to objectivity. This position argues that social phenomena are not only produced by social interactions but are also in a constant state of revision (Bryman, 2016).

I assume an interpretive epistemological position and try to understand human behaviour from the perspective of the participant rather than try to explain a single reality or truth. I seek "to grasp the subjective meaning of social action" (Bryman, 2016, p.26). As Schutz (1954) explains, "the thought objects constructed by the social scientist, in order to grasp (this) social reality, have to be founded upon the thought

objects constructed by the common-sense thinking of men [and women!], living their daily life within the social world" (p.267). Therefore, referring to this position, I aim to study social reality as the product of processes where humans negotiate the meanings of actions.

The project used multiple qualitative methods, centred on datavis generated by climate and environmental organisations. Data collection is based on visual analysis; interviews within organisations whose datavis I followed; and interviews and follow-up sessions with diverse participants from the UK and Poland (see Table 2).

Method	Purpose	No
• *Visual analysis*	Generate insights about different ways of evoking emotions through selected datavis about climate change; which emotions are encouraged in different sites by whom, and how.	13
• *Interviews with professional participants*	Enquire into the purpose and anticipated emotional responses to datavis from the perspectives of the selected professionals from the organisations.	9
• *Interviews with audience participants*	Enquire into emotional responses to selected datavis and potential political participation from the perspectives of audiences from Poland and the UK.	34
• *Follow up sessions*	Enquire into emotional responses to datavis selected by research participants and potential political participation from the perspectives of audiences from Poland and the UK.	13

Table 2: Overview of qualitative methods used in the research

3.3 Data visualisations

3.3.1 Following data visualisations

I set out to achieve my research aims by following major professional actors who produce or share data visualisations about climate change in Poland and the UK, as well as the people who have responded emotionally to them. Climate change was selected as a datavis case study for several reasons. First, it is a key site of datavis production, and as prominent datavis designer Andy Kirk said in November 2019 during a meeting organised by INDVIL project in Norway, "Environmental visualisations as a topic is our greatest challenge in the

field" (INDVIL, 2019). Secondly, climate change is one of the most pressing international problems, which impacts both Poland and the UK. It is therefore a very high-profile issue in everyday and public life, with lots of media coverage. Finally, climate change itself and public debate on climate change carry significant emotional weight (Weber, 2010), and may therefore elicit emotional responses.

Data visualisations circulate "across a wide range of media" including on websites, social media, printed newspapers and public spaces (Kennedy and Engebretsen, 2020, p.184). Therefore, identifying the organisations and media that climate and environmental organisations use to disseminate their data was the first step for my analysis. I decided to start with online spaces and digital datavis, and later, during the interviews with the datavis professionals from selected organisations, I asked about the other places they display their datavis about climate change. I discuss this issue in more detail in Section 3.5.1: 'Audience participant recruitment'.

In preliminary scoping work in September 2019, I adopted Hill's (2017) methodology, which used Google Image Scraper to identify visualisations circulating online. I was interested in datavis representing a diversity of issues related to climate change and a diversity of chart types. It was also important to identify and select animated and interactive visualisations. I scraped datavis about climate change from Google Images to identify the main actors of my research – relevant environmental and climate organisations who produce and/or publish data visualisations on climate change. As Hill (2017) argues, this tool shows "where images are being used […] and therefore functions as a filter to show only those pages where visualisations appear" (p.2). I focused on social media since this is a frequent starting point for research on visualisation and political mobilisation (Flam and Doerr, 2015). Because the term 'data visualisation' may be most likely used by data expert, I followed Hill's (2017) description and used more everyday alternatives like charts, graphs or maps, for example, 'climate change charts the UK'.

Next, I conducted an initial mapping of key datavis and identified six different major climate and environmental organisations that produce or share data visualisations about climate

change in Poland and the UK (see Table 3). To include a wide range of datavis types, I included different types of organisations, including four national branches of campaigning organisations and two national information-providing groups. These include campaigning organisations such as Greenpeace Poland and Greenpeace UK; World Wide Fund for Nature Poland and World Wide Fund for Nature UK; and information-providing organisations such as Carbon Brief UK and Nauka o klimacie Polska (Climate Science Poland). The organisations were not anonymised as explained in Section 3.7: 'Ethical considerations'.

The main difference between the organisations is that Carbon Brief UK and Climate Science Poland focus their work primarily on climate, while WWF and Greenpeace focus on the entire ecosystem (see Table 3). Information-providing organisations (such as Carbon Brief UK and Climate Science Poland) were created to improve the understanding of climate change science and base their work mainly on data and data visualisations. Campaigning organisations (such as Greenpeace and WWF), on the other hand, seek to protect and defend the environment from misuse and destruction by lobbying and mobilising members of the public, using various visuals in their work. I discuss the differences between the organisations in more detail in Table 3 and in Chapter Five.

Name	Description
• Greenpeace Poland • Greenpeace UK	An international, non-governmental campaigning organisation that defends the natural world and promotes peace by investigating, exposing and confronting environmental abuse, and championing environmentally responsible solutions.
• World Wide Fund for Nature (WWF) Poland • World Wide Fund for Nature (WWF) UK	An international, non-governmental campaigning organisation working in the field of wilderness preservation, and the reduction of human impact on the environment.
• Carbon Brief UK	An information-providing website designed to improve the understanding of climate change, both in terms of the science and the policy response.
• Nauka o klimacie Polska (Climate Science) Poland	An information-providing portal that refutes myths and fights 'fake news' about the climate.

Table 3: Organisations selected for analysis

The organisations agreed not to be anonymised (see Section 3.7).

Focusing on these six organisations, I followed data visualisations that the organisations had previously shared with the public online. They could be typically found and viewed on social media by the organisations' audiences who were not experts in data visualisation. I looked for different types of datavis that represented various climate issues and the ones that a significant number of people emotionally reacted to on social media and analysed 13 of them (see Chapter Four). These datavis were also used in semi-structured interviews with human actors; professionals who designed or/and shared them online; and audiences who reacted to them on social media.

3.3.2 Social semiotics approach

To address the emotions that datavis may convey and evoke, and to understand the visual rhetoric of my selected data visualisations (Hill, 2017), I examined the major aesthetic norms and conventions of 13 datavis on climate change produced and/or published by the selected climate and environmental organisations and asked whether and how key visual resources of the data visualisations were deployed to evoke particular emotions. I was influenced by social semiotic approaches given by van Leeuwen (2005), which combines descriptive, interpretive, and critical aims (Aiello, 2020). Social semiotics analysis entails "breaking down the visualisations into individual elements and assessing how these elements make meanings' but it also 'requires attention to the context of the visualisations" (Hill, 2017, p.85).

At a descriptive level, I made inventories (collected and described) of key emotive visual resources used in the data visualisations in my sample (see Appendix 12). I considered the visual features of datavis themselves, their visual components, composition, colours, fonts, and visual metaphors (Hill, 2014). Then, from an interpretive perspective, I situated visual resources in their historical, cultural, and institutional contexts of production and use. At this stage, I talked to people who commissioned, disseminated or made datavis for the organisations about their emotional responses to the selected datavis resources/features and asked: who created the datavis and which audiences do they address?

By doing this I tried to explore how key emotional potentials are established through the selection and combination of particular datavis resources and consider how production processes affect datavis aesthetics (Aiello, 2020). Finally, from a critical perspective, I linked texts and contexts – descriptive level and interpretive perspective – and connected the datavis with research findings, such as those that emerged from interviews with the datavis experts and with audiences. This helped me to explore the forms of emotional engagement that chosen datavis resources enable and promote and to identify specific socially-shared emotional norms about datavis related to climate change.

As the research was a three-part process in terms of data collection, analysis of the datavis (descriptive level of social semiotic analysis) was also used as a means to generate prompts and reference points for the interviews with professionals and audiences about emotional responses to datavis and to particular datavis features.

3.4 Professionals

3.4.1 Professional participant recruitment

In the case of professionals, my approach to sampling was purposive and used snowball techniques, based on the objectives of the study. To compare datavis production in two different national contexts, I aimed to recruit one or two professionals from each organisation whose datavis I followed in the research, including Greenpeace Poland and Greenpeace UK, WWF Poland and WWF UK, Carbon Brief UK and Climate Science Poland.

I started the professional participant recruitment process in October 2019. I used my networks in Poland and supervisors' connections in the UK to make initial contact with some of the organisations. For other organisations to which I did not have direct access or a connection, I contacted them using the e-mail addresses on the organisations' websites. In both cases, the message outlined who I was and what the research involved. I informed them that I was undertaking a PhD about emotional responses to data visualisations and (potential) political participation at the University of Sheffield in the UK, and that I was interested in their professional experiences relating to the datavis they shared with audiences. I also sent them some sample data visualisations they had published in the past

on social media and enquired about people who were responsible for the preparation, commissioning and/or dissemination of the data visualisation in the organisation. I tailored the message to the organisation and individual. An example of this is shown in Appendix 9.

All potential professional participants were given an information sheet about the nature of the research, their voluntary involvement in in-person interviews, and storage and distribution of the research data. They were made fully aware of the aim of the research, what the research was to involve, how their personal data would be used, and that the interview would be recorded. They were also informed that they could contact me at any time with questions, and that they could withdraw from the study at any time up to December 2021 without any negative consequences (see Appendix 4).

Accessing experts and professionals is not easy as most are usually very busy (Thomas, 1993). This supposition was borne out by my research. Several people failed to respond to my initial email, and one declined to participate in the study due to lack of time. Some of the organisations replied that they did not use many (advanced) datavis or emphasised that the organisation did not employ people who designed datavis on a daily basis in public facing campaigning or that the visualisations they designed were not strictly data visualisations. Nevertheless, many responded positively and were keen to be involved.

I suspected that many NGOs and small organisations may have "limited resources to either employ a data professional or train up a team in the necessary data skills" (Feigenbaum and Alamalhodaei, 2020, p.68) and therefore I decided that participants did not need to have expertise in designing data visualisations or be data professionals to take part in the research. I prioritise the experiences and knowledge of staff members involved not only in production and design but also in commissioning or dissemination of datavis. Many of the professional participants therefore were not identified by virtue of specific knowledge about data or datavis design. However, all participants were still experts in a particular subject. For example, most of the professionals were experts in (visual) communication and/or social media communication. I decided not to use the term 'datavis expert' in my thesis, instead

opting for ‘datavis professional’, which indicates the professional position of the participant rather than expertise in data and/or datavis design.

Once I had recruited professional participants, they were asked to sign a consent form (see Appendix 5) and to complete a demographic survey (Appendix 7). Participants returned their signed consent forms and demographic surveys through personal email addresses, and dates were set for the interviews. Professional participant recruitment came to an end in January 2020.

3.4.2 Meeting professional participants

In total, five women and five men from the six organisations were interviewed across five interviews in the UK and four interviews in Poland (see ‘Overview of professional participants’ in Appendix 11). In relation to nationality, they self-identified as English, British or Polish. One person from Poland had dual nationality and another from the UK chose not to answer this question. Professional participants from Poland were predominantly White Polish, while one person self-reported as White Polish and Dutch. Professional participants from the UK were predominantly White British and only one participant self-identified as Indian. They were aged 24 to 47 years old. All participants had completed tertiary education and nine were university educated; one person from Poland had a doctoral degree.

The participants were editorial leaders; people working with data and data visualisations including data analysts and multimedia producers; people responsible for digital engagement and other forms of communication with audiences, including online communication and social media specialists, but also media and policy officers and a sustainability development expert. They were all involved in designing, commissioning, and/or disseminating data visualisations in their respective environmental or climate organisations. Five participants were responsible for communication and dissemination of datavis, and five designed different kinds of datavis for their organisations.

3.4.3 Interviewing professionals

It was recognised from the beginning of the project that I would need to speak to those involved in the production of the datavis that I followed in the research to explore how they make decisions about datavis in particular national contexts, as well as their perceptions about which kinds of datavis may be most effective in generating particular kinds of responses from specific target audiences. The interview questions covered background and work experience, datavis production, targeted audiences, datavis and emotion, and datavis effectiveness.

I decided to conduct in-person interviews because the interviews drew upon visual elicitation methods (Pauwels, 2020) for which the physical presence of the interviewee and interviewer in the same place is important, as discussed later in the chapter (see Section 3.6.1: 'Visual elicitation'). The times and locations of the interviews were negotiated dependent on the professional participants' wishes. Most wanted to be interviewed in their work environments in their respective organisations' offices. Only two participants chose a "neutral location" (Herzog, 2005), such as a coffee shop. I was aware that public spaces tend to be noisy for interviews (Fujii, 2018). However, I agreed to these suggestions and employed some strategies to deal with distractions, including keeping the interviewee as close as possible to the recorder; finding a quiet location; and sitting as far away as possible from the coffee machines.

The key themes to be explored in these interviews were perspectives on and experiences of working with particular datavis produced by their organisations. These datavis were used as prompts to discuss participants experiences and practices more broadly. An interview schedule with a list of themes and questions to raise with interviewees was prepared in advance and used as a guide during the semi-structured interviews (see Appendix 2). I used the same broad question areas with each professional, but this was by no means an exhaustive list. Different questions were adapted to each interview, which were dependent on a participant's previous responses, experience, position and involvement in datavis production or dissemination within the organisation. Before each interview, I engaged in a

process of preparation by familiarizing myself with the work and ethos of the organisation, as a way of immersing myself in the participants' work setting (Odendahl and Shaw, 2002).

Interviews lasted between one and almost two hours, with the average interview being about one hour. The interviews commenced in December 2019 and came to an end in February 2020. I decided to interview professionals from Polish groups first since Polish is my native language and I found it easier to acquire interview skills in this way. A longer discussion on language and translational approaches can be found in Section 3.6.3 and power dynamics and issues relating to interviewing professional participants are discussed in Section 3.9: 'Positionality of the researcher and researcher effects.' The interview structure, and visual elicitation outlined in Section 3.6.1 worked well and helped to maintain the conversational flow. All interviews were audio recorded and transcribed.

3.5 Audiences

3.5.1 Audience participant recruitment

My approach to audience sampling was also purposive, and framed by the aims of the study. To compare datavis experiences and practices in two different national contexts, I aimed to recruit a diverse sample of 30 individuals from two geographical locations, 15 from the UK and 15 from Poland. I sought to include different socially located voices and to recruit a diverse research population in terms of age, education, ethnicity and race, gender, nationality, occupation and political affiliation within these contexts.

I started the professional participant recruitment process in June 2020. I had planned to use multiple offline and online recruitment strategies to access potential participants; online networks make data visualisations accessible for people while traditional offline settings can offer the opportunity to access potential participants who may not be Internet users or possess social media accounts, as pointed out by Deakin and Wakefield (2013). However, due to the Covid-19 crisis, I was not able to recruit offline (face-to-face) and therefore searched for the best online methods. I decided to use social media for two reasons: the selected organisations publish their datavis there; and they interact with their audiences, who share their opinions on social media (Sikkens et al., 2017). I was aware that this

approach could exclude certain groups of people and privilege others but decided that this was still likely to be the most effective way to recruit a diverse range of audience participants.

Platform selection was mainly based on datavis access and availability. Before deciding which platforms to focus on I asked climate and environmental organisations' members which social media and, potentially, other channels they used to distribute their datavis. Most pointed to three platforms: Facebook, Twitter, and Instagram. I traced potential participants on these platforms by following the six Polish and British organisations and the data visualisations that they had previously posted online. I followed up with some of the people living in the UK and Poland who in the past had responded (commented or shared) passionately to one of the data visualisations published by one of the organisations on social media.

I suspected that many of these potential audience participants could be interested in climate change, which could influence their emotions and attitudes towards datavis. My research aimed to recruit exactly these kinds of people, because I wanted to pick up nuanced differences between these emotional responses. Furthermore, Kennedy and colleagues (2016b) found in their research on engagements with datavis that, when subject matter of datavis addresses participants' interests, it may increase people's engagement during an interview. This was important in my study because the topic of data visualisation may not be appealing to people with no previous experience or interest in them.

I aimed to recruit a wide range of people who had different relations to datavis: people who appeared to be politically or personally moved by datavis but were not datavis experts. Some had a degree of skill in relation to datavis and knew what it was, while others were not familiar with it and used terms like maps, graphs and charts. Finally, some people had not encountered datavis before but this particular datavis really moved them. I also asked about political affiliation and engagement as this could affect the emotions of the participants about a given visualisation. As climate change is a highly politicized area,

especially in Poland, I was aware that political views could affect a person's emotions about a given visualisation.

To recruit a diverse sample, I focused on potential participants' personal profiles on Facebook, Instagram and Twitter and their publicly available information, such as their age, education level, ethnicity and race, gender, job and nationality. The Polish datavis were mainly commented on by Poles living in Poland and using Polish language. British datavis were commented on by people who knew English, including audiences from the USA, Germany or Spain. To make sure that I was inviting people living in the UK, I had to find information about their place of residence or ask them about this directly.

I invited potential participants through a private Facebook Messenger/Twitter/Instagram message (see Appendix 8) that explained who I was and what the research involved. I informed them that I was doing a PhD at a university in Sheffield in the UK, and that I was interested in their opinions and experiences of the datavis they had reacted to on social media. I also sent them the data visualisation they had reacted to in the past and a link to a project website I produced to introduce potential participants to the project. I promised confidentiality and anonymity and sent an information sheet about the nature of the research, the voluntary nature of their involvement in online interviews, and the recording, storage and distribution of my research data. All participants were informed that they could contact me for further questions and withdraw from the study at any time up to December 2021 without any negative consequences (see Appendix 3).

Assuming that the term data visualisation might not be known to everyone and that, as indicated above, understanding of what it is may differ, I explained to each of my potential audience participants before the interview how I defined it in the study. When communicating with them about the project, I tried to use the expression "graphs, charts and maps" when talking about datavis. It turned out that potential audience participants were more familiar with this phrase, and it helped them to understand what the research was about. Furthermore, I sent them an information sheet with different chart types which can be found in Appendix 3. Indeed, many audience participants said that it was helpful and gave them a grasp of what we were going to talk about in the interview. For example, at the

beginning of the interview with Claire (female, 46-year-old single mother, personal assistant, A-Levels or equivalent, based in the UK) she mentioned that she was not entirely sure what I wanted to talk about, but the few datavis examples I sent her helped her understand the research topic. This convinced me that data visualisation is perceived as an ambiguous phenomenon, and it is important for researchers to precisely define its meaning before recruitment and again during the interview itself.

However, the Covid-19 pandemic that began shortly before my recruitment, which took place first in Poland, made the process very slow and difficult. Although I decided to wait a few weeks with recruitment due to ethical reasons and uncertainty about the developing pandemic, its consequences, and related anxieties, I still received some responses that related to that situation and the resultant inability to attend an interview. People mentioned several reasons, including caring responsibilities, childcare and remote home learning, feelings of pressure and exhaustion, or the health problems of family members. The situation improved gradually over time and finally, after a few weeks, I was able to recruit the right number of people. Here lockdown, which caused many people to stop working, eventually sped up the process.

Participants who agreed to take part in the study were talked through the project and what was involved and then invited to complete and sign an informed consent form, which was written in lay terms (see Appendix 5), and an online demographic survey (see Appendix 6) to gather information including age, gender, nationality, ethnicity, educational background, and occupation. Participants returned their signed consent forms through their social media accounts or emails and submitted demographic surveys to an online interactive tool, Typeform (www.typeform.com). They were also asked to identify one or two data visualisations about climate change that had recently triggered their emotions and to be ready to discuss them during the interview. We arranged a mutually convenient date and platform (Zoom, Skype or Messenger) for each interview. The recruitment process commenced in June 2020 and came to an end in October 2020.

After the first attempt in both countries, as the demographic surveys indicated, I achieved a diverse sample in terms of age, education, gender, job and nationality, but all my

participants were White. I was aware that Poland is a relatively monocultural White country (Mayblin et al., 2016) and this was also reflected in my research sample. However, I decided to continue the recruitment process in the multicultural and superdiverse UK (Vertovec, 2007), with an emphasis on including a range of ethnic backgrounds and going beyond White European or White British voices. I used social media features as a strategy of inclusion since they allowed me to access people's names, personal data and appearance and therefore attempt to identify their ethnicity. However, I was sensitive to, and took care not to make assumptions about, or essentialise, ethnic identities but used the information shared on social media to attend to cultural difference and build a more diverse range of people to invite to participate in the research.

I would not have had access to this data if I had recruited in a more traditional offline way. This suggests that sampling for diversity may be more possible online. After a long process of re-analysing all comments and responses to all selected data visualisations, I sent around 25 additional invitations on Facebook, Instagram and Twitter explaining the project and the importance of including a diverse group of participants to ethnic minority people living in the UK. Six people replied to my messages, and five agreed to take part in the study.

It is therefore a limitation of this study that it does not reflect the experiences of a more culturally, ethnically and socially diverse range of people. This may be partly related to the fact that climate movements/groups themselves have a history of being understood as white, middle-class movements (Saunders et al., 2020; della Porta and Portos, 2021) – and that this issue is compounded by datavis also being seen as a relatively elitist way of disseminating knowledge.

In total, I sent around 200 recruitment messages on Instagram (n=75), Twitter (n= 45) and Facebook (n=80). I invited fewer Twitter users because fewer people reacted to the selected datavis there. Many potential participants did not open or read the message, which reflects the challenges of online recruitment and how difficult it can be to establish initial contact with potential participants. I also took into account that some people may not use social media very often and that it is important to give potential participants adequate time to

respond to a message. However, most of the messages read by potential participants were answered within a few days, and 40 out of 60 people (40 from Facebook, 17 from Instagram and 3 from Twitter) agreed to take part in the interviews. I declined to interview three people living outside the UK and Poland, two young people classed as underage (under sixteen), and one person requesting payment for participation in the interview.

3.5.2 Audience participant demographics

I recruited and carried out interviews with a total of 34 participants (see individual participants descriptions in Appendix 10): 16 were from Poland and 18 from the UK. I interviewed one more person than planned from Poland as I did not want to refuse anyone willing to participate in the study. I also interviewed three more people than planned from the UK to ensure that the sample reflected some ethnic diversity. Overall, 16 participants were female and 18 male, aged 19 to 72 years, with the 20-29 and 30-39 age ranges being best represented (18 participants).

As the study took place in the UK and Poland, almost all participants were residing in those countries (n=33). Only one participant was living outside the UK at the time of the interview, but two years earlier had lived and studied in the UK. Most of the participants self-reported as being British or Polish. Other nationalities included Italian-Polish and Polish-German-Austrian-Czech in Poland and Italian, Portuguese, Vietnamese, Tongan, Irish, and Anglo-Indian in the UK. Polish participants were White (n=16) and one person described her ethnicity as Italian. The situation was different in the more diverse UK. Eleven participants described their ethnicity as White English / Welsh / Scottish / Northern Irish / British. The remaining seven participants self-reported as any other White background (n=2), any other Asian Background (n=1), any other ethnic Background (n=1), Indian (n=1), White and Asian (n=1), and any other Mixed / Multiple Ethnic Background (n=1). Despite this diversity, participants in the UK were predominantly White (n=13). This provides an important direction for future research, with a stronger focus on diversity.

All participants from Poland had qualifications of some kind and two people were retired. Twelve people had higher degrees (including two doctoral degrees) and one post-secondary

degree; three had secondary degrees. Similarly, people from the UK who agreed to the interview had a fairly high level of education. They had qualifications of some kind and one person was retired. Nine people had higher degrees (including one doctoral degree) and nine people had completed A-Levels or equivalent qualifications. Employment sectors in both countries were quite diverse, including local government, teaching, media, business, science, construction, hospitality, transport and information services. However, very few participants were from the working class and people with higher education were dominant in the sample.

Most of the participants in both countries identified themselves as politically left-wing or liberal and as caring about climate change, for example, one participant was an active member of a Green Party. A few participants self-reported as more politically neutral. However, within the theme of climate change, audience participants took different positions and identities and created different kinds of narratives about datavis and how meaningful or not it was for them. No one was an expert in data visualisation but some were experts in related fields, such as data or visual design. Only five Polish and six UK participants used datavis in their work, including two academics. Finally, many of the participants from both countries were already quite active in environmental politics, although levels of engagement varied. Some were motivated politically in general and some were motivated around climate change in particular (see Tables 4 and 5).

Type of group	No. participants
People interested in climate change	11
People worked with/experienced in datavis (scientist, university teachers, economist, eco-manager)	5

Table 4: Types of audience groups in Poland

Type of group	No. participants
People interested in climate change	15
People worked with/experienced in datavis (scientist, university teachers, economist, eco-manager)	6

Table 5: Types of audience groups in the UK

3.5.3 Interviewing audiences

To answer my research questions, I carried out a series of semi-structured online interviews with audiences who responded to the datavis published by one of the organisations on social media (Facebook, Instagram, or Twitter). I had planned to conduct in-person interviews but, due to the Covid-19 pandemic and the lockdowns in the UK and Poland, I had to revise my research plans, moving it online. Some advantages and disadvantages of online interviewing are discussed in more detail in Section 3.5.5: 'Online interviews.'

Before the interviews, all participants were once again made fully aware of the aim of the research, what the research involved, how their personal data would be used, that their anonymity was assured, and that the interviews were to be audio recorded. Interviews lasted between forty minutes to almost two hours, with the average interview being about fifty minutes. They commenced in July 2020 and came to an end in November 2020. All interviews were audio recorded and transcribed.

I asked about emotions, opinions and motivations, and the overall actions of participants concerning the data visualisation. I developed a list of topics to be covered in advance and followed three themes based on my research questions; participants' background, encounters with data visualisations in general and datavis, and emotions and effectiveness (see the interview schedule in Appendix 1). As was the case with professionals, visualisation elicitation methods were also used in interviews with audiences. The datavis acted as a prompt to discuss audience participants' experiences and practices more broadly. I looked at and discussed specific data visualisations with them to understand the context of engagements with datavis as well as how they used particular visual resources. Aiello (2020) observes that asking questions not only about feelings, emotions and motivations but also different features of datavis can contribute "both to understanding the context itself and the reasons why specific semiotic resources come to be the way they are" (p.35). Moreover, to be able to collect more current data, I not only shared with my audience participants a historical datavis that had evoked emotions in them previously (and was used in the

recruitment process), but I asked them to identify and share with me at least one datavis that had recently evoked their emotions for any reason.

Only eight of the 34 user participants chose to bring datavis with them to the interviews. Another eight identified them during the interview, and six sent them to me afterwards. The variety of what they brought was wide-ranging, including infographics and cartoons. Those who sent them after the interview I invited to a follow-up interview to discuss them (see Subsection 3.5.4). The audience participants who did not identify any datavis indicated lack of time as the most common reason. However, this did not hinder the interviews.

I started each thematic section with some simple, broad, and open-ended questions, including: "Can you tell me briefly about yourself?" ('Background' section), "How often and where do you come across data visualisations?" ('Encounters with datavis in general' section) and "Can you tell me how you came across this one [datavis]?" ('Datavis, emotions and effectiveness' section). Then I moved forward to elicit and encourage detailed, in-depth conversation focusing on the datavis from the sample and those identified for the participant's purpose asking questions such as "How did it [the datavis] make you feel?", "Tell me what particular elements in it were striking for you/made you respond in a way you did and why?" or "Did it lead to change your practices, to do something/to act?"

The research focused on the audiences' subjective emotions. As mentioned in Section 3.2, I accepted "the methodological assumption that only feelings that are *communicated* in some manner bear social importance" (Hitzer, 2015, p.265) and relied mainly on capturing audience participants' emotions through self-reporting. Approaching participants' emotions was challenging because some of them considered them irrelevant in the research interview settings and tried to focus on their rational opinions and views. This was especially noticeable for men in certain occupations, as discussed in Chapter Seven: 'Data visualisation and differences'. For example, Tom (male, 24, white Polish scientist who worked with datavis about climate change professionally) tried to avoid talking about his emotions. When asked twice about his emotional response to the datavis *Warming Stripes*, Tom replied: "There is no need to emphasise emotions so much…" As Wettergren (2015)

suggests, research interviewees may consider emotions irrelevant outside their private spheres and associate them with “emotional situations,” and “emotional expressions” (e.g. crying), and therefore they may be reluctant to reveal their private and often difficult and painful experiences and memories to the researcher.

Moreover, the audience participants in my study were asked about climate change, a phenomenon that was terrifying for many of them and a politically sensitive topic, which also posed some challenges. Climate change data visualisations often evoked so-called ‘dark’ emotions in my audience participants, including sadness and fear on the one hand and anger on the other. These kinds of potentially dangerous emotions often “go to the heart of people’s identities, influencing who they believe they are” (Hitzer, 2015, p.265). Recalling these emotional experiences and memories may be painful and frightening for some participants, so I tried to be vigilant in such situations. As discussed in the ethical consideration sections (see Section 3.7), I conducted the interviews with sensitivity, avoiding using political and other classifications that could give rise to the discomfort of the participants. I also tried to avoid any follow-up questions that could stir up anxieties or fears.

Some participants were very emotional during the interviews in relation not only to climate change but also other topics, including Covid-19. For example, Marek (male, 40, white Polish, businessman), made clear from the beginning of the interview that he felt that most data, statistics and visualisations are distorted and manipulated and therefore he distrusted all of them. He raised his voice when asked about his general encounters with datavis and whether Covid-19 datavis were important for his understanding of the health crisis (pandemic). I recognized in Marek’s voice that it was difficult and emotional for him to share his beliefs and identities with me. In such situations, the qualitative approach I used allowed me to gradually develop rapport and trust between me and my audience participants. Establishing this relationship helped me to manage sensitivity during the interviews by putting participants at ease. Moreover, controversial topics or opinions were raised in a context of trust, which maximised the potential for truthful answers (Brewer, 2012) as the example of Marek shows.

While researching emotions and sensitive topics, I took into consideration other non-verbal elements of communication as "they can reveal more than what the participants were actually saying in their plain speaking" (Hitzer, 2015, p.88). Such responses were very informative, especially when participants had difficulty expressing their emotions verbally. For example, Jadwiga (female, 70, white Polish pensioner) who, in response to data visualisations of 50 most polluted cities in the EU by Greenpeace Poland (Figure 7), had tried to contact the authority that could help her (see Section 6.4) expressed her emotions of anger and helplessness using mainly gestures, facial expressions and long pauses between sentences. However, as discussed below, online interviewing made it difficult to observe non-verbal expressions of emotions.

As in the interviews with professionals, the first tranche of audience interviews was also conducted with Polish participants in the Polish language. In the later stages of the data collection in Poland, I became more familiar with the interviewing process. This increased my confidence as a researcher and allowed me to conduct the interviews in a more informal and personal manner without strictly sticking to the interview script (Fujii, 2018). Moreover, letting go of my own insecurities helped me to build a better rapport with audience participants from both countries. The interview structure and visual elicitation discussed in Section 3.6.1 also helped to create an open relationship with them and kept the conversation flowing.

3.5.4 Follow-up interviews

Audience participants who did not identify any datavis before or during the interview were invited to do so later and to discuss them in a follow-up session. Here, the questions followed only the third theme of the interview schedule, 'Datavis, emotions and effectiveness', including emotional responses to the datavis and elements that were of interest or significance for the participant. The follow-up interviews started with a simple open-ended question: "Can you tell me how you came across this one [a datavis identified by a participant]?" which acted as a prompt to discuss the encounter with the datavis more

broadly. The session then followed the interview schedule using the visual elicitation method discussed in the next section.

One reason to employ follow-up interviewing usually concerns the complexity of the information sought. Also in this study, it was not expected "to obtain full 'answers' all at once" (Read, 2018) since a comprehensive picture of participants' encounters with different datavis about climate change could emerge over time after the first interview. Moreover, identifying the additional datavis that audience participants found most emotive or that mobilised them to act and bringing it to the interview or follow-up interview was important for the study.

Audience participants who decided to take part in the follow-up interview had time to reflect on the questions asked during the first meeting and were better prepared to answer them again. As a result, many of them gained confidence and trust during follow-up sessions (Read, 2018). This familiarity and trust created more relaxed interactions between the participant and researcher than in a one-off interview. Some of the audience participants showed stronger commitment to the research and contacted me several times after the first encounter. In these cases, serial interviewing took on the tone of a collaboration (Read, 2018), which created a kind of productive "working relationship" (Fujii, 2018). I created stronger bonds with these participants and was not a stranger to them anymore. This not only helped to create more openness and comfort for both sides' interactions but also maximized the quality of the data.

The follow-up interviews were held online due to the Covid-19 pandemic. They lasted between ten to thirty minutes, with the average interview being just over fifteen minutes. They commenced in August 2020 and came to an end in December 2020. All interviews were audio recorded and transcribed. I conducted nine follow-up sessions with six people from Poland and four with four participants from the UK.

3.5.5 Online interviews

As mentioned in the previous sections, due to the Covid-19 pandemic and the lockdowns in the UK and Poland, I had to revise my research plans and move the interviews with audiences online. Online interviewing has many advantages but also several disadvantages, as discussed by a number of scholars (such as Holt, 2010; Hanna, 2012; Deakin and Wakefield, 2013; Tuttas, 2014; Archibald et al., 2019; Lupton, 2020). From a practical point of view, the advantages of conducting online interviews include flexibility with scheduling online meetings and access to participants who could not meet in person due to time or geographical constraints (Hanna, 2012). The Internet granted my audience participants more freedom and flexibility in choosing a convenient and comfortable location and time for the interview. It is also important to emphasise the minimisation of environmental concerns associated with travelling (Holt, 2010), which is also time-saving and low cost for the researcher (Deakin and Wakefield, 2013).

However, online interviews often involve technical problems (Tuttas, 2014), which was also reflected in my own experience. Several participants could not connect to the audio or video, and we had to switch to another communication platform. Another disadvantage of online interviewing is that only people with good Internet access and a certain level of technological knowledge and skills can take part, which can exclude or privilege certain groups (Deakin and Wakefield, 2013). Moreover, that I recruited potential participants from social media platforms meant that they had to have access to the Internet and electronic devices with which they could access it. They also had to go online to create an account on social media or had someone who helped them to do so.

It took me some time to integrate technology into the interview process and to set up the online interviews as it takes some planning (Lupton, 2020). To enable this, I focused on building trust and establishing relationships with potential participants and exploring and integrating technology into the interview process. I devoted a lot of time and attention to keeping in touch with audience participants on a regular basis and answering all their questions before and after the interviews. Some of the participants valued this a lot and said that it helped them to be more open during the interviews. I decided to be flexible and open

about communication platforms. I suggested three that share similar features and functionalities: Facebook Messenger, Skype, and Zoom. Each participant could choose the one they preferred, and Facebook Messenger turned out to be the easiest and most frequently chosen tool, especially for elderly people recruited through that platform. They did not want to move between platforms or did not know how to use another platform. I used my audio recorder as well as audio recording software in case one option broke down; the audio recorder offered better sound quality. Finally, I made a note of the different time zones in the UK and Poland: when asking about the availability of a participant for the interview, I chose the hours according to my time zone (GMT) as the schedule.

Face-to-face interviews were important for my study as I wanted to establish rapport with participants and use visual elicitation methods to look at and discuss specific data visualisations with them during the interviews (see Section 3.6.1: 'Visual elicitation'). To a large extent, I was able to do this in synchronous online interviews thanks to desktop sharing features within Skype, Zoom and Facebook Messenger, which let me share a datavis on my screen with audience participants' devices during the interviews. In some cases, it also allowed me to observe what the participants were doing with an animated or interactive datavis if they agreed to share their desktop with me. This was helpful but again required technological competence on behalf of the participant. However, as noted by Rogowski (2016), in an online visual elicitation, the ability to compare two or more images simultaneously is limited. It was therefore not possible to show the participants all the discussed images at once or to give them the freedom to decide what they wanted to talk about at a given moment.

In my online interviews, it was also sometimes difficult to 'record' the atmosphere of a place where my participants were during the interview or that the participants nonverbally expressed emotions. It depended on the angle at which the camera was set on their computer or smartphone during the interview. This was important for my analysis, especially of emotional reactions, as the place of the interview may have influenced the answers given and emotions expressed. An online interview can be conducted from anywhere: some participants were at work, one participant was outdoors, while most talked

to me from their homes. The chosen place, especially if it was not home, also influenced the conversations and the answers provided. For example, Aneta (female, 29, white Polish, inspector and eco-manager working for a local council, based in Poland), who decided to talk to me from the office, changed her tone of voice and became more formal after one of her co-workers entered her office to check if she had already finished talking to me. This shows that despite the flexibility of an online interview in choosing a place to be interviewed, it may also pose challenges for the researcher as they cannot choose an environment and create a quiet, private and relaxed atmosphere for the participant during the interview.

Moreover, two audience participants from Poland wanted to remain anonymous and they did not turn on their cameras. One of the reasons for this was their professional work and the research area, which is highly politicized in Poland. This convinced me that online interviews are well-suited to studies that touch on sensitive topics where some participants prefer to remain anonymous, even to the researcher – this is less possible with face-to-face interviews (Deakin and Wakefield, 2013). I had a spare available room at home suitable for interviewing, which helped me to create a quiet, relaxed and private environment on my side. I did not wear headphones because I used an audio recorder as well as audio recording software, so I had to assure each participant that the meeting was confidential and that there was no one in the house who could hear our conversation.

3.6 Interview reflections

3.6.1 Visual elicitation

I used visual elicitation (Pauwels, 2020) to look at and discuss with professional participants the datavis they produced and/or shared on social media and, with audience participants, the datavis they had previously reacted to on social media. The use of a visual object in a research interview stimulates discussion by evoking feelings and memories (Harper, 2002) and encourages more emotional conversation (Bagnoli, 2009). It was thus a useful method as it encouraged participants to re-engage with their ideas, memories and emotions (Willig, 2016) about datavis. This was especially important in the interviews with the audience

participants as some of them encountered the selected visualisations long before the interview and did not remember them very well.

Moreover, audience participants were asked to bring to the interview any datavis which evoked their emotions in some way, changed their minds about something, or mobilised them to act. I emphasised this request in the invitations to the interview and published it on the project website, but not all of the user participants were enthusiastic about this request. Eventually, they had the option to identify a datavis during the interview or to send one to me after the interview. Here, visual elicitation offered a way to collaboratively create data and knowledge with participants (Rose, 2016). The datavis were therefore not only used as elicitation tools but were also included within the analysis process.

Audience participants who talked to me about the datavis they reacted to were more confident and empowered to take an active role in the interview as it "positioned them as the 'expert'" (Rose, 2016, p.316). As a result, audience participants felt more comfortable and in control, which facilitated the building of rapport, openness and engagement in the interview as noted by Edo (male, 20, British, student, based in England), who was discussing one of the data visualisations he responded to online:

> Especially because it says that it's an hour interview. So it's like, you feel like you need to come to it with a lot of, uh, ideas and concepts, even though it's more relaxed form and the way that you are asking things and you have like visual aids as well. Like when you are showing me now on the screen the visualisation that I've shared… that's extremely useful to help that conversation go. But unless I know that this is going to be there, I just thought like, it might be like a job interview for an hour and quite an intense atmosphere.

The interviews were also much more emotional as the images tended to elicit deeper memories (Pink et al., 2015). Using visual elicitation proved to be a useful tool to add new meanings to traditional oral interview techniques (Harper, 2002).

3.6.2 Role of the interviewer

As Valentine (2007) argues, just by being present in the interview, asking questions and hearing the participant's responses, the researcher influences the narrative. I tried to be reflective about this impact and recognize my own role in the interviews dealing with sensitive topics and emotions. As an interviewer, I took on the role of an empathic listener, listening to the stories of the interviewees (Mason, 2002). From the beginning of my interaction with participants and during the interviews I focused on building rapport and trust. I looked to Brinkmann and Kvale (2005) as a model for the interviews, characterised as intimate and caring exchanges between researcher and participant. I tried to facilitate the conversation (Enosh and Buchbinder, 2005) and be interactive with my participants but at the same time giving them space to gather their thoughts and reflect on their emotional experiences and ideas. While doing this I followed Shotter's (2005) advice:

> Ethically, we must allow other people both to be specifically vague, that is, to be only partially clear, in what they say, while also allowing them to entertain the expectation that we will either assist them in further making their meaning clear, or allow them whatever further opportunities are required for them to do so (p.119).

I tried to experience the interviews not only intellectually but also emotionally (Gilbert, 2001), acknowledging the feelings of both a participant and mine as a researcher as part of the interview process (Dickson-Swift et al., 2009). I was aware of my own emotions and of the risk of projecting them on the subject of study and on my participants and tried to avoid this. However, since my research is built on the assumption that emotion and reason are not opposites, that emotionless 'neutrality' does not always generate good results and that researcher cannot be emotionally neutral, I embraced my emotions as "vital to analytical research processes" (Bergman Blix, 2015, p.126).

I worked hard to create a natural, relaxed and friendly conversation but sometimes it was quite an emotive process. I remember an interview with Hawa (female, 22, Irish Indian, student, based in the UK) who was not feeling well at the time of the interview. I had a heavy heart ending the interview and was worried about how she was feeling after our

conversation. After each interview with my participants, I sent an email to thank them, but also to 'check in' on them, which was all I could do as a researcher and interviewer.

3.6.3 Language and translational approaches

Part of my research data was collected in Poland and therefore the research process involved acts of translation from Polish, my native language, into English as the thesis is written in English. Since I can speak both languages fluently, I fulfilled both roles of researcher and translator while interviewing, analysing and writing up my thesis. Due to the large volume of material I collected, I worked bilingually. This meant that I translated only those sections of the Polish transcripts (n=24) that I intended to use in the analysis or quote directly in the thesis.

Translation is a form of knowledge-making (Temple and Young, 2004) and always provokes questions about the researcher's role in this process, including an element of interpretation but most importantly, the cultural meanings a language carries (Temple and Young, 2004) can be lost from research data. Furthermore, many scholars and writers argue that meaning is always constructed through a discourse between texts (Spivak, 2021) and therefore "there is no single correct translation of a text" (Temple and Young, 2004, p.165).

I acknowledged that it is impossible to take a totally "neutral position from which to translate" and that "the translator always makes the mark on the research, whether this is acknowledged or not" (Terence and Young, 2004, p.171). However, I tried to be as neutral as possible when speaking for my Polish participants and articulated their voices as accurately as possible (Gawlewicz, 2016) due to ethical responsibility and respect for my participants. I was, therefore "continuously involved in making choices about how to represent people" in my research (Gawlewicz, 2016, p.31).

Moreover, as discussed in more detail in Section 3.9, I had to reflect at every stage of my qualitative research, including translation, on how my position as a White Polish female researcher living, studying and conducting my research in the UK "may not only determine

the outcomes of a fieldwork, but also affect research-related interactions or relationships with informants" (Gawlewicz, 2016, p.30) from both countries, Poland and the UK.

3.7 Ethical considerations

The project obtained ethical approval through the University of Sheffield's ethical committee and worked to adhere to the guidelines. It also carefully followed the *University of Sheffield Research Ethics: General Principles and Statements*. A fair and equitable approach was taken to respondent recruitment and sampling. Participants from a range of socio-economic and cultural backgrounds were recruited, and diverse views were obtained. According to BSA Guidelines on Ethical Research (2017), I took responsibility for ensuring that the study did not have a negative impact on the physical, social and psychological well-being of my participants.

All participants were fully aware of the aim of the research, what the research was to involve, how their personal data would be used, and that the interviews would be recorded. They could ask any questions before taking part, and throughout the research process. They also had the right to withdraw from the study at any time up to December 2021. I obtained written informed consent from all audience and professional participants, who remain anonymous in the thesis.

The risks associated with audience interviews were mainly around two issues regarding the politically sensitive nature of audience interviews (Decker et al., 2011) and the focus on emotionality (Dickson-Swift et al., 2009). I talked with audience participants about often politicised data visualisations relating to climate change, which could increase their vulnerability to psychological and emotional distress. I therefore conducted the interviews with sensitivity, as skilfully and carefully as possible (Dickson-Swift et al., 2009), showing respect for the potential diversity of participants' opinions. As stated above, I avoided using political classifications that could give rise to unreasonable generalisations and the discomfort of the participants. I reassured them that there were no correct ways of feeling or no right or wrong answers to my questions to ensure their comfort throughout the interviews.

Each participant was assured that the interview was confidential and that there was no one around to hear our conversation. Their identities were anonymized as recommended by many official ethics guidelines and qualitative researchers (Saunders et al., 2014; Gerrard, 2020) and as noted in the research ethics application. Anonymity was applied to people other than the researcher, who saw most of the participants and had access to their information (Saunders et al., 2014). Participants were asked to choose fictional names/pseudonyms or were given these by the researcher who tried to select names that would resonate with them (Grinyer, 2002) but would not reveal too much about their backgrounds (Saunders et al., 2014).

Unexpectedly, eight audience participants wanted to have their own names used, which created a tension, as identified by Wiles and colleagues (2012), between the need to protect participants and their desire to be not only heard but also *seen* and recognised. Since the interviews did not touch upon highly sensitive topics and their unlikely identification on social media (among hundreds/thousands of other people who reacted to the selected datavis) was not deemed to pose any risk or threat to the participants. I decided, after a further process of informed consent, to respect the rights and wishes of participants (Guenther, 2009) and consent to the use of real first names. In this case, ethical obligations and the anonymity of the participants could be maintained while giving participants "the basic right to be who they are" (Guenther, 2009, p.414).

The anonymity arrangements were slightly different for the organisations, whose actual/real names were maintained for two main reasons. First, this was due to the focus being on the datavis views of professionals and not on the work of the organisations themselves. Second, because the organisations are large enough and distant from most readers, naming them is hardly a breach of confidentiality (Guenther, 2009). However, I disconnected professional participants from the organisation with which they worked and from other identifying characteristics, especially when they were attached to statements that could potentially harm the participant or organisation in any way (Guenther, 2009). In this case, participants were referred to by the characteristics of their work with datavis or in

a given organisation. Real names of the professional participants were avoided (Guenther, 2009).

Therefore, each professional participant was made aware before the interviews (see Appendix 4) that although steps had been taken to ensure their anonymity and that their real name and actual organisational role title would never be used, those familiar with their work in the organisation might still be able to identify them (Guenther, 2009). This strategy was aimed, on the one hand, at protecting their identities and, on the other, at avoiding the decontextualization of findings and loss of meaning by disconnecting the data from the organisations' names and characteristics (Guenther, 2009).

Data protection measures were adopted in line with the University of Sheffield's Research Ethics Policy Notes (2018). These were outlined in the research's ethics application, which was approved by the University of Sheffield in September 2019. All research data was treated confidentially, stored securely in a password-protected file for electronic information or a locked and secure filing cabinet space. Data was used only for this study and destroyed in line with the General Data Protection Regulation (GDPR) and the Data Protection Act 2018 (DPA) after completion. Audio recordings were erased once they had been transcribed. All consent forms were kept separately from the anonymised transcripts in a password-protected file for electronic information accessible only by the researcher.

3.8 Data analysis

I undertook a comparative analysis to gain greater understanding of social reality in two different national contexts. By comparing Poland and the UK I investigated how two nation states with different histories and experiences with social diversity may influence data visualisation exposure and how it can consequently differently shape emotions and political participation. It also helped me to explore whether demographic factors such as age, gender, education, ethnicity, nationality or occupation play a significant role in these processes and can lead to different data experiences.

The research process showed me that in practice, data collection and data analysis is a messy and heterogenous process, "unknowable in a regular and routinised way" (Law, 2003, p.3). In addition, my qualitative approach and semi-structured interviews also posed a methodological challenge for analysing collected data and making sense of complex responses to datavis and diverse and overlapping emotions. At the same time, it was important to bear in mind the broader socio-political contexts and their impact on my analysis. Therefore, from the very beginning of the data generation process, I was very careful and attentive to collected data. Following Mason's (2002) advice I started to interpret data before I had a fully organized data set. It was an ongoing process of 'wondering' and asking questions such as: What is going on and what might this mean? (Mason, 2002).

All collected data were then analysed in a more formal and structured way by means of a thematic analysis: "a method for identifying, analysing and reporting patterns (themes) within data" (Braun and Clarke, 2006, p.79). Braun and Clarke argue (2006) that thematic analysis is a foundational method for qualitative analysis and offer clear stages for the researcher to follow to carry it out. I adopted Braun and Clarke's (2006) method to analyse my data, as discussed below.

Completing analysis of visualisations and interviews, including transcribing, reading, and digesting material, was the first stage of analysis, which required familiarising myself with my data (Braun and Clarke, 2006). I took the time to transcribe most of the interviews and *read* the data to become immersed in it (Mason, 2018). I also collected and described key emotive visual resources used in the data visualisations on climate change in my sample (see Chapter Four) by looking at the visual features of datavis themselves (Hill, 2014).

Alongside transcription and reading the data I started taking notes and marking my personal reflections on the interview transcripts and my first ideas for coding (Braun and Clarke, 2006) to find what were emerging as the most important issues among participants. To generate initial codes, I looked at how all data collected worked alongside each other, with the research questions and literature review. It allowed me to see which themes were

arrived at deductively and which were arrived at inductively (Fereday and Muir-Cochrane, 2006). For example, analysis was partly structured according to the findings of Kennedy and Hill (2017) who identified emotional responses to a number of factors in datavis. I used these categories as a starting point, but I was also led by my own data and developed some categories inductively.

As I had conducted three kinds of interviews, including interviews with professionals from both Poland and the UK, and interviews and follow-up interviews with audiences from both Poland and the UK, it became troublesome to keep all transcripts together. Due to the sheer volume of data, I decided to use software for qualitative data analysis: NVivo for data management, coding and analysing my interview data. I conducted a thematic analysis of interview data: grouping the responses; finding and cataloguing themes; identifying the connections between themes and moving toward analytical insight; and finally making comparisons between participants and two countries. I started with descriptive coding, which required me to read each transcript again to code each paragraph according to a topic.

The aim of the comparative analysis was not to group participants from Poland and the UK into two national 'types', but rather to detect patterns among all participants. I used these two contexts to underline the complexity and contextual nature of the emotional engagements with datavis and audiences' potential political participation. I treated these two national contexts as units of analysis (Livingstone, 2003), and nodes, analytically linked with each other (Valentine et al., 2015, p.3). Therefore, they were kept apart in the analysis only when data indicated that patterns of datavis experiences and practices varied significantly across Poland and the UK. When each code was annotated I started "searching for themes", reviewing, and naming them (Braun and Clarke, 2006, p.87); identifying the connections between them; moving towards analytical insight; and finally making comparisons between participants from the UK and Poland. I include some illustrative codes and themes I devised in Appendix 13.

I spent a long time reading, writing and editing the data to draw identified codes together into coherent arguments that could be explored within the thesis. It was, however, impossible to present in the thesis all data and themes that reflected something integral to the aims of this research. I unavoidably had to make decisions regarding what to include and exclude. The process of collecting and analysing data can never be completely objective as it is inevitably informed by researchers (Mason, 2002), including their personal backgrounds and theoretical orientations, but also different choices and decisions. As noted by Enosh and Buchbinder (2005) "although the power to recall is in the hands of the interviewee, the power relation shifts when the research results are to be reported" (p.613). I tried to avoid misuse of this power while analysing data, quoting and reporting my findings by using "a wealth of descriptions and citations" (Enosh and Buchbinder, 2005, p. 613) as accurately as possible. I acknowledge and reflect on this issue in the following section.

3.9 Positionality of the researcher and researcher effects

I recognize that my location within the social world influenced all stages of my research process (Steier, 1991), from choosing the research questions and collecting, analysing and interpreting data to presenting the findings. Therefore, in this section I document and explore how my background, experience and personal assumptions and behaviour impacted the project and power relations (Edwards and Mauthner, 2002) between myself, professional and audience research participants. This is of great importance because the way a researcher is perceived by study participants has an impact on what 'truths' and accounts are told (Neal and Walters, 2006).

I am an early middle-aged White, Polish female who moved to the UK in her early adulthood. After completing postgraduate studies in sociology, and before doctoral studies, I worked for several years on local, national and international community art projects and in digital literacy education. My academic interest in sociology of emotions, visual sociology and visual methods, as well as my experience from working on participatory projects using data visualisations, motivated me to conduct doctoral research on data visualisations, emotions and political participation. I wanted to understand whether and how datavis can

be used as a tool to enhance participation and active citizenship and what role emotions play in this process. I am by no means a visualisation designer and I do not have such skills.

Initially, I was worried about the asymmetry of power between a researcher and professional participants that may appear in interviews with professionals due to the power associated with the participants through their professional position (Odendahl and Shaw, 2002). However, this asymmetry was not present in the interviews. This phenomenon is discussed in a study by Neal and Mclaughlin (2009) which shows that it is not always obvious where power lies in research involving elite participants and who is in control of the research; it is fluid and "cannot be easily identified as fixed and flowing from (our) elite research participants" (p.699).

Moreover, as mentioned above, not all of the participants from the organisations had expertise in designing data visualisations or were datavis professionals. Therefore, in some cases, I was perceived as having the greatest understanding and expertise in datavis. At times it caused my professional participants to become frustrated and vulnerable as they were not able to present themselves as being more knowledgeable than the researcher. As Neal and Mclaughlin argue (2009), these types of emotional experiences of elites during interviews may cause power to run "through our research relation in a much looser, messier and multidirectional way" (p.699).

However, as is often the case with interviews with experts/professionals, many of the professional participants from the organisations who replied to my invitation displayed a desire to help and professional curiosity about the research topic (Bogner et al., 2009) – a representative from one of the environmental organisations wrote in an email to me: "I am happy to help to the best of my abilities and I do not hide that I will be more eager to find out the results." Due to this interest and the shared understanding of the social relevance of the research (Bogner et al., 2009), I built connections with some of the organisations, with ongoing conversations and updates on the progression of the study. As a result, even though I was a junior researcher, interviews with professionals resembled an "exchange between peers" (Odendahl and Shaw, 2002, p.314).

The power relations were slightly different during interviews with audiences. Most of the educated and White participants, especially those from Poland, were keen to participate in the project. As a White and educated researcher, I was often recognised as a "familiar and knowable stranger" (Neal and Walters, 2006, p.180). These audience participants enjoyed the interviews and openly expressed their opinions and emotions about the topic of climate change which was also particular empowering for an educated middle class. All these factors helped me to build a strong partnership with these participants. The interviews with them lasted longer and they were more willingly agreed to a follow-up session.

Moreover, like Gawlewicz (2016), who conducted her research in the UK among Polish migrants, my Polish audience participants living in Poland also assumed that I shared a strong "sense of belonging to the Polish nation" (p.34). This was manifested, for example, by them taking for granted that I knew what was happening in Poland politically at the time of the interview, although I lived and studied in the UK. It often situated me as an insider in the interview process, making it easier to build a strong rapport.

I did not perceive that the national, ethnic or other differences or similarities between me and my audience participants from Poland or the UK created asymmetrical power relations and elicited better or worse data from them. As a researcher, I have held various positions which worked to both sometimes shut down and sometimes open up discussion, depending on the different characteristics of the participants, not only nationality or ethnicity but also age, gender, class and education. Despite this, I took care to be aware of and attentive to social and ethnic differences in the interview setting and how this may influence what was shared with me and how I was perceived by my audience participants from the UK and Poland.

However, in the recruitment process, people from ethnic minority communities, in most cases, were hard to reach and did not answer my messages. This might mean that familiarity understood as "sameness" (Neal and Walters, 2006) is important and can influence the research process and data collection.

3.10 Conclusion

This chapter has documented the methodological and ethical decisions taken throughout the research process. I have explored the theoretical foundations of this research and the practical negotiations. I have reflected upon the research methods and the semi-structured interview and explained why a qualitative approach is best for researching emotions, data visualisation and politically sensitive topics. Following this, the chapter covered an account of recruitment/sampling and data collection in three key sections for each of the three key datasets (data visualisations; professionals; and audiences). I then reflected in more detail on interviews, including visual elicitation, the role of the interviewer and the issues and challenges of doing research in sensitive and political areas. Following this, the chapter outlined the translational approaches used in the thesis, reflected on the ethical issues of this research and data analysis process. Finally, my position as a researcher was discussed.

The chapter explored the use of social media as an effective means of gaining access to (diverse) potential research participants. However, it also emphasised the challenges of ensuring diversity in the research process and the importance of being attentive to these differences in the interview setting, especially when working bilingually. Moreover, this chapter has shown the value of a blended methods approach and how online interviews can be very successful in researching emotions and politically sensitive fields, as well as in conducting visual elicitation. The following four chapters provide a discussion of the findings that were generated through data analysis.

Chapter Four:
Organisations' Perspectives on their Data Visualisations

4.1 Introduction

This chapter focuses on the perspectives and voices of those who produce or disseminate data visualisations about climate change, and on data visualisations that these organisations shared online with the public and which I followed in the research. I draw here on nine interviews with ten professionals from the organisations who designed, commissioned and/or disseminated datavis about climate change and on visual analysis of 13 selected data visualisations. As several scholars argue (Rose, 2016), to analyse visual material, it is important to explore the contexts in which the visuals are made as well as the people who make and share them, and their motivations. As I discussed in the literature chapter, datavis are not neutral; they are "the result of numerous choices involving a range of people (those who want the visualisation to be made, those making it, and others in between)" (Kennedy et al., 2016a, p.719). Therefore, by using the social semiotic framework discussed in Chapter Three, this first empirical chapter tracks the datavis back to those who create and use them and takes a closer look at the datavis themselves and their key visual resources that may evoke emotions in the audience participants.

The chapter first introduces the two different types of environmental and climate organisations selected as a sample for my study: environmental campaigning organisations and information-providing organisations. It investigates the implications of these distinctions on how the organisations use datavis and think about their audiences, as well as what skill sets they prioritise in-house. The chapter introduces and briefly describes 13 data visualisations selected for the study – the rationale behind these choices was discussed in Chapter Three. These datavis were designed and/or made available online by the climate or environmental organisations while the audience participants reacted to them on social media and discussed them in interviews. The chapter does not include all the visualisations that audience participants refer to in the interviews and following chapters, some of which were identified and brought to the interview or a follow-up session by the audience participants themselves. Due to their number, it is not possible to include all the datavis

here. Therefore, in this chapter, I only introduce the datavis from my sample, which was the basis for recruiting audience participants and the main visual material used in the study.

The second part of the chapter explores the organisations' perceptions of what kinds of data visualisations may be most effective in generating emotional responses and what kind of emotions (if any) the datavis that they produce or share online intend to evoke in their audiences. ~~The section uses a semiotic approach as this enables an analysis of the most emotive visual features of the 13 datavis selected for this study, their visual components, composition, colours, and visual metaphors (Hill, 2014).~~ My selection of semiotic resources draws on literature on visual analysis, data visualisations and data storytelling (Tufte, 2001; Kress and Van Leeuwen, 2006; Margolis and Pauwels, 2011; Kirk, 2012; Hill, 2014; Kennedy et al., 2016a; Feigenbaum and Alamalhodaei, 2020) that I have found useful for the purposes of this study.

The discussion in this chapter will pave the way for the next chapter, in which I will analyse the emotional reactions of the audiences themselves to data visualisations about climate change. As a result, together, both chapters investigate whether the datavis evoke emotions in the way the organisations intend them to.

4.2 Campaigning organisations

Greenpeace Poland and Greenpeace UK are a part of a network of independent non-governmental organisations. They are both linked to Greenpeace International, and their main goals are "to protect biodiversity in all its forms; prevent pollution and abuse of the earth's ocean, land, air and fresh water; end all nuclear threats; and promote peace, global disarmament and non-violence" (Greenpeace International, website) As stated on their websites, Greenpeace Poland and Greenpeace UK "do not accept money from governments, corporations and political parties" (Greenpeace org). Their work is funded almost entirely by donations and grants "from private foundations including European Climate Foundation, Rausing Trust, Oak Foundation, Umweltstiftung, Grassroots Foundation" (Greenpeace Poland, website) in Poland and "grants from charitable trusts and foundations based in the UK" (Greenpeace UK, website) in the UK. Greenpeace UK is made

up of two parts that work together: Greenpeace Limited and Greenpeace Environmental Trust. The Greenpeace Environmental Trust supports main campaign work while Greenpeace Limited, "runs hard-hitting campaigns and confronts environmental injustices" (Greenpeace UK, website). In 2020, Greenpeace Poland employed around 58 people but not all of them worked full-time (Greenpeace Poland, website). Greenpeace Limited currently employs around 163 people (Global Database, website) but similar to Greenpeace Poland, not all employees work full-time.

The World Wide Fund for Nature (WWF) UK and The World Wide Fund for Nature (WWF) Poland are part of an international non-governmental organisation The World Wide Fund for Nature. It is "the world's leading independent conservation organisation" and its main "mission is to create a world where people and wildlife can thrive together" (WWF UK, website). The organisations in both countries are involved in transforming the future for the world's wildlife; pushing for a reduction in carbon emissions; and pressing for measures to help people live sustainably. WWF UK employs around 482 people and the majority of its main income "comes from public donations in the form of memberships, adoptions and legacies" (WWF UK, website). WWF Poland employed around 150 people in 2020 (WWF Poland, website). Its work is funded from public sources such as European and state public funds and private sources including memberships and donations from individuals or organisations. In both cases, as in Greenpeace Poland and Greenpeace UK, not all employees work full time.

As discussed in Chapter Three, campaigning organisations such as Greenpeace and WWF do not employ people who specialize and work exclusively with data visualisation or climate change in their organisations as their activities cover a wider range than this issue. Therefore, the professionals from the organisations interviewed for the study had different roles and work experiences. In many cases, they were not experts in either data, data storytelling or climate change and were responsible for general or online communication with audiences. Some of them stated that the organisations lacked the necessary human and financial resources to create and share their own datavis with audiences on a daily

basis, including the time, skills or tools needed, as illustrated by Justyna, a communication specialist from WWF Poland:

> This may be simply due to the limitations of our resources. For example, we had a post a few weeks ago related to Australia, it was also just focused on the photo of the fire. Australia is on fire but then there was a description and some kinds of different data. So the data were there (...)

While Justyna from WWF Poland admitted that she would like to produce more data visualisations and share them with their audiences because she believes they are effective and can evoke emotions, Patrycja, a communication specialist from Greenpeace Poland stated that the organisation appreciate the importance of graphs, charts and maps, and use them from time to time, but it is hard to design datavis about climate change that would be as emotive and effective as other images, such as photographs:

> Here you are, two wolves are playing in the national park. It works better. The thing we use is the use of an image. (…) We are looking for these data visualisations all the time but it is difficult to find something that is strong and good enough. (…) But it is also interesting that when we communicate the climate, what the trends are and so on, for example, that these are difficult things and also people will not stop, so this famous polar bear or pictures of people in the face of a disaster often speak more to the consciousness than digits, numbers or maps, anything that is actually more difficult to perceive.

This contradiction in the views of organisation employees about the use of data visualisation in their work shows that some environmental campaigning organisations may not see datavis as a successful tool that can affect and influence their audiences. This is an important assumption, and I will explore whether this is true in Chapter 6. However, communication and social media specialists from most of the organisations stated that they sometimes outsource the design of datavis. Most often these are reports addressed to experts, less often visualisations addressed to audiences.

The issue of a lack of resources that prevents more frequent use of data visualisation reflects Feigenbaum and Alamalhodaei's (2020) argument that some civil society organisations often "face limited budgets, resources, and time" (p.68) and are not able to fund full-time data workers. As the authors suggest, some organisations in non-corporate workplaces "are being left behind in terms of both data literacy development and data capacity building in an increasingly datafied world is cause for concern" (Feigenbaum and Alamalhodaei, 2020, p.68) and is one of the reasons for the growing data divide.

When pressed further on whether the lack of resources is the reason for not using data visualisation at all, most of the professional participants stated that their organisations sometimes publish datavis on social media that are also outsourced or created by staff members who do not have much skill in the field of data or data visualisation. Olivia, a communication specialist from WWF UK highlighted this when asked about the authorship of hand-drawn data visualisations (see for example Figure 5) posted by the group on Instagram and Facebook: "Yeah, so she is in the social media team and this actually is not her job to do these illustrations, but because she is skilled, I think she did a few and we were like oh yeah, we might as well use you." In these situations, some of the campaigning organisations noted that datavis are often simple and may be created in a graphics editor such as Photoshop which allows editing photos and graphics including adding additional text to them, or in the case of hand-drawn datavis, in a digital illustration app called Procreate that allows creating sketches, paintings, illustrations and animations. This may suggest that communication specialists working in the environmental campaigning organisations believe in the effectiveness of data visualisation in their work and use them even though they often have limited resources.

Several professional participants from the environmental campaigning organisations admitted that they sometimes provide their audiences with datavis created by other organisations, an international office, or foreign branches of the organisation, as explained by Sebastian, a communication specialist from WWF Poland:

> But when it comes to our visualisations, we also have, for example, from an international office, when for example, IPCC reports appear, these are visualisations of data or a climate impact that is shown on some infographics.

On this occasion, the professional participants stressed that they only select datavis that are appropriate for the communication platforms they use and their audiences, which is further discussed in Chapter Seven (Section 7.2). For example, Amelia, a representative from WWF UK said that the organisation's audience on social media may be aware of climate change but may not necessarily be well educated on the subject, thus datavis posted there should not be too complicated. Amelia explained this while talking about datavis she had created and published on Facebook about climate concerns among British residents (see Figure 5) which adopts a simple hand-drawn visual style:

> This specifically would be for social media users who follow us on Facebook, Twitter or Instagram. So it's not necessarily a kind of audience who are really educated about climate change and know all the details, but probably have an awareness; they're on social media and wouldn't be completely new to the topic.

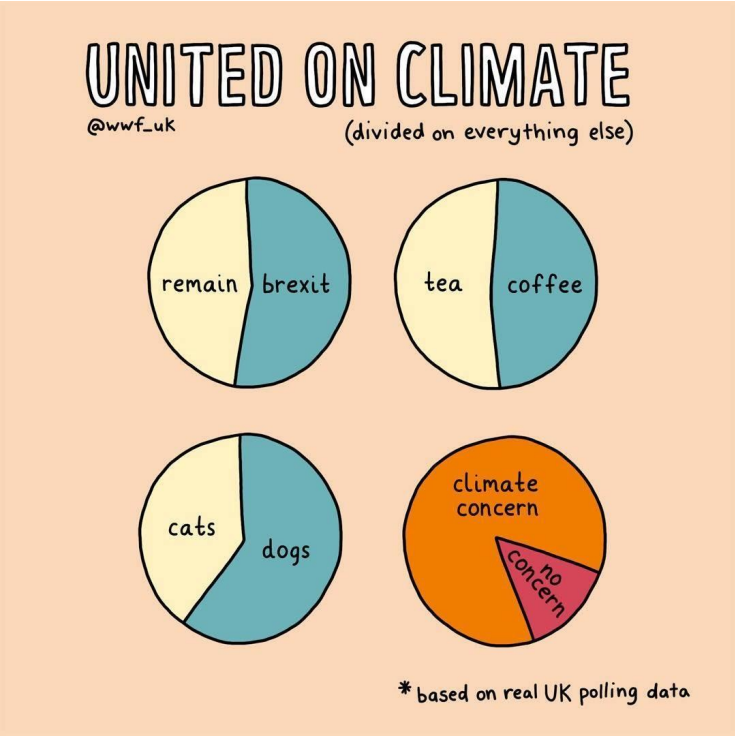


Figure 5: United on climate (divided on everything else)

Source: WWF UK, December 2019

When pressed further on what kind of datavis can appeal to the organisation's audience, Amelia referred to commonly used standardised datavis formats such as pie charts, bar charts and line graphs that often circulate online and in the media, and to which people may be exposed more often. She believed that such formats may be more accessible to the audience due to their ubiquity and gave an example designed by her datavis about climate concerns among British residents (see Figure 5) which has been published on Facebook and Instagram:

> I think around this time there was a lot of pie charts and infographics going around on Instagram and we wanted to kind of jump on that trend. So if people are looking at all this infographic stuff they're more likely to look at our infographics because if they're looking at lots of pie charts then they'll be happy to look at our kind of thing. We wanted to jump on that trend and kind of be merged into the whole Instagram world of being part of what everyone's talking about.

Other campaigning organisations also believe that the datavis they use should be easy to read and not too complicated. Patrycja, a communication specialist from Greenpeace Poland explained what she thinks works best in the organisation when they share datavis with audiences and why:

> The less data on the visualisation, the better, and when we want to present something, we always try not to make it too complicated. People spend little time on all the information that appears on the Internet. In my opinion, eighty per cent of cases I'd say that simple things will work, not the more complicated ones.

Taken together, these observations suggest that the organisations prefer to use simple, often DIY, visualisations in their daily online communication with audiences rather than complex ones containing lots of data. The exceptions are previously mentioned reports or bigger projects usually targeted to specific audiences; here, data visualisation is usually

prepared in cooperation with freelancers from outside the organisations or its production is outsourced. Olivia, a communication specialist from WWF UK explained that the group uses more complex visualisations in reports which are usually addressed to specific audiences who may be particularly interested in the topic of climate change, including journalists and decision-makers:

> We make a lot of our reports available on our website for people to use, and I think we'll then use those reports as our information and our facts. So if we do an article or a blog post or anything else, we'll then reference it back to that report. But the report itself, with the data visualisation, will be kind of targeted towards people who are in the know, who are making decisions about a certain topic at that time, I guess.

The contradiction in the above statements about the importance and use of complex data visualisation in reports or more specialized communication but the use of simpler datavis in daily online communication with audiences suggests two things. First, it indicates that the campaigning organisations target different datavis to different audiences. Second, it may suggest that datavis is seen by some professionals from the environmental campaigning organisations primarily as a scientific tool for imparting expertise, not as a tool that can inform and affect non-expert audiences. However, despite this general division into 'expert' and 'lay' audiences, most campaigning organisations were unable to determine how these different audiences react to different kinds of data visualisations published online, and whether data visualisations can mobilise them to action, except that emotions may play an important role in engagements with datavis, as further discussed in Section 4.4. I answer all these questions in my next three empirical chapters (see Chapters 5-7). In the following subsections, I introduce and briefly describe data visualisations that were published online by environmental campaigning organisations and selected for this study, in order to familiarize readers with the selected data visualisations to ease understanding of a subsequent discussion.

4.2.1 Datavis designed and/or published by campaigning organisations

This section briefly describes the seven data visualisations designed and/or published by the campaigning organisations selected for my study. The data visualisations are discussed in the section in the following order: (1) Greenpeace Poland; (2) Greenpeace UK; (3) WWF Poland; (4) WWF UK. I have endeavoured to include the data visualisations' titles (where possible), authors and countries of origin, and to provide information about the place and date of online publication, type of visualisation (static, interactive or animated), their captions, and primary subjects.

4.2.1.1 Greenpeace Poland

The first data visualisation published on social media by Greenpeace Poland was outsourced externally; the second was made with the use of the organisation's resources.

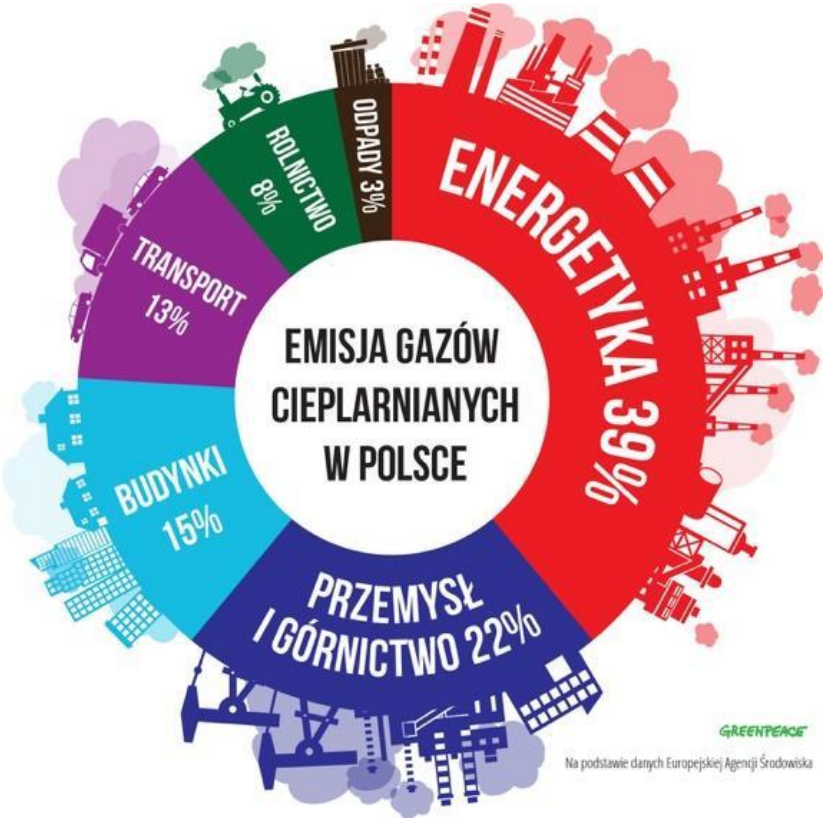


Figure 6: Greenhouse gas emissions in Poland

Source: Greenpeace Poland, December 2019. See a bigger version of this image here.

The static pie chart in Figure 6, entitled *Greenhouse gas emissions in Poland*, was designed, produced, and posted on Facebook by Greenpeace Poland in December 2018. The main theme of this chart is greenhouse gas emissions/air pollution, and it shows where exactly Polish greenhouse gas emissions come from (energy 39%, industry and mining 22%, buildings 15%, transport 13%, agriculture 8%, waste 3%). The post describing this visualisation on the organisation's Facebook page says that the biggest source is, of course, energy production (such a trend occurs in most countries); in Poland about 80% of electric power comes from coal, hence the large share of this sector. Industry and mining are in second place. Furthermore, the organisation suggests that conclusions from these data are unequivocal: to reduce Polish greenhouse gas emissions, Poland must move away from coal. Information on the datavis shows that the chart is based on data from the European Environment Agency.

Figure 7: 50 most polluted cities in the EU

Source: Greenpeace Poland, December 2019. See a bigger version of this image here. There is also a link posted by Greenpeace Poland with more information about this issue.

Figure 7 shows a static map entitled *50 most polluted cities in the EU*. It was designed, produced, and posted on Facebook by Greenpeace Poland in May 2018. The main theme of

this datavis is air pollution, and it shows that most of the cities with the worst air quality in the European Union are in Poland. The post describing this visualisation on the organisation's Facebook page says that Poland broke another infamous record: as many as 36 out of 50 cities with the worst air quality in the EU are located in Poland, and this is three more than two years ago. The organisation also listed these cities and encouraged users to check where their home was on this list.

4.2.1.2 Greenpeace UK

This data visualisation shared on Instagram by Greenpeace UK was designed by British data journalist Mona Chalabi.

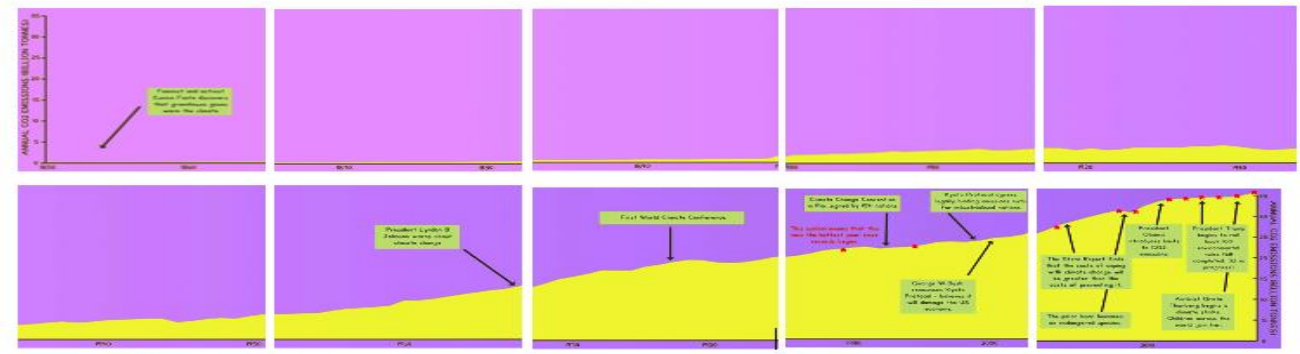


Figure 8: Annual CO2 emissions (billion tonnes)

Source: Greenpeace UK; author: Mona Chalabi. September 2020. See the full datavis here.

The line graph in Figure 8, entitled *Annual CO2 emissions (billion tonnes)*, was created by British data journalist Mona Chalabi. The datavis was posted on Instagram by Greenpeace UK in September 2020 with six hashtags: #fossilfuels, #co2, #carbon, #carbonemissions, #climatechange and #climateemergency. Its main theme is CO2 emissions/air pollution, and it shows the annual increase of CO2 emissions (in billion tonnes) from 1850 to 2010. The graph is broken up into ten pieces/images and, by swiping left, users can view/reveal the whole visualisation. Annotations added to the graph describe the deteriorating situation in the world related to climate change and actions taken by politicians or activists, or the lack thereof. The post describing this visualisation on the organisation's Instagram account says: "this is what climate inaction looks like! 😡 Indigenous People, scientists and activists have

been warning about climate change for decades. We're running out of time to fix things. We need urgent action from governments and corporations now!"

4.2.1.3 WWF Poland

The first data visualisation published on social media by WWF Poland was designed by WWF EU; the second was outsourced externally.

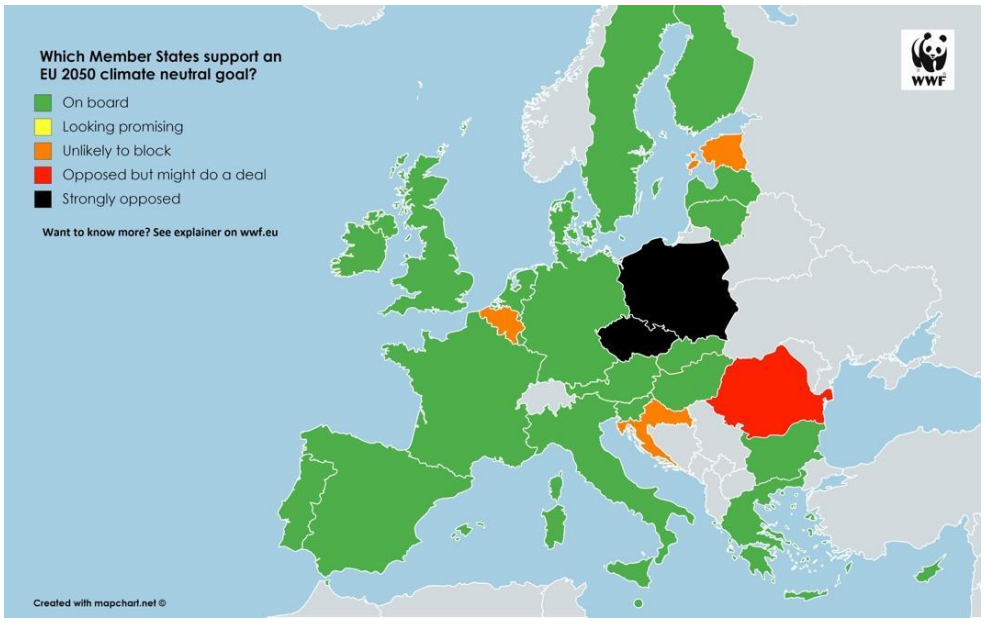


Figure 9: Which Member States support an EU 2050 climate neutral goal?

Source: WWF Poland, December 2019. See a bigger version of this image here.

Figure 9 shows a static map entitled *Which Member States support an EU 2050 climate neutral goal?* It was designed, produced, and originally shared on Facebook by WWF UE. WWF Poland retweeted it in June 2019 with two hashtags: #ClimateActionNow and #ClimateBreakdown. The main theme of this datavis is the EU 2050 climate neutrality agreement. The map shows that Poland and the Czech Republic (in black) are strongly opposed to an EU 2050 climate neutral goal; Romania (red) is opposed but might do a deal; Croatia, Belgium and Estonia (orange) are unlikely to block; and other EU countries (green) are on board and support the deal. The post describing this visualisation on the WWF Poland Twitter account says that the organisation hopes that Poland will support the European Council on the side of climate protection and adopt net zero for the EU 2050.

WWF Poland tagged the Polish prime minister (@MorawieckiM) in the tweet. There is information on the datavis that the map was created using mapchart.net.

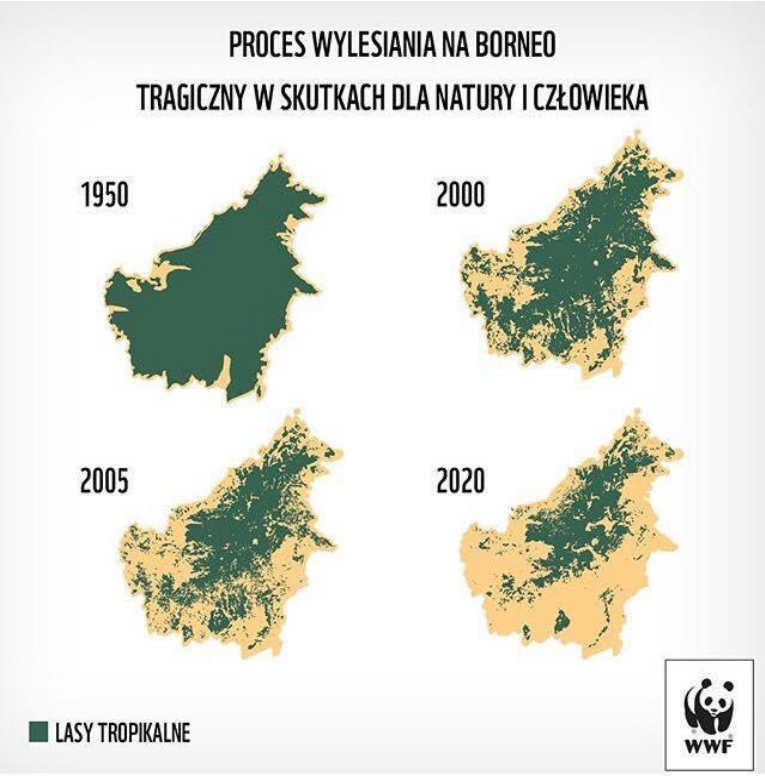


Figure 10: The deforestation process in Borneo is tragic for nature and humankind

Source: WWF Poland, December 2019. See a bigger version of this image here.

The static data visualisation in Figure 10, entitled *Deforestation process in Borneo is tragic for nature and humankind*, was designed, produced, and posted on Facebook by WWF Poland in August 2018. The main theme of this chart is deforestation. It compares four maps of Borneo, the third-largest island in the world, from different time periods, including 1950, 2000, 2005 and 2020. It shows that deforestation is increasing there: green represents forests and yellow represents deforestation. There is no post description on the WWF Poland Facebook page.

4.2.1.4 WWF UK

The following two examples of data visualisations published on social media by WWF UK were made with the use of the organisation's resources.

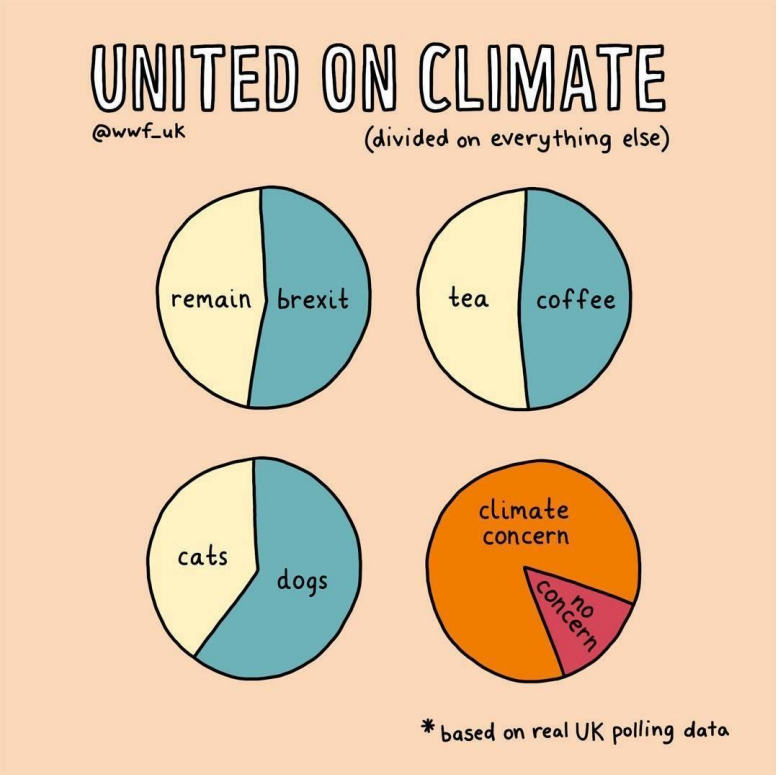


Figure 11: United on climate (divided on everything else)

Source: WWF UK, December 2019. See a bigger version of this image here.

Figure 11 shows a static data visualisation titled *United on climate (divided on everything else)*. It was designed, produced, and posted on Facebook by WWF UK in October 2019. The main theme of this chart is public concern about climate change. It presents four identically-sized pie charts that represent the views of UK residents on four different topics. The first three charts cover topics other than climate change and show that people of the UK disagree on them, while the last chart shows that most people are united in their concern about the climate. The conclusion is that British people are united on the climate and divided on other issues. The post describing this visualisation on the WWF UK Facebook page says that the science is clear and public concern about climate and nature is too. It asks why British leaders are not acting with the urgency that the people need. WWF UK also encourages users to read more about ways they can help fight the climate crisis in the link provided by the organisation.

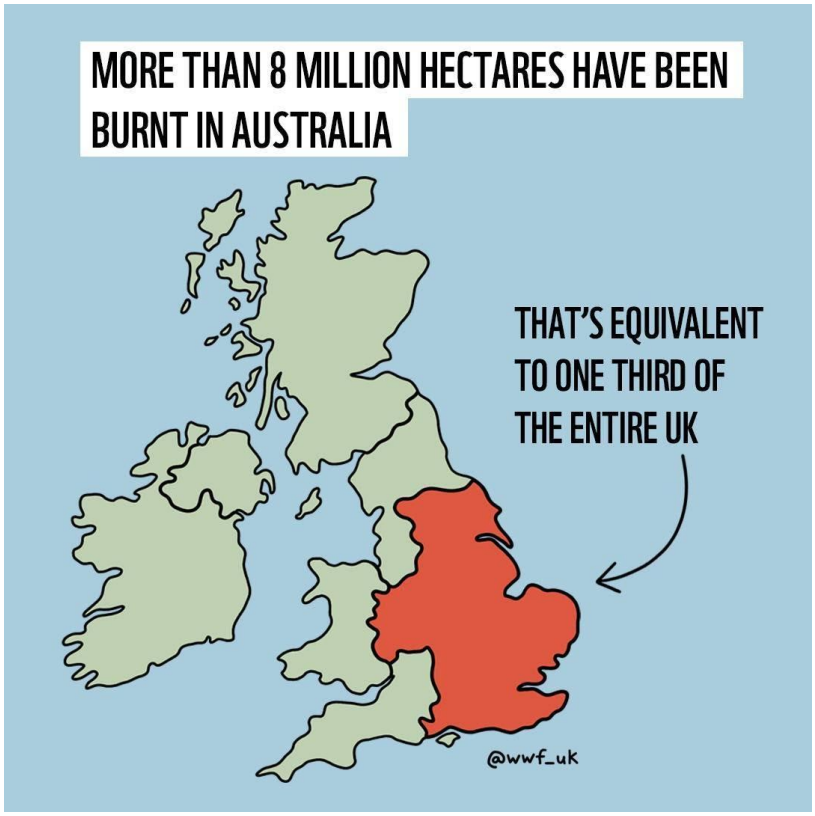


Figure 12: More than 8 million hectares have been burnt in Australia

Source: WWF UK, January 2020. See a bigger version of this image here.

The static map in Figure 12, entitled *More than 8 million hectares have been burnt in Australia*, was designed, produced, and posted on Facebook by WWF UK in January 2020. The main theme of this map is deforestation. It shows that eight million hectares have been burnt in Australia and that this is equivalent to one third of the entire United Kingdom. The post describing this visualisation on the organisation's Facebook page says that these are recent figures from Australia and the fire season is yet to reach its peak. There is also information on how people can help in the link provided by the organisation.

Section 4.2 examined specifics of environmental campaigning organisations selected for the study. It investigated how the organisations use climate change datavis in their work and think about their audiences. It also introduced datavis published on social media by these organisations and identified for the study. I will do the same with information-providing organisations in the following section.

4.3 Information-providing organisations

Information-providing climate organisations such as Carbon Brief in the UK and Nauka o klimacie Polska (Climate Science Poland) were created to improve the understanding of climate change in terms of science, and they focus their work mainly on data and data visualisations. Climate Science Poland is a Poland-based website run by the NGO Climate Education Foundation. Its main goal is to disseminate reliable scientific knowledge in the field of climate research. The operation of the website is financially supported by, among others, the European Climate Foundation and the University of Warsaw Foundation (Climate Science Poland, website). Carbon Brief, on the other hand, is a UK-based 'website run by Private Limited Company Carbon Brief LTD. The main goal of the organisation is to cover "the latest developments in climate science, climate policy and energy policy" (Carbon Brief, website). It specialises "in data-driven articles and graphics to help improve the understanding of climate change, both in terms of the science and the policy response" (Carbon Brief, website). It is funded by the European Climate Foundation (Carbon Brief, website). Both organisations employ fewer than 5 people, most of whom work for the organisation part-time.

Unlike the campaigning organisations, the information-providing organisations Carbon Brief UK and Climate Science Poland are represented in the study by people who are experts in the field of climate change and/or in data visualisation such as a multimedia producer, a journalist specialising in climate change issues and an atmospheric physicist. Moreover, Carbon Brief in the UK is the only organisation in the study that independently designs most of its datavis and employs visualisation specialists due to the specificity of its work described above. It is also the only organisation that sometimes designs more complex animated or interactive datavis. These are usually larger projects that take at least six months to produce and in which the entire team is involved. Steve, a representative from Carbon Brief involved in commissioning datavis explained when talking about a datavis showing how the UK transformed its electricity supply in just a decade:

> For things that are bigger and ambitious like this, we will take sometimes months even after a year sometimes. So, something like our decade of electricity

> transformation we would have decided that probably like six months in advance I think, I can't remember when this was published now July, I think it was last year. So we decided to do it, we committed to do it in January. So it's, this was at least six-month process.

This statement again refers to the time resources needed to design, in this case, a large-scale interactive data visualisation. Professionals from Carbon Brief UK often analyse data sets themselves which take even more time. In some cases, however, they use ready-made statistics and already analysed data sets to design datavis, as explained in detail below by Steve:

> Obviously, there are times when we know the data already exists, and there may be examples of other companies or organisations that have worked with that data, and we can see there's potential there to develop it in another way or something that's more akin to the Carbon Brief readership. Yes, so it does go both ways, but you know, we will sit down and discuss you know the particular stories and features that we want to develop and I think it's from there that we will kind of reach out to specific institutions that are doing the research, or trying to reach out to organisations that have, yeah, datasets that can be kind of paired with other datasets so we can start to build a particular picture that we want to tell.

Similarly, Climate Science Poland also makes extensive use of data visualisation in its work. However, as Anna, one of the professionals from the organisation stated, despite the accessibility of various software programmes that help the organisation visualise data without programming knowledge, creating an effective graph, chart or map is still not easy due to the lack of resources – especially time:

> Sometimes we prepare the visualisation for the article ourselves but it is also usually just a graph, not a very sophisticated one, just simple graphs or some kind of maps generated by automatic tools that are available on the Internet. […] It would

> probably be nice sometimes to make a visualisation that grabs attention, but in practice we do not have ideas or time to think about how to do it.

The above considerations again show that creating even a simple data visualisation requires appropriate resources and is a labour-intensive process, even for people who are more specialised in the subject of climate change. As Anna from Climate Science Poland mentioned, none of the employed people in the organisation works full-time, which distinguishes it from Carbon Brief UK. However, this does not limit the organisations' work that is based on data visualisations. Similarly to environmental campaigning organisations from the UK and Poland, Climate Science Poland often uses datavis from various sources – for example, those designed and published by other organisations or interactive chart and map generators on the websites of NASA, NOAA or the National Snow and Ice Data Center or previously mentioned *Warming stripes datavis* created by Ed Hawkins. The latter has been shared by the organisation on Facebook and met with great interest from Polish audiences, which I discuss in the following chapters. In this case, data visualisations from various online sources are used and modified for the needs of the organisation and to the Polish context, as further discussed by Anna, a communication specialist from Climate Science Poland:

> So it is rare for us to really design some data visualisation on our own. Usually these are adaptations, translations of an illustration that appeared in a scientific article or on a NASA website. Sometimes we prepare the visualisation for the article ourselves but it is also usually just a graph, not a very sophisticated one, just simple graphs or some kind of maps generated by automatic tools that are available on the Internet.

Reflecting their knowledge focus, Carbon Brief UK and Climate Science Poland also use datavis in a different way than campaigning groups. They usually publish them on their websites in their articles, where they supposedly fulfil two main functions, including simplifying complex ideas and making them more understandable for readers. They also make them available on social media mainly to arouse interest in the article by means of a

visual form, as discussed by the communication specialist from Climate Science Poland. When asked whether datavis can mobilise people to act, Anna replied:

> …I think visualisations are very effective in reaching people, for getting attention, but they are not necessarily enough on their own. This is to intrigue someone, get someone's attention, but then someone has to come to say what now, what about it.

This and other statements from the interviews indicate that datavis is perceived by many datavis professionals as an important and effective tool in reaching people and getting their attention. However, hardly anyone believes that it can mobilise people to act on its own. Rather, it is seen as one of many factors that can influence people's mobilisation.

The information providing organisations target their articles and data visualisations at audiences who they envisage as being more educated on the issue of climate change, as pointed out by Steve, the representative of Carbon Brief UK: "I think our audience has always been traditionally scientist, media, politicians." However, like environmental campaigning organisations, they did also make their datavis available on social media for wider publics.

There are overlaps between the organisations. For these information providing organisations, as for the campaigning organisations, the goal is to get people to care about and be on board with climate issues, but the educational aspect plays a more important role in this process than for campaigning organisations. This suggests that the effectiveness of visualisations means something different for information-providing and campaigning organisations, including mobilising to action, inviting a reader to explore data, or sharing it with others. I will explore these different practices provoked by datavis in more detail in Chapter 6. As in the case of campaigning organisations, it was difficult for information providing organisations to indicate what kinds of visualisations different audiences like and why, and what actions (if any) datavis can mobilise them to do.

4.3.1 Datavis designed and/or published by information-providing organisations

This subsection briefly describes the six data visualisations from my sample designed and/or published by the information-providing organisations selected for my study. The data visualisations are discussed in the section in the following order: (1) Carbon brief UK; (2) Climate Science Poland. As in the previous section on campaigning organisations, I have endeavoured to include the data visualisations' titles (where possible), authors and countries of origin, and to provide information about the place and date of online publication, type of visualisation (static, interactive or animated), their captions, and primary subjects.

4.3.1.1 Carbon Brief UK

The following four examples of data visualisations published on social media by Carbon Brief UK were made with the organisation's resources.

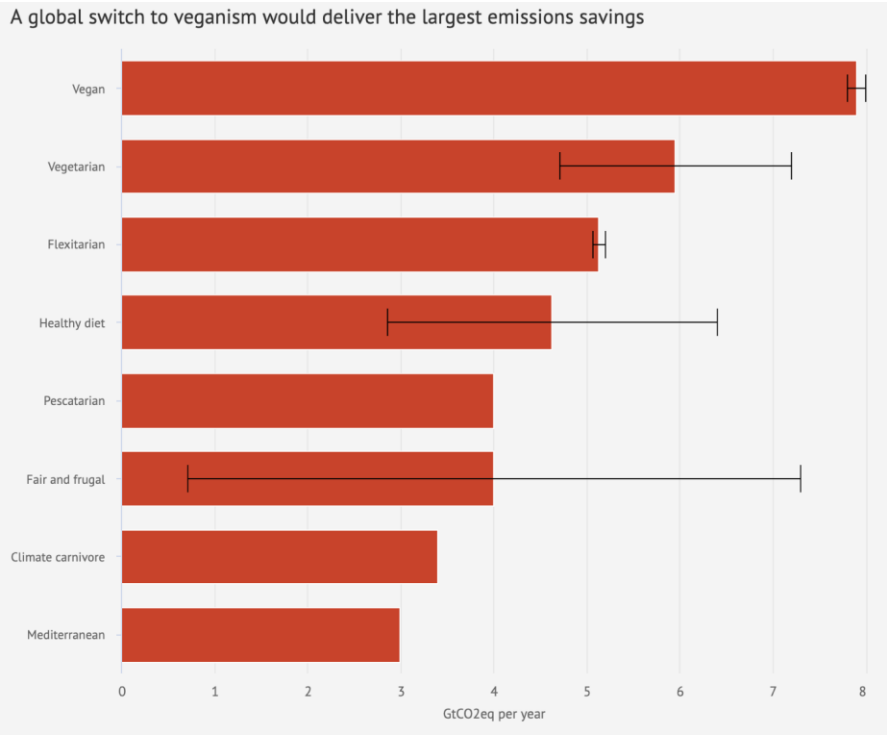


Figure 13: A global switch to veganism would deliver the largest emissions savings

Source: Carbon Brief UK, September 2020. See a bigger version of this image here.

The static bar chart in Figure 13, entitled *A global switch to veganism would deliver the largest emissions savings*, was designed, produced, and posted on Facebook by Carbon Brief

UK in September 2020. Its main theme is greenhouse gas emissions/air pollution. It shows how much greenhouse gases could be stemmed each year by 2050 if the world were to adopt various different diets represented by eight red bars arranged symmetrically and oriented in the same way (when compared to a 'business-as-usual' scenario). The post describing this datavis on the organisation's Facebook page says that according to the IPCC, a global switch to veganism, vegetarianism, or flexitarianism could deliver savings of 5bn tonnes (or above) of CO2 a year by 2050. Carbon Brief UK encourages audiences to read more about the issue in the link provided by the organisation. It is explained on the organisation's website that "error bars show the spread of results from different studies" and "data without error bars are from one study only" (Carbon Brief, website).

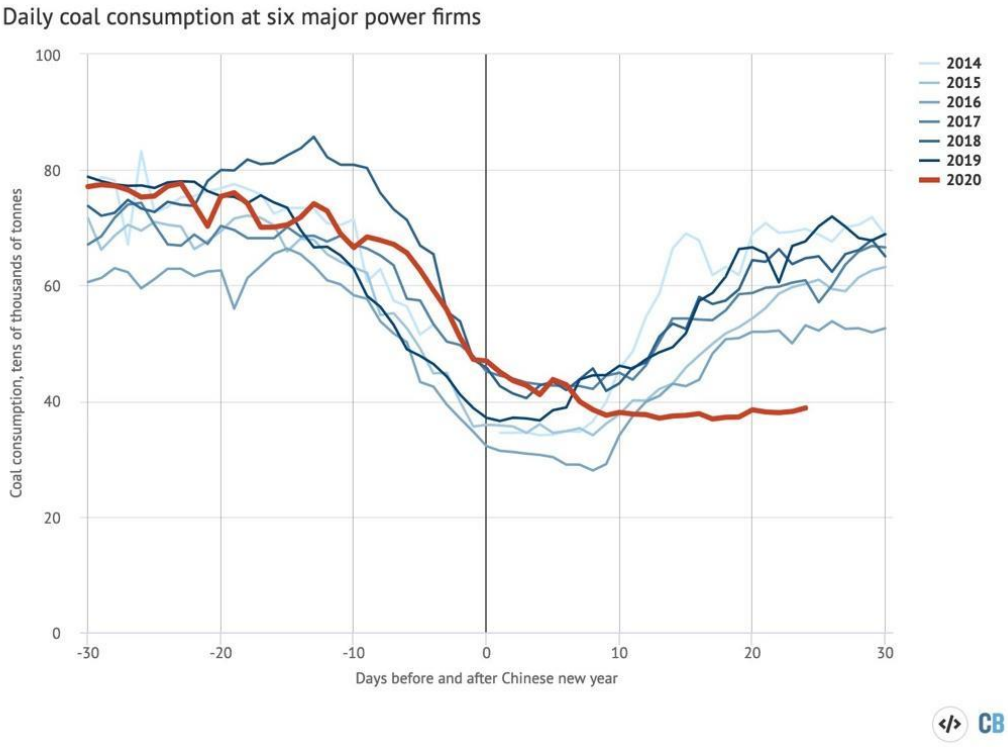


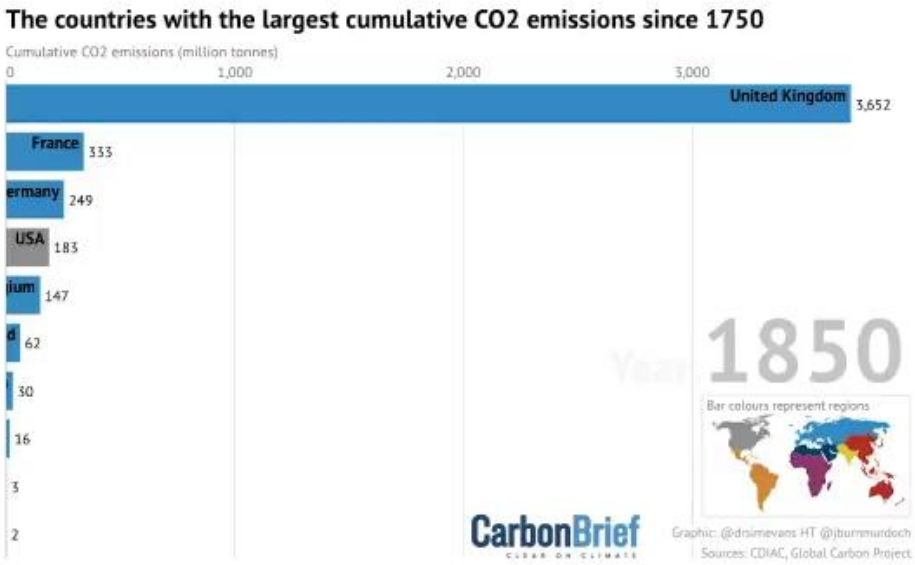
Figure 14: Daily coal consumption at six major power firms

Source: Carbon Brief UK, March 2020. See a bigger version of this image here.

Figure 14 shows a static line graph titled *Daily coal consumption at six major power firms*. It was designed and produced by Carbon Brief UK (analysis: Lauri Myllyvirta; chart: Tom Prater), and posted on the organisation's Instagram account in March 2020 with three hashtags: #coronavirus, #globalwarming, and #climatechange. Its main theme is coal

consumption/air pollution, and it shows that Coronavirus temporarily reduced China's CO2 emissions by a quarter in 2020 before and after Chinese New Year. It compares the seven years of the Chinese New Year period and shows how daily coal consumption at six major power firms in China has been reduced due to Coronavirus during that period. The X-axis shows days before and after Chinese New Year's eve, which falls on various dates in the second half of January or in February, and the Y-axis shows coal consumption, in tens of thousands of tonnes (10,000 tonnes per day). The datavis juxtaposes the increase in coal consumption after Chinese New Year in each of the previous seven years with the current year remaining at the same level.

The post describing this data visualisation on Instagram says: "as the world battles one of the most serious virus epidemics of the century, the impacts on energy demand and emissions are only beginning to be felt. In China, electricity demand and industrial output remain far below their usual levels across a range of indicators, many of which are at their lowest two-week average in several years. All told, the measures to contain Coronavirus have resulted in reductions of 15% to 40% in output across key industrial sectors. This is likely to have wiped out a quarter or more of the country's CO2 emissions over the past four weeks, the period when activity would normally have resumed after the Chinese new-year holiday." The organisation encourages audiences to read more about the issue in the link provided in the organisation's bio on Instagram.



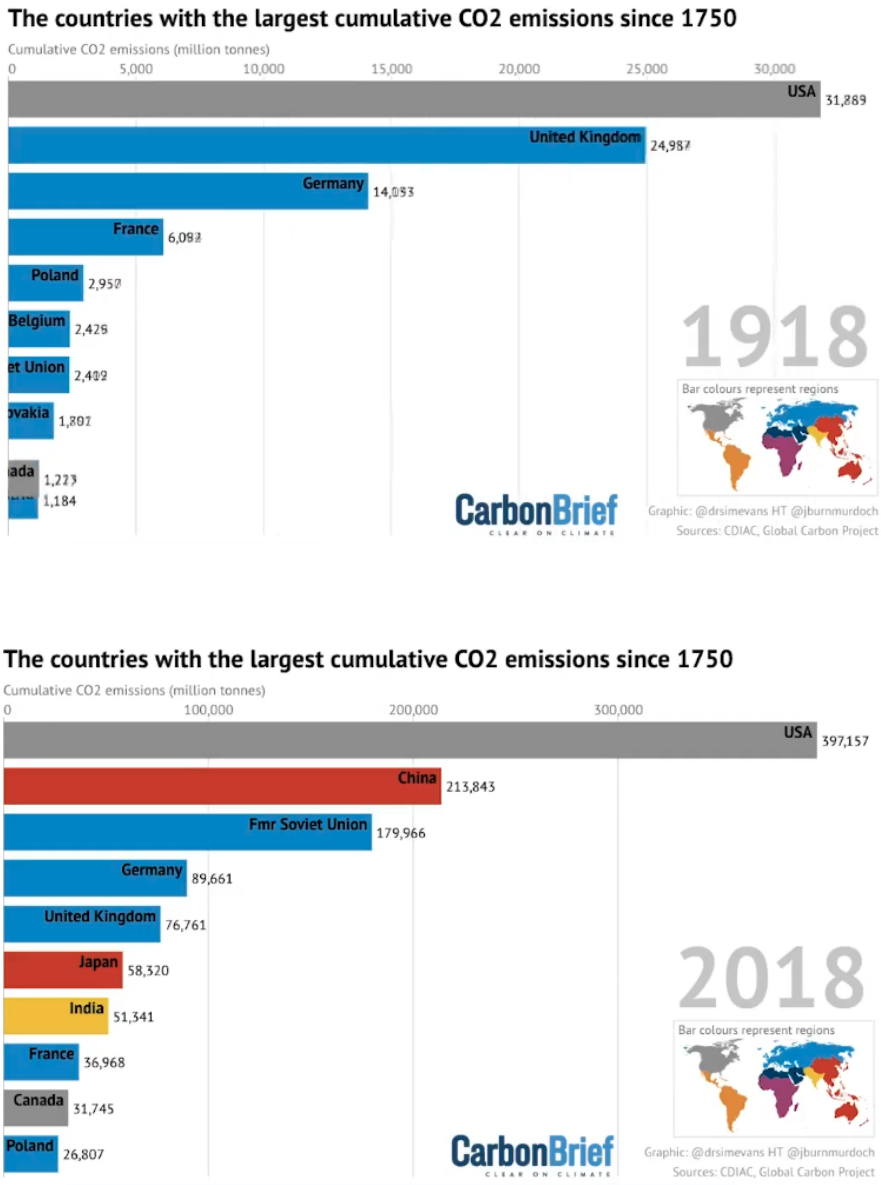


Figure 15: The countries with the largest cumulative CO2 emissions since 1750

Source: Carbon Brief, December 2019. See the full animation here.

Figure 15 shows an animated racing bar chart titled *The countries with the largest cumulative CO2 emissions since 1750*. It was designed, produced, and posted on Facebook by Carbon Brief UK in April 2019. The main theme of this chart is CO2 emission/air pollution, and it presents a ranking of the countries with the largest cumulative CO2 emissions between 1750 and 2018. Each racing bar represents a different country and each colour a different continent. The eye-catching bright red bars draw the reader's attention to China and Japan, which appear in the visualisation in the second half of the animation. The grey

bar representing the USA is more eye-catching than the other blue bars representing European countries; it is visible and grows steadily throughout the visualisation. The post describing this data visualisation on the Carbon Brief Facebook page also presents a ranking as of the start of 2019:

1) United States – 397 GtCO2
2) China – 214
3) former USSR – 180
4) Germany – 90
5) UK – 77
6) Japan – 58
7) India – 51
8) France – 37
9) Canada – 32
10) Poland – 27

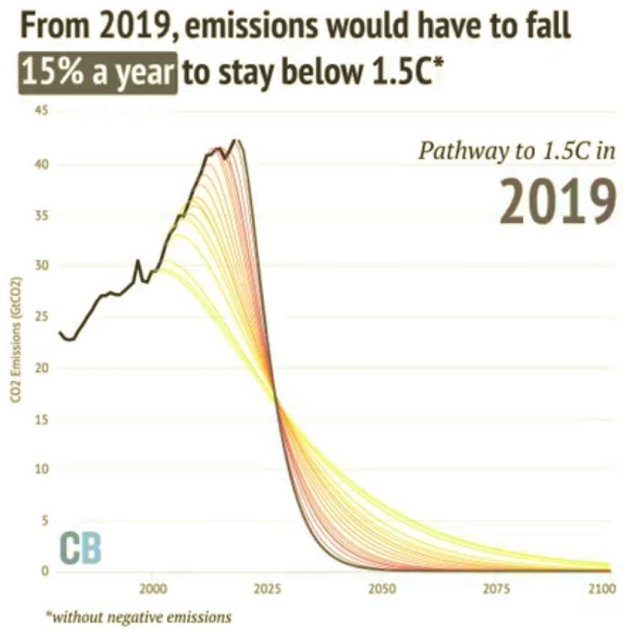


Figure 16: UNEP: 1.5C climate target 'slipping out of reach'

Source: Carbon Brief, October 2020. See the full animation here.

Figure 16 shows an animated line graph titled *UNEP: 1.5C climate target 'slipping out of reach'.* It was designed, produced, and posted on Twitter by Carbon Brief UK in October 2020. Its main theme is CO2 emissions/air pollution. It refers to the latest UN Environment Programme emissions gap report and shows that unless the world begins to rapidly reduce greenhouse gas emissions, the 1.5C goal of the Paris Agreement "will slip out of reach". It explains that if global emissions had peaked in 2000, a 3% annual fall would have been enough to stay below 1.5C. Instead, emissions continued to rise almost every year until 2018. Therefore, from 2019, emissions would have to fall 15% a year to stay below 1.5C. If emissions fail to drop then the 1.5C carbon budget will be used up within eight years (by 2027). The colours of the following years change gradually from yellow to orange, red and purple indicate the danger related to the increase in greenhouse gas emissions in the following years. The post describing this visual on the organisation's Facebook page encourages audiences to read more about the issue in the link provided by the organisation.

4.3.1.2 Climate Science Poland

The first of the two following examples of data visualisations published on social media by WWF Poland was designed by Ed Hawkins, and the second was outsourced externally.

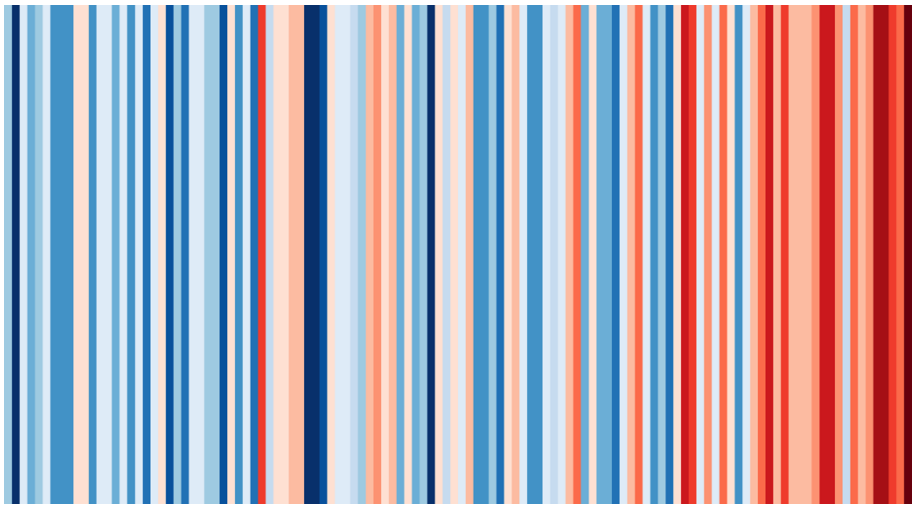


Figure 17: Warming stripes for Poland

Source: Climate Science Poland, May 2020. Author: Ed Hawkins (University of Reading). See a bigger version of this image posted on Facebook by Climate Science Poland here.

Figure 17 is *Warming stripes*, with which I introduced this thesis. It was generated by an interactive tool that allows users to create stripes of different countries, continents, oceans, or the entire globe that represent long-term temperature trends. The author of this interactive tool and data visualisation is Ed Hawkins, a climate scientist from the University of Reading. The datavis was posted on Facebook by the Climate Science Poland in September 2020. Its main theme is global warming, and it illustrates the rise in average temperatures in Poland over the past 100+ years. The post describing this data visualisation on the Facebook page says that this is an updated temperature visualisation from the #ShowYourStripes series, and that this is how the average temperature in Poland changed from 1901 to 2019. The post description explains what each stripe means (one year), that navy blue is the coldest and dark red is the warmest year, and that this visualisation should be read from left to right. Furthermore, it says that the stripe for 2019 (far right) is dark, almost brown because 2019 was record-breaking in the history of temperature measurements in Poland. Climate Science Poland encourages audiences to read more about it in the link provided by the organisations and notes that stripes for the world, Poland and other countries can be found here, and more information about the datavis can be found here.

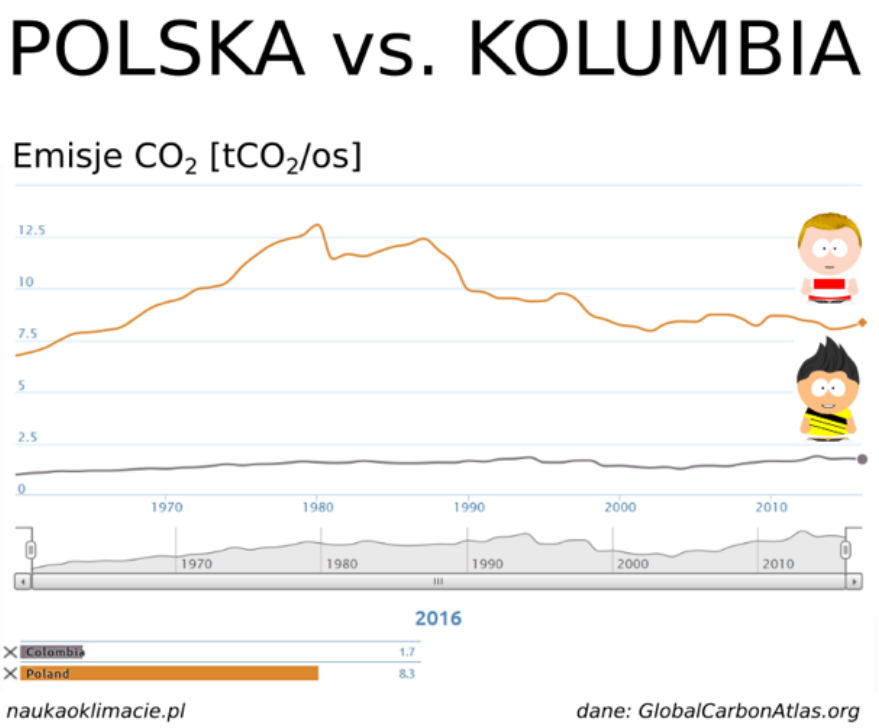


Figure 18: Poland vs Colombia (CO2 emissions)

Source: Climate Science Poland, December 2019. See a bigger version of this image here.

The static line graph is titled Poland vs Colombia. It was posted on Facebook by Climate Science Poland in June 2018 with four hashtags: #mundial2018, #POLCOL, #worldcup and #climate. The main theme of this datavis is CO2 emissions/air pollution, and it shows that over the years (from 1960 until 2016) Poland emitted more CO2 than Colombia. The post describing this graph on the organisation's Facebook page says that it presents a duel over emissions: Poland versus Columbia. It also explains that in the visualisation, the total CO2 emissions from fossil fuel combustion and cement production was divided by the number of inhabitants of each country. The organisation encourages audiences to read more about this topic in the link provided and notes that the graph was downloaded from the Global Carbon Atlas website, and the characters from the *South Park* series were drawn using sp studio.

Section 4.3 examined specifics of information-providing organisations selected for the study. It investigated how the organisations use climate change datavis and think about their audiences. It introduced datavis published on social media by these organisations and identified for the study. The next section will analyse most emotive visual features of the 13 datavis selected for this study.

4.4 Visual artefacts and emotions

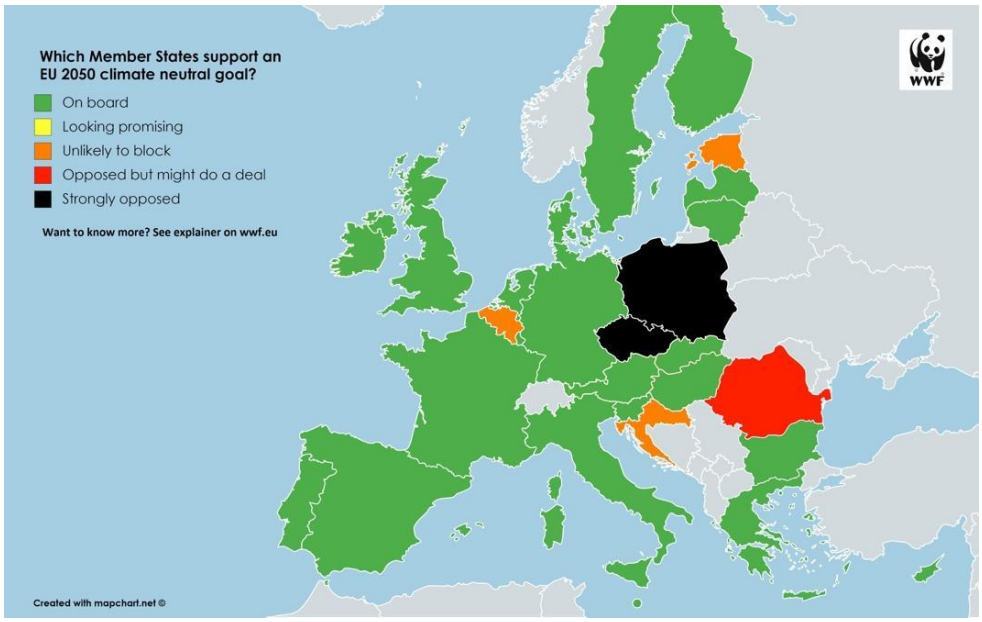
To address emotions that datavis features may convey and evoke, I investigated denotative meanings of the datavis selected for the study that were introduced in Sections 4.2.1 and 4.3.1. I first examined the major aesthetic norms and conventions of the 13 datavis. In my preparation for this, I identified eight main features of the datavis: (1) layout, (2) colour, (3) font, (4) graphical elements, (5) annotations, (6) interactivity, (7) animation, and (8) hand-drawn elements. For full descriptions of these see Appendix 12. In relation to the emotions that these features can convey and evoke in the 13 datavis from the sample, I found four that were most significant: colour, hand-drawn elements, interactivity, and animation. A detailed explanation of denotative meanings and how each is applied to the 13 visualisations can also be found in Appendix 12. In this subsection, I discuss the four main

features against what the organisations have said about their aesthetic choices to evoke emotions which is discussed in the following section 4.5.

4.4.1 Colour

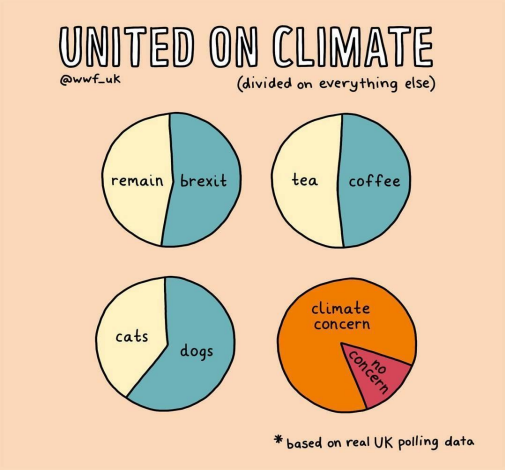
Colour is often seen as an expression of emotional meanings; however, these meanings are not universal, and their interpretation is always influenced by cultural context. Therefore, in my analysis, I have focused not only on particular colours, often seen to be intuitive (Muth, 2018), and the metaphors they may carry in a given culture such as red for danger, but also on their features such as brightness/value (the scale from light to dark), saturation (scale from full colour to pale), and the use of gradients and contrasts (Margolis and Pauwels, 2011).

Many of the datavis from the sample use common conventions and colour associations that may evoke emotions by conveying ideas. For example, the datavis designed by WWF EU and published on social media by WWF Poland *Which Member States support an EU 2050 climate neutral goal* (Figure 9) uses different colours such as green, orange, red and black to indicate which EU countries support an EU 2050 climate neutral goal, which are still hesitant, and which are opposed. Eye-catching, clashing colours engage and grab attention; the red and black can intuitively connote danger or death and invoke fear and a sense of warning, while the green can connote the environment and harmony with nature.



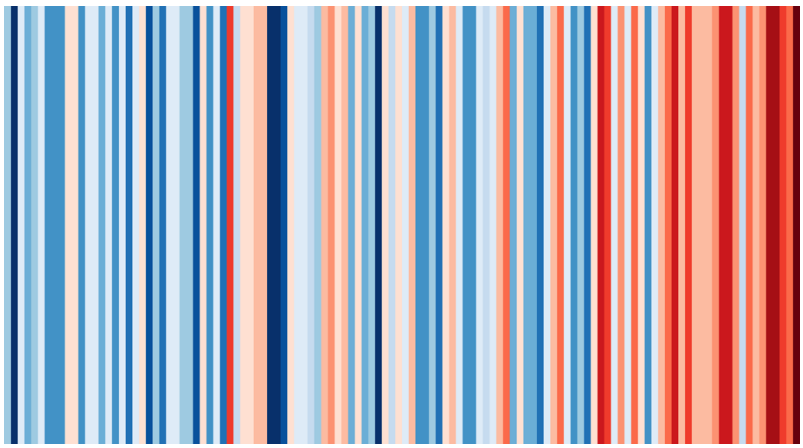
Source: WWF Poland.

Indeed, the colour red is alarming and may be used to invoke a sense of warning and danger as seen in many of the datavis (see Figures 6-7, 9, 11-12, 16-17), but it can also be used, like other colours, to show contrast by highlighting significance or showing difference (Feigenbaum and Alamalhodaei, 2020). The contrast can be created through colour choices such as brightness or saturation (see Figures 6, 7-9, 11-12, 15, 17). For example, datavis in Figure 11 *United on climate (divided on everything else)* uses bright orange and red only on one of the four pie charts. This stands out from the other charts, which use neutral pastel colours, creating an impression of neutrality. This juxtaposition may be alarming and can create a sense of warning and danger.



Source: WWF UK.

Moreover, the datavis can use the gradual colour transition to tell a visual data story. Feigenbaum and Alamalhodaei (2020) explain that "a colour gradient refers to a range of colour transitions that is often gradual and blends together as it progresses (i.e. from blue for cold to red for hot)" (p.132). For example, in datavis *Warming stripes for Poland* designed by Ed Hawkins (Figure 17), which communicates only through colour, each colour/stripe represents the temperature in Poland. Gradual colour transitions, from different shades of blue to red, show a temperature change over time in Poland, which can evoke fear, worry or sadness. Here, colours are also used on the basis of human associations as metaphors for warm (red) and cool (blue) periods/years.



Source: *#ShowYourStripes*.

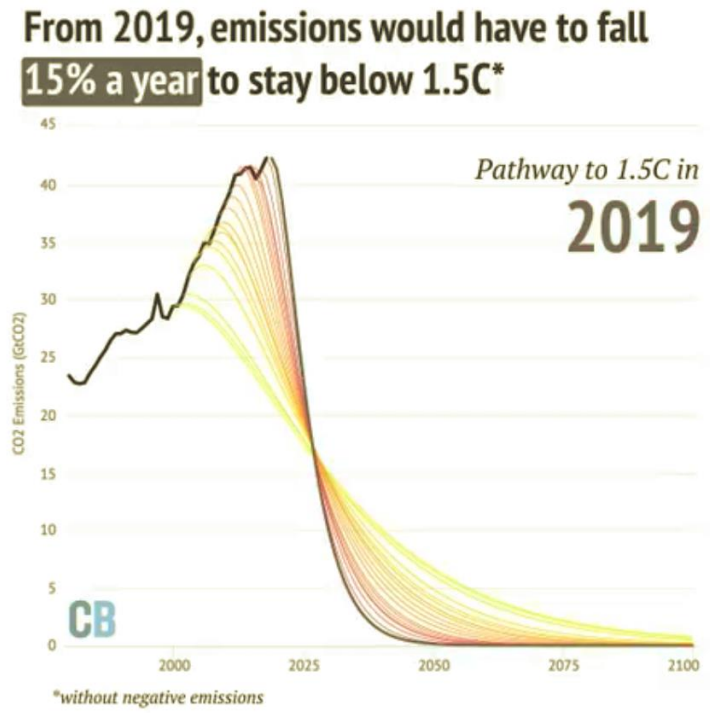
4.4.2 Hand-drawn elements

Hand-drawn elements are suggested to be another highly emotive feature of datavis. They are present in several data visualisations from my sample (Figures 8, 11-12). As suggested by some authors (Feigenbaum and Alamalhodaei, 2020; Simpson, 2020) the hand-drawn datavis and its aesthetic can create a feeling of authenticity and remind audiences about the human(s) who produced it. A good example of this is the datavis *United on climate (divided on everything else)* (Figure 11). It uses imprecise circles/pie charts which may indicate a more casual and relaxed atmosphere, and inaccuracy runs counter to the formal conventions of datavis, such as a clean and simple layout and precise elements (see Tufte, 2001; Kennedy et al., 2016a). Moreover, a kind of playfulness of hand-drawn elements may evoke friendly feelings towards the datavis. Therefore, emotions associated with this visual style include pleasure, joy, satisfaction and excitement.

4.4.3 Animation

Two animated datavis in my sample designed and published by Carbon Brief UK (Figures 15 and 16) engage users with a dynamic process, gradual building change, tension and dramatic narrative. Animated two-dimensional charts can represent change, growth or decline. According to Kress and van Leeuwen (2006), in Western cultures there has been "a shift from a focus on the vertical to a focus on the horizontal, a change from a concern with 'What is the state of affairs?' And 'Where are we?' to 'Where are we going?' And 'Have we progressed or are we in decline?'" (p.103). For example, datavis in Figure 16 (*UNEP: 1.5C*

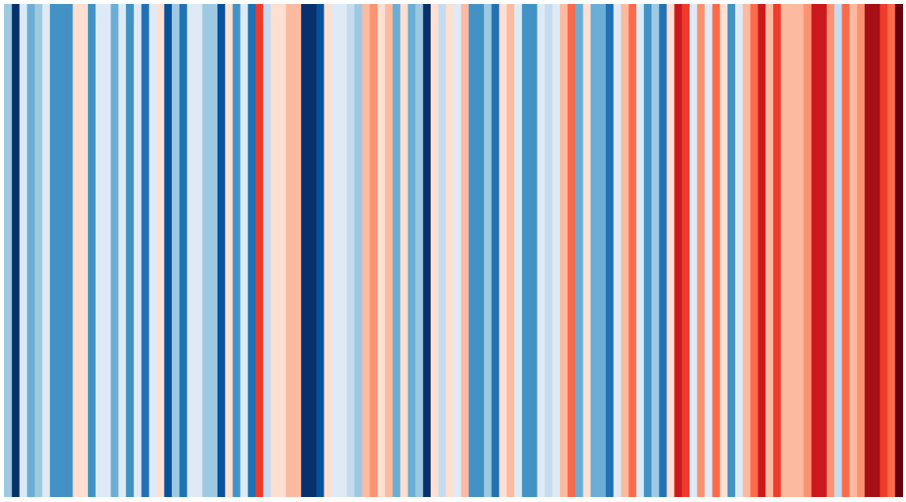
climate target 'slipping out of reach') uses this horizontal dimension to illustrate concerns about where greenhouse gas emissions are going. It can evoke emotions such as fear, sadness or worry.



Source: Carbon Brief.

4.4.4 Interactivity

On the other hand, quite different emotions can be evoked by interactive datavis. For example, *Warming stripes,* created by the interactive tool *#ShowYourStripes,* can engage users by allowing them to personalize the information they receive about the rise in average temperatures in different locations over the past 100+ years. Such interactivity can invite audiences "to explore the information on the datavis for themselves" (Kirk, 2021, p.295) and can evoke emotions such as joy, satisfaction or excitement.



Source: *#ShowYourStripes*.

4.5 Producing datavis to evoke emotions

The campaigning and information-providing organisations recognised different audiences who were more or less knowledgeable about climate change and therefore also about climate change datavis. Interestingly, despite their different objectives, none of the six organisations believed that there was any conflict between the informational and the emotional aspects of data visualisation. On the contrary, the interviewed professionals recognised three important roles that emotions may play in data visualisations. The first role is to grab audiences' attention and increase their interest in the topic of the data visualisation. This was considered to be especially important on social media.

The second role is to facilitate understanding of datavis by individuals who may not be able to understand information based on numbers or statistics, which reflects findings from Kennedy and Hill's (2017) research on visualisations and emotions. This kind of intuitive perception of information was recognised and mentioned by Anna from Climate Science Poland when asked about the importance of emotions in datavis: "There are different ways of receiving information and for someone a sense of increasing change, for example, is the way in which information can be conveyed so that they can feel there is a change coming." As an example of a data visualisation working in this way, Anna recalled 'Warming stripes' (Figure 17), which visualises data about the rise in average temperatures in Poland over the past 100+ years, created by Ed Hawkins and shared by Climate Science Poland on Facebook:

> It seems to me that people who are less analytical perceive this in such a way: oh… I don't know what it is exactly, but I can see that it is getting warmer. So, on one hand, it is a visualisation that, at some level not fully understandable, but some kind of looking, feeling and seeing that something is happening reaches people.

The third role of emotions in datavis mentioned especially by campaigning organisations is mobilising audiences to action. Patrycja, a communication specialist from Greenpeace Poland referred to this function in her statement about the importance of emotions in datavis:

> In my opinion, emotions are the key to convincing anyone to do anything and we must try to evoke them if we want some change. Because data and information are there. If it was enough that there is only data, then we would need no visualisation and organisations like ours. The fact that the mere fact of the existence of some data and facts is not enough, makes us arouse these emotions.

This comment links directly to my research question on whether emotional responses to datavis can mobilise people to act. It is suggested by the professional participant that emotions triggered by datavis may play a significant role in engagements with datavis and in motivating people to act and that visualisation is of great importance here, not just data and rational information.

This assumption was supported by other participants from information-providing and campaigning organisations who admitted that they understand 'a successful datavis' to be one that results in insights and/or emotional responses – often fear or worry. For example, Steve, the representative of Carbon Brief UK referred to the animated graph shown in Figure 16 titled "UNEP: 1.5C climate target 'slipping out of reach'" produced and published by the organisation on Twitter. It alludes to the dangers of increasing greenhouse gas emissions, and it was widely shared on social media, by Greta Thunberg, among others: "I think the reasons why things like this one have done well, the one that Greta shared, I think

because there is drama in there. It is literally like a cliff edge; you can view it and you can feel anxiety."

It should be emphasised that targeting and evoking emotions such as fear or worry largely occurs because climate change is an emotional topic and a risky and uncertain phenomenon (Weber, 2015). Olivia, a communication specialist from WWF UK drew attention to this, referring to datavis showing that more than eight hectares have been burnt in Australia in Figure 12: "I think we try to make things emotive, and I think just generally by the nature of the work, like the Australian bush fires, they are already emotive." Patrycja, a communication specialist from Greenpeace Poland, when asked about positive emotional engagement through data visualisation on climate change, after a moment of reflection, stated that it is difficult to be optimistic because the topic and the data that illustrate it are rather sad: "that is, when we talk about data visualisation in general, it does not… in the sense that the data is not exactly happy."

Most of the professionals recognised that their data visualisations usually illustrate climate change impacts and therefore prompt shock, worry, fear or anger among audiences. This reflects the literature, arguing that negative valanced emotions are most common in public discourse and media coverage of climate change (O'Neill et al., 2013). Journalists, authors and activists often use fear and shock to inform about the impact and consequences of climate change (Kluger, 2006; Wallace-Wells, 2017), which consequently affects the perceptions and feelings of citizens (Ogunbode et al., 2021). However, according to Hulme (2009), climate change is not simply an "issue" or a "threat". It is also a cultural and political phenomenon and so emotions related to climate change are not all about climate change itself. They are also influenced by the cultural context and linked to views of others and the type of change desired (Hulme, 2009).

Anna, a communication specialist from Climate Science Poland observed that, in her opinion, data visualisations that evoked the strongest emotions were those that showed how temperatures have changed or how iceberg ranges have changed over time:

> …visualisations that depict how the temperature or iceberg ranges change over time. These animated things show the progression of changes and their magnitude. They elicit responses like “it's awful," "it's heart-breaking," or "it's impressive," and we can see how they influence emotions.

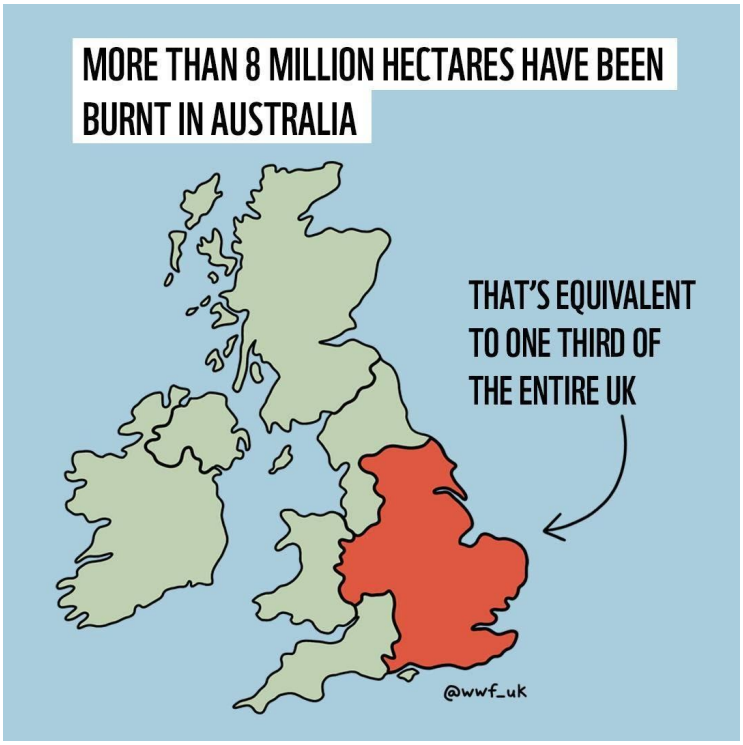
In this statement, alongside the negative responses cited, such as: “it's awful,” "it's heart-breaking," there is also the reaction, "that's impressive." This suggests that data visualisations illustrating potentially sad climate change impacts can arouse different kinds of emotions, those perceived as negative but also positive, such as excitement. Whether this is the case, and what role feeling rules play here, is examined in the next chapter.

Steve from Carbon Brief UK also referred to emotions other than sadness or worry, such as excitement and joy. He considered the success of data visualisation on social media in terms of the number of people who shared it and he believed that two extremes, either very positive or very negative emotions, tend to do better. He suggests that participation and engagement with datavis may not always be about scaring people with datavis showing consequences of climate change.

Targeting and evoking fearful emotions was also not the main goal of other organisations and professionals. When pressed further on whether data visualisations about climate change can evoke more positive emotions like joy or satisfaction, a few professional participants agreed that they could. Patrycja, a communication specialist from Greenpeace Poland emphasised once again that the data on climate change is generally not positive, but other, more nuanced types of data related to the phenomenon can also be found.

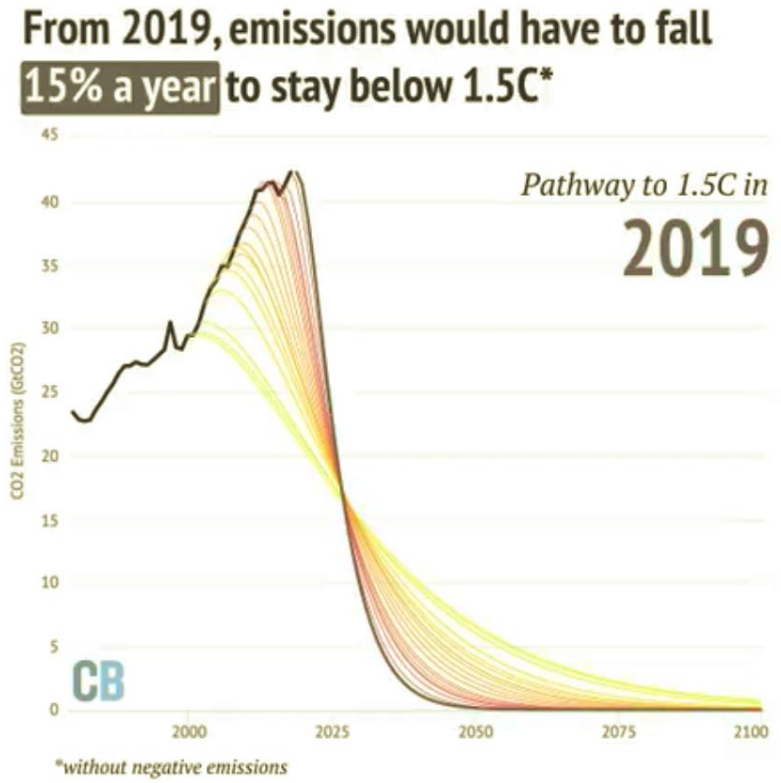
Apart from the above-discussed emotions related to data and the phenomenon of climate change, the professionals involved in the visualisation design process also emphasised aesthetic elements of datavis that can evoke emotions, such as hand-drawn elements, colours, animated or interactive datavis.

Most of the organisations use intuitive colours (Muth, 2018) such as red as a warning sign. Olivia, a communication specialist from WWF UK explained the reason for this while talking about the datavis *More than 8 million hectares have been burnt in Australia* (Figure 12*)* referenced several times already in this thesis: "We used the reds because it was associated with fires, we wanted them to make that connection, to understand that we're talking about fires. Red is also kind of like a stop sign, those kinds of warning colours."



Source: WWF UK.

Anthony, a multimedia producer from Carbon Brief UK pointed out the gradual colour transition in the animated data visualisation *UNEP: 1.5C climate target 'slipping out of reach'* (Figure 16), which used gradients as metaphors of approaching something fearful; the colour transition from light to dark is a sign of the danger related to the increase in greenhouse gas emissions in the following years: "you know, you can see it's kind of getting darker and darker as we're kind of edging closer to the deadline. Yeah, so that'll be emphasised in the colour."



Source: Carbon Brief.

However, for some professionals, it was important to maintain a balance between the sad and fearful data in a datavis, and a friendly and fun visual form created with the help of colour. Olivia from WWF UK who designed some data visualisations for the organisation illustrated this by discussing two datavis from the sample (see Figures 11 and 12):

> We don't want it to jump out with a very dark, horrible blue that they don't want to look at, we want it to be quite friendly, we want them to click on it to read more. People kind of share it because it's adorable but the message is quite serious. So I think there is definitely a way that you can invoke positive emotions with colour and hand-drawn font.

Olivia tried to find a balance between fear, worry, shock and fun through the positive stories and playful design of their hand-drawn datavis (Figure 11) containing four pie charts comparing the opinions of UK residents on a variety of topics:

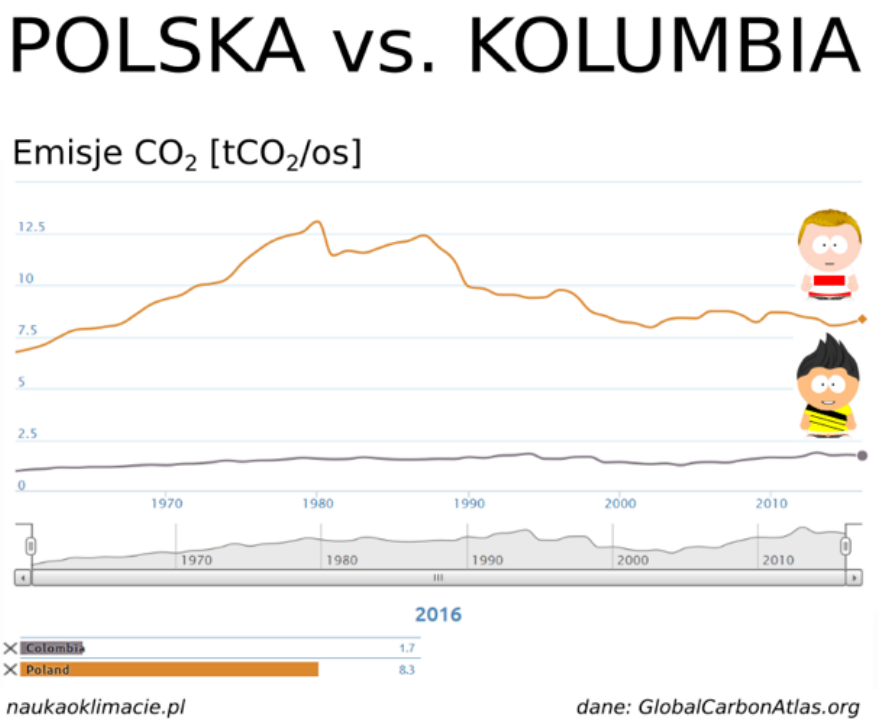
> The climate one is more of a friendly and playful, kind of almost fun illustration. The font I've used on the drawing is my handwriting, so that's what my handwriting looks like […] I think my illustration style is quite childish, it's kind of like children's books kind of thing. So we teamed these scary stats with nice-looking illustrations to – I mean almost confuse people, but not really.

Olivia believed that although the topic of climate change usually triggers fear and worry, the aesthetic choices and features of datavis design have the potential to evoke positive emotions such as fun and a sense of playfulness. The imprecise style of hand-drawn data visualisations (see Simpson, 2020) was also mentioned by Olivia from WWF UK when discussing the same hand-drawn datavis:

> The circles in the pie charts aren't actually perfect circles, or the arrows I draw in some of the illustrations aren't perfect arrows, and it's all about this – it's kind of people can relate to that. Instead of drawing perfect circles and perfect lines in these incredible illustrations, it's more like a doodle. I think people relate to that more, it's more friendly again, coming back to that thing of maybe just being able to associate with it more.

This links with Feigenbaum and Alamalhodaei's (2020) argument that hand-drawn graphs that operate in different aesthetics have the potential to humanise data by evoking positive associations and emotions.

To evoke this kind of positive association, other professionals use various types of graphic symbols or illustrations in their work with datavis. For example, Anna, a communication specialist from Climate Science Poland referred to online graphics from *South Park* used in the data visualisation shown in Figure 18 below which visualises CO2 emission in Poland and Colombia as a representation of each of these countries: "and they started to appear on the chart just to make it somehow more friendly, cheerful, and somehow people actually paid attention to these charts a little more often then."



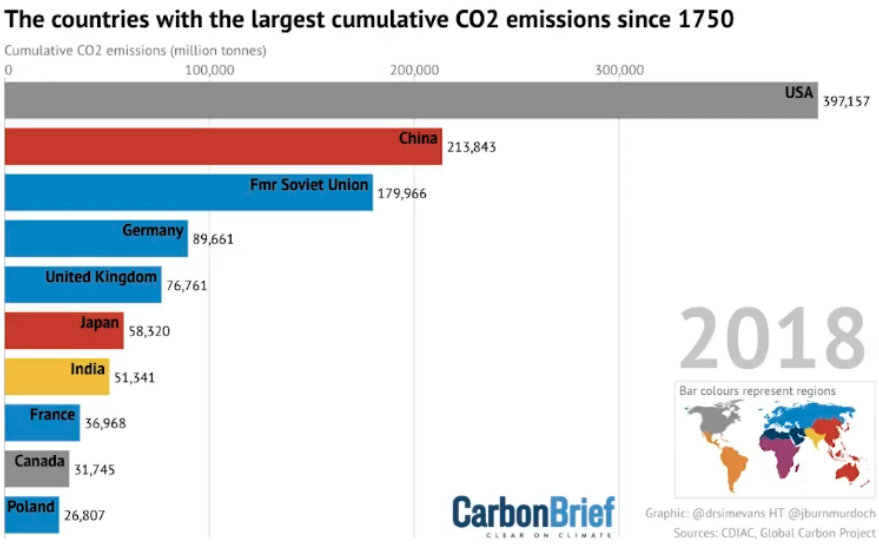
Source: Climate Science Poland.

The professional participants who designed or published visualisations for the information-providing organisations also believe that anxiety emotions can be induced by animated graphs, charts and maps. For example, Anthony from Carbon Brief pointed to the aforementioned animated line graph about the dangers of increasing greenhouse gas emissions in the following years: “I mean that this animated chart you can see it kind of resembles like a cliff edge, and so there’s potentially a sense like we’re about to hit a cliff edge like we’re in trouble.” As Steve, the second datavis professional from the organisation argues, it may look dramatic because: “you have got emissions that have to fall, and it gets more and it gets worse and worse and worse.”

However, it is not only animated line charts that are believed to evoke this type of dramatic narrative and emotions. The professionals from Carbon Brief also referred in their statements to an animated bar chart (Figure 15) showing the countries with the largest cumulative CO_2 emissions since 1750:

So, anything where there is some type of storytelling or dramatic narrative within. That's why this animation works so well because you are racing in this bar chart, you know we call this racing bar chart. This is a sense of you know you're anticipating where is this going what is going to happen you feel like you have to stay with it, you have to keep watching to see what is going to happen. You don't really know what is going to happen you might have a guess but then whoa look what's happened! They have overtaken them…

This datavis deploys features such as following certain categories/countries as they change significantly over time (Kirk, 2012). This comparison to other countries or time periods can trigger shame, pride, anger or worry.



Source: Carbon Brief.

Some of the professionals from the organisations agreed that these kinds of animated data visualisations may allow people to process information on more intuitive and emotional levels, not necessarily using the language of mathematics, as pointed out by Steve from Carbon Brief: "they allow you to see, feel the rhythm of changes and the build-up of a change, a certain kind of tension."

The professionals who create interactive datavis also believe that audiences enjoy interactive features, and their first emotional reactions may not be so much about the data

itself, but about its interactivity and the possibility of exploring data for themselves, as illustrated by Steve from Carbon Brief UK who talked about another interactive datavis designed by the organisation *Mapped: The world's coal power plants*:

> You can see very quickly how much coal there is in China but also the interactivity of it that is what people like, so if you live in the US you can just concentrate on the US and do your own do your own journeys through the data. So, people really like interactive data.

The above considerations may suggest that this enjoyable 'journey through the data' in interactive datavis is similar to what hand-drawn elements can evoke in terms of audiences' positive emotions.

The potential of the visual form and features to evoke emotions presented in this subsection is of great importance, however, whether this potential translates into reality, and whether datavis have such power, will be examined in the next chapter.

4.6 Conclusion

This chapter discussed different types of organisations selected for this study and introduced the 13 data visualisations that the organisations shared with the public on social media. It outlined the relationship between the type of organisation and their datavis practices and indicated that the campaigning and information-providing organisations use different approaches when using and sharing datavis with audiences. The chapter revealed the processes involved in datavis production and showed that designing even simple datavis requires resources that campaigning organisations in my study lack. This finding links with Feigenbaum and Alamalhodaei's (2020) argument that small organisations may have "limited resources to either employ a data professional or train up a team in the necessary data skills" (p.68). However, the chapter showed that campaigning organisations use DIY approaches to create their own datavis, which suggests that datavis are important in their work. At the same time, it should be emphasised that information-providing organisations are not larger and do not employ more people than campaigning organisations. They were

created to improve the understanding of climate change in terms of science and focus their work mainly on data and data visualisations, therefore they design and use more datavis and have more resources to do so.

The findings from the chapter showed that the organisations are aware of emotions being generated in their datavis and consider them to be an integral part of data communication. Data visualisations about climate change published by the organisations are the result of specific choices that can powerfully evoke different emotions in audiences which is suggested by a number of authors (see Tufte, 2001; Kress and Van Leeuwen, 2006; Margolis and Pauwels, 2011; Kirk, 2012; Hill, 2014; Kennedy et al., 2016; Feigenbaum and Alamalhodaei, 2020). The organisations identified three emotive factors in datavis that are mentioned by Kennedy and Hill (2017) in their research: subject matter, represented data and visual form. In their work, they mainly focus on emotions related to the scary and sad topic of datavis and data on climate change, such as fear, worry or sadness often evoked by use of colour or animated datavis. However, they also acknowledged that the datavis visual form can not only amplify this fear and anxiety, but also evoke joy and excitement. For example, some organisations believe that using interactive features or hand-drawn elements may produce positive emotions in their audiences. This partially confirms work of Alamalhodaei and colleagues (2020) on data comics. The authors suggest that some hand-drawn graphs despite their serious and often sad content are able to tackle different topics, for example climate change, “in a disarming format” by using “laughter, silliness, and absurdity” (p.249).

Finally, the chapter argued that most of the organisations were unable to determine whether and how data visualisations can mobilise audiences to action, except that they believe that emotions may play an important role in engagements with datavis. The chapter has presented professionals' perspectives on which datavis factors and visual features can evoke specific emotions in their audiences and how thinking about emotions can play a role in datavis design. The following chapter will expand these considerations and analyse audiences’ emotional experiences to answer the first research question and explore whether audiences’ emotional responses to the datavis are similar to those that the datavis

were meant to evoke. In other words, do datavis work in the way the organisations and datavis professionals intend them?

Chapter Five:
Audiences' Emotional Responses to Data Visualisations

5.1 Introduction

This chapter draws on 34 semi-structured interviews and 13 follow-up interviews with audience participants who reacted on social media to one or more climate change datavis, as introduced in the previous chapter. As discussed in Chapter 2, throughout the social science literature there is an argument that emotions are socially mediated and constructed (Hochschild, 1989) and embedded in the social and political context (Ahmed, 2004). These aspects of emotion making are an important factor while studying engagement with datavis (Kennedy and Hill, 2017; D'Ignazio and Bhargava, 2020; Simpson, 2020; Gray, 2020). However, to date, there has been little empirical contribution to the understanding of emotional experiences of data visualisations from a sociological perspective. To address this gap, this chapter explores the first research question of this thesis that is: how and in what ways does data visualisation convey and evoke emotional responses?

The chapter builds upon two previous empirical studies, presented in Chapter Two. The first one shows that "contextual, social and cultural factors matter when it comes to engaging with data visualisations" (Kennedy et al., 2016b, p.2). The second argues that engaging with datavis concerns many different emotions, triggered by various factors in a visualisation (Kennedy and Hill, 2017). However, the chapter goes beyond this work by expanding the authors' arguments regarding emotional responses to datavis in various ways. First, by showing that different socio-cultural (and political) contexts and factors can affect not only engagements with datavis in general, as argued by Kennedy and colleagues (2016b), but more specifically audiences' emotional responses to datavis. Second, the chapter advances work of Kennedy and Hill (2017) by identifying which emotions are evoked by which datavis factors and features.

The opening section of this chapter, therefore, begins with considerations of the role of factors *outside the datavis* in emotional responses to data visualisations about climate change, embedding audience participants' responses within their wider relational webs. Importantly, it recognises climate change as a highly emotional topic for the audience

participants and identifies the emotional weight it carries. It explores the importance of spatial proximity in emotional responses to data visualisation (Campbell and Offenhuber, 2019). These findings take the chapter to the Section 5.3, which examines the main emotive factors *in* datavis and considers which have the greatest emotional charge. Following this, Section 5.4 examines the relationship between these factors. Section 5.5 turns to explore in more detail the different features and visual form of datavis, showing how they work to evoke various emotions in different ways. Finally, the chapter concludes by comparing the findings from the audience participants with the findings from the professional participants to investigate whether datavis evoke emotions in the way the organisations intend them to.

5.2 Emotive factors *outside* datavis

This section first explores the role that various socio-cultural contexts and factors may play in emotional responses to data visualisations about climate change by embedding these emotional responses within their wider social and relational webs. Here, climate change is recognised as an emotional topic for audience participants and the emotional weight it carries is identified. The importance of the emotional impact of proximity techniques in data visualisation is also explored (Campbell and Offenhuber, 2019).

Based on their grounded, qualitative, empirical research with 46 users who were not experts in datavis, and using a range of methods, including focus group research, interviews and diary-keeping, Kennedy and colleagues (2016b) identified six socio-cultural factors that affect engagement with data visualisations including: “subject matter; source/media location; beliefs and opinions; time; emotions; and confidence and skills” (p.1). The researchers argue that audiences’ engagements with selected visualisations which represented a cross-section of visualisations on a variety of topics including migration data were affected by social and cultural contexts and factors. Similarly, my audience participants talked about their emotional responses to datavis in relation to different social contexts and factors. Therefore, this section, extends the work of Kennedy and colleagues (2016b) and explores what social contexts and factors may influence audiences’ engagements with datavis and their emotional responses to them.

As indicated previously, it is recognised that climate change is a strongly emotional topic (Weber, 2010). Importantly, McCright and Dunlap (2011) note how ideological polarization on this matter has increased and deepened over time. For example, the findings of a Gallup poll in 2015 show a huge gap between how much Democrats and Republicans in the US worry about global warming (The Gallup Organisation; 2015). Similarly, Kahan's study (2016) suggests that right-leaning individuals are much less likely to believe in and accept human-caused climate change than left-leaning people. Recognising these divisions and the emotions they may evoke in my audience participants, at the beginning of each interview, audience participants were asked about their interest in climate change and political views (see Appendix 1). This helped to identify their emotions in relation to the subject matter of datavis and disentangle emotional responses to climate change from emotional responses to other factors in datavis.

As mentioned in Chapter Three, most of the audience participants identified themselves on the political left and their emotions were often closely related to their political views and affiliations. Moreover, many of them recognised a link between their emotional responses to datavis, concerns about climate change, and being to some extent left-leaning individuals. For example, George, a 26-year-old British self-employed environmental consultant based in the UK illustrated this by connecting his political leaning to his approach to climate change:

> I'm into surfing and a big kind of ocean conservation advocate. And then I guess – I guess, unsurprisingly, I'm kind of on the left of the political spectrum because of all those things really. So, yeah, not crazy left but – so I don't describe myself as that really. And I've always been interested in climate change and environment.

Other audience participants identified themselves as completely leftist, slightly leftist, or placed themselves at the centre of the political spectrum. It was therefore not surprising that, as a risky and uncertain phenomenon (Weber, 2015), emotional responses to climate change itself played a significant role in how data visualisation about climate change was experienced by the audience participants in the study. This finding links to Kennedy and

Hill's (2017) work showing that the subject matter of visualisations provokes strong emotional responses. Many audience participants in my research emphasised that they had a long-standing interest in the environment, and they worried about the impacts of climate change. For example, Mark (male, 64, white British, insurance broker, based in the UK), when asked about his attitude to climate change, expressed his strong concerns about the role of humans in accelerating this process:

> I think I've always been interested to be honest. It's probably become more focused in the last probably ten years as it's obviously self-evident the damage that we're doing to the planet, and we need to do something about it.

Data visualisation from the sample that participants had encountered on social media evoked strong emotions in them, including worry, fear, and sadness in the first place, followed by frustration and anger. For example, sadness and anger can be found in Mariusz's (male, 48, white Polish, IT specialist from Poland) comment: "Climate change is a subject close to my heart, and I'm well aware of how much a person's actions degrade the environment. And there are days when the news raises my blood pressure."

Surprisingly, sad or frightening datavis made some participants feel good by confirming their beliefs. An example of this can be found in Bill's (male, 64, white British, taxi driver from England) statement about the map *More than eight hectares have been burnt in Australia* (Figure 12), which he came across on a WWF UK Facebook page and which triggered various emotions in him and provoked to comment on the datavis: "It confirmed what I already suspected and believed. So it made me feel happy that I'd got it right." This example shows that emotional responses to data visualisations about climate change, in this case pleasure at being correct, may derive not only from the data visualisation itself but from the beliefs and opinions an individual already possesses.

Out of all participants, only Jess (female, age 36, White British, works in customer service, based in the UK) and Ewa (female, age 36, white Polish, scientist and University teacher, based in Poland) admitted that a few years earlier they had denied the idea that climate change was caused by human activities. While discussing the WWF UK data visualisation

United in climate (divided on everything else) that she encountered on Facebook, Jess excitedly explained that her views had changed when she joined the Labour party a few years ago:

> I think the climate change stuff – when I sort of started moving back to the left politically, the climate change is meant to impact more on the people who can't do an awful lot about it… And I felt that, yeah, I think it was more tied in with my political views overall really that it was just deeply unfair.

As a left-leaning member of the Labour party, Jess felt anger as a response to seeing various data visualisations showing consequences of climate change that affected innocent people, while multinationals and large conglomerates were not expected to make much change. She was irritated and stressed this in her statements several times during the interview while talking about the WWF UK datavis, showing how much her political views and affiliation influenced her emotions regarding the visualisation of data on climate change.

On the other hand, Ewa, a researcher and academic teacher from a university in Poland who responded on Facebook to the visualisation in Figure 18 (Chapter 4) published by Climate Science Poland which shows data about CO2 emission over the years in Poland and Colombia, admitted that the change in her attitude towards climate change and her emotions related to climate datavis were influenced by explanations from the scientific community with which she identifies as a researcher and scientist:

> And because many scientific communities talked about it in a very scientific way, there were special groups of scientists tasked with the responsibility of developing climatic change data, and, indeed, all the evidence seems to show that man has a significant impact on climate change and therefore is capable of not making it worse.

Importantly, Ewa emphasised that various visualisations of climate change data played a role in the process of changing her opinion on humans' role in climate change. Moreover, they moved and mobilised her to act, which I discuss in Chapter Six.

The importance of the audiences' broader views, both about climate change in particular, and politics more generally, and feelings of belonging to a specific social or political group, community or network was also evident in the context of sharing datavis with others. Most of the audience participants who did this indicated that they usually discussed datavis with like-minded people, mainly relatives or close friends who shared the same values, opinions, beliefs and feelings about climate change as they did. For example, Aurora (female, 24, white Polish, psychology graduate, based in Poland) was very sad and angry when she saw for the first time *Warming Stripes* datavis published by Climate science Poland on Facebook which illustrates the rise in average temperatures in Poland over the past 100+ years. She explained with whom she shared this and other datavis about climate change on social media that she considers important and exciting:

> I usually hang out [on social media] with a very small group of friends who share my level of interest. They try to catch up on what's going on and pay attention to what's happening. We all can't stand the way things look and where are we heading.

In the last sentence of the quote from Aurora, the words 'we all can't stand the way things look and where are we heading' indicate emotions of sadness, anger and frustration. Aurora explained that these are emotions related not only to the data presented in the visualisation but also to the idea that there are people who do nothing about it and often worsen the situation related to climate change.

Indeed, emotional responses to datavis were often associated with frustration or anger against people who did not share the same values or political views as audience participants and did not care about climate change. Another example of this can be found in Jacek's (male, age 72, white Polish, pensioner, based in Poland) utterance about his reaction to the map of 50 most polluted cities in the EU (Figure 7) by Greenpeace Poland encountered by him on Facebook: "It provoked me. You know, I just can't deal with some of the people here in Poland." As Jacek further explained, this statement and anger referred indirectly to the political situation in Poland including the current government's attitude to climate policy

(see more in Chapter 7) and people who support it. This example shows that emotions in response to datavis may be affected by the political context and audiences' place of residence.

Most of the audience participants had strong emotions about the datavis that related directly to their lives, including those presenting issues that were within their local or national reach. Another example of this can be seen in Krzysztof (male, age 34, white Polish, lawyer, based in Poland) who, when asked about his emotional responses to the same data visualisation (Figure 7) showing the most polluted countries in Europe, including his, said: "Yeah, anger. Because people make me mad when they... well. You know, you can see the difference in the winter when they start firing the chimneys." As Krzysztof further explained, his anger was directed at people living in the same town as him and using massive coal-fired tile stoves, which have a huge impact on air pollution in most of Poland, including his town. Indeed, as statistics show, in 2018, coal accounted for 36% of the total energy used in Poland for heating residential spaces (GUS, Poland).

Similarly, Jan (male, 30, white Polish, educator, based in Poland) expressed anger when commenting on the same data visualisation (Figure 7): "Of course, I am angry. My country is all red!" When pressed further, he added that the datavis caused them to reflect on the environmental and political situation in his country and consequently his anger derived from his dissatisfaction with the Polish government and politicians. I talk more about these relationships in Chapter 7 where I consider the importance of national differences in emotional engagements with datavis.

Mariusz (male, 48, white Polish, works in IT, based in Poland), on the other hand, explained his anger during the interview and emotional comment on the same data visualisation posted on Facebook by Greenpeace Poland in reference to his dissatisfaction with his local authorities:

> I commented on this because… well, I decided to poke fun at my city's president, who is allied with a political group that I oppose, yeah. I think I referred to her and wrote something about her there.

The above examples show that most of the participants were sad, angry frustrated and/or terrified if the threat was felt to be near to them either in terms of political worries and beliefs or in terms of national space. This confirms the observation of Campbell and Offenhuber (2019) about the emotional impact of proximity techniques in visualised data. Based on a study with two hundred participants from the United States, the researchers argue that individuals "care more about people and events that are near us in time, space, and importance" (Campbell and Offenhuber, 2019, p.73, referencing Campbell, 2013). My findings confirm this argument, which is discussed further in Chapter 7.

The discussion in this section suggests that how audience participants in my study felt about datavis was dictated by their views and beliefs, which respond to and are situated within wider socio-cultural, political contexts. I therefore argue that emotional responses to datavis to a large extent depend on by whom and in what contexts visualisations are encountered. This corroborates and expands the work of Kennedy and colleagues (2016b) about engagements with datavis as social and relational. This section highlights that it is difficult to make simplistic, generalized claims about which emotional states specific data visualisations induce among diverse audiences. Social factors and contexts matter in regard to how people feel about datavis, and therefore tailoring datavis to trigger particular emotions in users may not always have the desired effect. It is further discussed in Chapter Seven.

However, audience participants had strong emotions about datavis that present issues or events which are spatially proximate. This confirms the existing work about emotional 'proximity techniques' in visualised data (Campbell and Offenhuber, 2019) demonstrating that although climate change is a global issue, most audience participants had stronger emotional responses to datavis that were most relevant to their spatial location. This local/national approach to datavis sits in tension with the global nature of environmental

politics (see also Section 7.2). A study of datavis that presents global data and topics may produce different findings.

My findings add to the emerging field of datavis in society, highlighting the importance of socio-cultural contexts and broader views in audiences' emotional engagements with datavis. These considerations move the chapter to the next section which explores emotional responses evoked by different factors *in* datavis. It argues that emotional responses are affected not only by subject matter/broader views as discussed in this section but also datavis itself. It examines the main emotive factors in datavis based on those identified by Kennedy and Hill (2017) to show which of the factors have the greatest emotional charge and why.

5.3 Emotive factors *in* datavis

The first part of this chapter began by considering the emotional responses to subject matter or represented data in datavis about climate change, and their embeddedness in wider relational webs and contexts. What has been said so far indicates that how people feel about datavis on climate change may be dictated by socio-cultural contexts and factors, peoples' beliefs and views. However, participants expressed a range of emotions in response to a variety of factors in datavis (as seen in Kennedy and Hill, 2017), not just subject matter or represented data. Importantly, some of these factors evoked more intense emotional responses than others, which in turn led to greater engagement in the given datavis.

This section builds on the work of Kennedy and Hill (2017), as it shows that engaging with datavis concerns many different emotions, triggered by various factors in a visualisation, including the subject matter, represented data, design and visual style, the source or original location of data visualisations, skill levels for making sense of data visualisations and visualisations in general. However, it does not just confirm what Kennedy and Hill (2017) have said – it moves the debate along by identifying which emotions are evoked by which datavis factors. Moreover, it considers which factors have the greatest emotional charge, along with potential reasons for this.

In my study audience participants explained that their negative responses to data visualisations resulted from their views and emotions about climate change. It is recognised that the climate change phenomenon is a strongly emotional topic (Weber, 2010). Negative valanced emotions are most common in public discourse and media coverage of climate change (O'Neill et al., 2013). Journalists, authors and activists often use fear and shock to inform about the impacts and consequences of climate change (Wallace-Wells, 2017; Kluger, 2006) which consequently affects the perceptions and feelings of citizens (Ogunbode et al., 2021). The interviews with my audience participants reflect these claims. The subject matter of datavis – climate change – largely determined audience participants' emotions. As mentioned in the previous section, it mainly evoked strong emotions of worry, fear, sadness about the consequences of climate change in the first place, followed by frustration and anger at others who ignore the issue. However, although climate change was the focus of all the data visualisations discussed in the interviews, each visualisation featured different sub-themes that evoked stronger or weaker emotional responses, for example highly emotional datavis on plastic consumption among UK audience participants or datavis on air pollution among Polish participants. This is further discussed in the section on the importance of national differences among audience participants (see Chapter 7).

Represented data triggered a mix of emotions including sadness, anger, shame and pride. In the case of Anjelo (male, 32, Tongan, meteorologist from the South Pacific Island of Tonga), who once lived in the UK for two years, the datavis *Warming stripes* (Figure 19) that represents long-term temperature trends in different regions of the world published on Facebook by Ed Hawkins evoked intense sadness. It was in response to data showing the impact of climate change on his place of origin and residence in the Pacific: "It sort of triggered some kind of sadness inside of me personally, looking at this figure and of course, the numbers won't lie." When pressed further on why he felt this way, Anjelo added:

> We here in the Pacific are in the frontline of taking in these consequences first. Compared to the other continents which are developed countries and I remember also I think, yes, this type of data visualisation it is the ripple effects, you know. When you looked at it, so many things come to your mind and to your heart.

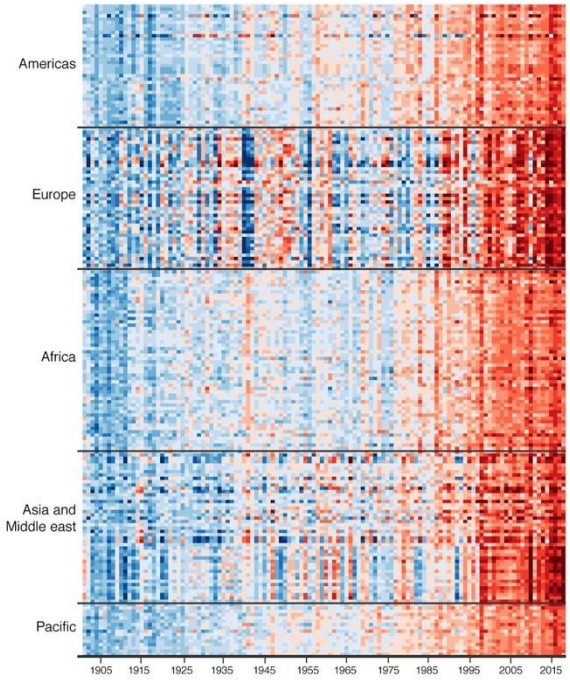


Figure 19: Warming stripes for Americas, Europe, Africa, Asia and Middle East and Pacific

Original source: *#ShowYourStripes*, June 2020. Author: Ed Hawkins

Some datavis enabled participants to compare different datasets, which made some of them feel proud or ashamed. For example, Mariusz, a 48-year-old Polish IT specialist when pressed further on what kind of emotions the datavis *50 most polluted cities in the EU* by Greenpeace Poland triggered in him, commented: “Generally negative because it's a shame these red dots are mostly in Poland. Disgrace.” He added that the data visualisation enabled him to make a quick comparison to other countries and it made him feel ashamed of the country he lived in and identified with.

Conversely, Jack (male, age 45, white British, self-employed electrician, based in the UK), who admitted that data visualisations on various topics make it easier for him to understand the data, described himself as feeling pride, satisfaction and relief when reflecting on the animated datavis by Carbon Brief showing that UK cumulative CO2 emissions were lower compared to other countries with the largest cumulative CO2 emissions since 1750 (Figure 15): “I felt really good actually, 'cos I’m United Kingdom [laughs]. You can see us retracting back and it seems like we’ve been more responsible.” When pressed further on why this datavis made him feel relieved, Jack added watching the animated bar chart at the same

time: ‘Well like I say, it’s, um, to see the United Kingdom go back down the scale the further we go, so we’re one, two, fourth – fifth way down. There are five countries ahead of us in the pollution [laughs].’

The strongly nationalised emotional responses of Mariusz and Jack towards the datavis and data it represents turned out to be a significant factor affecting participants’ emotions. this theme is explored in more detail in Chapter Seven, which discusses national differences in emotional engagements with datavis (see Section 7.2).

It was often the visual form of the datavis that triggered audiences’ first emotional response. It turned out to be the first and one of the most important reasons that motivated my audience participants to further explore the data (or not). This confirms the findings from focus groups with non-experts conducted by Kennedy and Hill (2017) which suggest that visual style may provoke people’s strong emotional responses and attract them to look more deeply into datavis. In most cases in my research, it was also the main factor alongside the subject matter that drew my audience participants’ attention to the datavis. For example, *Warming stripes* and its visual form evoked such strong positive experiences and emotions in most of the participants, as illustrated by Aurora (female, age 24, white Polish, psychology graduate, based in Poland) who encountered it on Facebook while scrolling her newsfeed:

> And I remember it looked so pretty, so nice and so interesting that I stopped and looked at this image and wondered what I was actually looking at. What is this? Somewhere in my head started to pop up ideas of what it could be… And finally it became clear, I started to read it…

Aurora and several other audience participants who responded to this datavis on social media stated that it was a pleasure to look at it and that they enjoyed this positive experience. They described themselves as feeling a kind of satisfaction and joy in response to the aesthetic of the *Warming stripes*. Interestingly, this positive emotional experience or

reaction of some audience participants was present, even though after further exploring the datavis, they often felt a bit anxious and sad about the data represented.

This contradiction between the appeal of the visual and the seriousness of the data suggests that although the subject matter of datavis or represented data may trigger frustration, fear, sadness, anger, worry or shame, the visual form has the potential to evoke more positive emotions such as joy and satisfaction. This finding can be of great importance if the consequences of negative emotions caused by climate change or climate data are taken seriously. For instance, Ogunbode and colleagues' research (2021) shows that negative emotions about climate change have negative effects on peoples' mental health including insomnia symptoms. Therefore, the potential of the visual form of datavis in evoking positive emotions may play an important role in affecting experiences of climate change data, as negative valanced emotions are most common in public discourse and media coverage of climate change (O'Neill et al., 2013). This is further explored in more detail in the later sections of this chapter.

As described above, three of the seven factors identified in the Kennedy and Hill (2017) study on emotional responses to datavis – represented data, subject matter, and visual style – were the most likely to evoke emotional responses in my study participants. However, there were other factors that also require attention. For example, the source or original location of the data visualisations discussed by Kennedy and Hill (2017) as a highly emotive factor in their study triggered various emotions in my audience participants, including contentment, frustration and anger. Most of the participants who reacted to this factor trusted the organisation they followed on social media and therefore trusted the datavis this organisation had shared with them. Therefore, the source of the datavis influenced their desire to explore the visualisation. Only a few of the participants showed distrust towards the organisations that had created or published the data visualisation and emotions that came with it. When asked about a map of 50 most polluted cities in the EU (Figure 7), which was created based on the data of the World Health Organisation report and which has already been mentioned as a strongly emotive visualisation many times in this thesis,

Marek (male, 40, white Polish, businessman, based in Poland) who came across it on Greenpeace Poland's Facebook page angrily replied:

> I mean, I know Greenpeace is not a credible information source, but a non-scientific information source. And I often have to start trolling when I see those manipulated graphics because there's no serious debate with them because they actually don't have any data!

Marek explained that his negative comment on Facebook in response to this visualisation that was 'this is bullshit' was due to his distrust of the Greenpeace. When pressed further on whether he is referring to anything specific and whether he can provide different data showing that this data(vis) is not true, he could not give an example. For Marek, the source of datavis was the most emotive factor in the whole data visualisation. The intensity of his anger had a direct effect on his willingness to engage with the datavis. The emotions triggered by the source of the data visualisations made the visualisation unworthy of his further attention.

Participants who were sceptical about the source of datavis didn't think that any other aspect of visualisation, such as data or visual style, was worth further attention. This confirms the finding from the previous sections that views and beliefs may play an important role in audiences' emotional engagements with datavis. However, it should be emphasised that many audience participants did not pay attention to the source of data visualisation or their original location and thus they did not have emotional responses to this factor. Therefore, I suggest that this is the least emotive factor in datavis in this study. Given the growing importance of fake news based on data and datavis, this area needs further attention, however, it is beyond the scope of this thesis.

Another factor that played a significant role in emotional engagement with data visualisations among my audience participants and which, like the previous factors, was also identified by Kennedy and Hill (2017), was skill levels for making sense of data visualisations. According to Kennedy and Hill (2017), "users had strong feelings about whether they had

the skills to decode visualisations" (p.7). I recognised a similar trend in my data. Audience participants who had some previous experience with datavis or data were more confident and positive about engaging with complex data visualisations, and their emotions were often triggered by visual form. Conversely, people with no university level education or prior experience with data, statistics or visualisations, often lacked confidence, which made them feel anxious. They were also more interested and more emotionally involved in simple datavis. For example, Claire (female, 46-year-old single mother, personal assistant, A-Levels or equivalent, based in the UK) from the beginning of the interview stressed that she did not know much about data visualisations.

The exceptions to this finding of the importance of skill levels in emotional engagements with datavis were hand-drawn datavis which evoked emotions in both types of participants. I will return to this factor when discussing the importance of demographic differences in emotional engagements with datavis in Chapter 7.

Importantly, audience participants reacted to the different factors of data visualisation from the very beginning of their encounter with them and switched between different kinds of emotions very quickly. This complexity of emotional responses can be clearly seen in George's (male, 26, white British, self-employed, environmental consultant based in the UK) musings about the datavis *United in climate (divided on everything else)* by WWF UK that he encountered and reacted to on WWF Instagram account (Figure 11):

> So it's kind of a positive reaction to the image and then I was kind of, er, intrigued about where the data had come from. And then [laughs] I guess the final stage was I can't believe there's that big a population who don't think it's important. So I kind of went through the whole range of emotions from that.

Different emotions were often triggered by different factors of datavis at the same time, including represented data, design and visual style, the subject matter, the source or original location of data visualisations, skill levels for making sense of data visualisations and the original source of the data. This indicates not only the complexity of emotions but also a

complex entanglement of different factors and emotions in datavis, as further explored in the next section. Moreover, engaging with datavis concerns a much greater number of different kinds of emotions than fear, sadness, frustration, anger, worry, shame, pride, joy, and satisfaction as presented in the following sections of this chapter. I therefore suggest that datavis can be seen as an 'emotional repository' in which various, dynamic and complex emotional experiences are located. Significantly, these experiences are social and relational.

This section summarizes and systematizes my findings regarding the various factors in visualisation identified by Kennedy and Hill (2017) that can trigger emotional responses in audiences. It moves the debate along by tying various emotions to them. The section identifies the three most emotive factors in datavis evoking different often contradictory emotions in audience participants – subject matter, visual style, and represented data – that are discussed in more detail in the next section.

5.4 Contradictory emotions in datavis

As suggested in the previous section, the subject matter, represented data and visual form were the factors that evoked the strongest, often contradictory, positive and negative emotional responses among the audience participants. This section develops this theme further to explore the relationships between the three factors and emotions they evoked, along with their possible consequences.

As indicated previously, the range of emotions in response to datavis about climate change varied. The subject matter of datavis and represented data usually triggered fear, sadness and worry, which links with the arguments of O'Neill and colleagues (2013) that images of causes and impacts of climate change usually lead to negative emotional responses. Importantly, O'Neill and colleagues (2013) argued that fearful representations of climate change can "distance or disengage individuals, rendering them feeling helpless, overwhelmed and not empowered to act" (p.2). However, this concern, expressed by O'Neill and others and by some of my expert participants, was not borne out in my data. None of the audience participants indicated that fearful datavis was overwhelming or made them feel helpless. On the contrary, it helped them to imagine/visualise and identify with the

issue, thereby activating compassion and desire to engage further and to actively do something. I discuss this further in Chapter Six.

An example of this can be seen in what Kate (female, age 47, white British, self-employed analyst, based in England) said about the complex datavis by Global Carbon Project (see Figure 20) that she encountered online some time before the interview and brought along to the interview as a datavis that changed her mind about something or mobilised her to act: "that one just blew me away and has completely changed my life." When pressed further on why this data visualisation illustrating over 1000 IPPC scenario categories from the IPCC Fifth Assessment Report, which summarize the wide range of emission scenarios published in the scientific literature and are defined on the basis of CO2-eq concentration levels (in ppm) in 2100 provoked her strong emotional responses, Kate answered:

> I think actually in 2017 I read the second scientist warning, and then the IPCC report came out in 2018, and I think that chart I showed you [see Figure 20], it was just that kind of chart showing how are we going to just completely turn that trajectory of carbon emissions by…, that's just never going to happen.

She added that it was this change of trajectory that made her sad and terrified that it is not going to happen in this current climate. Furthermore, when pressed further on how this line graph of emissions from fossil fuels and cement made her feel, in other words what emotions it evoked, Kate responded:

> Terrified, or we'll come back to that, just gobsmacked I think, just frightened. Yeah, worried, very worried, and yeah, that's at that point, and then yeah that's when I started delving into it a lot more.

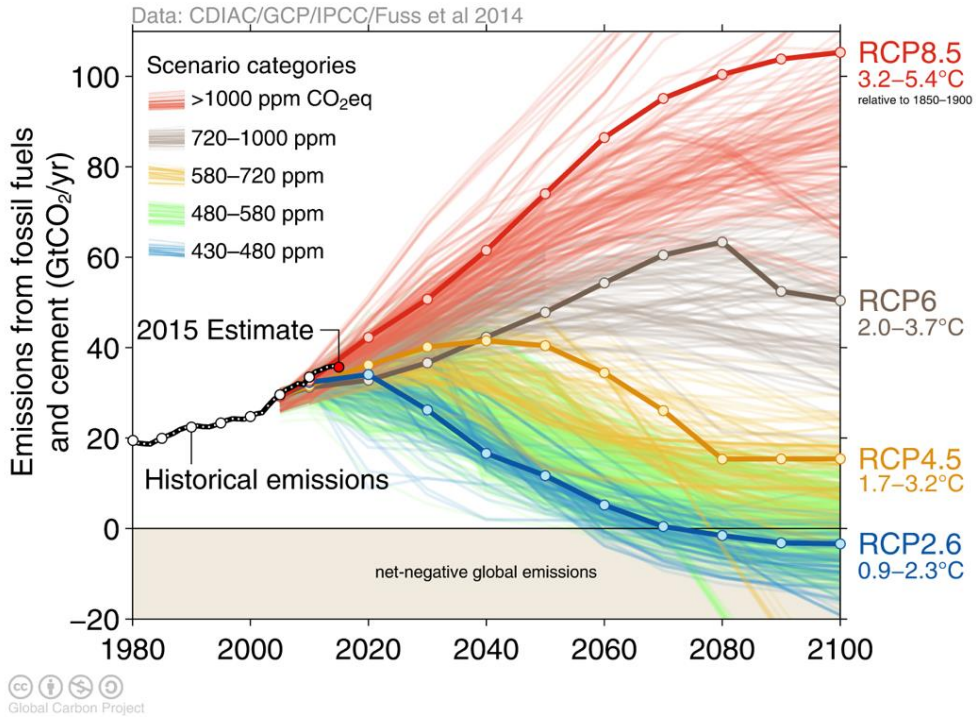


Figure 20: Emissions from fossil fuels and cement (Gt CO2/yr) in the Representative Concentration Pathways (RCPs)

Source: Global Carbon Project.

The intensity of Kate's worry had a direct effect on her willingness to do something. She stressed that despite her professional background, PhD in science, and training as an analyst, she did not understand the entire data visualisation due to its statistical nature and she did not spend a lot of time analysing it, but what she saw was striking and terrifying enough for her from the start to take some serious actions. Kate's example once again shows the importance of confidence in emotional engagements with datavis and a link between education and this confidence. I discuss these further in Chapter 7.

Likewise, many other participants indicated this type of shock, insight, or 'the aha moment' that emerged as first impressions when they encountered datavis. For example, Vera (female, age 19, white Polish-Italian, cook, based in Poland), said that many datavis she came across had a power to evoke in her: "Something in the sense of glare." The presence of this first impression, a kind of enlightenment as some other audience participants described it, played an important role in determining whether audience participants felt their attention was 'caught' by datavis and decided to explore it in more depth. This links

with Kennedy and colleagues' (2016b) argument that emotions "play a role in determining whether people decide to commit time to looking at a visualisation and interrogating the data within it" (p.13).

Furthermore, it was highlighted by some participants that this first impression could evoke not only fear or worry, as suggested above but other different kinds of emotions. Many participants who raised this issue indicated that they felt positively excited, satisfied or surprised by the visual form of the data visualisation. For example, Aurora (mentioned earlier) described her first reaction to the *Warming stripes for Poland* datavis she encountered on Facebook: "My first reaction was how delightful it was... that someone wanted to do it so professionally." Other audience participants who raised this issue also indicated that the visual form of datavis evoked positive emotions in them, including joy, satisfaction, fun and a sense of playfulness from the very beginning of the encounter, although the represented data were frightening and made them feel sad and angry at the same time. Consequently, many of them felt a simultaneous attraction to the visual form of a datavis but were concerned about the data and what was being visualised.

Therefore, despite this excitement, audience participants' feelings of discomfort often surfaced when they looked at the datavis more closely and realised that it actually presented data about the consequences of climate change and its impact. Some of the audience participants tried to align the contradiction between how they felt and how they *should feel* about what the data visualisation presented. Excitement, joy, satisfaction and surprise on one side, with worry, sadness, frustration, fear and anger on the other, were the emotions most commonly described by the participants. An example of the emotional work (Hochschild, 1989) that follows can be found in Tom's (male, 24, white Polish, scientist who works with datavis about climate change) comment about *Warming stripes for Poland* datavis (Figure 17) published by Climate Science Poland that he encountered and reacted to on Facebook:

> When it comes to visualisation, the impression is positive, yet when it comes to the phenomena, I'm having mixed feelings, because all the time it's like 'wow', it's a

> great way to show it, then on the other hand, we have this thought deep down... like, it's getting worse overall.

Tom felt attracted to the datavis but tried to align the contradiction between how he felt and how he *should feel* about the subject matter of the datavis. Another example of this disparity between 'head' and 'heart' and the emotional work done can be found in Hawa's (female, 22, Irish Indian, undergraduate student of Civil & Environmental Engineering, based in England) responses to the question about her emotional response to the animated data visualisation *Arctic sea ice is also in danger* showing the extent of Arctic sea ice that has dropped in recent years published by BBC. Hawa came across this animation online some time ago and brought it to the interview as an example of a datavis that provoked their strong emotional responses and mobilised her to act: "So it's definitely engaging, it makes me feel happier, it makes me feel more engaged in the content that it's saying, "average 1981 to 2010 sea ice extent minimum." That's what it's saying." Hawa's positive reaction was related to the visual form of the datavis, her skill for making sense of datavis, and the discovery of data and information that she had not seen before. She strongly enjoyed these experiences. However, when pressed further on whether there were other emotions as well, Hawa commented: "It doesn't make me happy because what it's actually saying is that the ice is melting. I think understanding the concept, but it was negative emotions when I understood the concept." Audience participants often experienced this type of conflicting emotions in response to the visual form of datavis and represented data when they were exposed to the data visualisations on climate change. Their reactions were often conditioned not only by the feelings they had but also by feelings that were appropriate to the situation, cultural and social patterns, norms and expectations – the 'feeling rules' (Hochschild, 1989) they accepted and followed.

My research data suggests that engagement with data visualisation involves many, often contradictory different emotions triggered by the subject matter and data it represents, the visual form of data visualisation, among other things. In response to these conflicting emotions, some audience participants tried to invoke absent but desirable emotions regarding the subject matter and represented data and suppress present but undesirable

emotions regarding the visual form. This reflects the work of Hochschild (1989) which was discussed in Chapter 2. Hochschild introduced the concept of feeling rules and emotional work, which refer to self-management of one's own emotions in a given social situation that is regulated by feeling rules that guide people's emotions. My research connects to Hochschild's concepts, and I argue that feeling rules and emotional management in response to datavis on climate change could be seen in my data. Highlighting the emotional work that happens when people engage with datavis is a contribution to knowledge.

Moreover, my findings contribute to knowledge by showing that datavis about worrying topics like climate change may not distance or make audiences feel helpless, overwhelmed or disempowered to act, as argued by some scholars (see for example O'Neill et al, 2013) and some professionals from climate and environmental organisations interviewed in this study. This is an interesting and important contribution to understanding the potential impact of data visualisation related not only to climate change but also, for example, to the Covid-19 pandemic. This finding primarily relates to my second research question on whether datavis can influence political participation and mobilise people to act, which I will explore in the next chapter (see Chapter 6).

Finally, by showing the emotive potential of the design and visual form of datavis, this section extends the debate introduced by Otto and Marie Neurath about what datavis can do as a visual tool "for making data transparent and for communicating in ways that data themselves cannot" (Kennedy, 2015). The research data provides empirical evidence for the claim that visual as well as numerical aspects play an important role in audiences' engagements with data(vis) (Kennedy and Hill, 2017). This suggests that the way datavis appear is important in terms of the emotions it evokes, with a consequent impact on audiences' engagements with datavis. This provokes a further question about the role different datavis formats and visual features play in these processes. I explore this in the next section.

5.5 The power of visual form

This section examines emotional responses to datavis features, arguing that visual form is as emotionally appealing as the subject matter and represented data itself. While some relationships between visual features of datavis and emotional responses to them seem logical and obvious and have been discussed by scholars and datavis designers (for example by Margolis and Pauwels, 2011; Muth, 2018; Feigenbaum and Alamalhodaei, 2020; Simpson, 2020), there is still little sociological evidence about whether and how they work in the context of datavis. This chapter addresses this gap. It investigates which datavis formats and visual features are emotionally engaging to audiences and why. It compares these findings with what the professionals from the campaigning and information-providing organisations said about the importance of visual form and what the visual analysis in the previous chapter showed.

Most of my audience participants who did not have mathematical and statistical skills or previous experience with datavis found simple data visualisations more accessible, emotive and useful than other more complex datavis. When asked to identify a data visualisation about climate change that moved them, changed their mind about something or mobilised them to act, most of the participants brought along simple line graphs, bar charts or maps. They also pointed to the specific features they liked most, such as seeing everything at once on maps and seeing a change over time on a line graph.

As Kennedy (2020) argues, the simple and standardised formats of bar and line charts have become commonplace, for example the Covid-19 'flatten the curve' datavis or line charts of case numbers. Such charts were prevalent in the UK and Polish news during the Coronavirus pandemic and at the time of my interviews with participants. People were exposed to these formats in the press and on social media, and this could have influenced audience participants' answers, familiarity with these formats, and the datavis they brought to the interview. Indeed, my audience participants often referred to simple datavis about Covid-19 during the interviews and the emotions they evoked in them, including 30-year-old Jo from the UK, who discussed government line graphs and bar charts about people most at risk of complications and death from Coronavirus:

> I have also found myself looking on the UK government's website and looking at graphs about age groups and Covid-19. I think I mostly do it to stop myself from being so anxious about things. It makes you feel much better when you see a graph showing that of all the people in the UK that have died from Covid-19 only 35 people in your age group with no previously known underlying health conditions have died. I wouldn't have known that if I hadn't looked at the datavis.

As shown in Jo's example above, the simple formats of data visualisations can not only provide important information but also evoke strong emotions in audiences in response to the represented data. those related to the pandemic may calm and reassure some people, evoking positive emotions by enabling them to understand the complex situation and the large amount of data shared with them by different sources, as Jo noted after making the above statements.

However, a distinction must be made here between simple datavis that look professional, coherent, appealing and attractive from those that look 'amateurish' and visually inconsistent. For Adam (male, 34, white Polish, academic teacher involved in anti-smog activities in his town based in Poland), bar charts made in Excel were very unattractive, evoking negative emotions and distrust towards the author and source of the datavis:

> I don't like Excel charts and don't trust them. When I come across Excel charts in publications, I become sceptical. This is some kind of bias, of course. Yes. And Excel bar graphs are a horrible thing.

Adam added that he does not like datavis made in Excel even though sometimes he himself uses this tool in his academic work for quick data visualisation, hence it is easy for him to recognise them.

In this case, the visual form and the feelings associated with it once again are a very important factor influencing engagement with datavis and desire to look more deeply into

it. When pressed further on why this was so meaningful for him, Adam replied that he had no idea. Interestingly, he said he was aware that it was unimportant how the data visualisation looked – more important was whether it was reliable or not, but nevertheless, he felt strongly affected by the aesthetics of the visualisation. Similarly, Peter (male, 50, White British, software developer, based in the UK) who was fascinated by more complex data visualisations said, pointing to the information sheet about my research with different chart types (see Appendix 3) that for him and probably for others data visualisations made in Excel were just boring: "Excel I think has kind of commoditised simpler charts to such an extent that people fall asleep if they see a simple pie chart, as you have there in the middle, on the top." This kind of aversion, emotional distrust or boredom towards data visualisations made in Excel discouraged some participants to devote any time to data exploration. Most often, these were people confident in their skills and abilities or who had an educational background in the field of data, computer science, statistics or visualisation. Most of them knew how to read particular chart types. This and other demographic differences between my audience participants proved to be an important factor affecting emotional engagements with datavis, which I discuss in Chapter Seven.

On the other hand, more complex and innovative datavis often provoked positive emotions such as excitement, contentment or joy in this kind of audience participants. These emotions were often related to visual form, including animations, interactivity or hand-drawn datavis. For example, Peter, mentioned above, reflected on the various interactive datavis he came across online and that he found the most striking: "So they can be fun to use, sometimes a little overwhelming, but they can be fun to use. And they do get the point across." However, even those who appreciated more complex and innovative data visualisations emphasised that it was not easy to encounter them, as they are relatively rare, including interactive ones. As some of the audience participants said, this is also one of the reasons why they stood out so much and appealed to them.

However, undoubtedly, simple forms of data visualisation also have the potential to evoke specific emotions. The audience participants indicated that different types of datavis, including maps and line graphs, may use different techniques and impact audiences'

emotions in different ways, thus evoking different kinds of emotional responses. Many participants pointed to the specific features that had particular appeal or impact, such as seeing everything at once on maps or seeing a change over time on a line chart. The emotional impact of spatial proximity, mentioned above, was particularly noteworthy in response to maps. Audience participants often indicated the maps as being most emotive for them, justifying that they could see the scale of the phenomenon on a map from a distant perspective, but at the same time felt strongly connected to it since it allowed them to powerfully imagine the scale of the phenomenon. This is an important point as maps allowed some audience participants to see beyond their own contexts. For example, Bill, a taxi driver from the UK, discussed the map by WWF UK that he encountered on Facebook, which showed the area of burnt Australian forests in relation to the area of the UK, his place of residence (Figure 12):

> You're talking about five hours, six hours driving, and you'd be just driving through a complete burnt, dead area, for as far as the eye could see in every direction. You know, it's frightening.

Maps where audience participants could compare the scale of an event or issue with the rest of the world or other countries especially evoked compassion, sympathy or fear, as shown by Jan's (a 30-year-old Polish educator from Poland) quote reflecting on the near real-time map of fires around the world by NASA that he came across online some time ago during catastrophic fires in Brazil and Australia:

> Anxious, just like that, even terrified. You learn about these fires and so on, and you know there's a fire somewhere, but now a map appears that actually shows what's going on, not just that, it shows what is happening at the very moment we're looking at it. It's really burning right now, it's really bad. So I'm scared for sure. Terrified, you could say.

As Jan noted, maps allowed him to feel distant events as if they were closer in time and space which affected his emotions.

The second pattern I identified was a feeling of uncertainty in response to line graphs. In many of my audience participants, line graphs evoked what Rosling et al. (2018) called "the straight-line instinct." As the statistician and his colleagues explain, the straight-line instinct makes people assume that the trend presented by a line graph will continue in a straight line all the time, which may explain the common shock and fear associated with these types of datavis. Indeed, participants talked about a sudden change over time and a feeling of risk and danger associated with this. Ewa, a 36-year-old scientist and university teacher from Poland, whose case I discussed in the previous section and who changed her mind about climate change as being human-caused, illustrates this speaking about one of the line graphs (Figure 21) that she encountered on Facebook, which shows climate change over the past 12,000 years: "It surely is disturbing, mainly because of how big and sudden the change is. So, I suppose the first thing that comes to mind is shock."

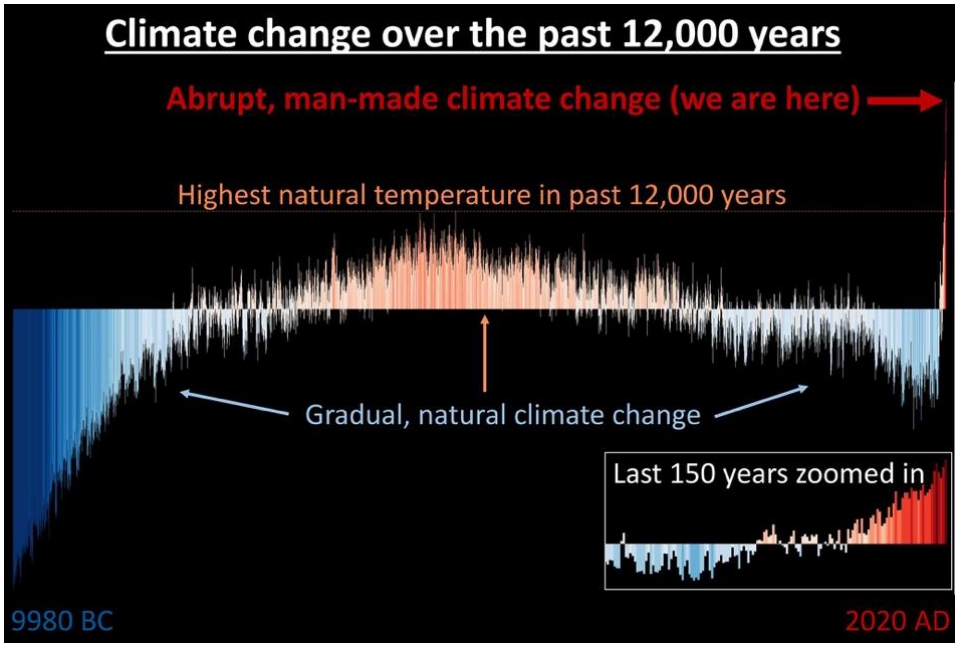


Figure 21: Climate change over the past 12,000 years

Source: The Logic of Science profile on Facebook.

Kate, on the other hand, a 47-year-old analyst from the UK, mentioned above, illustrates this in a dramatic and frightening way by describing the line graph *Emissions from fossil fuels*

and cement she encountered some time ago on the Internet and which she brought to the interview as an example of a highly emotive datavis (Figure 20):

> I think the visual form, just that change of trajectory that we need, it's like the Titanic, you know, you can't turn that corner that quickly, that was just – that's just all I can remember thinking is like that's impossible for us to change that rapidly, that steeply.

The above examples show that some formats of data visualisation have the potential to evoke stronger emotions than others. Moreover, the audience participants stressed the importance of some visual features and how they affected their emotions to varying degrees. Therefore, I also explore here the resources which aroused the most or strongest emotions in the audience participants and which thus seemed to be the most effective. These are colour, hand-drawn elements, animation and interactivity.

Colour turned out to be the most emotive element. Many audience participants emphasised that it was the first aspect of datavis that attracted their attention while browsing their social media, even when they did not know what the image was about. For example, Aurora described her experiences with the data visualisation *Warming Stripes for Poland*, which she encountered in a hurry on Facebook:

> I remember flying somewhere, coming across this beautiful… scrolling on my phone and seeing bars in weird colours. I had no idea what was going on. I didn't quite see the gradient. The colours passed through each other nicely. And I remember thinking it was so cool, pretty, and fascinating that I had to pause and look at it, not sure what I was looking at, thinking "What is this?"

The example of Aurora is one of many showing that colour can evoke positive emotions and a desire to explore the datavis, but this is not always the case. For some participants, the choice of colours in a given data visualisation can be irritating and frustrating and discourage them from looking at datavis further. I was illustrated by George, a 26-year-old

environmental consultant who sometimes uses datavis in his work. In his statement he refers to his colour blindness:

> I struggle with a lot of environmental stuff because there's a lot of greens used. So I don't know whether this is relevant, but climate change graphs and things like that, when they use different dotted lines with reds and greens, I don't know what's going on and I really struggle with that. I wish somebody would say, can we not do this 'cos I don't know what's going on. So, yeah.

In situations when colour did not discourage my audience participants, I identified three functions that it can perform. First, as shown by Aurora's statement above, it can catch people's attention. Then, in the context of climate change, it can perform a warning function – most often mentioned was the colour red and its intensity. Like Jan who previously in this section discussed his emotional reaction to the map of fires around the world, most participants who raised this issue indicated that the standard colours associated with fear evoked a sense of worry and insecurity: "Yes, a lot of red and it shows that something is wrong after all." This confirms the previously mentioned argument that some colours called intuitive (Muth, 2018) may carry certain metaphors in a given culture such as red for danger. The third function of colour was the creation of narratives which illustrates a point made by Feigenbaum and Alamalhodaei (2020). Aurora illustrates this speaking once again about *Warming Stripes* datavis by Ed Hawkins. However, this time she describes her interaction with the interactive tool on the #warmingstripes website, which allows users to generate a visualisation of temperature changes in any country or region of the world. Aurora recalls how she spent a moment checking 'warming stripes' of several countries and a moment when one of them evoked stronger emotions in her due to the intensely changing colours:

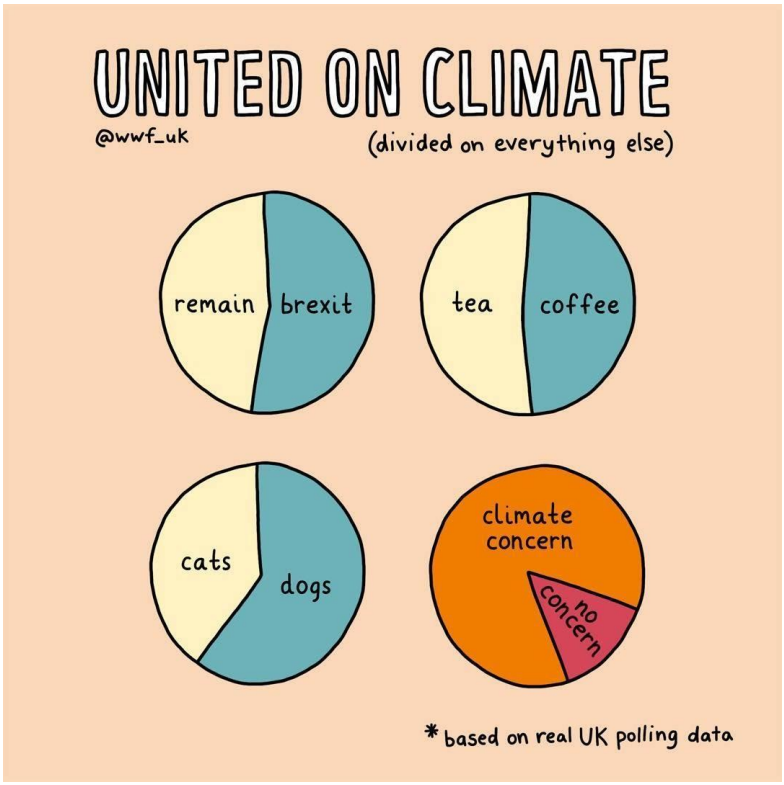
> I remember one of the countries left a powerful impression on me, but I won't name which one because that was a few months ago. But seriously, one of the charts was like: calm, calm, calm, and then a sudden break off, a dramatic difference. I remember it left a powerful impression on me.

Hand-drawn datavis or elements of datavis were another highly emotional element. For example, Rachel (female, 38, white British, learning technologist, based in the UK) discussed the Mona Chalabi data visualisation of the annual increase of CO2 emission (in billion tonnes) from 1850 until 2010 (Figure 8) that she encountered on the Greenpeace UK Instagram account. This graph, which is broken up into ten pieces/images, moved Rachel because of its visual form and interactivity: "You could see there was like a story to tell, and I was interested to see how the graph would pan out, and it's quite simple and the colours are quite playful. It doesn't feel too serious, even though it's about a serious topic."

The visual form of this hand-drawn datavis evoked a kind of intimacy and informality in Rachel in relation to the data visualisation. This conforms with Simpson's (2020) argument regarding the impact of hand-drawn datavis on emotions. As the author argues, this kind of datavis can be more emotive as they are often presented "as imperfect and incomplete representations of a concept" and are "not associated with technical neutrality", thus they appear more subjective (Simpson, 2020, p.165).

Marjorie (female, 60, white and Asian Anglo-Indian, pensioner, based in the UK), who commented on the hand-drawn data visualisations about climate concerns among British residents published by WWF UK on Facebook (Figure 11), expressed a similar sentiment: "And so, I looked at that and I thought it was funny, basically." When pressed further on why this was funny, she said:

> I looked at it again and I thought, well, either this is somebody trying to pull a fast one, or it's actually quite a good joke. And that's why I sort of like looked at it and thought, yeah, that is really funny, actually. There's no numbers, so it's not meant to be – what's the word? Not taken seriously, but not meant to be looked at that hard.



Source: WWF UK.

Marjorie emphasised in her comments that she stopped scrolling through her news feed on Facebook because this datavis drew her attention. She described it as funny and playful, and referred to mundane and everyday activities, which illustrate the point made by Feigenbaum and Alamalhodaei (2020). The authors distinguish between conventional datavis and graphic novels, such as hand-drawn datavis, which operate in different aesthetics and have the potential to humanise data by evoking positive associations and emotions.

It should be mentioned, however, that for some people, hand-drawn datavis can also seem unprofessional, which was indicated by Jack's statement about the same datavis by WWF UK (Figure 11), which Marjorie commented above. Jack briefly summed up the impression this data visualisation made on him: “I don’t like this one. It looks like a drawing for children.” He was put off by his initial dislike of the aesthetics of the visualisation, and although he was asked about it several times, he did not want to talk about this visualisation any more as if it were not worth his attention.

The third visual feature that was strongly emotive for the audience participants was animation. In response to the question about particular elements of the datavis that made her feel emotional, Hawa (student from the UK) answered that it is usually animation:

> Yeah, it makes me feel happier seeing them (…). Sometimes they can be moving – some charts, some graphs are moving charts or graphs so it makes me feel happier, more enlightened, triggers feelings of happiness because I am able to visually see and observe data that is important. Because it's also about, you know, like, you know it can be about climate change and I'm able to observe the data patterns over time which makes me feel quite powerful as well, because I'm in command of, you know, understanding what the data is trying to say to us.

Similarly, Jack (electrician, based in the UK) enjoyed observing the animated bar chart of the countries with the largest cumulative CO2 emissions since 1750 by Carbon Brief (Figure 15): "I enjoyed it and curiosity, yeah. Curiosity with watching it, yeah, it definitely – it draws me to it, my curiosity." He was drawn to it and felt pleasure derived from watching the animation that gradually satisfied his curiosity, as he explained later when asked more closely about his emotions.

The last feature that strongly triggered the emotions of my audience participants was the interactivity of the data visualisation. This was related to the excitement and joy in response to the opportunity to explore data for yourself. This advances Kirk's (2012) argument about the distinction in the functions that data visualisation can perform, such as explaining or inviting exploration. Some datavis not only provided an explanatory picture of the data but also facilitated visual exploration, which significantly increased the emotional engagement of the participants.

These participants enjoyed the experience of and ability to independently search for data on interactive visualisations. It encouraged them to spend more time exploring the datavis and expanding their knowledge about not only their close surroundings but also other countries with which they had no personal ties. When pressed further on why the interactive datavis

Warming stripes for Poland (Figure 17) was so exciting for her, Natalia (educator and photographer, based in Poland) commented while exploring the datavis at the same time: "And because they're so interactive, it's amazing, I love it. I'd just stay here and look at different countries. I'm gonna look at other ones..." This suggests that some people may like the visualisations that invite exploration more and are willing to devote more attention to them.

Similarly, Peter (software developer from the UK) who enjoyed complex datavis reflected on some interactive datavis that he came across online but was unable to identify for the research: "So they can be fun to use, sometimes a little overwhelming, but they can be fun to use. And they do get the point across." However, Peter emphasised that it is not easy to encounter interactive datavis, as they are relatively rare. As some of the audience participants emphasised, this is also one of the reasons why they stood out so much and appealed to them.

Overall, more innovative datavis often provoked positive emotions in participants, such as excitement, contentment or joy. These emotions were most often related to visual form including animation, interactivity or hand-drawn datavis. Table 6 below provides an overview of the themes, exemplified with recurrent resources from the semiotic analysis and interviews with the audience participants.

Themes	Examples of frequent features	Emotions evoked
Emotions associated with risk of climate change (change over time)	Red, black, and bright colours; line charts.	Fear, worry, sadness
Emotions associated with comparison to other countries or other periods of time (users situate themselves)	Red colour; comparison of two or more elements/objects/categories; maps.	Shame, pride, relief, anger, worry, sadness, frustration
Emotions associated with interactivity, playfulness, and friendly visual style of a datavis	Hand drawn datavis or elements; neutral or pastel colours; animation; interactivity.	Pleasure, joy, satisfaction, excitement

Table 6: Examples of the most emotive features in data visualisations

It can be said that the resources used by professionals from the organisations – such as the use of animation and colours to induce fear, simplicity to which users usually respond positively, and hand-drawn datavis or elements of datavis that add joy, fun and authenticity – affect emotions and enable or increase audiences' involvement in data visualisation. Therefore, in most cases, the intuitions of the professionals from the campaigning and information-providing organisations were confirmed by what the audiences said about the potential of visual form of datavis. The most underestimated form turned out to be maps, which professionals rarely mentioned in their statements, and which often made a great impression on the audience participants.

Likewise, the organisations did not create or publish a lot of animations or interactive data visualisations that made a great impression on the audiences. However, this is largely due to the fact that designing such data visualisations takes time and resources and therefore little is produced. This was also confirmed by audience participants, who stated that not many examples of this type of visualisation can be found online.

Hand-drawn elements were appreciated mainly by the campaigning organisations, while most of the audience participants who had contact with them associated them with positive emotions. Surprisingly, audience participants focused much more on the visual resources of data visualisation related to their positive emotions, while professionals emphasised that it is not easy to evoke positive emotions in audiences because datavis about climate change contains sad and scary data. One of the prime examples of this are animations that professional participants believe can create fear and dramatic narratives, while many audience participants felt a great pleasure to look at.

These findings contribute to existing debates on the emotive potential of visual features of datavis including colour (Margolis and Pauwels, 2011; Muth, 2018), hand-drawn datavis (Simpson, 2020; Feigenbaum and Alamalhodaei, 2020), animation and interactivity (Kirk, 2012) highlighting that for audiences, these elements are the most emotive elements of datavis. Moreover, the chapter has shed light on emotional responses to different formats of datavis, suggesting that maps and line graphs have the potential to evoke stronger

emotional responses in audiences than other datavis formats. The chapter also suggests that some professionals might underestimate the potential impacts of the visual form of datavis.

5.6 Conclusion

It was highlighted in the introduction to this thesis that emotional responses to datavis are largely overlooked within sociological literature. This chapter has offered detailed accounts and analysis of the emotional experiences of audience participants engaging with climate change datavis. It began by examining audiences' emotional responses to subject matter datavis, as largely dictated by wider socio-cultural contexts, their broader views and beliefs, both about climate change in particular, and politics more generally. By emphasising the importance of these relationships, this discussion contributes towards an improved understanding of the role that different contexts may play in engagements with datavis. It was argued in this chapter that emotional responses to datavis are not experienced in a relationship vacuum but as part of a web of interconnected relationships and elements *outside* the datavis.

The discussion then turned to the different factors *inside* datavis that can affect the emotional experiences of audiences. It became clear that while the topic of climate change itself evokes strong emotions such as worry, fear, sadness, anger and frustration, there are other factors that can strengthen these emotions and evoke others, such as compassion, surprise, pride, shame, joy or contentment. They also often determine whether people paid attention to the data and datavis in the first place. Therefore, I suggest that data visualisation can be seen as an 'emotional repository' of dynamic and complex emotional experiences. It can trigger multiple, simultaneous, changing and often contradictory emotions. Moreover, boundaries between these emotions are a little fuzzy and therefore they do not fit into neat positive, neutral or negative categories.

The next sections showed that these emotions evoked by datavis are mainly related to the three factors in datavis: the subject of the visualisation, the represented data, and the visual form. The nuances associated with multiple and sometimes conflicting emotional responses

to datavis were explored, and I argued that it is not helpful to make simplistic, generalized claims about the effectiveness of attempting to induce particular emotional states among audiences. People experience different often contradictory emotions in response to datavis and move between them very quickly. It is therefore difficult to categorise them and clearly indicate what kinds of emotions particular data visualisations evoke, what emotions dominate and why.

The chapter concluded by considering the emotional potential of visual form in communicating data by identifying the four most emotive visual elements of datavis: colour, hand-drawn elements, animation and interactivity. I argued that these features have the power to evoke positive emotions in audience participants even though the subject matter and data of the datavis are sad or terrifying. This extends existing debates, suggesting that datavis has the potential to make unpalatable data, for example on climate change, more enjoyable. This provokes a question about whether this is what datavis designers or experts want and where this can lead. These findings pave the way for the next chapter, in which I explore whether and how datavis can mobilise people to act and what role the emotional responses to datavis may play in these processes.

Chapter Six:
Datavis and Political Participation

6.1 Introduction

This chapter focuses on the second research question: to what extent do emotional experiences of datavis relate to people's (potential) political participation? It empirically examines Nærland's (2020) statement that data visualisations can mobilise people to act as citizens and take part in political debates or everyday discussions. The chapter advances a debate discussed in Chapter Two which suggests that political decisions are the result of not only rational judgements but also certain emotions that motivate people to act and participate in public life (Coleman, 2013; Wahl-Jorgensen, 2019). This chapter builds on the findings of the previous chapter, which showed that data visualisation evokes multiple and often contradictory emotions that play an important role in involving audiences in climate change issues, which in turn may provoke them to participate democratically.

As discussed in Chapter Two, I understand political participation in a wider sense as not only goal-orientated "actions directed towards influencing governmental decisions and political outcomes" (Ekman and Amnå, 2012, p.289) but also all the other ways in which people engage in political life, such as discussing politics, following political issues, writing to editors, donating money, volunteering to help others or solve local problems, or recycling for environmental reasons. These are what have been termed civil (latent political) participation by Ekman and Amnå (2012). Moreover, I suggest that the division between formal and informal or online and offline political participation is often unhelpful. Therefore, this chapter examines diverse forms of political participation mobilised by datavis and develops a typology of participatory practices and political activities that people engage with from the micro and everyday to the meso and the macro. The notion of a continuum of political participation is explored, which implies a progression from mundane forms of political actions to various types of more established political participation on a more public and collective scale. Adopting this bottom-up, grounded approach enables me to identify and understand a broad range of audiences' political engagements with datavis and the paths that lead to them.

The first two sections begin by considering the informal talk, decisions, mundane acts and practices that people undertake as part of their daily lives that do not formally relate to the political domain but can be seen as 'pre-political' (Ekman and Amnå, 2012), such as sharing and discussing a datavis with others and changes in daily behaviour and practices. I briefly discuss various forms of usually long-term, individual practices and approach them as a distinctive form of material participation (Marres, 2016). I examine these diverse practices within the wider contexts in which they are practised, which helps to understand whether and how they can facilitate political participation on a more public and collective scale.

Section 6.4 builds upon this discussion but links it first to more established, conventional, formal and organized political participation and then to the unconventional online and offline political participation as distinguished by Lamprianou (2013). I investigate what types of data visualisations were more motivating for the participants and why. The chapter concludes by arguing that datavis can mobilise people to act on different levels and that emotions play an important role in these processes. I also suggest that the participatory practices undertaken by audience participants overlap and are relational, so it is unhelpful to draw hard lines between them, as divisions such as formal/informal, conventional/unconventional tend to do.

6.2 Discussing and sharing datavis with others

As discussed in Chapter Two, datavis is a tool that can facilitate access to information and knowledge about important, often complex, social and political issues. It can increase people's understanding of abstract numeric information (Alamalhodaei et al., 2020) and change their minds about something as a result. This potential was often pointed out by audience participants. For example, Ewa (female, 36, white Polish, scientist and university teacher, based in Poland), introduced in the previous chapter, discussed her emotional reaction to the data visualisations she encountered online (Figure 21). She claimed that the datavis which shows a reconstruction of Earth's global climate over the last 12,000 years not only helped her understand the problem, but also shocked her and prompted her to change her mind about climate change as a man-made phenomenon:

> It surely is disturbing, mainly because how big and sudden the change is. So, I suppose the first thing that comes to mind is shock. So these are the charts that will definitely change minds. They have changed mine too, like I said. I realised to what extent human activities influence the climate.

As Ewa added after a brief moment of reflection, the most emotional things about data visualisations that have moved her and changed her views and opinions were line graphs like the one mentioned above, which show an increase in the average temperature over the years or an increase in carbon dioxide in the atmosphere. This emotional potential of line charts was also discussed in the previous chapter (see Section 5.5).

However, my research shows that datavis can prompt people not only to rethink things, care for, or seek out additional information on a particular issue, as many audience participants mentioned, but also to discuss and share the information and datavis with others. The importance of this everyday, mundane sharing practice confirms Nærland's (2020) claim about datavis potential to mobilise people to take part in political debates or everyday discussions. Indeed, many audience participants who felt emotionally disturbed by data visualisations evoking multiple emotions in them, as described in Chapter Five, said that the first reaction that came to their mind was to want to share the graph, chart or map with others or have a conversation about it. They did so in a variety of online and offline contexts, with a wide variety of people, ranging from partners and people with whom they lived, relatives and friends, colleagues or clients from work, residents of the same city, and even strangers. Several examples of this are presented in statements by Alan (male, 25, white British, teaching assistant and wildlife rescue worker), Bill (male, 64, white British, taxi driver), Claire (female, 46, white British, personal assistant), Jo (female, 32, white British, graphic designer), Krzysztof (male, 34, white Polish, lawyer), Marjorie (female, 60, white and Asian Anglo-Indian, pensioner, based in the UK) and Natalia (female, 36, white Polish, educator and photographer) who, when asked how datavis motivated them, said:

> I was prompted to make my comment out of a sense of duty and frustration. Duty because I know how important the issues raised are, and how long we've known

about them, and I feel it is important to keep on engaging in such posts to bring about conversation. (…) I have emailed people, signed petitions, shared many posts and repeated lots of this information by word of mouth at work and at home. (Alan, in response to Mona Chalabi datavis published on Instagram by Greenpeace UK)

There's no two ways about it. And it's a graph I would like to send to every single population denier that I've ever come across! (Bill, in response to *More than eight hectares have been burnt in Australia* datavis published on Facebook by WWF UK)

"Look, this is happening, how awful is this?" And I put those posts and put them on Facebook, just to make my friends aware on Facebook that it's happening.
Yeah, I kind of like wanted to talk to people about it as well 'cos I couldn't understand why it wasn't headline news. (Claire, in response to *More than eight hectares have been burnt in Australi*a datavis published by WWF UK on Facebook)

When I come across data visualisations I like or think that they might help me explain or educate others I save them to my phone. (Jo, in response to *Food production and greenhouse gas emission* datavis published by Carbon Brief UK on Facebook)

For example, this visualisation to which I reacted ... sometimes when I talk to my friends, I say that I will post something on Face[book] for them to see. (Krzysztof, in response to *50 most polluted cities in the EU* datavis published by Greenpeace UK on Facebook)

Yeah, and I probably end up talking about it when I get a chance to have a conversation with my school friends. (Marjorie, in response to *United on climate. Divided on everything else* datavis published by WWF UK on Facebook)

I usually like it or share it. If this is information that is important to me, I prefer to share it, pass it on to my friends. (Natalia about datavis in general)

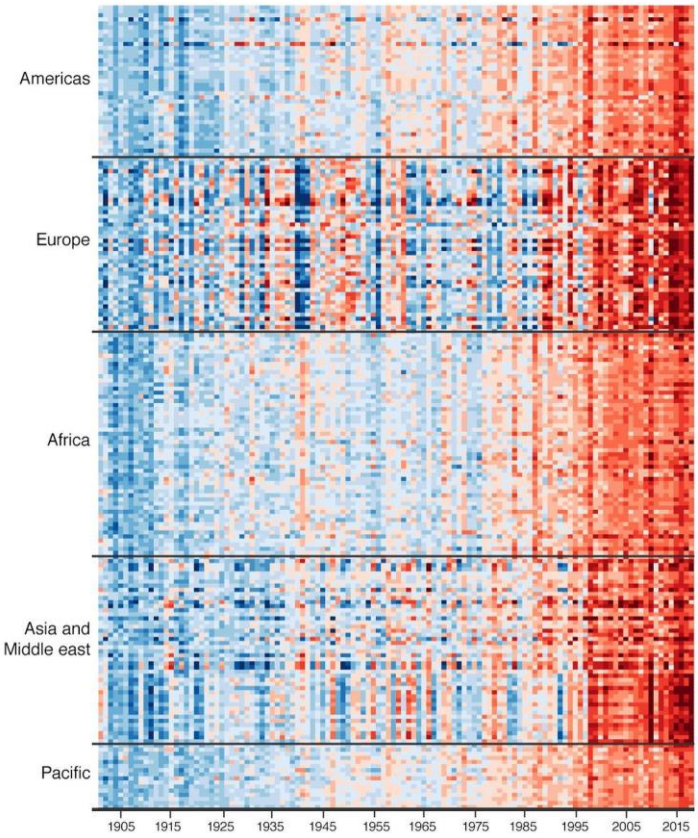
The main purpose of sharing data visualisations with others was to raise awareness and educate other people, or to start a conversation about the issue represented in the data visualisation. These discussions usually took place in a private space such as the home, but also in a workplace. Audience participants often used social media to communicate and share datavis with others and to deliberate about the common good. For Hawa (female, 22, Irish Indian, student, based in England), sharing the WWF UK visualisation about burning forests in Australia (see Figure 12) on Facebook was a way to show her worry and commitment to a problem when she could not support the organisation in a more formal way, such as financially:

> Hawa: Because at the moment, I don't have enough money in my bank account to support them in a charity donation or anything like that, so I definitely supported them via social media a bit more.
> Monika: Ah okay so how did you support them on social media?
> Hawa: I share it with other people.

The case of Hawa and other similar stories of audience participants sharing and discussing datavis online show that social media and the online environment play an important role in peoples' mobilisation prompted by datavis. It indicates that datavis and the online environment lend themselves to sharing as an everyday form of political activism.

Indeed, for many audience participants sharing datavis online or offline with friends, family, colleagues from work or strangers was an informal path to political engagement and the beginning of their further actions, which confirms Dahlgren's (2002) recognition of the importance of informal conversation in undertaking civic actions. For example, Anjelo, a 32-year-old meteorologist from the South Pacific Island of Tonga, who talked in the previous chapter about his emotions related to *Warming stripes*, not only commented on it online on social media but (successfully) asked the author Ed Hawkins to design a version for his island:

But then Tonga was not included in that list, drop-down list, and hence why my comment as well if we could be included in the drop-down list we would share our data sets so that we can have our own stripes. It triggered concern, some sense of being sad, you know, of knowing where we are heading if we are continuing on, on this rate. And it also triggered a sense of help-ness, a sense of being alert and a sense of – of asking the questions. What can I do? What can I do? What can I provide for Tonga to be shown, for Tonga to have its stripes so that we can use that, you know, consultations when we go out to the smaller communities?



Source: *#ShowYourStripes*; Author: Professor Ed Hawkins.

Moreover, Anjelo personally shared the original *Warming* stripes datavis with colleagues at work and tried to reproduce it with them using their own data sets:

I shared these colour stripes with my co-workers. And then they themselves were surprised as well in this type of data visualisation and then we tried to reproduce similar sort of stripes but using our – our own data sets. We have not gone out

> publicly with this 'show your stripes' data visualisation format. But then yes that's what led me on to discuss this with my staff and then my boss. And even our climate section, we shared this – this idea…

This, like other examples, shows that actions taken online and in person in response to datavis often intertwine and influence each other, so – as I pointed out in the introduction to this chapter – it makes no sense to separate them. Moreover, it was the interactive data visualisation that provoked and encouraged Anjelo to share and discuss it with colleagues, which consequently activated and mobilised them to further action. This may suggest that interactive datavis not only strongly influence the emotions of audiences when people are given the opportunity to explore data on their own as discussed in the previous chapter but is also a powerful tool of social and political interaction that can empower their mobilisation.

Similar to Anjelo, Aneta (female, 29, Polish, inspector and eco-manager working for a local council, based in Poland) also tried to use graphs, charts and maps in her professional work. However, she did this to mobilise residents of her town to convert from coal to ecological heating. During the interview, she discussed two datavis that she found on the Internet. The first, titled *Awash with plastic*, was published by Techpedia.pl and shows plastic waste inputs from land into the ocean. The second was published by cieplosystemowe.pl and illustrates the tenfold difference in emissions of harmful substances between the heat produced by individual heating and the same amount of heat generated and supplied by the district heating system. Aneta decided to share these two datavis with others during her workshops and in her opinion, they turned out to be the most effective elements in her work:

> I mean, I can motivate other residents with these visualisations. In this case, having these infographics motivate me to communicate the problem more precisely. Maybe they won't change my mind, but I know... based on my own experience, I believe they may influence the behaviour of those who are directly impacted, for example, those who own c*oal-fired tile stoves*. They can be more affected.

In her comments, Aneta emphasises that the data visualisations made a great impression on her and motivated her to share them and the problem they present with the residents in order to mobilise them to act. However, importantly, she stated that the datavis did not change her mind about a given topic in any way when she encountered them online, but they did affect her emotions. This means that mobilisation to action, in this case sharing datavis with others, can be triggered by emotions alone; these do not need to be accompanied by a change of mind. Datavis do not only change minds, they also confirm and reinforce beliefs and values.

Some other audience participants, who were mobilised by datavis in many different ways, also stated that these datavis did not change their minds. They explained that they had known about the issue represented in the datavis for a long time and therefore they were not surprised by what was presented. When asked why these datavis mobilised them to care more and often act, they said that it: "in some way emphasised this knowledge" (Archibald, a 65-year-old white Polish journalist), "reaffirmed previous assumptions" (Lucyna, a 36-year-old white Polish PR manager), and "has helped to reinforce belief that action does need to be taken" (Alan, a 25-year-old white British teaching assistant and wildlife rescue worker). Given that most of the audience participants expressed strong emotional responses to the datavis, as documented in the previous sections, I argue that emotions also played an important role in their mobilisation.

Several audience participants pointed directly to the data and figures communicated by the datavis as significant, reliable evidence of what they already knew, such as Lucyna, who tried to explain what it was in the datavis *Warming stripes* that motivated her to not only share it with other people but also strengthen her pro-environmental practices and lifestyle:

> First of all, data. I am a person who is convinced by facts and, most notably, data. And, in this regard, the way this is presented is fantastic for me in terms of education and validation. It serves as a validation and educational tool for others who I want to educate on the matter.

Lucyna considered the datavis to be excellent educational material about climate change, which she could share with other people. Furthermore, talking about datavis and mobilisation, she excitedly referred to Covid-19 visualisations that were ubiquitous in the media at the time of the interview, including the racing bar chart published by Flourish Studio showing Global Deaths Due to Various Causes and Covid-19 and to data visualisations and simulations published by *The Washington Post* showing why outbreaks like Coronavirus spread exponentially, and how to "flatten the curve." She admitted that the data(vis) made a great impression on her and confirmed her presumptions, convincing her that the rules introduced by the Polish government made sense, which in turn motivated her to share with others and follow the implemented measures:

> …for example, the Covid data visualisations and restrictions against going outside. I believe it was convincing since many people were questioning if the lockdown made sense or if promoting staying home was really worth it. And these are the things that answer this question, and that the rules that they'd imposed were not so pointless after all, right?

Moreover, when discussing the impact of Covid-19 data visualisations on her behaviour, she explained she finds data presented graphically more comprehensible and convincing.

This trust in data, related to emotions, and its impact on audiences encountering data visualisations have also been recognised by one of the campaigning organisations. Bartek, a communication specialist from Greenpeace Poland gave an example of a bar chart comparing coal mining in Poland from 1913 to 2017 (Figure 22). He explained that coal is one of the largest contributors to anthropogenic climate change and that Poland, being one of the largest coal-mining countries in Europe, does not want to resign from coal which dominates the power sector in the country. He added that he often shows this datavis during his presentations and, according to him, it always evokes emotions and makes a strong impression on his audience, mobilising people to discuss the problem:

People are so blown away when I tell them that we are still mining the same amount as we were in 1947. They say, 'Hell no, 1947, this is a bunch of bullshit' and I know from government sources that this information, this one data, that we are still mining the same amount as we were in 1947 cut off any discussion in the council of ministers… People are rather shocked. No comment here. Even those who are sceptical of the entire narrative don't dispute this; I haven't had anyone dispute this chart.

Figure 22: Coal mining in Poland from 1913 to 2017 (in million tons)

Source: Greenpeace Poland archive.

The comments presented above reflect and confirm Beer's (2016) argument cited in Chapter Two that an intensification of metrics in social and political life in recent years has generated certain kinds of knowledge and thinking based on data and numbers. As Nærland (2020) points out, in reference to the work of Beer, datavis play an important role in these processes as they "discursively constitute the trust in numbers" (p.43). They are based on data, statistics, or numbers, and therefore often seem more objective to people than other visuals. My findings in this and the previous chapter extend these debates by showing that this impression of datavis being objective is an important aspect that influences both the emotions and mobilisation of audiences.

The findings presented thus far in this chapter show that datavis not only mobilise audience participants to share datavis with others and participate in informal and everyday discussions as suggested by Nærland (2020). Datavis also has the potential to bring people together around a particular issue or concern, as shown in Anjelo's example, or change behaviour or daily practices, as in Lucyna's example. These other forms of daily and informal mobilisation on a micro-scale will be discussed further in the next section.

6.3 Change in individual daily practices

As noted in the previous chapter, many audience participants expressed strong emotions about datavis which showed events closer to them in space and time or that directly related to their daily life and place of living (see Section 5.2). Regarding their mobilisation, it was also important that datavis pointed out the things that they can change as individuals in their daily lives. Consequently, they reacted to these datavis by undertaking everyday pro-environmental practices in their immediate environment, such as eating less meat, buying environmentally friendly products, reducing food waste, using less plastic, reducing car use, and purchasing solar panels, solar batteries or electric cars. This distinctive form of 'material participation', as Marres (2016) has termed it, usually, though not always, took place in the private sphere.

Asked to identify a datavis that somehow motivated her to action, Ewa (a 36-year-old Polish, scientist and university teacher mentioned in the previous section), pointed to *Virtual water inside products*, a datavis that compared the water footprint of some selected food products consumed by the individual and showed the total volume of freshwater used to produce them. She explained that, unlike the line graph discussed in the previous section, which shocked her and changed her mind about climate change being man-made, this visualisation clearly showed what she could do as an individual to improve the situation. In reference to the previous visualisation showing a reconstruction of Earth's global climate over the last 12,000 years and its lack of mobilising potential, she explained:

> …a person can interpret things based on their everyday life, not some astronomical statistics like one gigaton per year for the entire country. This kind of data is so

abstract that I believe it says little to an average person. Because it has no direct correlation to their life, it has, in my opinion, less impact on a person.

The datavis *Virtual water inside products* (Figure 23) not only shocked and moved Ewa, but it provided her with easily relatable information, changing her perception of how the food products she chooses affect the environment. Moreover, it influenced her daily decisions and habits related to meat consumption and grocery shopping:

> My jaw dropped when I realised how much water is used in, for example, beef production… Also, influenced by this graphic and some additional, if superficial, reading on the subject, I decided to eat less meat… by a tiny amount, yes, but that's something, I guess.

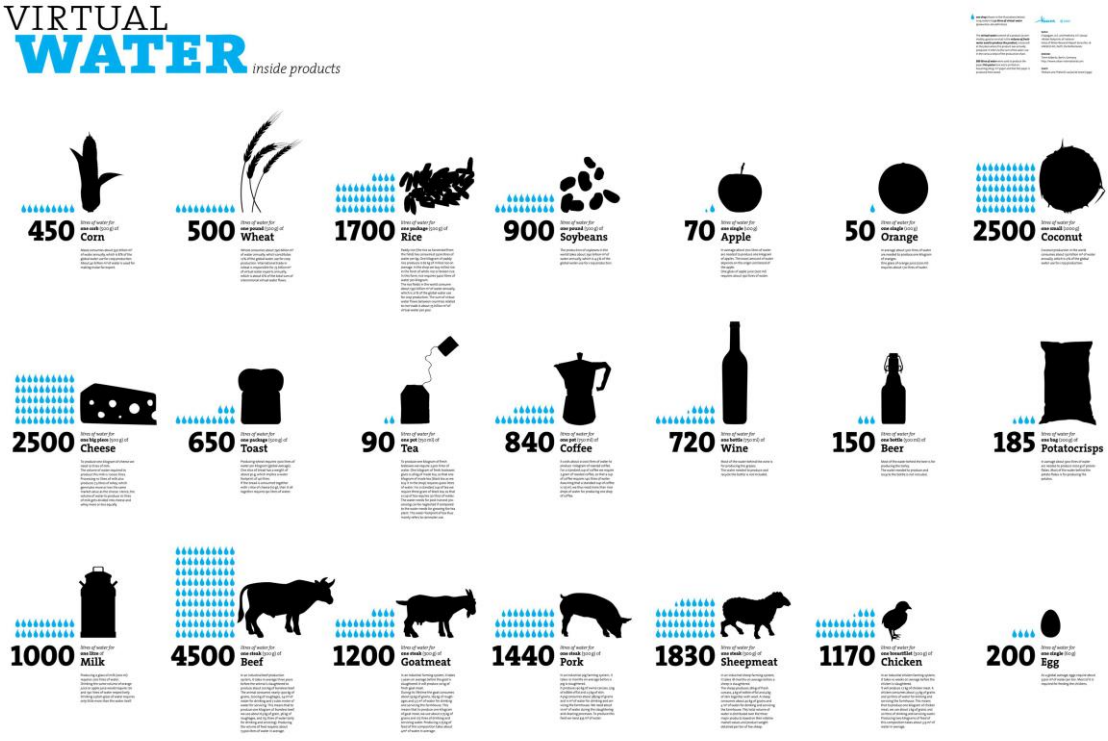


Figure 23: Virtual water inside products.

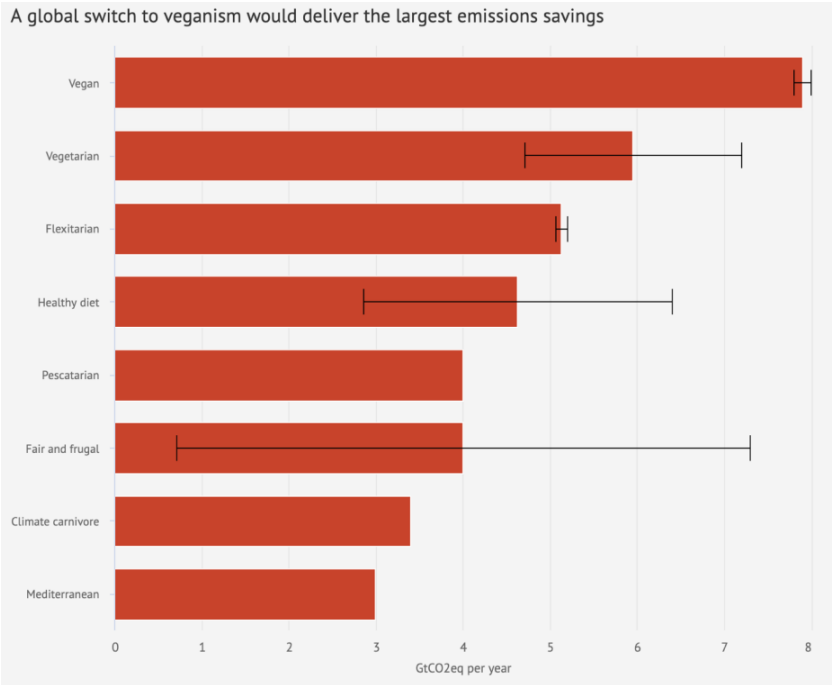
Source: http://virtualwater.eu. See full datavis: *Virtual water inside products*

Ewa's reaction was triggered, among other things, by her emotions, as after a moment of reflection, she answered the question of why it mobilised her to reduce her beef

consumption: “I was also probably a little embarrassed that I didn't know that and that I eat as much beef as I eat.” This example once again shows the importance of emotional responses to data (visualisation) in mobilisation and participatory processes.

Likewise, Jo (a 32-year-old British graphic designer mentioned in the previous section) was prompted by data visualisation to make long-term, persistent changes in behaviour. It was a data visualisation similar to that published by Carbon Brief on food production and greenhouse gas emissions (Figure 13) that moved her to stop consuming dairy products and become vegan, strengthening her earlier pro-environmental efforts:

> Yes, I think at the time I was still consuming dairy. Now we don’t buy anything other than oat milk and oat yoghurt etc. I am now a vegan, I don’t fly, I don’t buy fast fashion, and I try to be plastic-free as much as possible. I try not to consume more than I need.



Source: Carbon Brief UK.

On the other hand, for Mariusz (a 48-year-old IT specialist from Poland), the catalyst for action was maps showing the particle pollution in various Polish cities, including his, which

he encountered in weather information on TV (see an example of a map here). These and similar datavis, including the map of *50 most polluted cities in the EU* by Greenpeace Poland, evoked anger and frustration in him, as discussed in the previous chapter, and consequently mobilised him to change the type of heating he had at home (the situation in Poland relating to coal heating and air pollution was described in the first chapter):

> For some time now, TV stations have been including air quality information in their weather forecasts, especially during heat seasons. They show it visually, in the form of colours and larger and smaller dots dispersed across the map. This type of material affects the imagination and is effective in reaching people. And so I recognised that something was horribly wrong and that something needed to be done about it. And this compelled me to choose one course of action over another.

The data visualisations described here by Mariusz showing data on air pollution were the only ones that audience participants of the study recognised outside of the Internet and recalled during the interviews (see also Jadwiga's story in the next section). This shows that the Internet was the main – but not the only – place when they encountered data visualisations on climate change that motivated them to act.

Many audience participants stated that they had already been active around environmental issues, and that the datavis often reinforced their mobilisation, strengthened existing pro-environmental practices or encouraged long-term, persistent behavioural changes. Importantly, as discussed in Chapters Three and Five, most of the audience participants had pre-existing dispositions and described themselves as people with pro-environmental attitudes, for whom climate change was perceived as one of the greatest challenges of our times. Therefore, it was not surprising that many of them had taken some pro-environmental action before they encountered a data visualisation discussed in the interview or any other datavis. In these cases, datavis played the role of reinforcing and sustaining beliefs, perspectives, emotions and knowledge.

Bill, a 64-year-old taxi driver from England, was one of the few people who acted on a slightly larger scale than other participants who were affected by datavis. In his case, it was a datavis by WWF UK showing the area of burnt Australian forests in relation to the area of the UK (Figure 12) that not only prompted his emotions as previously indicated in Chapter Five but also re-enforced his mobilisation, making him even more determined to help in tackling climate change:

> Bill: 'I'm about to switch and buy an electric taxi and it's kind of financially challenged me a little bit, but I'm even more determined to do it.
> Monika: Okay so it has mobilised you to do more?
> Bill: Yeah, it's helping to make me do more. I've just agreed to have solar panels put on the house and a solar battery for charging up from the sunlight. It's motivational, I think that's the word.

The practices mentioned so far in this section often led to small but easily noticeable changes in the immediate environment and therefore audience participants were highly motivated to engage in them, as stated by Bill. Those who were mobilised recognised the value of individual daily practices, such as Maciej (male, 41, white Polish, economist based in Poland), who reacted on Facebook to a pie chart of greenhouse gas emissions by Greenpeace Poland and emphasised the importance of everyday behaviour when talking about his mobilisation evoked by datavis:

> I think it's our normal, everyday decisions that matter, not petitions. If I sign a petition against, say, deforestation in Brazil or anywhere else, something about an avocado or palm tree plantation, how is that gonna help? It will only help if I and others quit buying it, at which point it will no longer be lucrative. That's all.

When asked how exactly the datavis mobilised him, Maciej added: "For example at the level of my daily dietary decisions. This is one thing."

For Aurora (female, white Polish, psychology graduate from Poland), these individual daily practices were as important as more formal political participation. A datavis that she encountered on an online platform 9GAG showing carbon dioxide emissions per capita by country in 2019, in which Poland was among the top 30 emitting countries, not only made her feel embarrassed but also strengthened her mobilisation and reminded her that she could try to change her daily practices even more:

> It was that Poland is so high there. I felt ashamed. As if that weren't enough, the vast difference in emissions between countries has strengthened my commitment to avoid buying things I don't need, to do something more... I've gone for walks instead of using the bus, like, in a sense, I realised that these are small things that will always bring the emission down a notch. It [datavis] served as a reminder that it is important to walk a bit more, buy less if I don't have to, I don't buy, and sort waste a little better because this is kind of embarrassing. And somewhere along the way, it reminded me that maybe we can try a little harder and everything will be OK.

Aurora explained that this datavis spoke to her in a more personal way and allowed her to compare Poland, her country of origin and residence, with other countries that emit more or less carbon dioxide. It gave her hope that reducing emissions is possible and that every person can influence it: “Yes, because the information refers to the resident like me. It is kind of personal. It's a matter of making a connection: this is something I have direct control over.” However, at the same time, she was ashamed that the residents of Poland, including her, did so badly on this list. This again demonstrates the importance of different often contradictory emotional responses to a data visualisation and their impact on audience participants' motivations to act.

Aurora’s narrative confirms Dahlgren’s (2002) argument that the engagement of people in social or environmental issues – such as climate change – is associated not only with rational opinions or judgements but to a large extent with their feelings and belonging to ‘social collectivities’, understood as a specific group or community, such as a nation,

neighbourhood, city, or associations and organisations of civil society, the region or global society.

The importance of belonging and 'being recognised' on a given data visualisation was also emphasised by two other audience participants, who had encountered a datavis but had not been mobilised because they could not see the possibility of action. However, they believed that certain datavis could mobilise them. Natalia (female, 36, educator and photographer based in Poland) talked about an imagined datavis in response to the question of whether any data visualisation could mobilise her to act:

> One that would bring up, you know, my place of residence… Or, I don't know, my block of flats… for example, produces the most waste and this waste emits the most of whatever. So, I would start by, you know, talking to the other residents to find out why that is the case, right? You know, for me to take action, I'd need information which I have some kind of influence over. I could also write to the president, that's some kind of influence, too. But something more local and mine, closer to home.

Steve, a professional from Carbon Brief UK also drew attention to the importance of feeling a sense of belonging and the capacity of data visualisations to give visibility to different people or groups. He described the mobilisation among Polish audiences provoked by the animated 'racing' bar chart, already mentioned several times in the thesis, showing the ten countries with the largest cumulative CO_2 emissions since 1750 (Figure 15):

> …Poland is number ten and people have emailed us and asked why is Poland at number ten. They were saying that was not right. We have had a lot of people from Poland emailing us about this. 'That it's outrageous, Poland shouldn't be in there because Poland didn't exist after 1750 for some time so how do you get the data for that.' And it's a good question and so we had to explain, we had to add a thing to the article explaining why Poland is included in that.

The data collection process was questioned because Poland vanished from the map of the world until 1918, having been partitioned between Prussia, Russia and Austria in 1795. The datavis formed a negative and not entirely accurate picture of the country, some Polish people believed, which motivated them to act and contact the organisation that had designed and disseminated it. As Steve from Carbon Brief noted, these reactions were not purely informative, but also emotional: "They [Polish audiences] didn't like it, they thought it was like a shame… public shaming of Poland by being there at number ten." In response to these complaints, the organisation acknowledged and explained what decisions and choices had been made in producing the datavis. Interestingly, this example not only shows the potential of datavis to mobilise audiences but also what the outcome or results of this mobilisation could be.

The comments presented above indicate that emotions evoked by a datavis may play a significant role in mobilising citizens to speak up on issues related to their belonging to a given group. The example of Anjelo, described in the previous section, also illustrates this. As noted above, Anjelo commented on the *Warming stripes* datavis (Figure 19) and (successfully) asked the author of the datavis, Ed Hawkins, to add the missing data from his island to the interactive website #ShowYourStripes from which the published data visualisation was generated. He recalled this event in the interview: "And hence my comment, if such a stripe can be done for our island individually because there was also something I could remember that you can go and enter your data sets for your respective islands."

My findings reflect Nærland's (2020) claim that "visualisation-enhanced recognition may […] be important for people's sense of belonging to a community, and in turn their motivations for civic engagement" (p.44). However, my findings add to this point by suggesting that different individuals or groups may have strong emotions and be mobilised not only by being recognised by a datavis, like Aurora or Mariusz, mentioned earlier in this section, but also by being misrecognised. This was the case with the datavis designed by Carbon Brief UK and Polish audiences. Moreover, some may have strong emotions and be mobilised by being not recognised at all, as in the case of Anjelo.

The interviews with audiences show that some audience participants, like Aurora or Mariusz, could not recognize how this related to their lives and what actions are possible for them, and were therefore not mobilised. Jacek (male, 72, Polish, pensioner, based in Poland), for example, commented in response to the question about mobilisation regarding the datavis he had encountered on Facebook, the one that mobilised Mariusz, showing 50 cities with the worst air quality in the EU, including 33 Polish cities (Figure 7): ‘'You aren't really asking me if I can do something about this by myself or with a group of people on a city level, are you?”

The above findings suggest that mobilisation (or lack thereof) in response to datavis and the emotions it triggers differs from person to person. It relates to a combination of the datavis type and the individuals’ ability to interpret it in a way that makes it possible to see how they can act. Thus, when considering and determining the place of data visualisation in participatory practices, the contextual aspect of these processes cannot be overlooked. Data visualisation seems to be an effective tool for mobilising people to act at an individual and everyday level, but datavis does not exist in a vacuum, separate from other communication elements and tools. Several audience participants highlighted this, emphasising the significant but not sole importance of data visualisation in their mobilisation. Edo (male, 20, British, mixed/multiple ethnic background, student and activist, based in England), for example, in response to the question of whether any data visualisation mobilised him to act, replied by pointing to a film by naturalist David Attenborough:

> I would say that yes, because although I couldn’t particularly point out any elements or specific things that I’ve seen, I would say that – let’s say David Attenborough’s recent film. There’s a lot of good visual, data visualisation on that, and that helps re-affirm, a) what I already know, but also that it’s worth acting on, there is like an urgent thing that needs acting on. And whilst nothing strictly tipped me over the edge to get into activism, there’s always been good data visualisation around it, which has helped me continue doing what I do, rather than just giving up.

As Edo and some other audience participants recognised, where they encountered datavis was important for them, as it could mobilise them more in particular contexts. This adds to the work of Kennedy and colleagues (2016b) and the findings from the previous chapter, showing the importance of context not only in engaging with datavis, as argued by Kennedy and colleagues and in emotional responses to it, as suggested in the previous chapter, but also in mobilising people to act.

6.4 Conventional or unconventional political participation

Some audience participants undertook larger-scale political activities in response to datavis. Unconventional, semi-formal and less traditional forms of political participation – such as signing a petition, joining a protest or donating money to organisations (Lamprianou, 2013) – were more common among participants than conventional and more formal forms of political participation – such as campaigning, attending political meetings, contacting officials or voting (Lamprianou, 2013).

In response to the question about mobilisation provoked by a data visualisation, some audience participants stated that they had signed a petition, donated money to an organisation or joined a protest. Donating to organisations was mentioned by a few people who found it the fastest and most effective way to help and get involved. For example, Nguyen (female, 25, Vietnamese, business developer, based in England) stated that a donation in response to the datavis *More than eight hectares have been burnt in Australia* by WWF UK (Figure 12) that she encountered on Facebook and that made her feel emotional was the easiest way to show her mobilisation:

> Nguyen: I think I would – like I personally would just go to WWF to do some kind of donation, because that's like the quickest, and the most convenient thing you can do from home. Yeah. That would be my first reaction.
> Monika: Okay. Did you do it?

The largest number of audience participants said that they had signed a petition. Importantly, many of them were not entirely sure if the actions taken were in response to the particular data visualisation. For example, 72-year-old Jacek from Poland had a hard time remembering when his involvement increased because it had been some time since he had encountered the data visualisation of the 50 most polluted cities in the EU that we talked about in the interview:

> Yes. I mean… it's hard to say whether it was the catalyst or just an extra straw on the camel's back. But for sure somewhere around the time of this map, maybe before but surely after, I signed various petitions, talked to people. I don't remember anymore. But it seemed to me that this was the point at which young people came to the streets, to prod this government a bit to try to gain a hold on these European environmental guidelines. It's most likely the time I attended the protest.

In this case, datavis and emotional responses were part of a constellation of factors that mobilised people to act as already mentioned several times in this and the previous chapter.

Moreover, similar to Jo, a 32-year-old graphic designer from England who responded to the data visualisation on food production and greenhouse gas emissions (Figure 13), other audience participants indicated that it was difficult to identify one specific action that one particular data visualisation had triggered. In response to a question about how the datavis mobilised her to act, Jo stated: “I have signed many petitions in the past after becoming aware of issues like this and also emailed my local MP about some of these issues. He doesn’t seem to care to be honest.”

Even though different categories of involvement triggered by datavis were often relational and existed across public and private, more and less formal, and online and offline spaces, as in the case of Jo, many audience participants remembered that a particular data visualisation made a strong impression on them and mobilised them to take action or continue their involvement. However, the latter more formal form of political participation mentioned above by Jo – contacting officials – was rarely mentioned in interviews as

something people engaged in after experiencing a data visualisation. Only one other reference was made to this type of action, by Jadwiga, a 70-year-old pensioner from Poland. She contacted various bodies and organisations in response to a data visualisation showing that most of the cities with the worst air quality in the EU are in Poland (Figure 7). The datavis made her feel very worried:

> Jadwiga: I even wrote to Greenpeace too. But Greenpeace told me that they couldn't help.
> Monika: I understand. You saw this map and realised that most of these cities are in Poland, including your city?
> Jadwiga: Right.
> Monika: And how did the whole situation turn out, exactly?
> Jadwiga: So, when I went online, I discovered… I don't remember exactly because it was a long time ago… and I just up and googled it on my phone. I found something there, I don't remember anymore, probably on Facebook. And I sent a lengthy message, so… and I got a response that nothing. Nothing at all.
> Monika: That there's nothing they can do about it?
> Jadwiga: Nothing. Listen, I called the Environmental Protection Department every day, nothing.
> Monika: Oh, so you called a lot –
> Jadwiga: Correct. I was in my state office, in the Environmental Protection Department, and they said they had nothing to do with it.

Jadwiga had been concerned about air pollution long before she encountered the datavis online. However, as she explained, slightly nervously, during the interview, it was the data visualisation that mobilised her to take decisive action. However, with resignation in her voice she explained that despite the many actions taken, she did not receive a response:

> Because what can we do? What can I, a simple woman, a senior citizen, do about this? I can only talk to people about the situation, nothing else. This is my experience. How many calls have I made, how many messages have I written – I have

> a whole file. This is not pleasant for me. I'm fighting here for my right to live and breathe in my flat with dignity.

In Jadwiga's voice there was a feeling of helplessness. As she later pointed out, all she could do was check the level of contamination in the weather news on TV and on the Internet:

> Every day. Because TV stations, mostly Polsat and TVN, often feature an air quality map next to the map of Poland. However, if I am concerned and want to know, I check the air quality outside my window, I have been monitoring the air quality online for a long time, perhaps a year.

This data visualisation turned out to be an informative and participatory tool. It provided Jadwiga with data and mobilised her to act and contact officials. However, for Jadwiga this was insufficient. She felt she was left alone with an unsolved problem. It created a feeling of disempowerment about whether anything could be done and made her consider her involvement and political participation to be meaningless.

It was different with Kate (female, 47, British self-employed analyst, based in England), whom I introduced in the previous chapter. She stated during the interview that it was the previously mentioned line graph showing emissions from fossil fuels and cement that provoked her to make a big change in her life and join a local community group (Figure 20):

> This [encountering the datavis] was a turning point, you know, researched everything since then, delved very deep down that rabbit hole, Alice in Wonderland's hole, and yeah, just changed my life completely and I'm not working anymore, I'm just focusing on this kind of stuff.

Kate, very worried and sad about the current climate change situation, listed all the actions she had taken in response to the datavis:

> Yeah, so a lot of research, obsessive research, we've got a transition town group in our town, Sustainable [name of the city], so reached out to them, started going to a lot more things and interacting with them. And it's been a gradual thing and then they were petitioning for a climate emergency at the local council, and at the county council, so joined in with that and that's why we've set up the eco group, [name of the city] really was to get signatures on that and then it just kind of exploded because suddenly everyone wanted to understand more about everything eco. So that took over my life for quite a while with everybody coming in.

Kate acted on different levels and a more collective and public scale than the other audience participants, including campaigning, attending political meetings, and contacting officials. Her actions intertwined, overlapped and existed across public and private, more and less formal, and online and offline spaces, and it would be hard to draw hard lines between them. Her actions were initiated by the data visualisation and developed gradually. The mobilisation was provoked by many factors including the emotional responses to data visualisation as in many other examples in the research. Kate explained her situation in more detail:

> Yeah, so I mean there were other reasons why I've stopped working, financially we're fine, and we've had a few family illnesses and stuff, so it was kind of all a gradual thing, and I'll probably go back to work eventually but just wanted a few years of trying to sort of like almost, having a bit of a, yeah, a break to try and understand all this.

Even though organisations who work with climate change datavis were undoubtedly aware of its potential, including emotionally, as discussed in Chapter Four, they could not say whether datavis actually mobilise people to act. Only one organisation shared an example that could contribute to this discussion. The representative of Greenpeace Poland referred to a bar chart (Figure 24) based on World Health Organisation data and published on the organisation's website. It was the prototype for the map of 50 most polluted cities in the EU and contributed to a change in policy towards the environment in many Polish cities:

These WHO figures, on the other hand, had a very tangible impact on reality. Today there is a government initiative devoted to the cities that are, that were on the list. This form, this seemingly basic table with data has struck gold. It was approximately 3 p.m. on Friday when I released it to TVN 24, and one of the producers shared it on Twitter and Facebook, and it started trending within 2 hours. And I recall being on TVN 24 with the mayor of Zywiec city on Sunday morning, when he had to explain why he was at the top of the list. People started talking about it right away. There were a slew of publications on this matter, on a regional and municipal level. And at the level of society as a whole, of course. It was May 2016, 2017… And then, a year later, there was an initiative devoted to these cities.

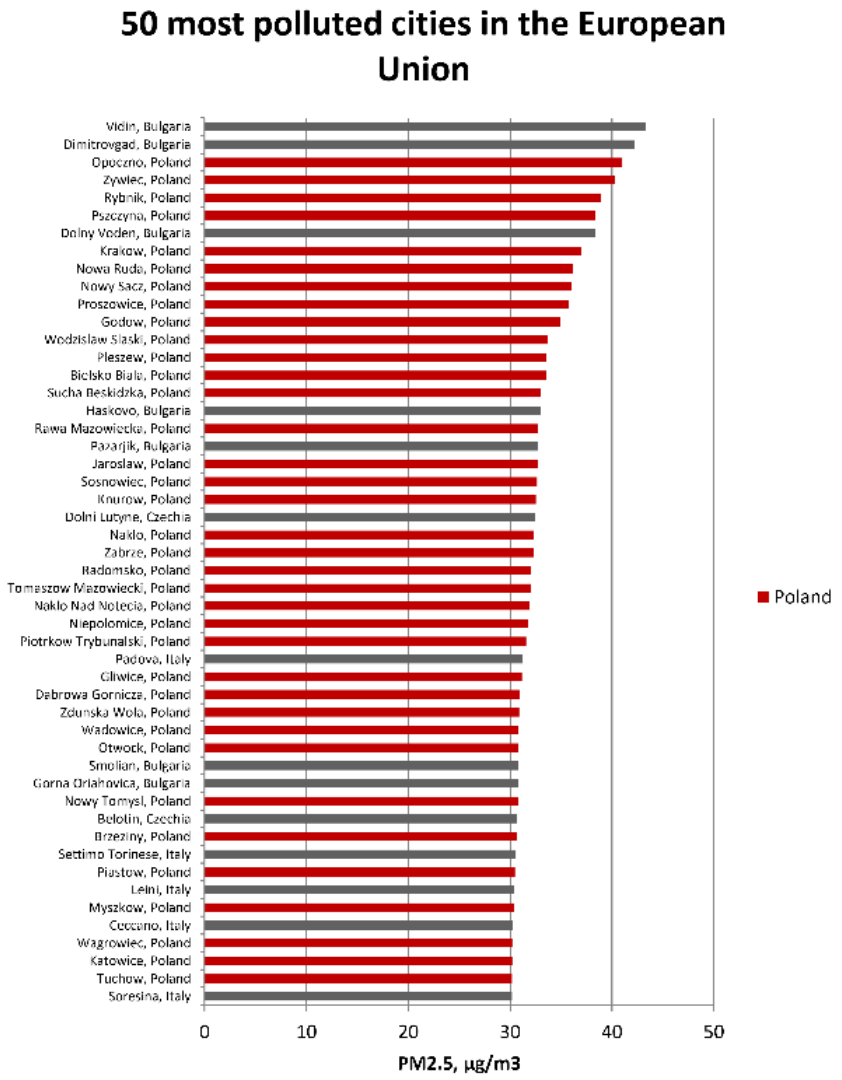


Figure 24: 50 most polluted cities in the European Union (bar chart)

Source: Greenpeace Poland.

As it turned out, the impact of the data visualisation had long-term effects on policymaking in many Polish cities and towns:

> Later, a special tool was created for these cities, those local governments that felt attacked at the beginning. Probably two years later, from this first ranking or three years later, we conducted together with these local governments joint lobbying activities against… and it was public lobbying with mayors, presidents of these cities, probably 23 presidents, marshals and mayors agreed with us to appeal to the minister of energy.

The above examples show that data visualisation may work in different ways. It circulates in the public sphere, mobilising people to act and encouraging their political participation, but it can also serve as a political-administrative steering-tool (Nangen, 2020) affecting and mobilising policy makers.

6.5 Discussion and Conclusion

This chapter has confirmed empirically the statement made by Nærland (2020), that data visualisation can enable and mobilise people to function as citizens and take part in political debates or everyday discussions. It argued that datavis' emotional potential, as well as rational, plays an important role in these processes. However, the chapter extended this debate by demonstrating that political participation in response to data visualisation takes place on many different levels, online and in-person. The chapter developed a typology of participatory responses and political activities from the micro and everyday/informal, such as not buying plastic, vegetarianism, sharing datavis, to the meso/semi-formal, like donating money or signing a petition, to the macro/formal including being part of a lobbying group or writing to political bodies. Table 7 below provides a summary of this typology.

Table 7: The types of practices and activities engaged in by participants in response to datavis

Question: Did datavis lead to change your practices, to do something/to act? (Question: What did you do?)	Examples from the research
Shared a datavis online with my friends/family (on social media or via privet message)	**Edo** in response to Mona Chalabi datavis published on Instagram by Greenpeace UK
Shared a datavis offline with my colleagues/friends/family (at home/at work/during the meeting)	**Aneta** in response to the *Greenhouse gas emissions in Poland* datavis published by Greenpeace Poland on Facebook
Created my own datavis to share it with people	**Anjelo** in response to the *Warming stripes* datavis by Ed Hawkins published by Ed Hawkins
Started walking more instead of using public transport	**Aurora** in response to the *Warming stripes* datavis by Ed Hawkins published by Climate Science Poland on Facebook
Stopped buying products that contained plastic	**Claire** in response to the *More than eight hectares have been burnt in Australia* datavis published on Facebook by WWF UK
Stopped/limited meat consumption	**Ewa** in response to the *Virtual water inside products* datavis she encountered online
Cut diary out of my diet	**Jo** in response to the *A global switch to veganism would deliver the largest emissions savings* datavis by Carbon Brief UK published on Facebook
Bought environmentally friendly products e.g. eco-friendly deodorant	**Natalia** in response to different datavis she encountered on social media
Reduced buying new stuff and try to be more aware of where things are coming from	**Marjorie** in response to the *United on climate. Divided on everything else* datavis published by WWF UK on Facebook
Reduced food waste	**Natalia** in response to different datavis she encountered on social media
Tried to use my car less for short journeys	**Jack** in response to the bar chart *The countries with the largest cumulative CO2 emissions since 1750* by Carbon Brief UK published on Facebook
Added insulation to my house Installed an alternative energy source e.g. solar panels, solar battery	**Bill** in response to the *More than eight hectares have been burnt in Australia* datavis published by WWF UK on Facebook and other datavis
Replaced an old coal stove with more environmental-friendly gas heating	**Krzysztof** in response to the *50 most polluted cities in the UE* datavis published by Greenpeace Poland on Facebook
Made me more determined to buy an electric car	**Bill** in response to the *More than eight hectares have been burnt in Australia* datavis

	published by WWF UK on Facebook and other datavis
Donated money to environmental charity	**Nguyen** in response to the *More than eight hectares have been burnt in Australia* datavis published by WWF UK on Facebook
Signed a petition	**Alan** in response to Mona Chalabi datavis published on Instagram by Greenpeace UK
Joined a protest	**Jan** in response to the *UE 2050 climate neutral goal* published by WWF Poland on Twitter
Contacted officials (MP, city council)	**Jadwiga** in response to the *50 most polluted cities in the UE* published by Greenpeace Poland on Facebook
Joined a sustainability town group	**Kate** in response to a datavis like *Emissions from fossil fuels and cement* by Global Carbon Project
Set up an eco-group in my town	**Kate** in response to a datavis like *Emissions from fossil fuels and cement* by Global Carbon Project
Activities ranked in terms of level of participation micro/informal/everyday meso/semi formal/unconventional macro/formal/conventional	

In the chapter, I have demonstrated that datavis can sustain or reinforce pre-existing mobilisation rather than initiate mobilisation, leading to changes in daily practices as a form of 'material' participation and to more established political participation. Graphs, charts and maps more often motivate people to act on an informal, individual, and daily level, and less frequently on a more formal, collective and public scale. Across the interviews it was clear that less organised, unconventional forms of participation were more common among audience participants than more traditional and organised forms. Nevertheless, the findings show that datavis can also successfully guide policy or decision-making.

The chapter suggests that not all data visualisations are equally effective. Where data visualisations did not make it clear what actions individuals could take, some audience

participants indicated that they were not mobilised to act further, even when a datavis shocked them, changed their minds or caused them to care about a particular issue. On the other hand, data visualisations that had a greater impact on the behaviour and decisions of participants were those that indicated what could be done and how people could contribute to bringing about change.

When considering and determining the place of data visualisation in participatory processes, the contextual aspect of these practices cannot be overlooked. Data visualisation seems to be an effective tool for mobilising audiences to act and for shaping their practices, especially at an everyday level, but this does not occur in a vacuum. Only several participants remembered exactly what actions were taken in response to a particular datavis. Their mobilisation and participation were influenced by other factors such as, for example, information possessed before seeing the datavis or the context of encountering the datavis.

Therefore, the chapter concludes by suggesting that participation enabled by data visualisation is not straightforward. It happens on many levels and depends on the person encountering the datavis and the context in which the encounter takes place. Datavis is a part of the constellation of factors and cannot be seen as the only factor influencing political participation. Furthermore, the different categories of involvement triggered by various data visualisations are intertwined; they overlap and exist across public and private, formal and informal, and online and offline spaces. They are not fixed or static but leaky and relational. Therefore, it is not helpful to divide into these types and categories and indicate which are more valuable or effective, especially in the context of datavis that audiences often encounter online.

These complex and varied narratives extend the ideas of Nærland (2020) and others interested in the participatory potential of data visualisation and make a significant contribution to the existing literature as they offer far deeper, empirically-grounded insight than is currently available. This includes the range of political practices and activities triggered by datavis, the extent to which sharing and everyday practices can be viewed as political and the role of emotions in these processes. Moreover, the findings add to the

existing debates about the importance of emotions in political practices (see Coleman, 2013; Wahl-Jorgensen, 2019), showing that emotions evoked by datavis play an important role in political mobilisation and participation. However, it is not the same for everyone, and I turn to differences in the next chapter.

Chapter Seven:
Datavis and Difference

7.1 Introduction

The previous chapters indicate that existing experiences, socio-cultural and political factors, and contexts in which people encounter graphs, charts and maps are of great importance to the way datavis is perceived and the motivation in inspires, or lack thereof, to act under its influence. I have also discussed how data and hence datavis are neither neutral nor objective: they are shaped by and reflect social divisions and unequal social relations (D'Ignazio and Klein, 2020). Despite this, little attention has been paid to demographic differences between datavis audiences and related inequalities in how people perceive data visualisation (see exception Peck et al., 2019) as several practitioners and scholars argue (such as D'Ignazio and Bhargava, 2019; D'Ignazio and Klein, 2020). Moreover, there has been very limited research on the role of national differences in relation to data visualisation experiences.

Addressing this gap, this chapter seeks to answer my third research question. It investigates whether national and other demographic differences between audience participants in my research – including age, education, ethnicity and race, gender, political attitudes and work experience – may lead to unequal experiences of datavis and consequently unequal political participation. It considers different socially located voices and focuses on two different geo-historical, demographic and democratic contexts – the United Kingdom and Poland – as introduced in Chapter Two. I use these two contexts to underline the complexity and contextual nature of emotional engagements with datavis and audiences' potential political participation. Rather than employing a traditional comparison of differences and similarities between the UK and Poland, I use a more transnational perspective and treat these two national contexts as units of analysis (Livingstone, 2003) and nodes that are analytically linked with each other (Jackson et al., 2015).

The chapter covers the material discussed in the interviews with professionals in campaigning and information-providing organisations and their audiences. It is divided into two sections. The first explores the role of national and related cultural differences in

relation to datavis and whether datavis work in the same or different ways in different national contexts, primarily in Poland and the UK. It explores 'datavis exposure', i.e. what kind of datavis are used and why, and what visual styles are produced, and discusses the reception of these data visualisations. It identifies and considers what was most emotive for datavis audiences from Poland and from the UK and the possible reasons for this. The chapter then looks beyond national differences. Section 7.3 explores whether other demographic factors such as age, education, ethnicity and race, gender, political attitudes and work experience play a role in the audience participants' emotional engagements with datavis.

7.2 Data visualisation: national differences and similarities

This section covers the material discussed in the interviews with datavis audiences from Poland and the UK and professionals from the major environmental and climate change organisations from these two countries. Although national contexts may play an important role in engagements with datavis, there has been hardly any research on the role of national differences in relation to bottom-up experiences of data visualisation. Therefore, this section compares the two national contexts that were introduced in Chapter Two (Poland and the UK) to explore these differences. However, it also refers to other national contexts that the interviewed participants discussed, as they are also relevant.

Although professionals from all Polish organisations admitted to using foreign datavis in their work, they also believed that such datavis may not be engaging for Polish audiences. Sebastian, a communication specialist from WWF Poland emphasised this when discussing various graphs, charts and maps provided to him by the international WWF office: "In my opinion, for example, they are not perfectly suited to the Polish recipient. They are not very interesting for Polish recipients." He added that the international datavis they use are usually translated into Polish, and often, if copyright law allows, modified and adapted to Polish audiences. This was also confirmed by representatives from Greenpeace Poland and Climate Science Poland.

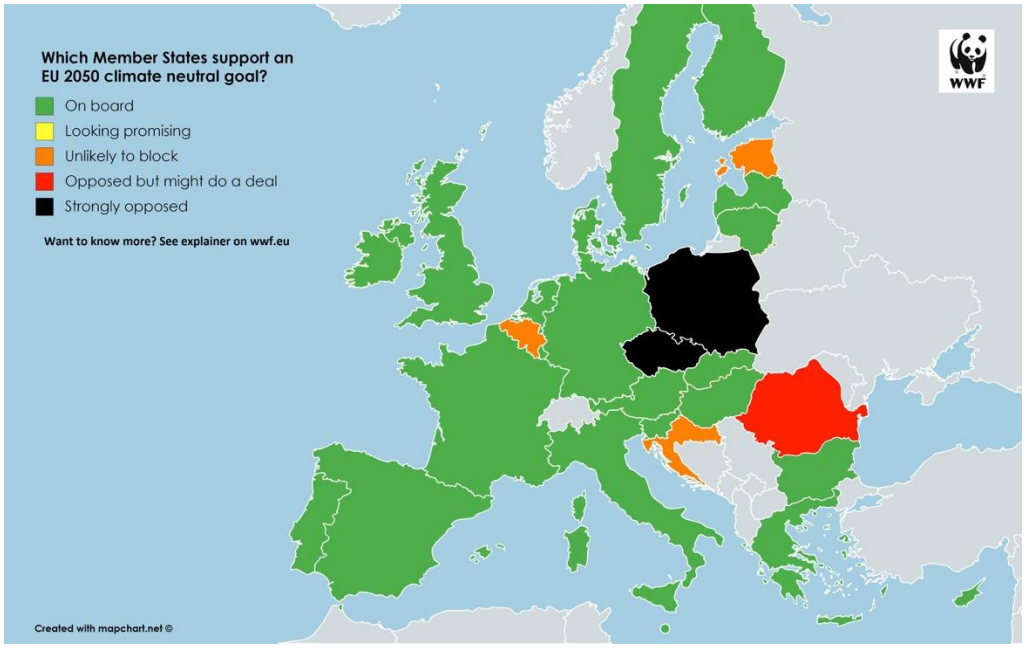
When pressed further on why he believed international datavis were not interesting for Polish audiences, Sebastian from WWF Poland commented that in the case of datavis and other visuals published in Poland, a national and local context works best. He believed that graphs, charts and maps showing global issues, not related to the Polish context, are of little interest to the Polish audiences. For this reason, when Polish organisations use datavis created by foreign organisations – which happens quite often, as seen in the sample for this study – they always look for the Polish context or modify them.

This was confirmed in my interviews with audiences, which indicated that Polish audiences were usually more interested in the issues which directly related to their country. This dependence was not so noticeable during interviews in the UK where many audience participants were also interested in more international issues. Perhaps not surprisingly then, professionals from the UK organisations did not tend to mention the importance of national context in datavis. This could be for several reasons. First, the UK organisations may not use many foreign or non-English language data visualisations in their work, therefore it is difficult to say how the recipients would react to them; and second, it may be related to the multiculturalism and high levels of migration to the UK, which distinguishes it from Poland. As discussed in Chapter Two, the United Kingdom is considered to be “super-diverse” (Vertovec, 2007); and Poland, a post-socialist European society, is still perceived as a low migration destination country and “relatively homogenous 'white' society” (Mayblin et al., 2016).

Unlike most people living in the UK, many Polish residents do not speak English, which may make it difficult for them to interact with transnational, often English-language, types of data visualisations. However, the findings of my study show that the English language in data visualisations was not always an obstacle for Polish audience participants in engaging with them. For Jan, a 30-year-old educator from Poland, it was the English-language map *Which Member States support an EU 2050 climate neutral goal?* (Figure 9) published by WWF Poland on Twitter that triggered his emotions. However, despite being English-language, the map referred directly to Polish audiences, showing that Poland and the Czech

Republic were the only countries that did not support an EU 2050 climate neutral goal. When asked about difficulties in understanding the datavis, Jan replied:

> Well, my English is rather basic but I can catch some context. I was able to understand a lot of things even without knowing English.



. Source: WWF Poland.

Several other audience participants also brought to the interview data visualisations in English produced by foreign organisations. However, it should be emphasised that many of them had a good command of the English language and used it on a daily basis at work. I discuss education further in the next section.

Some data visualisations did not have any text, including title or legend. In such situations, the language was even more irrelevant. Polish organisations simply added a Polish description of the visualisation in the social media post as in the case of *Warming Stripes* (Figure 17) which was designed and produced in the UK and published by Climate Science Poland on Facebook, and successfully consumed by Polish audiences in Poland. This example not only shows the mobile nature and transnational potential of some data

visualisation, which may be produced in the UK and successfully used in other countries but also points to the importance of the design context of published datavis.

The fact that Polish audience participants much more than British were moved by datavis which related to national rather than global problems may be also due to the country's climate change policy. At the time of the interviews, Poland was the only EU country refusing to agree to pledge climate neutrality by 2050, a government decision with which many residents of the country did not agree. Some of them have even filed climate change lawsuits against the Polish government over failure to ensure climate security. This made climate change a very important and politicised topic among people living in Poland, including my audience participants. Their comments, to which I return later in this chapter, showed that the topic of climate change is perceived as an important national and political problem which may be one of the reasons for the greater interest in domestic rather than international issues.

Furthermore, comparatively, Polish and British audiences found different topics of graphs, charts and maps more emotive, which means that national context was a factor in relation to emotional experiences of datavis on climate change. For the UK audience participants, it was datavis on plastic that moved them and stoked the most interest – more than half of them mentioned and discussed plastic as an issue. Clare (female, age 46, white British, personal assistant, based in the UK) illustrates this in speaking about whether any datavis on climate change mobilised her to act:

> Plastic, the data that I saw on plastic. The images and obviously on the TV, on Facebook, on Twitter, about the – oh, it's disgusting, obviously, what's happening with the oceans at the moment with plastic.

Jack (male, age 45, white British, self-employed, electrician based in the UK) made a similar point in recalling the data visualisations on plastic consumption that changed his habits. However, in his statement he alluded to why this topic could be so striking for people living in the UK:

> Recycling of plastics and things like that. I'm fully aware that most of it was being sold off and dumped in other countries as our country's been irresponsible. So, therefore, I was more keen to have fresh produce than plastic bottles of milk.

On the other hand, graphs, charts and maps on smog and air pollution were more striking for Polish audiences. In this quote, the very annoyed Mariusz from Poland, introduced earlier in this chapter, explained his reaction to the map (Figure 7) showing his city among the 50 most polluted cities in the EU:

> I commented on it because… oh, I wanted to give a little punch on the president's nose, who is from a political camp which I do not support, yes. I think I referred to her there, I wrote something about her.

Like Mariusz, several other audience participants from Poland spoke about air quality in the country and Polish reliance on coal in relation to datavis that evoked strong emotions in them. For example, Jacek, a 72-year-old pensioner was angry and frustrated talking about the same datavis of the 50 most polluted cities in the EU that moved Mariusz:

> I am angry. Nothing is done about it… And yet it is known that this Polish economy is based mainly on coal, which is not acceptable at all. Just the whole coal lobby and the mining community… every politician is afraid of touching it because it has been nurtured in Poland for decades.

As discussed in Chapter Five, as in the case of the UK, the topic of a graph, chart or map relating to the main problem of climate change in the country was one of the most emotive factors in datavis for Polish participants. Together, the above perceptions and attitudes towards datavis suggest that the wider national context, including the situation in the country and the climate change policy, should be considered when discussing emotional experiences with datavis and whether they can mobilise people to act.

At the same time, some Polish professionals pointed to the transnational nature of data visualisations where graphs, charts or maps can be produced in one country and successfully consumed in different national and cultural contexts, in this case in Poland. As mentioned in Chapter Four, Polish campaigning and information-providing organisations often use data visualisations from various, sometimes foreign sources, mainly due to the lack of resources to produce their own visualisations. They used, for example, datavis designed by NASA or *Warming stripes*. The latter was shared by Climate Science Poland on Facebook (Figure 17) and met with great interest by Polish audiences. In previous chapters, I discussed the examples of Aurora, Lucyna and Tom and their emotional responses to and mobilisation evoked by this datavis. This suggests that datavis has a transnational as well as a national character. It can be used globally, but the national context must be taken into account when designing or sharing datavis.

This transnational aspect of datavis was also noticed by the professionals from Carbon Brief UK, whose main goal is to provide knowledge about climate change and who therefore design many datavis. The organisation adapted and translated its articles and datavis into different languages, such as Mandarin, Turkish, Hindi, Spanish, German, French, Indonesian, and Portuguese, to test whether the content and datavis would work in different national contexts. Steve, a datavis professional from Carbon Brief UK recalls situations in which journalists from other countries used the organisation's original datavis or asked for permission to translate them into their national language like, for example, from Russia:

> We had an email yesterday from Russia from a Russian newspaper saying that they want to take… we did a tipping point centre graphic about two weeks ago, and they emailed us saying can we take, can we have the original file and can we translate all of the English words and in the infographic into Russian.

This type of request was because some countries did not have access to many data visualisations or even data in their country. At the same time, the people from these countries believed that the visualisation produced in the UK might be of interest to audiences in their countries. Steve from Carbon Brief UK found it difficult to say how these

datavis were perceived in these countries, but he gave an example of a datavis that was, in his opinion, effective in Turkey:

> We translated a big Turkish profile on the energy and climate into Turkish and that did really well in Turkey. That was quite interesting because we were told internally in Turkey that there wasn't really any content in Turkey explaining their own domestic energy and climate situation and their policies. And we were told that if you did it in Turkish it would do very well. Because there is nothing in Turkey that explained all this to the Turkish audience, and we did that, and it did very well particularly on social media in Turkey.

This transnational aspect of datavis was also indicated earlier in the thesis by Anjelo, a 32-year-old Tongan living in Tonga, a Polynesian kingdom. After completing his studies in the UK and returning to Tonga, he decided to use the aforementioned *Warming Stripes* datavis (Figure 19) produced in the UK as inspiration for his work and designed similar datavis for his island, as described in the previous chapter. His statements about how he wanted to do it suggest that he believed that the national context matters in designing datavis: "As I mentioned earlier on, is that – taking that idea and that strategy and then combining it with our local data and everything and then reproducing it in a similar way." When asked about the data visualisation design process and what "combining it with our local data and everything" means Anjelo added, referring to Covid-19 datavis:

> It's important that we try to connect the link between scientific studies to our traditional knowledge. That would be, I think, a very effective data visualisation strategy moving on in these kinds of areas. For example, we had this information coming in from the World Health Organisation when this pandemic came about in December last year. And then it's been I would say redeveloped and it's sort of like a hybrid. This information from the international platform comes in and then it's been mixed with what we know locally, scientifically and knowing our people, knowing our mentality, knowing their reactions, knowing their daily livelihoods and then represent data visualisation that is acceptable at these grass root levels.

Anjelo not only highlighted the importance and inclusion of traditional knowledge in the data visualisation design process but also explained why original data visualisations, for example from the UK, are not used in Tonga and why he believes they would not work there:

> If you bring a data visualisation from the UK you bring it raw as it is and just convert it and then bang, and then you present it here to Tonga at our level, nobody would understand, nobody would care unless we do our manipulation at least. The message doesn't change, the figures don't change, but then presenting it in the visualisation way that is fitting for the community, fitting for who you talk to, is the – is what we do here in Tonga.

An engaging visualisation for the people of Tonga is thus, in Anjelo's opinion, a combination of a global or, as he put it, "Western and European" perspective and data, with the national context, geography, local culture, beliefs, religion, understandings, lifestyle and experiences that he listed. His statement also highlighted again the importance of visual form in datavis which links to my findings from the previous empirical chapters, which show how important this factor is in emotional engagements with datavis.

These are important findings because, as earlier examples in this section show, and as Anjelo believed, it is the national aspect of the datavis, such as the data, but also the design and visual form, which can vary greatly from country to country and thus determine whether people connect to datavis on an emotional level and whether it motivates them to act.

The findings from this section also refer to national differences in data visualisations on a more global scale. This echoes the argument made by Milan and Treré (2019) who call for a "de-Westernisation of critical data studies" (p.321). The authors extend Chan's (2013) argument that digital cultures "emerging in the periphery – commonly considered merely subaltern to the 'center' – do much more than replicate the technological future imagined

in the mainstream centers of technological entrepreneurship" (Milan and Treré, 2019, p. 324). They suggest that data universalism "tends to assimilate the heterogeneity of diverse contexts and to gloss over differences and cultural specificities" (p. 324) and is therefore "asocial and ahistorical, presenting technology (and datafication-related dynamics) as something operating outside of history and of specific sociopolitical, cultural, and economic contexts" (p.325). By evidencing and emphasising the importance of national and local contexts, my work adds to these debates by suggesting that datavis also do not simply travel "unchanged from the North to the South" (Milan and Treré, 2019, p.324).

Moreover, national differences in data/datavis are also related to the resources of different countries and, as Anjelo also noted, they are highly unequal from country to country:

> In terms of data visualisation, in the United Kingdom is I would say the best data visualisation that I have seen. I think the underlying factor that is affecting the standard and the quality of data visualisation in the United Kingdom is because firstly, the resources that are available, not only that but the skillset needed to produce those data visualisations, are all there. Not only physical means but also human resources and, of course, financial. I would say in Tonga it's not the same as in the UK because as I have mentioned there are some differences, we have our limitations in terms of resources, in terms of the skillset, in terms of the workers. And of course, financial also support to create this data visualisation.

The lack of resources mentioned by Anjelo is related to the uneven distribution of capacities to generate, access, process (and visualise) large data sets. Andrejevic (2014), who focuses his work on the relation between "those who collect, store, and mine large quantities of data, and those whom data collection targets" (p.1673), calls this kind of asymmetric relation "the big data divide" (p.1673) and argues that this distinction "potentially exacerbate power imbalance in the digital era" (p.1673).

7.3 Data visualisation and other demographic differences

Audience participants from Poland and the United Kingdom agreed that data visualisations are important and strongly emotive for them and mobilise them to act. However, despite these similar experiences in both countries, it is important to look beyond national differences. Therefore, this section explores whether other individual demographic differences and social factors, including political attitudes, educational background, work experience, age, gender, ethnicity and race, inform perceptions of data visualisation and whether they can influence audiences' political participation. It covers the material discussed in the interviews with datavis professionals, and the interviews with datavis audiences from the UK and Poland. As discussed in Chapter Three, I strived for diversity in my sample and collected comprehensive data on each participant's demographic profile and analysed this in relation to the interview accounts.

7.3.1 Political attitudes

Most of the audience participants were quite politically motivated, many of them around climate change particularly and few around politics more generally, such as Jess (female, age 36, White British, works in customer service), introduced previously, who was a member of the Labour Party or Jo (female, age 32, white British, graphic designer), who was a member of the Green Party. Climate change was a highly politicised topic, especially in Poland at the time, therefore, political views could affect audience participants' emotions about a given visualisation and their related mobilisation, or lack thereof.

There is no doubt that what drove Polish and British audience participants' emotions on datavis about climate change was how particular arguments seen in datavis connected with their political attitudes and identities. This links back to the discussion in Chapter Five of the importance of political views in emotional engagements with datavis. This was particularly evident in Poland. As previously mentioned, climate change was a highly politicised and polarised area in the debate connected to the presidential elections held at that time and was reflected in the different attitudes of various candidates to this topic. Power in the country was exercised by the right-wing Law and Justice party, which did not support the EU's 2050 climate change neutrality goals.

Consequently, most of the audience participants from Poland who were left-leaning felt angry and frustrated with the government decisions on this and other issues, such as the almost total ban on abortion in Poland, which sparked women's strikes across the country at the time of the interviews. These predominantly negative emotions relating to the country's politics were expressed during the interviews, when the audience participants discussed various data visualisations. Jan, a 30-year-old white Polish educator, for example, in response to the question about whether the map (Figure 9) showing which countries support an EU 2050 climate neutral goal that he encountered and reacted to on Twitter changed his mind about something, said:

> Well, the matter got worse even more so that already knowing that this government is not very eager to improve the situation, somewhere in the back of the head, this wilderness and so on, the actions of the Ministry of the Environment are rather harmful. Even then, having such a low opinion, as it has already turned out, Poland does not agree with what is described on this map, it made it even worse. And this black spot visualised it perfectly.

These emotions of anger and frustration influence not only audiences' engagements with datavis but also their desire to act. Mariusz (male, 48, white Polish, works in IT, based in Poland), who admitted that he was in opposition to the ruling political party in Poland, when asked about the reason for his reaction to data visualisations showing 50 most polluted cities in the UE (Figure 7) on Facebook, answered:

> I commented on this because… well, I decided to poke fun at my city's president, who is allied with a political group that I oppose, yeah. I think I referred to her and wrote something about her there.

However, Poland was not the only country experiencing political polarisation at the time of the interviews. It was not so much directly about climate change as "the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050"

(GOV.UK, 2019). However, British audience participants were strongly emotional about other topics such as Brexit or the Black Lives Matter movement. For example, Jess (female, 36, White British, works in customer service, based in the UK), a member of the Labour Party, commented frustratedly on her emotional responses to the datavis (Figure 11) showing the views of the UK residents on four different topics including public concern about climate change that she came across on Facebook:

> I guess with data visualisation you have less than a second to have an impact on somebody. And this one did. And all I was thinking was how stupid people are. And I was thinking of tea and coffee drinkers, and I was thinking of the demographics of tea and coffee drinkers, of people in their sixties and seventies who drink tea and didn't finish school. I was thinking of young people versus old people. I was thinking of Remainers versus Leavers and the sort of how Britain is kind of chopped in half between – it just – it put all my sort of – that ingrained arrogance that you have as an educated millennial, into one neat little package and jump out at me.

These findings link to the work of Peck and colleagues (2019) who found that political bias and beliefs can affect perceptions of data visualisations. In my research, however, I found that political affiliation may not only negate the impact of datavis on audiences, as suggested by Peck and colleagues (2019), but it can also increase peoples' mobilisation and political participation. The users who were motivated by this kind of political dislike often employed a more formal approach to participation than those who were more neutral.

7.3.2 Education and work experience

As explained in Chapter Three, some of my audience participants had some degree of skill in relation to datavis while others did not know what it was and had not encountered a lot of datavis before, even though one particular graph, chart or map may have really moved them. Those people working with data, statistics or visualisations and a few specific professional categories most often represented by men, including IT specialists or software developers, were interested in and paid attention to more complex data visualisations. They brought to the interview and discussed complex graphs, charts or maps, such as Sankey

diagrams or interactive datavis. For Tony (male, 50, White Italian, R&D Manager based in the UK), who studied and worked with datavis, it was a Sankey diagram 'The UK 2050 Calculator' exploring how the UK can meet the 2050 emission reduction target that he came across for the first time during his postgraduate course at university that stoked his interest, sparked excitement and joy and mobilised him to use it in his work:

> So, for me, I was really surprised by this type of visualisation and the – yeah, and I was really excited to use it. Because it has so much information. There is so much knowledge into this, that it's really – yeah, as I said, it was the first time that I came across it. I was quite happy to discover it.

Similarly, Peter, a 50-year-old software developer from England who admitted that he often deals with data and visualisation in his work, reacted to an innovative, interactive datavis he encountered for the first time some time before the interview but were not able to identify for the research: "So, yeah, that's what struck me about that one, that was quite an innovative visualisation that I'd never seen before, and I haven't seen elsewhere. I enjoyed looking at it." These comments show that the skills and experience related to data visualisation play a very important role in engagements with datavis.

Moreover, in a few cases, men with skills in the field of data or visualisation seemed to want to avoid being too 'emotional' while talking about datavis. As noted earlier, Tom, 24, a white Polish scientist based in Poland who worked with datavis about climate change for some time, when asked second time about his emotional response to *Warming stripes* that he encountered on Facebook replied: "There is no need to emphasise emotions so much…" These kinds of responses may include considerations about self-presentation when someone wants to appear professional and whether emotions would conflict with that message. This once again can be seen as an example of Arlie Hochschild's (1989) argument about 'feeling rules' and emotional management, where she argues that there are social expectations about how to feel in a certain situation and how people fit with these expectations.

On the other hand, people without formal education or professional experience with datavis who often lacked statistical skills were usually triggered by simple datavis that gave them immediate insight and understanding of the presented issue. Bill (a 64-year-old white British taxi driver from England) illustrated this when speaking about a datavis showing the area of burnt Australian forests in relation to the area of the UK (Figure 12) he encountered on Facebook: “It’s a way of just at a glance understanding a problem. Anybody that sees that can see that there’s a problem.”

Another example was Claire, a 46-year-old single mother and personal assistant from the UK, who from the beginning of the interview stressed uncertainly that she did not know much about data visualisations and therefore did not know if what she said would be helpful. When asked about her engagements with datavis on social media, particularly how often she comments on them, answered: “On the actual graphs? Not very often, no. It wouldn’t be something that I would comment on if I saw a graph. I don’t really comment that much on graphs.” When pressed further on why she did not comment on datavis, she replied confusedly, referring to the WWF map showing burnt Australian forests in relation to the area of the UK that she encountered on Facebook (Figure 12):

> I just – I don’t know. I suppose it’s because there’s so much data out there, it’s kind of – to me, sometimes it can be quite confusing when I see graphs. […] Yeah, it’s like that one that I commented on, the WWF, it kind of like – when things are put into perspective for me, because obviously, if things are put into laymen’s terms, like if – like the one on the WWF, when they said, “This is the equivalent to so many football fields. This is equivalent to the size of the UK. This is equivalent to this.” I feel like I can kind of like comprehend the information a little bit more. Does that make sense?

7.3.3 Age

Another important demographic factor related to datavis skills was age. Jadwiga (70-year-old pensioner from Poland) was one of the five people over 60 who participated in the study. She initially said that she was unable to say anything about datavis because she had no experience and skills in this field, and therefore might not be the right person to talk to.

However, after explaining to her how datavis was understood in the study and that no experience was required, she agreed to an interview. When talking about the *50 most polluted cities in the EU data visualisation*, she often nervously emphasised that she did not know what to say and expressed strong emotions in response to her skills and experience with datavis. Moreover, when asked about other datavis that she came across on social media, she remembered one that she was unable to identify for the interview but made a strong impression on her: "I mean, there were some fragments of growth or… well, we unfortunately increase or decrease… Lowering occurs more rarely. So… Well, there are rather ups and downs. I don't know" In this utterance, Jadwiga spoke about line charts, which after maps were most familiar to her.

Among older people, such as Jadwiga or Jacek (male, 72, white Polish pensioner from Poland), I noticed a lower level of technological skills which resulted in some issues with identifying and sharing data visualisations of their choice with me. However, Jacek, unlike Jadwiga, did not care, trying to find other ways to send me a visualisation, such as taking pictures of his computer screen. Jadwiga ultimately did not identify any datavis, stressing that she only used a smartphone as she had no access to a computer. This also made it more difficult to interview her and talk about the visualisations that were presented to her on the screen of her smartphone. She had difficulties with reading them accurately and repeatedly asked me for help and information about what was shown on it.

7.3.4 Gender

Overall, the lack of confidence and skills in engagements with data visualisation was associated with emotions and was more often presented by women. Or contrarily, the confidence, skills and data or computer science education illustrated above were more often possessed or demonstrated by men. This reflects previous work on audiences' engagements with datavis and findings which show that "users need to feel that they have the necessary skills to decode visualisations" (Kennedy et al., 2016b, p.15), and that these skills may "come from exposure through formal education" (Peck et al., 2019, p.7). Moreover, it confirms the work of D'Ignazio and Bhargava (2020) on structural reasons for inequalities in datavis perceptions and understandings. As discussed in Chapter Two, the

authors discuss and criticize mainstream approaches to datavis teaching, arguing that data and the skills to work with it are not evenly distributed. D'Ignazio and Bhargava (2020) argue that "corporations, governments, and elite universities are the primary institutions which have the resources to undertake this work" (p.130). Moreover, within those institutions, the vast majority of those who do such work are wealthy, well-educated, White, and male, who overly emphasise the technical approach to teaching and learning datavis.

Moreover, inaccurate representation of data scientists as white men and ignoring women playing significant roles in the field of data and datavis may lead to biases in data(vis) authorship. Just to give one example, a recent analysis by *The Times* entitled 'Phwoar! Look at the vital statistics on these lads' ranked the most influential Covid-19 data scientists, and they are all White males. The findings of this section, therefore, add to the existing debates about data and datavis inequalities, showing that emotions associated with confidence and skills in relation to datavis are gendered and age-related and that the existing bank of knowledge around data(vis) may be skewed towards the interest of White males.

7.3.5 Ethnicity and race

As explained in Chapter Three, I strived for diversity in terms of ethnicity amongst my participants and recognised race as a social division. Despite the efforts I made and described in Chapter Three, only five people from minority ethnic communities in the UK agreed to take part in the research. Those who agreed to participate in the research were all educated to degree level and above and a few had some experience working with data visualisation, such as Anjelo (a 32-year-old, Tongan, climatologist from Tonga who self-reported as having an 'other ethnic' background) and Edo (a 20-year-old British, student working for climate NGO in the UK who self-reported as mixed ethnic background).

These difficulties in recruiting a more diverse sample in terms of ethnicity and race could be related to my position as a White researcher. My position may not have facilitated the process of recruiting and building relationships with minority ethnic communities and posits me and whiteness itself as an 'other.' Some scholars, for example Sin (2007), Clarke and Agyeman (2010) and Britton (2019), reflect on the gaze of 'white others' when the interviewer is white and the study participants are not. In doing so, they draw on the term

white gaze, popularised by writer Toni Morrison, who argues that it "assumes whiteness as the primary referent of power, prestige and progress across the world" (Pailey, 2020, p.733). Based on their research with African-Caribbean and South Asian communities in Britain, Clarke and Agyeman (2010) suggest that the white gaze can cause problems in the research process, and that in contrast, "familiarity/'sameness'" can facilitate the research relationship "without fear of imposing mainstream stereotypes" (p.90).

On the other hand, almost all the professionals working in the climate and environmental organisations I spoke to, including communication specialists and visualisation designers, were White males or females, except for one person who self-described herself as Indian. This may reflect not only the above-mentioned biases in data authorship but also in environmental politics. Just to give one example, in 2021 Reuters "ranked the 1,000 "most influential" climate scientists - largely based on their publication record and social media engagement" (Tandon, 2021). Only 111 of them were based in countries of the Global South, of whom 88 were from China and 122 scientists were female (Schipper et al., 2021). As argued by Tandon (2021), such biases in climate authorship "make it likely that the existing bank of knowledge around climate change and its impacts is skewed towards the interests of male authors from the global north." The author argues this may consequently "create blind spots" (Tandon, 2021) around the needs of people most exposed to climate change, especially low income groups, women and global South countries.

My findings in the previous section support this claim. Anjelo, the meteorologist from Tonga, when asked about his interest in climate change and datavis, explained that he believed there were insufficient data visualisations of climate in and on Tonga, even though the country is very exposed to climate change consequences:

> I think we have a lot – a depth of knowledge here in the Pacific Islands and especially here in Tonga, that is still not represented or visualised in a way that is effective enough. I still feel that there's something that we have, but to put it out there that's the gap that we want to really address. And my interest in climate change is because

> not only that we are in the front line of experiencing this devastating impact on our islands compared to the past twenty years. I think that's the main passion that's in me because – this is an issue that we do not have a voice, we do not have much control over in the outcome. Nor the input because when we talk about our greenhouse gas emissions, we are very insignificant to produce such outputs. As I mentioned we are on the other side of the world that is harvesting the impact of climate change, global warming, sea-level rise at a very alarming rate.

Except for these important findings, I did not observe any trend in emotional responses to datavis in relation to ethnicity among my audience participants. There are two possible reasons for this. First, as suggested above, more people of colour should have been interviewed. Second, in his interview, Anjelo pointed to different styles of engaging in climate change issues and therefore in type of datavis produced by the Tongan community. The datavis that worked best, for example in Tonga, were those connected with Tongans' everyday experiences and cultural and religious practices. This reflects Clarke and Agyeman's (2010) work on African-Caribbean and South Asian communities in Britain and their engagement in climate change issues, described below, which may also explain the difficulty in recruiting more ethnically diverse participants in the UK.

Clarke and Agyeman (2010) identified two cultural explanations for non-involvement in environmental behaviours and initiatives of African-Caribbean and South Asian communities in their study in Britain. First, a 'different mindset' "identified the cultural context in which African-Caribbean and South Asian communities perceived their involvement in the environmental and sustainability debate(s)" (p.90). Second 'self-empowering spaces/home culture' "explored the spaces of agency and empowerment that were experienced through everyday cultural and religious practices" (p.91). Clarke and Agyeman (2010) suggest that engaging in dialogue about these issues "should help to identify effective policy options to tackle non-participation in environmental activities and encourage more cohesive communities in working towards environmental change" (p.93).

Findings from my research add to this debate suggesting that ethnicity may matter in shaping not only how ethnically diverse communities "construct their environmental identities and sense(s) of agency and dis/empowerment in environmental participation" (Clarke and Agyeman, 2010, p.93; see also Neal and Agyeman, 2006) but also consequently how the minority ethnic communities react (or not) to certain datavis on climate change. This again shows that datavis designed by White, often male, datavis designers or climate experts may not include but instead marginalise these communities in debates around climate change.

7.4 Conclusion

This chapter argued that although datavis has a transnational potential and can be used globally, the national context influences audiences' perceptions and attitudes towards datavis, and whether and what types of datavis can mobilise people to act. Furthermore, it confirms the argument put forward by Milan and Treré (2019) that data universalism is asocial and ahistorical, showing that national context plays an important role in how people engage emotionally with datavis and what this means for mobilisation and political participation. The findings suggest that the uneven distribution of capacities to generate, access, process and visualise large data sets and the dominance of the English language may consequently lead to unequal experiences of datavis, which was especially evident in the example of Tonga.

However, other factors beyond nationality, including political affiliation, education, occupation, gender, age, ethnicity and race, also inform audiences' attitudes and perceptions of data visualisation. Political affiliation or sympathies seem to strongly influence audiences' emotional responses to datavis and whether it can mobilise them to act, especially when the topic of datavis is highly politicised, such as in the case of climate change. These findings advance the work of Peck and colleagues (2019) who found that political bias and beliefs can affect the perception of data visualisations. Moreover, there was a visible relationship between numerical and statistical skills, education and prior experience with data visualisations, confidence and the type of datavis that was emotive to audiences. The audience participants who worked with data, statistics or visualisations and

a few specific socio-professional categories were moved by more complex data visualisations. On the other hand, the lack of these skills, education and experiences made some audiences, most often women and older people, feel less confident and much more likely to interact with more standardized and simply designed datavis. These considerations confirm existing findings whereby "users need to feel that they have the necessary skills to decode visualisations" (Kennedy et al., 2016b, p.15) and that these skills may "come from exposure through formal education" (Peck et al., 2019). My findings add to these existing debates showing that emotions associated with confidence and skills in relation to datavis are gendered and age related.

Overall, the findings of this chapter extend existing debates about the importance of differences in datavis (see Peck et al., 2019; D'Ignazio and Klein, 2020), showing that national contexts and other demographic and social factors may lead to unequal emotional engagement with datavis and mobilisation or lack thereof. The chapter suggests that some demographic, often vulnerable, groups may be discriminated against in data(vis) practices (D'Ignazio and Klein, 2020) which may be the reason why some people do not engage with datavis or do not pay attention to datavis and are consequently not mobilised by it. Finally, it is suggested that datavis, in this case about climate change, may be skewed towards and target the interests of White (usually) men, from the Global North. This, in turn, can create blind spots around the needs of more vulnerable people, including ethnic minority communities, and lead to a lack of emotional engagement and consequently non-participation in, for example, environmental activities (Clarke and Agyeman 2010).

Chapter Eight:
Conclusion

8.1 Introduction

It is 10th October 2021, and the writing of this thesis is slowly coming to an end. The Covid-19 pandemic that entered the lives of people around the world during my fieldwork in late 2019 has brought many challenges to my work: from methods issues around arranging and carrying out interviews (discussed in Chapter Three), to the toll that isolation has taken on collective mental health. However, it has also shown or rather reinforced the undeniable importance of datavis in everyday social life (Kennedy and Hill, 2017). Most of us are familiar with or have seen at least one version of the famous 'flatten the curve' line chart (Figure 25), explaining the need to slow down the spread of the virus so that healthcare systems would not become overburdened. The visual display of data on new Covid cases, distribution of cases, recoveries, deaths and, later, the number of vaccinated people could be found everywhere, from government websites, television and Internet news, to research centres and data scientists' websites that provided real-time statistics in the form of datavis, to make data available to citizens all over the world (see worldmeters, The COVID Tracking Project). This widespread availability of datavis meant that more people than ever had access to real-time statistics and big data. As Bowe and colleagues (2020) suggest, this might give people a chance to strengthen their collective data literacy. However, the question of how people engaged with such datavis remains open.

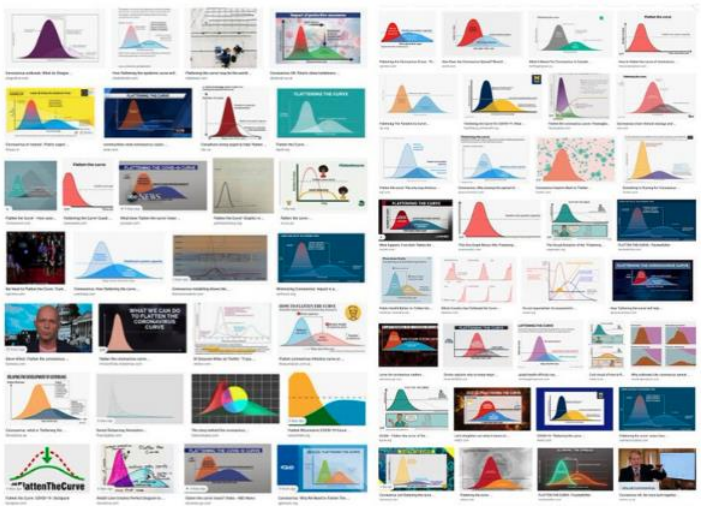


Figure 25: Flatten the curve line charts

Source: LSE blog, Helen Kennedy (adapted from Andy Kirk, Twitter)

The Coronavirus crisis has also demonstrated the importance of emotions in everyday social life and politics (Degerman et al., 2020). As argued in Chapter Two, emotions not only have an individual dimension, but also a collective one, which makes them social (Hochschild, 1989; Ahmed, 2004; Burkitt 2014), and this was also the case in the examples given above. Since the Covid-19 outbreak, we have witnessed not only heavily emotional polarization between citizens in different countries over media reports of the pandemic and government reactions to it (Nielsen et al., 2020) or the Covid vaccine (Gabbatt, 2021), but also more political actions and protests that involve emotions such as the Black Lives Matter protests in the United States and the United Kingdom, protests over abortion ban in Poland, insurrection at the US Capitol and global climate change protests. All these movements expressed strong emotions, often anger, in their statements and actions. Although datavis on climate change was the main subject of this study, participants referred to most of the above events in interviews, especially the pandemic. I discussed some of these references in my thesis to locate audiences' emotional responses to datavis in everyday practices and show that they are always embodied in a wider social context. This grounded approach connects to my epistemological position of studying social reality as the product of processes where humans negotiate the meanings of actions (Schutz, 1954) in different social contexts.

In October 2020, during the fieldwork, I read a news article about audience beliefs and responses to statistics and widespread graphs, charts and maps about Covid-19, entitled 'Facts v feelings: how to stop our emotions misleading us' (Harford, 2020). The author of the article states that if we put a claim about, for example, climate change on a graph to be shared on social media, it attracts attention and engagement not because it is true or false, but because of the way people feel about the issue. I believe this to some extent, given my audience participants' responses to datavis about climate change. However, the reason I draw upon this article as I end my thesis is that, since 2019, when I started working on my project, there has still been little empirical research from a bottom-up audience perspective (Kennedy et al., 2016b; Kennedy and Hill, 2017) on this important, ever-growing relationship

between datavis and emotional experiences of audiences and, importantly, where those experiences can lead. Therefore, I turn from the news back to my research questions to advance understanding of how different people engage emotionally with data visualisations and what these experiences mean for political participation in datafied democracies.

In my analysis, I have drawn upon a broad range of literature from a variety of disciplines and sociological sub-fields, such as the emerging field of critical data studies, the sociology of emotions, and limited existing research on data visualisation in society, as well as on emotions in political communication and in social movements. I did this to bridge the gap that currently exists in understanding whether and how datavis can trigger emotional responses and the impact of datavis on mobilisation and political participation in different national contexts. Only limited empirical research has been carried out regarding datavis, emotions and mobilisation, and none has compared national contexts.

Most of my participants were not surprised to see a research project focusing on emotional responses to climate change visualisations and were therefore keen to participate. Nevertheless, many were surprised that the research was conducted from a sociological perspective, not a psychological, cognitive or computer science one. As outlined in the introduction and the methods chapter, the overarching aim of this thesis was to explore the role that data visualisations and emotional responses to them play in mobilising people towards political participation and civic engagement sociologically, using semi-structured qualitative interviews to generate rich narratives of lived experience. This approach contributes to understanding the importance of datavis as an area of sociological inquiry.

Included in this final chapter is a section called 'Findings and academic contributions' which summarises the research findings, arguments and academic contributions of this thesis. It demonstrates how the research questions were addressed and identifies the interdisciplinary developments offered by my findings and analysis. Arguments and concerns outlined throughout the thesis are drawn together in this concluding chapter. Following this opening section, the thesis reflects upon the possible limitations of this study

and offers several suggestions for future research direction. Finally, it closes with concluding thoughts.

8.2 Findings and academic contributions

This section offers the key findings and insights of this thesis in relation to my three research questions. I argue that my thesis advances understanding of how diverse audiences from different national contexts engage emotionally with data visualisations. The section expands on these findings in subsections entitled: emotions, participation, and national and demographic differences, which framing the findings around the three overarching research questions:

1. How and in what ways does data visualisation convey and evoke emotional responses?
2. To what extent do those experiences relate to people's (potential) political participation?
3. What role, if any, do national and demographic differences play in these processes?

8.2.1 Key findings in relation to research questions

There are five main findings in relation to my three research questions that I have tried to communicate through this thesis. The first finding extends the work of Kennedy and Hill (2017) on emotional engagements with datavis and answers my first research question. It shows that **datavis can be seen as what I have called an 'emotional repository' of dynamic, complex emotional experiences that are always social and relational.** By this I mean that data visualisations can trigger various, multiple, simultaneous, changing and often contradictory emotional responses, relating mainly to the subject matter, data or visual form of the data visualisation.

In relation to this and the first research question, the second key finding shows that **the way datavis and its visual elements appear to people affects emotional responses to and engagement with data(vis) in diverse ways**. The visual form of datavis can make negative and distressing data, for example on climate catastrophe, more appealing and enjoyable. This finding suggests that the visual form of datavis offers "a way to engage with some

people about datafication" (as suggested by Kennedy et al., 2020, p.1759) and datavis, which extends the debate introduced by Otto and Marie Neurath about what datavis can do as a visual tool for not only making data transparent but also for communicating it in ways that data themselves cannot.

The third key finding answers my second research question. It shows that **the emotions evoked by datavis played an important role in mobilising audiences to participate in different datafied democracies**. This advances Nærland's (2020) theoretical statement about datavis and political mobilisation. Datavis reinforce pre-existing mobilisation, or they can lead to changes in daily practices as a form of civic participation. They more often motivate people to act on an individual and daily level, and less frequently on a collective and public scale. However, the role data visualisations and emotions play in processes of participation is not straightforward, depending on the person encountering the datavis and the context in which it takes place.

The fourth main finding answers my third research question and extends existing debates (see Kennedy et al., 2016b; Peck et al., 2019; D'Ignazio and Bhargava, 2020) about the importance of differences in engagements with data and data visualisations. It **demonstrates that demographic differences including age, education, ethnicity and race, gender, political affiliation, and work experience inform the way datavis is perceived and often lead to unequal emotional experiences of datavis and mobilisation prompted by it**. Moreover, the chapter suggests that some demographic, often vulnerable, groups may be discriminated against in data practices, which may be the reason why some people do not engage (including emotionally) with datavis or do not pay attention to (some) datavis and are consequently not mobilised by it.

The fifth key finding answering my third research question about national differences in engagements with datavis **demonstrates that although datavis has a transnational potential and is globally mobile, it is also nationalised**. Especially in monocultural countries such as Poland, datavis showing a national or local context were more emotive and mobilising for audiences. This challenges the dominance and universalism of such

transnational datavis and extends the argument put forward by Milan and Treré (2019) about data universalism being asocial and ahistorical and operating outside of specific socio-political, cultural, and economic contexts.

8.2.2 Emotions

Chapters Four and Five considered the first research question and looked at audiences' emotional experiences of datavis about climate change and how datavis designers and campaigners engage with the emotional potential of graphs, charts and maps. These two chapters provided an empirical examination of the ways in which different emotions play a significant role in engagements with datavis, something which has been argued by several practitioners and scholars (such as Kennedy and Hill, 2017; D'Ignazio and Bhargava, 2020; Simpson, 2020). The findings of these chapters go beyond what others have already contributed. Existing work started the debate and emphasised the importance of emotions in datavis, but it did not account for the nuances of audiences' emotional experiences of datavis and the nature of these emotions, and therefore there was scope for further sociological work to be done.

The narratives provided by participants showed that emotional responses to datavis depend to a large extent on the person who encounters the datavis and vary according to the audiences' political or ideological position and views and socio-cultural contexts, factors and affiliations. I argued that audiences respond to subject matter of datavis as well as particular datavis factors, and their response to subject matter is shaped by their broader views, both about climate change in particular, and politics more generally. In exploring this, the chapter expanded existing research by showing that different socio-cultural contexts and factors *outside* of datavis can affect not only engagements with datavis in general, as argued by Kennedy and colleagues (2016b), but more specifically audiences' emotional responses to datavis. My research highlights that it is difficult to make simplistic, generalized claims about whether specific data visualisations induce particular emotional states among diverse audiences. Context and differences between audience participants matter in regard to how they feel about datavis (discussed in more detail in Chapter Seven) and therefore tailoring datavis to trigger particular emotions in audiences may not always have the desired effect.

The findings showed that participants cared more about datavis that were more relevant to them and presented issues or events geographically close to them.

Furthermore, the narratives provided by the participants suggested that emotions in audiences' engagement with datavis are multiple, simultaneous and ever-changing. Boundaries between emotions are fuzzy and therefore they do not fit into neat positive, neutral or negative categories. Audience participants reacted to the different factors of data visualisation from the very beginning of their encounter with it and switched between different kinds of emotions quickly. Therefore, in addition to confirming earlier empirical work on datavis having an emotional impact on people (Kennedy and Hill, 2017), the chapter argued that datavis can be seen as an 'emotional repository' in which dynamic and complex emotional experiences are located. The chapter expanded upon Kennedy and Hill's (2017) study of emotional responses to six datavis factors by examining which of these factors *inside* of datavis are most likely to stimulate an emotional engagement among audience participants, what kind of engagement that might be, as well as its consequences. It moved the debate along by indicating the importance of three datavis factors – subject matter, represented data, and visual style – that evoke the strongest emotions among audiences.

I then revealed the tension within the three emotional factors mentioned above by identifying contradictory positive and negative emotional responses to them. Analysis showed that many participants felt excitement and simultaneous attraction to the visual form of a datavis but were concerned and worried about the data and what is being visualised. Moreover, some of them tried to align the contradiction between positive feelings about the visual form and how they should feel about what the data visualisation presented. Drawing on Hochschild's (1989) concept of feeling rules and emotion management, by which she refers to social expectations about how to feel in a certain situation and how people fit with these expectations, I argued that this disparity between audiences' 'head' and 'heart' and subsequent emotional work show that feeling rules about datavis on climate change exist. These findings also develop the feeling rules concept itself, showing that they can be applied to new contexts of digital and data (visualisation)

research. Furthermore, these conflicting emotions provided empirical evidence for the claim that visual, as well as numerical aspects, play an important role in peoples' engagements with datavis (Kennedy and Hill, 2017). This contributes to existing debate by arguing that the way datavis and its elements appear to people is important in terms of emotional responses to and engagement with them.

Finally, I argued that particular features of datavis evoke particular emotions. Colour often induces fear but similar to hand-drawn elements, animations or interactive forms can also add more positive emotions, such as enjoyment and fun. These emotions in turn enable or increase audiences' involvement in visualisations. The above findings contributed empirically to existing debates among datavis designers and scholars who claim that some visual elements/forms of data visualisation can convey and evoke different emotions in audiences. My findings expanded these ideas by showing which of them have the greatest potential for doing so and why.

8.2.3 Participation

Chapter Six considered the second research question, examining whether the emotional experiences of datavis discussed in Chapters Four and Five relate to audiences' (potential) political participation. It interrogated empirically Nærland's (2020) theoretical claim that data visualisations enable and mobilise people to function as citizens and take part in political debates or everyday discussions. Consequently, the chapter contributed to knowledge by empirically examining the relationships between datavis, emotions and political participation from a bottom-up, qualitative sociological perspective.

The chapter empirically supported Nærland's (2020) claims and advanced the work of others in the area of mobilisation and political participation in a number of ways. First, I argued that data visualisations about climate change have the potential to reinforce pre-existing mobilisation and can lead to changes in daily practices. They can motivate some people to act on an individual and daily level, and less frequently on a collective, public or global scale. This ties in with the finding about emotional responses to national, regional and local datavis discussed in Chapter Five. The chapter highlighted not obviously political

acts in the private sphere, such as sharing and discussing datavis with others, and changes in daily practices as a distinctive form of civic engagements and material participation. Most audience participants showed greater engagement in responding to datavis that related directly to their daily lives and showed them what they could change as an individual. Thus, in most cases, the participants reacted to them by undertaking activities in their immediate environment, such as eating less meat, buying environmentally friendly products, reducing food waste, using less plastic, reducing car use, or purchasing solar panels, solar batteries or electric cars.

However, these changes in daily practices could also lead to political participation on a more public scale. Here, the chapter referred to the work of Lamprianou (2013) and recognized two types of political participation provoked by datavis: unconventional and conventional. Unconventional, less traditional and more informal forms of political participation such as signing a petition, joining a protest or donating money to an organisation were more common among the audience participants than conventional ones such as contacting officials or voting. Donating to an organisation was mentioned by a few people who found it the fastest and most effective way to help and get involved. However, the largest number of participants was mobilised to sign a petition related to climate protection. More conventional forms of political participation on a macro and formal level triggered by a datavis were rarely mentioned in interviews. Only two participants decided to contact officials in response to the encountered data visualisations on climate change and one joined a transition town group and set up an eco group in her town.

By using the notion of a continuum, which implies a progression from individual engagement in the private sphere to various types of political participation on a more public and collective scale, the chapter developed a typology of participatory responses and personal political activities mobilised by data visualisations from the micro/informal and everyday (not buying plastic, vegetarianism, sharing datavis) to the meso/semi formal (going on a march, signing a petition) to the macro/formal (being part of a lobbying group, contacting officials, voting). This typology included four categories of civic engagement and participation: (1) sharing data visualisation (the micro/informal/everyday level); (2) changes

in everyday practices (the micro/informal/everyday level); (3) unconventional political participation (meso/semi-formal level); and (4) conventional political participation (macro/formal level). The findings suggest that the boundary between the private and public spheres is blurring within this range of participatory activities. Different categories of involvement triggered by various data visualisations were intertwined, overlapped and, as mentioned above, existed across public and private, formal and informal, or online and offline spaces. They were not fixed or static but relational.

The interviews showed that not all data visualisations evoked emotions in similar ways. The data visualisations that had greater mobilisation potential and impact on the behaviour and decisions of participants were those that indicated what could be done and how people could contribute to a change of situation. Mobilisation was therefore often about whether people could see the possibility of action in a datavis. those datavis that were not related to everyday life or did not make clear what action Individuals could take evoked emotions in the participants and could change their minds or activate them to care about a particular issue, but they mobilised audiences to act less often.

The chapter did not overlook the contextual aspect of these individual political practices and participation on a more public scale. Audience participants' mobilisation and participation were influenced or shaped by factors such as information possessed before encountering the datavis, perception of climate change, and national, cultural and social background. It was argued that datavis themselves are only a part of the constellation of different factors influencing participation. Therefore mobilisation, like emotion, does not just reside in the text but the interaction of the individual with the text and the context and thus cannot be separated from other factors. It was not only about the type of datavis but about a combination of the datavis and the individuals' ability to interpret it in a way that makes it possible to see how they can act. Therefore, the chapter's final argument was that participation enabled by a data visualisation is not straightforward, happens on many levels, and is dependent on the person encountering the datavis and the context in which it takes place.

8.2.4 National and demographic differences

Chapter Seven examined the roles that national and other demographic characteristics may play in emotional responses to datavis and its ability to mobilise people to act. It focused on two different geo-historical, demographic and democratic contexts: the United Kingdom and Poland. The chapter examined different socially located voices in terms of age, education, ethnicity and race, gender, nationality, political affiliation, and work experience within these contexts. By doing this, it addressed points made by a number of practitioners and scholars (such as Kennedy et al., 2020; D'Ignazio and Klein, 2020) about the absence of national comparative approaches, diversity and inequality in data studies research into perceptions of data and datavis (see exceptions Peck et al., 2019; Kennedy et al., 2020). The chapter therefore advanced existing work in a number of ways. It showed that national context plays an important role in emotional engagements with datavis, especially in monocultural countries.

The chapter first argued that datavis can be seen as a transnational as well as a global phenomenon because datavis can be produced in one country and then consumed elsewhere in different contexts. However, the chapter challenged the dominance and universalism of such transnational datavis by showing that Polish organisations do much more than just replicate them. Moreover, the datavis adapted to show a national or local context were more emotive and mobilising for audiences. This was clearly visible in Poland due to its ethnic and cultural homogeneity, but was not as noticeable in the more multicultural UK.

Narratives of the participants from Poland and the UK showed that audiences may pay more attention to the types of datavis that they are more familiar with, for example those widely published and discussed in the national media, such as maps in Poland and line graphs and bar charts in the UK. Also, different topics such as plastic consumption in the UK and coal consumption in Poland were more emotional for audience participants in these respective countries than other climate issues, showing again that, in the case of datavis, national context does matter.

This finding not only revealed national differences in datavis production but also how these differences relate to unequal access to and experiences of datavis and therefore datafication. This finding links with the argument put forward by Milan and Treré (2019) about data universalism being asocial and ahistorical and operating outside of specific socio-political, cultural, and economic contexts. It also reflects findings from Chapters Six and Seven, which indicated that socio-cultural factors and contexts in which people encounter graphs, charts and maps are of great importance to the way datavis is perceived and the motivation, or lack thereof, to act under its influence.

Moreover, the chapter argued that demographic and social characteristics other than nationality, including age, education, ethnicity and race, occupation, gender, and political affiliation, also inform audiences' emotions and perceptions of data visualisation. For example, political affiliation or sympathies strongly influence audiences' emotional responses to datavis and whether it can mobilise them to act, especially when the topic of datavis is highly politicised, such as in the case of climate change. These findings advance the work of Peck and colleagues (2019) who found that political bias and beliefs can affect the perception of data visualisations. There was also a visible relationship between prior experience with data visualisations, age or gender and the type of data visualisation that audiences found most emotive. The audience participants who worked with data or visualisations and a few specific socio-professional categories were interested in and moved by more complex data visualisations.

On the other hand, a lack of these experiences or those who did not have university level education made some audiences, most often women and older people, feel less confident and much more likely to interact with simply designed datavis. These considerations confirm existing findings that audiences "need to feel that they have the skills to decode visualisations" (Kennedy et al., 2016b, p.15) and that these skills may "come from exposure through formal education" (Peck et al., 2019, p.7). My findings add to these debates showing that emotions associated with confidence and skills in relation to datavis are gendered and age related. The chapter argued that even though some groups, including women, less educated and older people, may have limited statistical skills, they may still be

enthusiastic and have strong emotions, related not only to their lack of confidence or visual and statistical skills towards graphs, charts or maps of their choice and therefore connecting emotionally with datavis can facilitate their access to data. It may therefore be important to embrace and value emotions in datavis as a fundamental way in which humans can engage with data and learn from it, especially for groups who are otherwise excluded from data-driven conversations/society (Kennedy and Hill, 2018; D'Ignazio and Bhargava, 2020).

Finally, the chapter suggested that difficulties in recruiting participants from ethnic minority communities may have been related to my position as a White researcher, which may not facilitate the process of building relationships with minority ethnic communities. The chapter suggested that datavis about climate change may be skewed towards and target the interests of Whites, usually males, from the Global North. This, in turn, "can create blind spots around the needs of the most vulnerable people" (Tandon, 2021), including ethnic minority communities, and lead to a lack of (emotional) engagement and consequently non-participation in, for example, environmental activities, as argued by Clarke and Agyeman (2010).

8.2.5 Academic contributions

This study makes a number of original contributions into theorising data visualisation through a sociological lens and understanding of diverse audiences' experiences of datafication. It affords a unique contribution to an urgent research agenda, bringing together critical data studies, the sociology of emotions and the limited existing research on datavis in society, as well as drawing on other relevant bodies of literature, for example on emotions in political communication and in social movements, to advance understandings of how different people engage emotionally with data visualisations and what these experiences mean for political participation in datafied democracies. As critical data studies is interdisciplinary, my thesis moves beyond sociology to also contribute to media/communication and information studies and other disciplines. It does so by advancing understanding of experiences of data visualisation from an audience 'bottom-up' perspective (Couldry and Powell, 2014) and focusing on factors that affect diverse audiences' engagement, mobilisation and political participation.

I have contributed to the emerging sociology of data, as the narratives of this research tell an important story of data visualisation as not simply being a technological issue but a social, relational and contextual phenomenon. The findings of the thesis show that emotions and data(vis) connect. This develops Hochschild's (1989) sociological work on emotions showing that big data has emotional reach and engagements with it require emotional management. Furthermore, I have extended the work of Kennedy and Hill (2017) on emotional engagements with datavis by arguing that datavis can be seen as an 'emotional repository' and by showing the importance of visual design in emotional engagements with datavis. Moreover, I have advanced Nærland's (2020) theoretical statement about datavis and potential political mobilisation by showing empirically that emotions evoked by datavis play an important role in mobilising audiences to participate in different datafied democracies, more often on a daily and individual level than on a public and collective scale. Finally, I have further contributed to existing debates (see Kennedy et al., 2016b; Peck et al., 2019; D'Ignazio and Bhargava, 2020) about the importance of differences in emotional engagements with data visualisations, showing that national, demographic and social differences inform how datavis is perceived in complex and diverse ways, and so often lead to unequal emotional experiences of datavis and mobilisation prompted by it, or lack thereof.

Finally, by offering an empirical understanding of the emotional significance of data visualisation, my research has the potential to challenge two assumptions. First, that understanding of datavis is the main prerequisite to mobilising people to act, as many studies focusing on the capacity of data visualisation to convey knowledge and persuade audiences through rational arguments show. Second that emotive images are a more effective means of engagement than datavis, as a number of studies indicate. My research demonstrates the important role that emotions play in shaping political practices in datafied democracies and the need to take them into account in relation to data practices with other phenomena.

8.2.6 Methods reflections

My research approach has contributed to ongoing methodological debates about engaging with matters of emotions, research on politically sensitive topics, comparative design, researching bilingually and transnationally and online interviewing. The value of semi-structured interviews and visual elicitation has been demonstrated in their potential to provide insights into emotional responses to datavis about climate change in two national contexts and the diverse ways in which they can be implemented. It is argued that online synchronous interviews can be successful in researching emotions and politically sensitive topics, as well as in conducting visual elicitation.

The thesis explored the use of social media as a means of gaining access to (diverse) research participants. This means of recruitment has advantages in terms of inclusivity and targeting participants from ethnic minority communities. However, it also has its limitations. These are, along with other limitations of my methods, discussed in the next section.

I argue that it is through sociological methods that the experiences of datavis come to be illuminated. The social nature of datavis, and the aforementioned absence of studies from a bottom-up sociological perspective, further illustrates the importance of focusing on the audiences' engagements with datavis to understand its location and importance within the social world.

One of the biggest challenges of my three-part research process was being sensitive to each participant and at the same time navigating the pressures of multi-method qualitative research. I tried to see the world through my participants' eyes, because, as Dickson-Swift (2009) argues, the ability to be empathetic is one of the most important skills needed to undertake qualitative research. However, it can also be emotionally overwhelming. Indeed, being empathetic, it was sometimes hard not to get drawn into emotions, especially when a participant was experiencing strong emotions about the research topic or psychological distress related, for example, to a lockdown situation or the ongoing pandemic. I argue that researchers need to be aware of the emotional challenges of studying emotions in an emotionally sensitive way.

8.3 Limitations of the study and future research

As stated several times in this work, more and more data visualisations saturate everyday life as an increasingly important means of communicating information to publics and there is a great need for scrutiny of people's interactions with them. This thesis has made apparent that emotional engagements with datavis deserve far more focus than current literature has to offer and more qualitative sociological research into the complexities of these engagements is necessary. However, social researchers should always invite criticism and be open to scrutiny (Shipman, 1997), therefore this section reflects upon the limitations of my study. Moreover, it suggests how these limitations can be addressed through future explorations and discusses several potential avenues for further study.

The most significant limitation of this research has been the lack of diversity in political views and perspectives on climate change. Most participants described themselves as left leaning and pro-ecological. Further research on a larger sample of people with different perspectives and political views could begin building a bigger picture of the diversity of emotional experiences of datavis about climate change and whether and how they can mobilise people to act. The aim of such a research project would not be to compare their experiences but to explore the variation and dynamics of emotional responses and potential political participation. Although the thesis lacks this political diversity, it does portray a rich array of lived and nuanced emotional experiences of datavis and where they can lead. By doing this it demonstrates a level of complexity and insight not visible within other studies that prioritise psychological or cognitive models. It would be also interesting to extend the range of organisations that use datavis about climate change to include climate change sceptic groups and smaller organisations, to see what they think about datavis and how they use them in their work.

This research is focused on Poland and the United Kingdom. Although that was also the premise of the study, the findings of this thesis suggest that national differences can lead to unequal experiences of datavis and so a broader, more diverse and beyond Eurocentric range of social narratives and voices is necessary. Future research could be carried out in other national contexts and regions. This could provide greater understandings of datavis

practices and the importance of national differences in datavis experiences. It is important to look beyond Eurocentric experiences of datavis and focus also on underrepresented in sociological datavis research countries and regions, like the so-called Global South. Milan and Treré (2019) call for "a de-Westernization of critical data studies, in view of promoting a reparation to the cognitive injustice that fails to recognize non-mainstream ways of knowing the world through data" (p.320). Importantly, this region is most vulnerable to climate change, making it an area of study that would clearly benefit from further attention.

Further research could also aim for a more demographically diverse sample and to include more marginalised voices and communities. The methods chapter acknowledged that some measures were employed to recruit people from a range of backgrounds and efforts were made to recognise differences and possible inequalities during analysis. Nevertheless, the participants from this study were, for the main part, White British and White Polish and tended to be educated to degree level and above. Therefore, it is a limitation of this study that it does not reflect the experiences of a more culturally, ethnically and socially diverse range of people. This may be partly related to the fact that climate movements/groups themselves have a history of being understood as white, middle-class movements – and that this issue is compounded by datavis also being seen as a relatively elitist way of disseminating knowledge. Further research applied to different case study areas or several topics could be productive and allow for more explicit attention to emotions in datavis and potential political participation that these emotions provoke. Such a study would also contribute significantly to the literature and would have the potential to inform datavis professionals' practice beyond areas related to climate change. For example, in light of the rapid increase in the use of visualisations in the wake of Covid-19 and the Black Lives Matter movement, these topics could become central to a future study. However, it could be also beneficial to experiment with a participatory method to identify together with diverse research participants what datavis to focus on in the study on emotional responses to datavis. This would allow a focus on the topics that matter to diverse participants and could lead to richer data being generated.

I would also encourage critical engagement with disability and class contexts that have not been discussed in this thesis. Moreover, further research could also focus on intersectionality. As Kennedy and colleagues (2020) pointed out in their study, inequalities relating to dis/ability, poverty and their intersections "informed understandings of and feelings about data practices in complex and diverse ways" (p.1745).

As the findings of this thesis show, national context and regional/local approaches to datavis play an important role in audiences' perceptions of datavis, and whether and what types of datavis can mobilise people to act. This creates a kind of tension with global environmental governance and the global scale of environmental politics. It is therefore argued that more attention could also be given to datavis that present global rather than local data and topics. This could allow for an investigation of what kind of global datavis have the potential to trigger emotions and mobilise people to act and participate in datafied democracies.

The thesis recognised that some datavis and their visual features, including colour, hand-drawn elements, interactive and animated elements, are more emotive than others. Importantly, these features have the potential to evoke positive emotions including joy and excitement and contradict emotions evoked by sad or scary data or the subject matter of the datavis. In this way, the datavis can make an unpalatable subject like climate disaster more palatable. This idea is also worth examining in more depth. For example, how can data visualisations, including those beyond the desktop, be combined with art and design and where can this lead? Could this kind of datavis for example be more accessible and emotive to audiences and empower them to take part in data-driven conversations?

Another limitation relates to recruitment of participants and conducting interviews online. While online recruitment and remote interviews have their benefits within social research, which are discussed in Chapter Three, they also have some disadvantages. One of the most important is the challenge of including marginalised communities who may not be found online and/or on social media. Moreover, face-to-face interviews could facilitate building rapport and relationships with participants. Due to the Covid-19 pandemic, this aspect of the research was beyond my control, and I had to recruit my audience participants and

conduct interviews remotely. However, future research on datavis, emotions and participation could benefit from more traditional and offline recruitment.

Finally, in the context of mobilisation and political participation, it would be worth looking at the outcomes of actions that were mobilised by datavis. This is missing from my study and could be an important topic for further research. Contrarily, it would be worth examining the implications for people who, for various reasons, including those indicated in this thesis, do not pay attention to, do not engage with, and consequently are not mobilised by data visualisation.

8.4 Concluding thoughts

In this concluding chapter and throughout the whole thesis I have reflected upon how diverse people engage emotionally with datavis and what this means for mobilisation and political participation in datafied democracies. My argument, reduced from eight chapters to a sentence, would be 'complex emotional responses to datavis can mobilise diverse audiences to act and participate in datafied democracies in various ways.' I have problematised this and argued that a stronger grasp of engagements with datavis and where they can lead is achieved by thinking sociologically.

I have illustrated how different contexts, factors and relationships give rise to emotions and political practices, making a case for sociology and particularly the sociology of emotions to act as a facilitator for understandings of diverse audiences' engagements with datavis. I have illustrated my novel approach to understanding the social impact of data visualisation, an increasingly important means of communicating information to publics.

I consider this study as a starting point and acknowledge the potential for future research. I have argued that one of the most urgent future challenges is to include more marginalised voices, communities and countries in discussions about how important datavis are to them and what kind of datavis.

Finally, in conclusion to this conclusion, I suggest that by offering this empirical understanding of the emotive and participatory potential of datavis, this thesis may

challenge findings from other studies which suggest that emotive imagery, for example photos of the negative consequences of climate change, is a more effective means of engagement than data and datavis.

Researchers' and activists' narratives emphasise that using images such as photos in visual communication can effectively engage people with climate change issues, but no equivalent narrative exists for datavis. A higher priority must be, therefore, given to data visualizations with greater recognition of the significance of emotions they can trigger because these emotions can be the only way for many vulnerable groups to access data and consequently to participate (or not) in datafied societies. Therefore, although my project's main contribution is academic, its findings have a wider social impact for datavis and climate communication professionals. They can inform their future practice with research-based knowledge.

Bibliography

Ahmed, S. (2004). *The Cultural Politics of Emotions.* Edinburg: Edinburg University Press.

Aiello, G. (2006). Theoretical advances in critical visual analysis: perception, ideology, mythologies, and social semiotics. *Journal of Visual Literacy.* 26(2), pp.89-102.

Aiello, G. (2020). Inventorizing, situating, transforming: Social semiotics and data visualization. In: Engebretsen, M. and Kennedy, H. eds. *Data visualization in society.* Amsterdam: Amsterdam University Press. pp.30-39.

Alamalhodaei, A., Alberda, A. and Feigenbaum, A. (2020). Humanizing data through 'data comics': An introduction to graphic medicine and graphic social science. In: Engebretsen, M. and Kennedy, H. eds. *Data Visualization in Society*. Amsterdam: Amsterdam University Press. pp.347-366.

Andrejevic, M. (2014). The Big Data Divide. International Journal of Communication. 8 (1), pp. 1673-1689.

Archibald, M., Ambagtsheer, R., Casey, M. and Lawless, M. (2019). Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods.* 18.

Bagnoli, A. (2009). Beyond the Standard Interview: The Use of Graphic Elicitation and Arts-Based Methods. *Qualitative Research.* 9, pp.547-570.

Bang, H. (2009). Political Community: The Blind Spot of Modern Democratic Decision-Making. *British Politics.* 4, pp.100-116.

Barber, B. (1984), Strong Democracy: Participatory Politics for a New Age. Berkeley: University of California Press.

BBC. (2016). Eight reasons Leave won the UK's referendum on the EU. [online]. [Viewed December 2021]. Available from: https://www.bbc.co.uk/news/uk-politics-eu-referendum-36574526

BBC. (2021). Climate change: Stripes campaign 'started conversations'. [online] [Viewed January 2022]. Available from: https://www.bbc.co.uk/news/uk-england-berkshire-57560185

Beer, D. (2016). *Metric Power.* London: Palgrave Macmillan.

Bennett, L. and Segerberg, A. (2014). *The logic of connective action: Digital media and the personalization of contentious politics.* Cambridge University Press.

Bergman Blix, S. (2015). Emotional insights in the field. In: Flam, H. and Kleres, J. eds. *Methods of Exploring Emotions.* London: Routledge.

Bimber, B. (2002). Political Communication in the 2000 Election: Guest Editor's Introduction. *Political Communication.* 19, pp.1-3.

Boczkowski, P.J. and Papacharissi, Z. (2018). *Trump and the Media.* Cambridge, London: The MIT Press.

Bogner, A., Littig, B. and Menz, W. (2009). *Interviewing Experts.* Palgrave Macmillan.

Borkin, M., Bylinskii, Z., Kim, N., Bainbridge, C., Yeh, C., Borkin, D., Pfister, H. and Oliva, A. (2015). Beyond Memorability: Visualization Recognition and Recall. *IEEE transactions on visualization and computer graphics.* 22.

Bowe, E., Simmons, E., Mattern, S. (2020). Learning from lines: Critical COVID data visualizations and the quarantine quotidian. *Big Data & Society*. 7.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology.* 3, pp.77-101.

Brewer, J. (2012). Researching Sensitive Topics. In: Becker, S. and Bryman, A. eds. *Understanding Research for Social Policy and Practice.* Policy Press. pp.69-73.

Brinkmann, S. and Kvale, S. (2005). Confronting the ethics of qualitative research. *Journal of Constructivist Psychology.* 18, pp.157-181.

Britton, J. (2019). Being an insider and outsider: whiteness as a key dimension of difference. *Qualitative Research*. 20.

Browning, C. (2019). Brexit populism and fantasies of fulfilment. *Cambridge Review of International Affairs.* 32, pp.1-23.

Bryman, A. (2016). *Social Research Methods.* 5 ed. London: Oxford University Press.

Burkitt, I. (2014). *Emotions and Social Relations.* London: SAGE Publications Ltd.

Cairo, A. (2013). *Emotional Data Visualization: Periscopic's "U.S. Gun Deaths" and the Challenge of Uncertainty* [online]. [Viewed 12 August]. Available from: http://www.peachpit.com/articles/article.aspx?p=2036558

Cairo, A. (2019). Empathy through visualization. *Thefunctionalart.com.* [Online]. Available from: http://www.thefunctionalart.com/2019/03/empathy-through-visualization.html

Cairo, A. (2020). *How Charts Lie: Getting Smarter about Visual Information.* W. W. Norton & Company.

Cairo, A. (2016). *The truthful art: data, charts, and maps for communication*. New Riders.

Campbell, G. (2013). *The Philosophy of Rhetoric.* Cambridge: Cambridge University Press.

Campbell, S. and Offenhuber, D. (2019). Feeling numbers: The emotional impact of proximity techniques in visualization. *Information Design Journal.* 25.

Chalabi, M. (2016). *OpenVis Conference: Informing without Alienating - Mona Chalabi. You tube: https://www.youtube.com/watch?v=5C8AvYVt4_0.*

Channel 4. (2016). Do we really send £350m a week to Brussels? [Energy consumption in households in 2018] [online]. [Viewed December 2021]. Available from: https://www.channel4.com/news/factcheck/factcheck-send-350m-week-brussels

Clarke, L. and Agyeman, J. (2010). Is there more to environmental participation than meets the eye? Understanding agency, empowerment and disempowerment among black and minority ethnic communities. *Area.* 43, pp.88 - 95.

Climate Outreach. (2021). *Our theory of change.* [online]. Available from: https://climateoutreach.org/about-us/theory-of-change/

Coleman, S. (2013). *How Voters feel.* New York: Cambridge University Press.

Coleman, S. (2017). *Can the Internet Strengthen Democracy?* MA: Polity Press.

Coleman, S. and Blumler, J. (2009). *The Internet and Democratic Citizenship: Theory, Practice and Policy.*

Collective, T.T. (2014). *Visualising Information for Advocacy.* [online]. 2 ed. Bangalore: Tactical Tech.

Couldry, N. and Powell, A. (2014). Big Data from the bottom up. *Big Data & Society.* 1.

Czarniawska, B. (2015). The rhetoric of emotions. In: Flam, H. and Kleres, J. eds. *Methods of Exploring Emotions.* 1 st ed. London: Routledge. pp.67-78.

D'Ignazio, C. and Bhargava, R. eds. (2020). *Data Visualization literacy: A feminist starting point* Amsterdam: Amsterdam University Press.

D'Ignazio, C. and Klein, L.F. (2020). *Data Feminism.* [online]. The MIT Press.

D'Ignazio, C. and Klein, L. (2016). Feminist Data Visualization. In: *IEEE VIS Conference*, *Baltimore, Maryland*.

Dahlgren, P. (2002). In Search of the Talkative Public: Media, Deliberative Democracy and Civic Culture. *Javnost - The Public.* 9(3), pp.5-25.

Dalton, R. (2008). Citizenship Norms and the Expansion Of Political Participation. *Political Studies.* 56, pp.76-98.

Deakin, H. and Wakefield, K. (2013). Skype Interviewing: Reflections of Two PhD Researchers. *Qualitative Research.* 14.

Decker, S., Naugle, A., Carter-Visscher, R., Bell, K. and Blankenship, A. (2011). Ethical Issues in Research on Sensitive Topics: Participants' Experiences of Distress and Benefit. *Journal of empirical research on human research ethics : JERHRE.* 6, pp.55-64.

della Porta, D. and Portos, M. (2021). Rich kids of Europe? Social basis and strategic choices in the climate activism of Fridays for Future*. Italian Political Science Review/Rivista Italiana di Scienza Politica*. pp.1-26.

Dickson-Swift, V., James, E., Kippen, S. and Liamputtong, P. (2009). Researching sensitive topics: Qualitative research as emotion work. *Qualitative Research.* 9, pp.61-79.

Doerr, N. (2010). Politicizing Precarity, Producing Visual Dialogues on Migration: Transnational Public Spaces in Social Movements. *Forum Qualitative Social Research* 11(2).

Duffy, B. (2018). *Brexit misperceptions.* Policy Institute at King's and Ipsos MORI.

Edwards, R. and Mauthner, M. (2002). Ethics and feminist research: theory and practice. In: Melanie, M., et al. eds. *Ethics in Qualitative Research.*

Ekman, J. and Amnå, E. (2012). Political participation and civic engagement: Towards a new typology. *Human Affairs.* 22.

Enosh, G. and Buchbinder, E. (2005). The Interactive Construction of Narrative Styles in Sensitive Interviews: The Case of Domestic Violence Research. *Qualitative Inquiry.* 11, pp.588-617.

Eubanks, V. (2018). *Automating Inequality: How High-tech Tools Profile, Police, and Punish the Poor.* New York: St. Martin's Press.

Feigenbaum, A. and Alamalhodaei, A. (2020). *The Data Storytelling Workbook.* London, New York: Routledge.

Fereday, J. and Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods.* 5, pp.1-11.

Flam, H. and Doerr, N. (2015). Visuals and emotions in social movements. In: Flam, H. and Jochen, K. eds. *Methods of Exploring Emotions.* London: Routledge.

Friendly, M., Chen, C.-h., Härdle, W.K. and Unwin, A. (2008). A Brief History of Data Visualization. In: Chen, C.-h., et al. eds. *Handbook of Data Visualization.* Springer. pp.15-56.

Fujii, L.A. (2018). *Interviewing in Social Science Research A Relational Approach.* New York: NY: Routledge.

Gabbatt, A (2021) 'Polarization over Covid vaccine prompts some Americans to get shot in secret', The Guardian. [online] [Viewed January 2022]. Available from: https://www.theguardian.com/us-news/2021/jul/29/covid-vaccine-polarization-secret-shot

Gangadharan, S. (2012). Digital inclusion and data profiling. *First Monday.* 17.

Gawlewicz, A. (2016). Language and translation strategies in researching migrant experience of difference from the position of migrant researcher. *Qualitative Research.* 16, pp.27–42.

Gerbaudo, P. (2016). Rousing the Facebook Crowd: Digital enthusiasm and emotional contagion in the 2011 protests in Egypt and Spain. [online]. pp.254-227.

Gerbaudo, P. (2018). The Digital Party: Political Organisation and Online Democracy.

Gerrard, Y. (2020). What's in a (pseudo)name?: Ethical conundrums for the principles of anonymisation in social media research. *Qualitative Research.* 21.

Gilbert, K. (2001). *The Emotional Nature of Qualitative Research.* London: CRC Press.

Given, L.M. (2008). *The Sage encyclopedia of qualitative research methods.* [online]. Los Angeles, [Calif.]; London: SAGE.

GOV.UK. (2019). *UK becomes first major economy to pass net zero emissions law.* [online]. [Viewed 11.08.2021]. Available from: https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

Gray, J. (2020). The data epic: Visualization practices for narrating life and death at a distance. In: Engebretsen, M. and Kennedy, H. eds. *Data Visualization in Society.* Amsterdam: Amsterdam University Press.

Grinyer, A. (2002). The Anonymity of Research Participants: Assumptions, Ethics and Practicalities. *Social Research Update.* 36.

Guenther, K. (2009). The Politics of Names: Rethinking the Methodological and Ethical Significance of Naming People, Organizations, and Places. *Qualitative Research.* 9, pp.411-421.

GUS Poland (2019). *Zużycie energii w gospodarstwach domowych w 2018 roku*. [online]. [Viewed 11.08.2021]. Available from: https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-energii-w-gospodarstwach-domowych-w-2018-roku,12,1.html.

Hanna, P. (2012). Using internet technologies (such as Skype) as a research medium: A research note. *Qualitative Research.* 12, pp.239-242.

Harford, T. (2020) 'Facts v feelings: how to stop our emotions misleading us'. The Guardian Science Notes and Theories. [online] [Viewed March 2021]. Available from: https://www.theguardian.com/science/2020/sep/10/facts-v-feelings-how-to-stop-emotions-misleading-us?CMP=share_btn_tw&fbclid=IwAR33FdkR1vcFJveWCOcxzxenwHEyyqWzDS0T4rxbG6IDx6f_JiFZoEMWnoA

Harold, J., Lorenzoni, I., Shipley, T. and Coventry, K. (2020). Communication of IPCC visuals: IPCC authors' views and assessments of visual complexity. *Climatic Change.* 158.

Haroz, S., Kosara, R. and Franconeri, S. (2015). ISOTYPE Visualization: Working Memory, Performance, and Engagement with Pictographs. *CHI.*

Haroz, S. and Whitney, D. (2012). How Capacity Limits of Attention Influence Information Visualization Effectiveness. *IEEE Transactions on Visualization and Computer Graphics.* 18, pp.2402-2410.

Harper, D. (2002). Talking About Pictures: A Case for Photo Elicitation. *Visual Studies.* 17, pp.13-26.

Heaphy, B. and Einarsdottir, A. (2013). Scripting Civil Partnerships: Interviewing couples together and apart. *Qualitative Research.* 13, pp.53-70.

Herzog, H. (2005). On Home Turf: Interview Location and Its Social Meaning. *Qualitative Sociology.* 28, pp.25-47.

Hill, R. (2014). How Social Semiotics Can Help Us Understand Big Data Visualisations - Seeing Data. [online]. Available from: http://seeingdata.org/seeing-data-blog/how-social-semiotics-can-help-us-understand-big-data-visualisations/

Hill, R.L. (2017). The political potential of numbers: data visualisation in the abortion debate. *Women, Gender & Research.* [online]. 26(1), pp.83-96.

Hitzer, B. (2015). How to detect emotions?: The cancer taboo and its challenge to a history of emotions. In: Flam, H. and Kleres, J. eds. *Methods of Exploring Emotions.* London: Routledge. pp.259-267.

Hochschild, A.R. (1989). *The managed heart: commercialization of human feeling.* Berkeley: London: University of California Press.

Holt, A. (2010). Using the telephone for narrative interviewing: A research note. *Qualitative Research.* 10, pp.113-121.

Hulme, M. (2009). *Why We Disagree About Climate Change.* Cambridge: Cambridge University Press.

Iakhnis, E., Rathbun, B., Reifler, J. and Scotto, T. (2018). Populist referendum: Was 'Brexit' an expression of nativist and anti-elitist sentiment? *Research & Politics.* 5.

INDVIL. (2019). *INDVIL data visualization event.* [Viewed 11.12.2019]. Available from: https://www.youtube.com/watch?v=rll2_rUEnAU&feature=youtu.be

Instat.gov.al. (2019). *Migration statistics in Poland data and methodology.*

Jackson, L., Valentine, G., Piekut, A., Winiarska, A. and Harris, C. (2015). Mapping the meaning of 'difference' in Europe: A social topography of prejudice. *Ethnicities.* 15, pp.568-585.

Jaggar, A.M. (1989). Love and knowledge: Emotion in feminist epistemology. *Inquiry.* 32(2), pp.151-176.

James, W. (1884). What is an Emotion? *Mind.* [online]. 9(34), pp.88-205. Available from: https://www.jstor.org/stable/2246769

Jasiewicz, K. (2008). The New Populism in Poland: The Usual Suspects? *Problems of Post-communism.* 55(3), pp.7-25.

Jasper, J. M., and Poulsen, J. D. (1995). Recruiting strangers and friends: Moral shocks and social networks in animal rights and anti-nuclear protests. *Social Problems, 42*(4), pp.493–512.

Jewitt, C. and Henriksen, B. (2016). Social Semiotic Multimodality. In: Klug, N.M. and Stöckl, H. eds. *Handbuch Sprache im multimodalen Kontex.* Berlin, München, Boston: De Gruyter.

Kahan, D.M. (2016). 'Ordinary science intelligence': a science-comprehension measure for study of risk and science communication, with notes on evolution and climate change. *Journal of Risk Research.* 20(8), pp.995-1016.

Kemper, T.D. (1978). *A social interactional theory of emotions.* New York: Wiley.

Kennedy, H. (2012). Perspectives on Sentiment Analysis. *Journal of Broadcasting & Electronic Media.* 56, pp.435-450.

Kennedy, H. (2015). Seeing Data: Visualisation design should consider how we respond to statistics emotionally as well as rationally. *LSE Impact Blog.* [Online] [Viewed September 2019]. Available from: https://blogs.lse.ac.uk/impactofsocialsciences/2015/07/22/seeing-data-how-people-engage-with-data-visualisations/

Kennedy, H. (2020). Simple data visualisations have become key to communicating about the COVID-19 pandemic, but we know little about their impact. *LSE Impact Blog.* [Online] [Viewed August 2021]. Available from: https://blogs.lse.ac.uk/impactofsocialsciences/2020/05/04/simple-data-visualisations-have-become-key-to-communicating-about-the-covid-19-pandemic-but-we-know-little-about-their-impact/

Kennedy, H. and Engebretsen, M. (2020). Introduction: The relationship between graphs, charts, maps and meanings, feelings, engagements. In: Engebretsen, M. and Kennedy, H. eds. *Data Visualization in Society.* Amsterdam: Amsterdam University Press. pp.19-32.

Kennedy, H. and Hill, R. (2017). The feeling of numbers: Emotions in everyday engagements with data and their visualization. *Sociology.* [online]. [Viewed 5.01.2019].

Kennedy, H., Hill, R., Aiello, G. and Allen, W. (2016a). The work that visualization conventions do. *Information, Communication & Society* [online]. 19(6), pp.715-735.

Kennedy, H., Hill, R., Lucy, Allen, W. and Kirk, A. (2016b). Engaging with (big) data visualizations: Factors that affect engagement and resulting new definitions of effectiveness. *First Monday.* [online]. 21(11). [Viewed 5.04.2020].

Kennedy, H., Steedman, R. and Jones, R. (2020). Approaching public perceptions of datafication through the lens of inequality: a case study in public service media. *Information, Communication & Society*, 24:12, pp.1745-1761.

Kirk, A. (2012). *Data Visualization: a successful design process.* Birmingham: Packt Publishing Ltd.

Kirk, A. (2016). *Data Visualisation: A Handbook for Data Driven Design.* London: Sage Publications Ltd.

Kluger, J. (2006). Earth at the Tipping Point: Global Warming Heats Up. *Time.* [online]. Available from: http://content.time.com/time/magazine/article/0,9171,1176980,00.html

Kosara, R., & Mackinlay, J.D. (2013). Storytelling: The next step for visualization. *IEEE Computer*, 46(5), 44-50.

Kress, G. (2009). *Multimodality: A Social Semiotic Approach to Contemporary Communication.* London: Routledge.

Kress, G.R. and Van Leeuwen, T. (2006). *Reading images: the grammar of visual design.* London: London: Routledge.

Lamprianou, I. (2013). Contemporary Political Participation Research: A Critical Assessment. In: Demetriou, K. N. eds. *Democracy in Transition: Political Participation in the European Union.* pp.21-42. Springer.

Lange, C.G. (1885). *The Emotions.* Baltimore, MD William & Wilkins.

Law, J. (2003). Making a Mess with Method. In: Outhwaite, W. and Turner, S.P. eds. *The Sage Handbook of Social Science Methodology.* Sage.

Ledin, P. and Machin, D. (2018). Doing critical discourse studies with multimodality: from metafunctions to materiality. *Critical Discourse Studies.* 16, pp.1-17.

Levantesi, S. (2021). Hawkins: ‘Governments must decide, or the climate will get out of control'. [online]. [Viewed December 2021]. Available from: https://global.ilmanifesto.it/ed-hawkins-governments-must-decide-or-the-climate-will-get-out-of-control/

Livingstone, S. (2003). On the Challenges of Cross-National Comparative Media Research. *European Journal of Communication.* 18.

Lupi, G. (2017). How we can find ourselves in data. In: *TED: Ideas Worth Spreading*.

Lupton, D. (2020). Doing Fieldwork in a Pandemic.

Margolis, E. and Pauwels, L. (2011). *The SAGE handbook of visual research methods.* Los Angeles, C.A.: SAGE.

Marres, N. (2016). *Material participation: Technology, the environment and everyday publics.* Basingstoke: Palgrave Macmillan

Maslach, C. (1982). *Burnout: The Cost of Caring.* New Jersey: Prentice-Hall.

Mason, J. (2002). *Qualitative Researching.* 2 ed. London: Sage Publications.

Mayblin, L., Valentine, G. and Winiarska, A., W. (2016) Migration and diversity in a post-socialist context: Creating integrative encounters in Poland. *Environment and Planning A*, 48.

Mayer-Schönberger, V. and Cukier, K. (2013). *Big Data: A Revolution that Will Transform how We Live, Work, and Think.* Canada: Eamon Dolan/Houghton Mifflin Harcourt.

McCright, A. and Dunlap, R. (2011). The Politicization Of Climate Change And Polarization In The American Public's Views Of Global Warming, 2001-2010. *The Sociological Quarterly.* 52, pp.155 - 194.

Migracje.gov.pl (2019) *Statystyki – Polska – Aktualne dokumenty – Mapa – Rok: 2019* [online] [Viewed December 2020]. Available from:

https://migracje.gov.pl/statystyki/zakres/polska/typ/dokumenty/widok/mapa/rok/2019/?x=0.6471andy=0.6217andlevel=0.25

Migration_Observatory (2018) *Migrants in the UK: An Overview*. Available online: https://migrationobservatory.ox.ac.uk/resources/briefings/migrants-in-the-uk-an-overview/.

Milan, S. and Treré, E. (2019). Big Data from the South(s): Beyond Data Universalism. *Television & New Media.* 20, pp.319-335.

Muth, L.C. (2018). What to consider when choosing colors for data visualization. *Datawrapper.* [Online]. Available from: https://blog.datawrapper.de/colors/

Neal, S. and Mclaughlin, E. (2009). Researching Up? Interviews, Emotionality and Policy-Making Elites. *Journal of Social Policy.* 38.

Neal, S. and Walters, S. (2006). Strangers asking strange questions? A methodological narrative of researching belonging and identity in English rural communities. *Journal of Rural Studies.* 22, pp.177-189.

Nikolow, S. (2013) 'Words Divide, Pictures Unite.' Otto Neurath's Pictorial Statistics. In: *Historical Context.* Volume 2 Volume 2 eds. Heinrich, R., Nemeth, E., Pichler, W. and Wagner, D. Berlin, Boston: De Gruyter, pp.85-98.

Nielsen, R., Cherubini, F., and Andi, S. (2020). Few winners, many losers: the COVID-19 pandemic's dramatic and unequal impact on independent news media. *Reuters Institute for the Study of Journalism*.

Noble, S.U. (2018). *Algorithms of Oppression: How Search Engines Reinforce Racism.* New York: New York University Press.

Nærland, T.U. (2020). The political significance of data visualization: Four key perspectives. In: Engebretsen, M. and Kennedy, H. eds. *Data Visualization in Society.* Amsterdam: Amsterdam University Press. pp.40-47.

Odendahl, T. and Shaw, A.M. (2002). Interviewing elites. In: Gubrium, J. and Holstein, J. eds. *Handbook of Interview Research: Context and Method.* Thousand Oaks, CA: SAGE. pp.299-316.

Ogunbode, C., Pallesen, S., Böhm, G., Doran, R., Wlodarczyk, A., Lu, S., Jiang, F., Salmela-Aro, K., Hanss, D., Acquadro, M.D., Ardi, R., Chegeni, R., Ghanbarian, E., Park, J., Tsubakita, T., Tan, C.-S., Karlijn, v.d.B., Chukwuorji, J., Kehinde, O. and Aquino, S. (2021). Negative emotions about climate change are related to insomnia symptoms and mental health: Cross-sectional evidence from 25 countries. *Current Psychology.*

Owczarek, D. (2017). *The roots of populism in Poland: unsustainable growth and cultural backlash.* Barcelona: Barcelona Centre for Intenrational Affairs.

O'Neill, S., Boykoff, M., Niemeyer, S. and Day, S. (2013). On the use of imagery for climate change engagement. *Global Environmental Change.* 23, pp.413–421.

Pailey, R.N. (2020). De-centring the 'White Gaze' of Development. *Development and Change.* 51, pp.729-745.

Pandey, A., Manivannan, A., Nov, O., Satterthwaite, M. and Bertini, E. (2014). The Persuasive Power of Data Visualization. *Visualization and Computer Graphics, IEEE Transactions on.* 20, pp.2211-2220.

Pankowski, R. (2010). *The Populist Radical Right in Poland. The Patriots.* Routledge.

Papacharissi, Z. (2015). *Affective Publics. Sentiment, technology and politics.* New York: Oxford University Press.

Pauwels, L. (2020). *Visual Elicitation in Interviews.* SAGE Publications Limited, 2020.

Peck, E., Ayuso, S. and El-Etr, O. (2019) Data is Personal: Attitudes and Perceptions of Data Visualisation in Rural Pennsylvania, CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. 04. 1-12.

Pentland, A. (2013). The Data-Driven Society. *Scientific American.* 309, pp.78-83.

Pew Research Center (2019). *The European Union.* [online]. [Viewed 11.05.2020]. Available from: https://www.pewresearch.org/global/2019/10/14/the-european-union/

Piekut, A., Rees, P., Valentine, G. and Kupiszewski, M. (2011). The tale of two cities: Diversity in Leeds and Warsaw. *Working Paper of the University of Leeds, School of Geography.* 11, pp.1-130.

Piekut, A. and Valentine, G. (2017). Spaces of encounter and attitudes towards difference: A comparative study of two European cities. *Social Science Research, 62, pp. 175-188*.

Pink, S., Horst, H., Postill, J., Hjorth, L., Lewis, T. and Tacchi, J. (2015). *Digital Ethnography: Principles and Practices.* SAGE Publications Ltd.

Read, B. (2018). Serial Interviews: When and Why to Talk to Someone More Than Once. *International Journal of Qualitative Methods.* 17.

Rettberg, J.W. (2020). Ways of knowing with data visualizations. In: Kennedy, H. and Engebretsen, M. eds. *Data visualization in society.* Amsterdam: Amsterdam University Press. pp.35-48.

Rogowski, Ł. (2016). Funkcje zdjęć w wywiadach fotograficznych [Roles of photos in photo interviews]. *Przegląd Socjologii Jakościowej.* 4(10).

Rose, G. (2016). *Visual Methodologies. An Introduction to Researching with Visual Materials.* 4 ed. University of Oxford, UK.

Rosling, H., Rosling, O. and Rönnlund, A.R. (2018). *Factfulness: ten reasons we're wrong about the world - and why things are better than you think*. Hodder and Stoughton Ltd.

Saunders, B., Kitzinger, J. and Kitzinger, C. (2015). Anonymising interview data: challenges and compromise in practice. *Qualitative Research*. 15, pp.616-632.

Saunders, C., Doherty, B., Hayes, G. (2020). A New Climate Movement? Extinction Rebellion's Activists in Profile.

Savage, M., Devine, F., Cunningham, N., Taylor, M., Li, Y., Hjellbrekke, J., Le Roux, B., Friedman, S. and Miles, A. (2013). A New Model of Social Class? Findings from the BBC's Great British Class Survey Experiment. *Sociology.* 47, pp.219-250.

Schipper, L., Ensor, J., Mukherji, A., Mirzabaev, A., Fraser, A., Harvey, B., Totin, E., Garschagen, M., Pathak, M., Antwi-Agyei, P., Tanner, T. and Shawoo, Z. (2021). Equity in climate scholarship: a manifesto for action. *Climate and Development.* pp.1-4.

Schutz, A. (1954). Concept and theory formation in the social sciences. *Journal of Philosophy*, 51, pp.257-273.

Shipman, Martin (1997). *The Limitations of Social Research*, Longman.

Shotter, J. (2005). Acknowledging unique others: Ethics, "expressive realism," and social constructionism. *Journal of Constructivist Psychology.* 18, pp.103-130.

Sikkens, E., van San, M., Sieckelinck, S., Boeije, H. and de Winter, M. (2017). Participant Recruitment through Social Media: Lessons Learned from a Qualitative Radicalization Study Using Facebook. *Field methods.* [online]. 29 (2), pp.130-139.

Simpson, J. (2020). Visualizing data: A lived experience. In: Engebretsen, M. and Kennedy, H. eds. *Data Visualization in Society.* Amsterdam: Amsterdam University Press. pp.157-168.

Sin, Chih. (2007). Ethnic-matching in qualitative research: Reversing the gaze on 'white others' and 'white' as 'other'. *Qualitative Research*. 7.

Spivak, G.C. (2021). The politics of translation. In: Routledge ed. *The Translation Studies Reader.* 4 ed.

Steier, F. (1991). *Research and Reflexivity.* SAGE Publications Ltd.

Stone, J. (2018). British public still believe Vote Leave '£350million a week to EU' myth from Brexit referendum. *Independent*. Available online:

https://www.independent.co.uk/news/uk/politics/vote-leave-brexit-lies-eu-pay-money-remain-poll-boris-johnson-a8603646.html [Accessed January 2021].

Tandon, Ayesha (2021). Analysis: The lack of diversity in climate-science research. *Carbon Brief 2021* (10):1-25

Temple, B. and Young, A. (2004). Qualitative Research and Translation Dilemmas. *Qualitative Research - QUAL RES.* 4, pp.161-178.

Tessier, S. (2012). From Field Notes, to Transcripts, to Tape Recordings: Evolution or Combination? *International Journal of Qualitative Methods.* 11, pp.446-460.

The Gallup Organisation (2015). College-Educated Republicans Most Skeptical of Global Warming. [online] [Viewed November 2019]. Available from: https://news.gallup.com/poll/182159/college-educated-republicans-skeptical-global-warming.aspx

Therrell, M. and Trotter, M. (2011). Waniyetu Wówapi: Native American Records of Weather and Climate. *Bulletin of the American Meteorological Society*. 92, pp.583-592.

Thoits, P.A. (1990). The sociology of emotions. *Annual Review of Sociology.* 15, pp.317-342.

Thomas, R.J. (1993). Interviewing important people in big companies. *Journal of Contemporary Ethnography* (22), pp.80-96.

Tufte, E.R. (2001). *The visual display of quantitative information.* 2nd ed. ed. Cheshire, Conn.: Graphics Press.

Turner, J.H. (2009). *The Sociology of Emotions: Basic Theoretical Arguments.* SAGE Publications and The International Society for Research on Emotion.

Turner, J.H. and Stets, J.E. (2011). *The Sociology of Emotions handbook.* Cambridge University Press.

Tuttas, C. (2014). Lessons Learned Using Web Conference Technology for Online Focus Group Interviews. *Qualitative health research.* 25.

Valentine, G., Winiarska, A., Harris, C. and Jackson, L. (2015). Mapping the meaning of 'difference' in Europe: a social topography of prejudice. *Ethnicities.* 15(4), pp.568-585.

van Deth, J.W. (2016). What is political participation? eds. *Oxford Research Encyclopedia of Politics*. Oxford: Oxford University Press.

van Dijck, J. (2014). Datafication, Dataism and Dataveillance: Big Data Between Scientific Paradigm and Ideology. *Surveillance & Society.* 12, pp.197-208.

van Leeuwen, T. (2005). *Introducing social semiotics.* London: Routledge.

Vertovec, S. (2007). Super-Diversity and Its Implications. *Ethnic and Racial Studies.* 30, pp.1024-1054.

Wahl-Jorgensen, K. (2019). *Emotions, Media and Politics.* Polity Press.

Wallace-Wells, D. (2017). The Uninhabitable Earth. *New York Magazine.* [online]. [Viewed 7 May 2021]. Available from: https://nymag.com/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html

Warren, M. (2002). What Can Democratic Participation Mean Today? *Political Theory.* 30, pp.677-701.

Weber, E. (2010). What Shapes Perceptions of Climate Change? *Wiley Interdisciplinary Reviews: Climate Change.* 1, pp.332 - 342.

Weber, E. (2015). What shapes perceptions of climate change? New research since 2010. *Wiley Interdisciplinary Reviews: Climate Change.* 7.

Weber, M. (1946). *Essays in Sociology.* New York: Oxford University Press.

Wettergren, A. (2015). How do we know what they feel? In: Flam, H. and Kleres, J. eds. *Methods of Exploring Emotions.*

Wihbey, J., Jackson, S., Cruz, P. and Welles, B. eds. (2020). *Visualizing diversity: Data deficiencies and semiotic strategies.* Amsterdam University Press.

Wiles, R., Coffey, A., Robinson, J. and Heath, S. (2012). Anonymisation and visual images: Issues of respect, 'voice' and protection. *International Journal of Social Research Methodology.* 15, pp.41-53.

Willig, C. (2016). Reflections on the Use of Object Elicitation. *Qualitative Psychology.* 4.

WWF (2020) Poland: 2050 climate neutrality feasible and beneficial - report, 2020. Available online: https://www.wwf.eu/?961391/Poland-2050-climate-neutrality-feasible-and-beneficial-report [Accessed. December 2020]

Appendices

Appendix 1 – Interview schedule: audiences

Semi-structured interview schedule for audiences

The participant has been asked to bring along one or a couple of data visualisation/s about climate change that recently evoked her/his emotions. The researcher also brought one historical datavis from the sample for social semiotic analysis that had evoked emotions in the participant in the past and was used in the recruitment process. The participant was invited to the study because s/he had responded (commented) emotionally and passionately to this data visualisation on social media. The participant will be asked about these two sets of datavis about climate change.

I. Opening

Hi. My name is Monika. I am a PhD researcher at the University of Sheffield. I would like to ask you some questions about how you feel, respond and use graphs, charts and maps about climate change. I will use the term 'data visualisations' or 'datavis' to refer to these. The interview focuses on your emotions and responses to these datavis, so there are no wrong answers. All of your answers will be interesting to me. It should take about 60 minutes. Are you ready, can we start?
(Transition: Let me begin by asking you some questions about you and your background)

II. Body

BACKGROUND

- Can you tell me briefly about yourself?

Prompts: what is your job (if working); education; personal life; interests; political views?

- Are you or have you been interested in climate change or active in environmental politics?

Prompts: how long, any experiences; has this interest affected your political involvement?
(Transition to the next topic: Now, I have some general questions about your encounters with datavis)

ENCOUNTERS WITH DATA VISUALISATIONS IN GENERAL

[the researcher shares the computer screen with various types of charts: https://bit.ly/37GalK3]

- How often and where do you come across data visualisations?

Prompts: any experiences in a data-related or visual-related fields?

- How often do you comment on them?
- Are there particular things about datavis that strike you?

Prompts: what chart types (https://bit.ly/37GalK3); what formats: static, interactive; subject matter; location of the datavis; visual style.

- Do you use or rely on datavis for understanding social, political or environmental issues?

Prompts: what kind of issues and why; can you give some examples; have datavis become more or less important for your understanding of the health crisis (pandemic) and why?

- How important do you think datavis is?

(Transition to the next topic: I have asked you to bring along data visualisations to which you have had an emotional response and/or mobilise you to act, and I brought some as well. Now, I will ask you some questions about those)

DATAVIS, EMOTIONS AND EFFECTIVENESS

[focus on the data visualisations that the researcher and participant have brought along and on the shared computer screen with datavis; all the questions below are asked in turn for each datavis]

- Can you tell me how you came across this one?

Prompts: try to recall this situation; how, where and when; time involved in engaging with it?
[focus on the datavis brought by the participant] Why did you select this example to bring to the interview?

- How did it make you feel?

Prompts: Can you remember how you responded when you saw this data visualisation (graph/chart/map); did it trigger particular emotions, positive or negative; why did it make you feel this way?
[focus on the datavis brought by the researcher] Here, you commented: '…' What was it that motivated you to make that comment?

- Tell me what particular elements in it were striking for you/made you respond in a way you did and why?

Prompts: what in the content of the datavis connected with you; any feelings about represented data, visual style or the subject of data visualisations; e.g. composition and layout; colours; fonts; components of datavis; titles; introductions; key/legend, other accompanying text and explanation; source of data; source of the datavis; interactive features or animation; connection to the relevance of time (real-time data), connection to your place, connection to your interests.

- Did this datavis change your mind about anything?

Prompts: how and why; did it surprise you?

- What did it change?

Prompts: can you give me some examples?

- Did it lead to change your practices, to do something/to act?

['yes'] Prompts: why; how? ['no'] Prompts: why do you think it evoked emotions in you, but did not mobilise you do act?

- What did you do?

Prompts: e.g. you signed a petition; contacted officials; took part in a demonstration or strike; attended a meeting or debate; campaigned; did advocacy within an organisation; voted in elections; donated money to an organisation; blogged; posted comments online.
[focus on all the datavis]

- Did any datavis on climate change change your mind about anything or lead to change your practices, to do something/to act?
- Do you think data visualisations are an effective way of communicating information about climate change?

Prompt: do you think that datavis can mobilise people to act, any examples?
(Transition: Thank you. That was the last question)

III. Closing

It was very interesting finding out more about your experiences. Is there anything else you think would be helpful for me to know about?
Thank you. I appreciate the time you took for this interview. Would it be all right to get in touch with you again if I have any more questions?

Appendix 2 – Interview schedule: professionals

Semi-structured interview schedule for the organisations

I. Opening

Hello. My name is Monika Fratczak and as a PhD researcher, I would like to ask you some questions about your experiences with data visualisations.

As you already know my research explores what people experience while engaging with data visualisation on climate change, and what, if any, is the role of data visualisation in enabling political participation. In other words, I'm researching whether data visualisation has an emotional impact on people, and whether and how it can prompt political mobilisation.

This conversation will focus on your experiences of working with data visualisation and your opinions about how people engage with them.

In this study, data visualisation is defined as graphical representations of data which are primarily, but not solely, numeric.

The interview should take about 60 minutes.

(Transition: Let me begin by asking you some questions about your background and work experience)

II. Body

BACKGROUND AND WORK EXPERIENCE

- Tell me briefly about you and how you came to work in this field?
- What is your role/job title, and what does your work involve?

(Transition to the next topic: Now I will ask you some questions about data visualisation production in your organisation)

DATAVIS PRODUCTION

- How frequently do you design/produce/publish datavis within your organisation?

Prompts: how many datavis on climate change?

- Talk me through the process by which you design/produce datavis.

Prompts: what kind of technologies and resources do you use; how do you choose different elements of datavis for example colours, fonts, titles, chart type (graphs, charts, maps, other; static, interactive, other), formats (posters, banners, flyers, reports, other)?

- Can you tell me more about how are their content or focus decided?

Prompts: are they coming from the central office; can you design/produce them; do you have any guidelines?

- Can you show me the datavis I asked you to bring along?
  Why did you choose these?
  Prompts: [focus on the datavis]; was it difficult to choose them?

(Transition to the next topic: Now I would like to talk about your audiences)

AUDIENCES

- Who is your target audience?

Prompts: which audiences do you aim to address (general publics; policy makers; activist/advocacy/campaign groups; young/older people; active/not active); what do you know about them; what are your sources of information.

- Do you target particular datavis at particular audiences?

Prompts: how are you speaking to different audiences?

- Where and in which contexts people can access your datavis?

Prompts: online and offline spaces or any other ways; what spaces do you use most often and why; what works best; [focus on the datavis discussed so far] what about these?

- Can you tell me more about people's reactions to your data visualisations?

Prompts: what are your sources of information; what do you do with their responses?

(Transition to the next topic: Next topic is about datavis and emotions)

DATAVIS AND EMOTIONS

- Do you think that data visualisations can trigger emotions?

Prompts: give examples; what emotions; how; which elements of datavis trigger emotions?

- Do you think that emotions matter in responses to datavis?
- Can you tell me more about why do emotions matter?

Prompts: any conflict between informational and emotive/persuasive aspect?

- Are you hoping to enact/trigger any emotions with these specific datavis?

Prompts: [focus on the datavis discussed so far]; what emotions are targeted in particular; how they were designed for this; what works best?

(Transition to the next topic: Finally, the last topic is about datavis and they effectiveness)

DATAVIS EFFECTIVENESS

- What do you think makes a data visualisation effective?

Prompts: what does effective mean to you?

- What, if anything, do you think makes your example datavis effective?

Prompts: [focus on the examples discussed so far]; what is the aim; what kind of reactions/political mobilisation are you trying to trigger; does it work?

- Have you ever seen any evidence that a datavis on climate change mobilised people to act/be politically active?

Prompts: best datavis on climate change; who do you know that makes a striking datavis on climate change; organisations/designers?

- What do you think about the futures of datavis as a way to communicate information and prompt activism/participation?

(Transition: Thank you. That was the last question)

III. Closing

It has been a pleasure finding out more about your experiences, and I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know about? Would it be all right to get in touch with you again if I have any more questions?

Appendix 3 – Information sheet: audiences

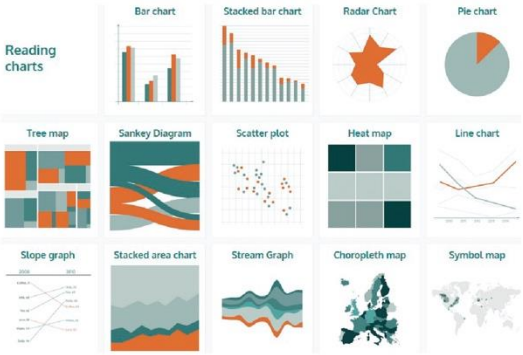
The University Of Sheffield.

Economic and Social Research Council

White Rose Social Sciences DTP

Experiences of data visualization (graphs, charts, maps)

I would like to invite you to take part in my research project. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. If there is anything that is not clear or if you would like more information, please contact me.



The source of the image: **http://seeingdata.org/sections/inside-the-chart/**. Used with permission.

1. What is the project's purpose?

Data visualizations are increasing as part of everyday life and as information tools for providing certain knowledge and understanding about social issues and concerns. The purpose of this investigation is to explore what people experience while engaging with data visualization in their everyday lives and what, if any, is the role of data visualization in enabling political participation in the UK and Poland; that is, whether data visualization has an emotional impact on people, and whether and how it can prompt political action in two different national contexts.

2. Why have you been chosen?

Participants will be invited to the study from Poland and from the UK. You have been chosen as one of them because of your interest in and response to data visualization. Hearing your experiences and perspectives will be valuable for this research, and it would be beneficial to include them in the study.

3. Do you have to take part?

Your involvement is entirely voluntary. If you decide to take part, you will be asked to sign a consent form, but you can still withdraw at any time without any negative consequences. You do not have to give a reason. If you wish to withdraw, please contact me.

4. What will you have to do if you take part?

You will be invited to have an interview either face to face at a mutually convenient venue or on Skype if you prefer. The interview is semi-structured and is expected to take around 60 minutes. It will involve answering a small number of questions and talking about your experiences and will be an opportunity for the researcher to gain a more in-depth perspective of your engagement with data visualization that you have previously reacted to. After agreeing to participate, the consent form will be emailed prior to you, and the exact mutually convenient date for the interview will be determined.

5. Will you be recorded, and how will the recorded media be used?

Your responses will be recorded, with your permission. The recordings will be used only for analysis and deleted immediately after transcription.

6. Possible disadvantages, risks and benefits

The interview is not expected to pose any risk or threat to you. Questions are all based around your feelings and judgements. At a very most, you might find discussing some emotional aspects of your experiences challenging.

This research will make an original contribution to knowledge, as to date, research on data visualization, emotions, and democratic participation has not been undertaken. There are no direct benefits to you, however, some people enjoy having the opportunity to reflect on topics important to them.

7. Will your taking part in this project be kept confidential?

All the information that we collect about you during the research will be kept strictly confidential and will only be accessible to me and my supervisors. You will not be able to be identified in any reports or publications. If you agree to us sharing the information you provide with other researchers (e.g. by making it available in a data archive), then your personal details will not be included..

8. What will happen to the data collected, and the results of the research project?

According to data protection legislation, I am required to inform you that the legal basis we are applying in order to process your personal data is that *'processing is necessary for the performance of a task carried out in the public interest'* (Article 6(1)(e)). Further information can be found in the University's Privacy Notice: **https://www.sheffield.ac.uk/govern/data-protection/privacy/general**.
As I will be collecting some data that is defined in the legislation as more sensitive (emotional experiences), I need to let you know that we are applying the following condition in law: that the use of your data is necessary for scientific or historical research purposes.

Once the interview has been completed it will be completely anonymized. Interviewees will be immediately assigned pseudonyms to ensure the confidentiality and anonymity of you in the publication or dissemination of any findings from this research.

Procedures for handling, processing, storage and destruction of study data meet the requirements of Data Protection Act 2018. All interview responses and information, which is collected about you during the research, will be stored in password protected strictly confidential electronic sites on the University's secure drives. Any personal information will be kept for 6 months after the end of the study, and all other raw data and interview notes must be held securely for at least 5 years from the date of completion of the study. After this time, your data will be deleted. Due to the nature of this study, other researchers may likely find the data collected to be useful in answering future research questions. I will ask for your explicit consent for your anonymous data to be shared in this way.

9. Who is the Data Controller, organizer and funder of the research?

The University of Sheffield is the Data Controller and organizes the study. The Economic and Social Research Council's PhD funding program provides financial support for the research.

10. Who has ethically reviewed the project?

This project has been ethically approved via the University of Sheffield's Ethics Review Procedure, as administered by the Department of Sociological Studies.

11. What if you wish to complain about the research?

If you have a concern about any aspect of this study, please contact me. If this is not satisfactory, then please contact my supervisors by email or by post:
Professor Helen Kennedy: h.kennedy@sheffield.ac.uk or
Professor Sarah Neal: s.neal@sheffield.ac.uk

Department of Sociological Studies
University of Sheffield, Western Rd
Sheffield S10 2TU

If you feel your complaint has not been handled to your satisfaction you can contact the Head of Department **Professor Nathan Hughes** by email: nathan.hughes@sheffield.ac.uk.

If the complaint relates to how your personal data has been handled, information about how to raise a complaint can be found in the University's Privacy Notice:

https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

Many thanks for reading this information!

Researcher: **Monika Fratczak**
Telephone: **07713839649**
Email: **mefratczak1@sheffiled.ac.uk**

Appendix 4 – Information sheet: professionals

The University Of Sheffield.

Economic and Social Research Council

White Rose Social Sciences DTP

Can data visualization mobilize people to act?

I would like to invite you to take part in my research project. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. If there is anything that is not clear or if you would like more information, please contact me.

1. What is the project's purpose?

The recent increase in private, public and political use of data, and the increased circulation of data through visual representations indicate that data visualizations (graphs, charts and maps) are gaining importance. Data are everywhere, and data visualizations are not solely useful for small groups of experts or professionals. The purpose of this investigation is to explore what people experience while engaging with data visualization in their everyday lives and what, if any, is the role of data visualization in enabling political participation in the UK and Poland; that is, whether data visualization has an emotional impact on people, and whether and how it can prompt political action in two different national contexts.

2. Why have you been chosen?

I am inviting people who work with data visualizations in Poland and the UK to be interviewed about their experience and perspectives. You have been chosen as one of them because you design, publish or commission data visualizations. Your experiences are valued for this research, and it would be very helpful and beneficial to include them in the study.

3. Do you have to take part?

Your involvement is entirely voluntary. If you decide to take part, you will be asked to sign a consent form, but you can still withdraw at any time without any negative consequences. You do not have to give a reason. If you wish to withdraw from the research, please contact me.

4. What will you have to do if you take part?

You will be invited to have a face to face or skype interview. It is expected to take around 60 minutes to answer a short set of the questions. These will focus on your experiences and will be an opportunity for me to gain a more in-depth perspective of your engagement with data visualization that you design or commission within the organization. After agreeing to participate, the consent form will be emailed prior to you, and the exact mutually convenient date for the interview will be determined.

5. Will you be recorded, and how will the recorded media be used?

Your responses will be recorded, with your permission. The recordings will be used only for analysis and deleted immediately after transcription.

6. Possible disadvantages, risks and benefits

The interview is not expected to pose any risk or threat to you. Questions will be easy to answer. I will ask about data visualizations, why or when it is effective and how you use it.

This research will make an original contribution to knowledge, as to date, research on data visualization, emotions, and democratic participation has not been undertaken. The project's findings may be relevant to your organization or your work.

6. Possible disadvantages, risks and benefits

The interview is not expected to pose any risk or threat to you. Questions are all based around your feelings and judgements. At a very most, you might find discussing some emotional aspects of your experiences challenging.

This research will make an original contribution to knowledge, as to date, research on data visualization, emotions, and democratic participation has not been undertaken. There are no direct benefits to you, however, some people enjoy having the opportunity to reflect on topics important to them.

7. Will your taking part in this project be kept confidential?

All the information that we collect about you during the research will be kept strictly confidential and will only be accessible to me and my supervisors. You will not be able to be identified in any reports or publications. If you agree to us sharing the information you provide with other researchers (e.g. by making it available in a data archive), then your personal details will not be included..

8. What will happen to the data collected, and the results of the research project?

According to data protection legislation, I am required to inform you that the legal basis we are applying in order to process your personal data is that *'processing is necessary for the performance of a task carried out in the public interest'* (Article 6(1)(e)). Further information can be found in the University's Privacy Notice: **https://www.sheffield.ac.uk/govern/data-protection/privacy/general**.
As I will be collecting some data that is defined in the legislation as more sensitive (emotional experiences), I need to let you know that we are applying the following condition in law: that the use of your data is necessary for scientific or historical research purposes.

Once the interview has been completed it will be completely anonymized. Interviewees will be immediately assigned pseudonyms to ensure the confidentiality and anonymity of you in the publication or dissemination of any findings from this research.

Procedures for handling, processing, storage and destruction of study data meet the requirements of Data Protection Act 2018. All interview responses and information, which is collected about you during the research, will be stored in password protected strictly confidential electronic sites on the University's secure drives. Any personal information will be kept for 6 months after the end of the study, and all other raw data and interview notes must be held securely for at least 5 years from the date of completion of the study. After this time, your data will be deleted. Due to the nature of this study, other researchers may likely find the data collected to be useful in answering future research questions. I will ask for your explicit consent for your anonymous data to be shared in this way.

9. Who is the Data Controller, organizer and funder of the research?

The University of Sheffield is the Data Controller and organizes the study. The Economic and Social Research Council's PhD funding program provides financial support for the research.

10. Who has ethically reviewed the project?

This project has been ethically approved via the University of Sheffield's Ethics Review Procedure, as administered by the Department of Sociological Studies.

11. What if you wish to complain about the research?

If you have a concern about any aspect of this study, please contact me. If this is not satisfactory, then please contact my supervisors by email or by post:
Professor Helen Kennedy: h.kennedy@sheffield.ac.uk or
Professor Sarah Neal: s.neal@sheffield.ac.uk

Department of Sociological Studies
University of Sheffield, Western Rd
Sheffield S10 2TU

If you feel your complaint has not been handled to your satisfaction you can contact the Head of Department **Professor Nathan Hughes** by email: nathan.hughes@sheffield.ac.uk.

If the complaint relates to how your personal data has been handled, information about how to raise a complaint can be found in the University's Privacy Notice:

https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

Many thanks for reading this information!

Researcher: **Monika Fratczak**
Telephone: **07713839649**
Email: **mefratczak1@sheffiled.ac.uk**

Appendix 5 – Participant consent form

Experiences of data visualisation

Consent Form

Please tick the appropriate boxes	**Yes**	**No**
Taking Part in the Project		
I have read and understood the project information sheet dated 01/10/2019 or the project has been fully explained to me. (If you will answer No to this question, please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I agree to take part in the project. I understand that taking part in the project will include being interviewed and audio recorded.	☐	☐
I understand that my taking part is voluntary and that I can withdraw from the study at any time; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.	☐	☐
How my information will be used during and after the project		
I understand my personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project.	☐	☐
I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.	☐	☐
I understand and agree that other authorised researchers will have access to this anonymised data.	☐	☐
I understand and agree that other authorised researchers may use my data in publications, reports, web pages, and other research outputs.	☐	☐
I give permission for the anonymised interview data that I provide to be deposited in ORDA, the University of Sheffield *data* repository so it can be used for future research and learning.	☐	☐
So that the information you provide can be used legally by the researchers		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield.	☐	☐

Name of participant [printed]	Signature	Date
Name of Researcher [printed]	Signature	Date

Project contact details for further information:

Lead researcher: Monika Fratczak, email: mefratczak1@sheffield.ac.uk, phone number: 07713839649.
Supervisors: Professor Helen Kennedy, email: h.kennedy@sheffield.ac.uk; Professor Sarah Neal, email: s.neal@sheffield.ac.uk.
Head of Department: Professor Nathan Hughes, email: nathan.hughes@sheffield.ac.uk.
Department of Sociological Studies
University of Sheffield, Western Rd
Sheffield S10 2TU

Appendix 6 – Demographic survey: audiences

Experiences of data visualisation (graphs, charts, maps)
Questionnaire for Participants

CONTACT DETAILS (please write below)

Full name: Email: Telephone: Country of residence:

BIOGRAPHICAL DETAILS (please tick the appropriate boxes and/or write below)
Age:

Gender: ☐ Female ☐ Male ☐ Non-binary ☐ Own definition ☐ Prefer not to say

How would you describe your nationality?

Which of the following best describes your ethnicity?

White:

☐ English / Welsh / Scottish / Northern Irish / British

☐ Irish ☐ Gypsy or Irish Traveller

☐ Any other White Background:

Mixed / Multiple Ethnic Groups

☐ White and Black Caribbean ☐ White and Black African

☐ White and Asian

☐ Any other Mixed / Multiple Ethnic Background:

Asian / Asian British

☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Chinese

☐ Any other Asian Background:

Black / African / Caribbean / Black British

☐ African ☐ Caribbean

☐ Any other Black / African / Caribbean Background:

Other Ethnic Group

☐ Arab ☐ Any other ethnic Background:

What is the highest degree you have received?

☐ Less than GCSE (General Certificate of Secondary Education) or equivalent

☐ GCSE (General Certificate of Secondary Education) or equivalent

☐ A-Levels or equivalent

☐ University undergraduate programme

☐ University post-graduate programme

☐ Doctoral degree

Which of these best describes what you were doing last month? (Mark all that apply)

☐ Working full time (30 or more hours per week)

☐ Working part time (less than 30 hours a week)

☐ Unemployed and looking for work

☐ Full time student

☐ Retired

☐ Not in paid work for any other reason

☐ Other

Occupation (if working):

POLITICAL ENGAGEMENT

Which of the following activities, if any, have you done at least once? (Mark all that apply)

☐ voting in elections ☐ being a member of a political party / volunteer organisation

☐ contacting officials ☐ attending a meeting or debate

☐ participating in a protest ☐ signing a petition

☐ campaigning ☐ donating money to a social / political organisation

☐ blogging about politics ☐ posting comments on political issues online

☐ other (Please specify):

MEDIA USE

Which of the following media, if any, do you use at least once a week? (Mark all that apply)

Social Media

☐ Facebook

☐ Twitter

☐ Snapchat or Instagram

☐ Read or write online blogs

☐ YouTube, Vimeo, or other online video sites

☐ other social media sites (Please specify which site(s)):

News

☐ Read physical newspapers

☐ Read magazines or journals

☐ Visit online news sites

☐ Use news apps

How frequently do you use each type of media?

Social Media *News*

☐ Less than once weekly ☐ Less than once weekly

☐ Weekly ☐ Weekly

☐ Daily ☐ Daily

☐ More than once a day ☐ More than once a day

How many hours a day: How many hours a day:

Many thanks for completing this form!

Appendix 7 – Demographic survey: professionals

Can data visualisation mobilise people to act?

Questionnaire for Participants

BIOGRAPHICAL DETAILS (please tick the appropriate boxes and/or write below)
Age:

Gender:

☐ Female ☐ Male ☐ Non-binary ☐ Own definition ☐ Prefer not to say

How would you describe your nationality?

☐ English ☐ Other (Please specify)

Which of the following best describes your ethnicity?

White:

☐ English / Welsh / Scottish / Northern Irish / British

☐ Irish ☐ Gypsy or Irish Traveller

☐ Any other White Background:

Mixed / Multiple Ethnic Groups

☐ White and Black Caribbean ☐ White and Black African

☐ White and Asian

☐ Any other Mixed / Multiple Ethnic Background:

Asian / Asian British

☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Chinese

☐ Any other Asian Background:

Black / African / Caribbean / Black British

☐ African ☐ Caribbean

☐ Any other Black / African / Caribbean Background:

Other Ethnic Group

☐ Arab ☐ Any other ethnic Background:

What is the highest degree you have received?

☐ Less than GCSE (General Certificate of Secondary Education) or equivalent

☐ GCSE (General Certificate of Secondary Education) or equivalent

☐ A-Levels or equivalent

☐ University undergraduate programme

☐ University post-graduate programme

☐ Doctoral degree

Many thanks for completing this form!

Appendix 8 – Invitation message: audiences

"Dear/Hi … [insert name], I am a PhD student at the University of Sheffield, and I am researching what people experience while engaging with data visualisation (graph, charts and maps) on climate change. I invite 15 people from the [insert country] to take part in the study. I was really interested in your response/comment to this data visualisation: … [insert link], and I would love to interview/chat with you about this! It involves answering a few questions and talking about your experiences and feelings. They are not complicated, and I am not looking for experts in climate change or data visualisations. The chat will be held online via Skype, Zoom or Messenger (whatever suits you best) and take around 45-60 minutes. Please go there to find out more about me and my research: https://readymag.com/u10841756/2076221/, and get back to me if you are interested in taking part in my study. Best wishes, Monika."

Appendix 9 – Invitation message: professionals

Hello [insert name],

I hope you are well and don't mind me contacting you. I obtained your email address from [insert name]. I am a second-year PhD researcher at the University of Sheffield. I previously worked on community art projects and in digital literacy education.

My research focuses on people's experiences of engaging with data visualisation and the role data visualisation plays in enabling political participation (see attached project Information Sheet). The increased circulation of data through visual representations suggests that datavis are gaining importance, but, rather surprisingly, we still don't know whether and how they can mobilise people to act, which is the subject of my research. It focuses on graphs, charts and maps about climate change and compares the UK and Poland.

This study combines three methods. One of them is interviews with the organisations whose data visualisation I aim to follow as part of my project. The aim of the interviews is to talk about datavis production and related intentions and to identify datavis to analyse and discuss with audiences in the rest of my study. I would ask for an interview with the person or people who choose, commission or design data visualisations for [insert organisation]. Each interview (face to face or Skype) will take around 60 minutes.

I think my research and its findings may be of interest to, and benefit, your organisation. They will be relevant to your work, as they will provide insights into how people engage and respond to your datavis. I will also produce a short report for you at the end of the research process.

My PhD is supervised by experienced academics including Professor Helen Kennedy and Professor Sarah Neal. Helen Kennedy is an expert on data visualisation: https://www.sheffield.ac.uk/socstudies/staff/staff-profiles/helen-kennedy. She has carried out extensive research into how people respond to data visualisations, working with Andy Kirk from Visualising Data and Clever Franke, amongst others (see https://bit.ly/33FOEa7 and https://bit.ly/34O9zb4 for examples of her work).

I really hope you will be willing to help and be involved with my research project, and I look forward to hearing from you.

Best wishes,
Monika Fratczak

University of Sheffield

Appendix 10 – Overview of audience participants

Audience participants from Poland

Name	Gender	Age	Nationality	Ethnicity	Degree	Occupation
1. Vera	Female	19	Polish-Italian	Italian	Secondary	Cook
2. Tom	Male	24	Polish	Polish	Higher	Scientist
3. Aurora	Female	24	Polish	Polish	Higher	Psychology graduate
4. Jan	Male	25-30	Polish	Polish	Higher	Educator
5. Aneta	Female	29	Polish	Polish	Higher	Official, inspector, eco-manager
6. Adam	Male	34	Polish	Polish	Doctoral degree	University teacher
7. Natalia	Female	35	Polish	Polish	Post-secondary	Educator, photographer, animator
8. Mariusz	Male	48	Polish	Polish	Higher	IT specialist
9. Jadwiga	Female	70	Polish	Polish	Secondary	Retired
10. Jacek	Male	72	Polish	Polish, German, Austrian, Czech	Higher	Retired
11. Krzysztof	Male	34	Polish	Polish	Higher	Lawyer
12. Lucyna	Female	35	Polish	Polish	Higher	PR manager

13. Ewa	Female	36	Polish	Polish	Doctoral degree	Scientist, University teacher
14. Maciej	Male	41	Polish	Polish	Higher	Economist, trainer
15. Archibald	Male	65	Polish	Polish	Higher	Journalist
16. Marek	Male	40	Polish	Polish	Secondary	Businessman

Audience participants from the UK

Name	Gender	Age	Nationality	Ethnicity	Degree	Occupation
1. Tom	Male	25	British	White English / Welsh / Scottish / Northern Irish / British	A-Levels or equivalent	Teaching Assistant, Wildlife Rescue Worker
2. Jess	Female	36	British	White English / Welsh / Scottish / Northern Irish / British	University undergraduate	Customer service officer
3. Peter	Male	50	British	White English / Welsh / Scottish / Northern Irish / British	University undergraduate	Software developer
4. Tony	Male	50	Italian	Any other white background	University post-graduate	R&D Manager
5. Rita	Female	40	Portuguese	Any other white background	A-Levels or equivalent	Admin Assistant

6. Ann	Female	46	British	White English / Welsh / Scottish / Northern Irish / British	A-Levels or equivalent	Personal assistant
7. George	Male	26	British	White English / Welsh / Scottish / Northern Irish / British	University undergraduate	Environmental Consultant Self employed
8. Jack	Male	45	British	White English / Welsh / Scottish / Northern Irish / British	A-Levels or equivalent	Electrician Self employed
9. Kate	Female	47	British	White English / Welsh / Scottish / Northern Irish / British	Doctoral degree	Analyst
10. Mark	Male	64	British	White English / Welsh / Scottish / Northern Irish / British	A-Levels or equivalent	Insurance broker
11. Rachel	Female	38	British	White English / Welsh / Scottish / Northern Irish / British	University post-graduate	Learning technologist
12. Bill	Male	64	British	White English / Welsh /	A-Levels or	Taxi Driver Self employed

				Scottish / Northern Irish / British		
13. Jo	Female	32	British	White English / Welsh / Scottish / Northern Irish / British	University undergraduate	Publishing, Graphic design, Self employed
14. Nguyen	Female	25	Vietnamese	Any other Asian Background	University undergraduate	Business Development
15. Anjelo	Male	32	Tongan	Any other ethnic Background	University post-graduate	Meteorologist
16. Hawa	Female	22	Irish	Indian	A-Levels or equivalent	Student
17. Marjorie	Female	60	Angloindian	White and Asian	A-Levels or equivalent	Retired
18. Edo	Male	20	British	Any other Mixed / Multiple Ethnic Background	A-Levels or equivalent	Student

Appendix 11 – Overview of professional participants

Organisation	Name	Gender	Age	Nationality	Ethnicity	Degree
Nauka o klimacie Poland (Climate Science Poland)	Anna	Female	39	Polish	White Polish	Doctoral degree
Greenpeace Poland	Bartek	Male	33	Polish	White Polish	Higher
Greenpeace Poland	Patrycja	Female	27	Polish	White Polish	Secondary
WWF Poland	Justyna	Female	26	Polish	White Polish	Higher
WWF Poland	Sebastian	Male	29	Polish and Dutch	Polish and Dutch	Higher
Carbon Brief UK	Steve	Male	47	British	White English/ Welsh/ Scottish/ Northern Irish/ British	University undergraduate
Carbon Brief UK	Anthony	Male	33	English	White English/ Welsh/ Scottish/ Northern Irish/ British	University postgraduate
Greenpeace UK	David	Male	36	n/a	n/a	University postgraduate
WWF UK	Olivia	Female	24	English	White English/ Welsh/ Scottish/ Northern Irish/ British	University undergraduate
WWF UK	Amelia	Female	25	English	Indian	University undergraduate

Appendix 12 – Semiotic analysis table

Datavis	Composition & layout	Colour	Components	Interactivity	Animation	Hand drawing
Figure 10	- two-dimensional and top-down view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge; - high angle suggests objectivity and shows the situation from an impersonal distance.	- green represents forests and connotes the environment and harmony with nature; - yellow represents deforestation and connotates a sense of lost.	- clear elements such as the logo at the bottom and tittle suggest trustiness, transparency and verifiability.	NA	NA	NA
Figure 9	- two-dimensional and top-down view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge; - high angle suggests objectivity and show the situation from an impersonal distance.	- eye catching, clashing colours engage and grab attention; - red and black represent two countries (Poland and Czech Republic) that do not support an EU 2050 climate neutral goal and connotate danger, or death; the red can evoke fear and a sense of warning; - green represents countries that support an EU 2050 climate neutral goal and connotes the environment and harmony with nature.	- clear elements such as the logo at the top and the inclusion of the link for further information suggest trustiness, transparency and verifiability.	NA	NA	NA
Figure 6	- two-dimensional and front view suggest objectivity and dispassionate knowledge.	- eye-catching bright colours engage and grab attention; - red represents t*he Energy sector in Poland which produces the most greenhouse gas* emission and connotates danger; red can evoke fear and a sense of warning	- clear elements such as the logo at the bottom and tittle suggest trustiness and transparency; - graphic pictures representing sectors of the economy presented in the visualisation make the data visualisation more friendly for users.	NA	NA	NA
Figure 7	- two-dimensional and top-down view and minimal text suggest objectivity, simplicity and dispassionate knowledge; - high angle suggests objectivity and show the situation from an impersonal distance.	- eye-catching bright yellow part of the title ('worst air') grabs attention; - red dots represent 50 most polluted cities in the UE and connotate danger. - red is very emotive and can evoke fear and a sense of warning - green dots represent 25 less polluted cities in the UE and connotate harmony with nature.	- clear elements such as the logo at the bottom, tittle and the legend suggest trustiness and transparency.	NA	NA	NA
Figure 12	- two-dimensional and top-down view, clean layout, absence of any decoration and	- red represents burned forests in Australia as a third of Great Britain and is associated with danger and	- clear elements such as the logo at the top and the inclusion of the link for further information	NA	NA	- hand drawn elements

	minimal text suggest objectivity, simplicity and dispassionate knowledge; - high angle suggests objectivity and show the situation from an impersonal distance.	death; can arouse fear and a sense of warning; - green represents the remaining two-thirds of the UK and connotes harmony with nature and safety. - pastel green and blue can evoke friendly feelings towards the visual form of the data vis.	suggest trustiness, transparency and verifiability.			suggest a kind of playfulness and can evoke friendly feelings towards the visual form of the data vis.
Figure 11	- two-dimensional, top-down view, clean layout and absence of any decoration suggest objectivity, simplicity and dispassionate knowledge.	- eye-catching bright orange and red draw users' attention to the last pie chart; - red is alarming; it represents people who are not concerned about climate; it can evoke a sense of warning and danger; - neutral pastel colours represent the opinions of UK residents on topics other than climate change; these colours can evoke a feeling of neutrality and less importance of the remaining three pie charts.	- first part of the title is eye-catching; it is written in large, capital, white bold letters. - four pie charts are arranged symmetrically, equal in size and oriented in the same way create a relation of similarity between them; - circles organizing information and creating neatness; - precise and clear elements, such as the logo at the top, minimal text and the inclusion of information about data source suggests trustiness.	NA	NA	- hand drawn data vis suggests a kind of playfulness and can evoke friendly feelings towards the visual form of the data vis.
Figure 8	- two-dimensional view suggests objectivity and dispassionate knowledge.	- eye-catching bright red draw users' attention to the hottest years; - eye-catching bright yellow gradually spreads over the line chart and represents CO2 emissions increasing over time; it can be overwhelming, evoke fear, worry or sadness. - neutral pastel colours such as purple and green can evoke friendly feelings towards the visual form of the data vis.	- Two-dimensional line graph can create a dynamic process with meaning such as 'change', and 'grow'; - clearly labelled x and y scales, precise descriptions and dates suggest transparency and verifiability.	NA	NA	- hand drawn data vis suggests a kind of playfulness and can evoke friendly feelings towards the visual form of the data vis.
Figure 13	- two-dimensional view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge.	- eye-catching bright red bars draw users' attention to different kinds of diets and show how much CO2e each of the diets produces each year.	- eight bar charts are arranged symmetrically and oriented in the same way create a relation of similarity between them.	NA	NA	NA

Figure 14	- two-dimensional view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge.	- red colour distinguishes the current year from the other lines that are drawn in various neutral shades of blue; - red attracts attention, distinguishes the curve from the other curves, and emphasises the (temporary) change and hope for the future.	- clearly labelled x and y scales, precise description, years and the logo at the bottom create transparency and verifiability; - the use of numbers create objectivity; - lines create order, organising information and creating neatness. - the line chart creates a dynamic process with meaning such as 'change', 'grow' and 'decrease' and focuses on the horizontal dimension with a concern 'Where is it going?'; - by highlighting the contrast and showing similarities between all 7 years the data vis can evoke shock.	NA	NA	NA
Figure 15	- two-dimensional view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge.	- different colours represent different continents/countries; - the eye-catching bright red bars draw users' attention to China and Japan, which appear in the visualisation in the second half of the animation; can evoke shock; - the grey bar representing the USA is more eye-catching than the other blue bars representing European countries; it is visible and grows throughout the visualisation; the grey colour here can symbolize no surprise and stable growth.	- comparison of many countries can create relation of similarity between two or more of them; - two-dimensional charts: creating a dynamic process with meaning such as 'change', 'grow', 'decrease', etc. - precise descriptions and figures, small map serving as legend suggest transparency and verifiability; - clear elements such as the logo at the bottom and indication of the source of the data and the authors: suggest trustiness and transparency; - use of numbers creates objectivity and verifiability.	NA	– dynamic process; gradual building of change and dramatic narration	NA
Figure 16	- two-dimensional view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge.	- yellow and purple colours highlight and draw attention to the most important information the line graph; - the colour of the following years changes gradually from yellow to orange, red and purple indicate the danger related to the increase in greenhouse gas emissions in the following years; it can cause fear and anxiety about what is to come.	- two-dimensional charts: creating a dynamic process with meaning such as 'change', 'grow', and 'decrease'; - a shift from a focus on the vertical to a focus on the horizontal, a change from a concern with 'What is the state of affairs?' and 'Where are we?' to 'Where are we going?';	NA	– dynamic process; gradual building of change and dra	NA

			- precise descriptions and figures and clear elements such as the logo at the bottom suggest transparency and verifiability; - use of numbers creates objectivity and verifiability.		matic narration	
Figure 17	- two-dimensional and top-down view, clean layout, absence of any decoration and minimal text suggest objectivity, simplicity and dispassionate knowledge.	- each coloured stripe represents the temperature in Poland; - the reddest stripes represent the warmest periods of time and connotate danger; it can evoke fear and a sense of warning; - blue represent coolest periods of time and connotate a kind of balance and security; -gradually changing colours in different shades of blue and red show a negative change in temperature over time; it can evoke fear, worry, sadness.	NA	NA	NA	NA
Figure 18	- two-dimensional and top-down view suggest objectivity and dispassionate knowledge.	- orange line is the most eye-catching and represents CO2 emission in Poland; it is alarming and connotates that situation in Poland is worse than in Colombia represented by more neutral gray line on the graph.	- elements such as the organisation's page address at the bottom, title, axis description and the inclusion of the data source suggest trustiness, transparency and verifiability; - graphic characters from the South Park series graphic characters from the South Park series can make the visualisation more friendly, funny, and playful.	NA	NA	NA

Appendix 13 – Examples of codes and themes

Name	Quotations from the interviews (examples)	Files (participants)	References
	animals' lives but also people." Hawa "Well, upset and concerned for Australia and the terrible loss of habitat and wildlife. Literally millions and millions of animals perished in that fire as well as property and that sort of thing. But a terrible loss, you know?" Mark "I think the turtle picture's more attention grabbing because people will just focus on the emotion or compassion." Nguyen "It is, it is, because that gives you the summary of the perspective of time, of what is increasing or declining. So, that for summary is great. But again, for an impact, it's always a brutal image of an animal suffering. That for me – because you can see on the reports of every welfare organisation, they have charts and pie charts of everything, and no one will care because that doesn't make an impact. What makes an impact is the graphic information of an animal dying. That is when you make a connection." Rita		
excitement	"And so I felt, by the time I'd got to the end of the post, it would be ridiculous of me not to share it, if that makes sense?" Edo	1	1
happiness, pleasure	"It confirmed what I already suspected and believed. So it made me feel happy that I'd got it right." Bill	4	6

Feb 7, 2021 15

Name	Quotations from the interviews (examples)	Files (participants)	References
	"It's very, very important because without it you won't be able to, as I said, compare one piece of data against another visually. It won't – it won't make you happy or improve your mood. Sometimes seeing something in a picture format can improve your mood as well." Hawa "Um, I was just – it was just – I was happy to see basically like a carbon brief looking at the – at this data, to basically show if pandemic was having – was effectively, at least for a period of time, was having a beneficial impact in terms of climate change. Because obviously there was a small pause." Tony "Yeah, I felt positive, happy. Surprising how many of these electric vehicles are on the road actually, a lot more – we're talking thousands here, 142,000 Tesla vehicles which I was shocked because they were around 100,000 dollars." Jack		
relief	"Relief. Well like I say, it's, um, to see United Kingdom go back down the scale the further we go, so we're one, two, fourth – fifth way down. There's five countries ahead of us in the pollution [laughs]." Jack	1	1
General encounters with dataviz			

Feb 7, 2021 16

Name	Quotations from the interviews (examples)	Files (participants)	References
	wa "Yeah, so I was quite impressed with this. It wasn't busy, I wasn't getting confused what I was looking at and trying to find out what's what." Jack "I don't like heat maps for that, I prefer, you know, I find them a little bit too complicated unless you've got a lot of time to sit [laughs]." Kate		
11. (E) expertise and emotions	"So, yes personally it was very informative, it was very engaging when I first saw this, but it also, um, on a more personal level it also touched me very deep in my heart to see where we are heading towards given – despite my background in this kind of areas." Angelo	1	1
12. (E) negative emotions			
anger	"With the way that things were just shows that we're not progressing in the way that we should be. You know, the Paris Agreement was signed years ago, and yet in 2019 the arctic sea ice volume was way below what it should be still, it's not improving, it's getting worse. So yeah, it was a bit angry." Endo	3	4

Feb 7, 2021 9

Name	Quotations from the interviews (examples)	Files (participants)	References
	"It doesn't make me happy because what it's actually saying is that the ice is melting. I think understanding the concept but it was negative emotions when I understood the concept. Angry maybe 'cos, you know, it's – I think what it's trying to say is that the sea ice is diminishing. It's reducing." Hawa "It makes me feel angry and sad when I see things like this. I think mainly because it feels like such a simple thing we can do to stop this madness and yet we're still not doing it." Jo		
disgust		0	0
fear	"Generally as far as climate change is concerned bar line graphs as in the left-hand side there, they show a time progression, and one of the most horrifying ones is the increase in CO2 in the atmosphere, and you can link that pretty much directly to the melting ice." Bill "Every time I use it with clients, they have it up on their TV in the office so people can see it and people are like, oh that's scary." George "Fear, yeah, that it may happen. You know, so many people's lives could have been lost as well, you know, not just animals' lives but also people." Hawa	7	15

Feb 7, 2021 10

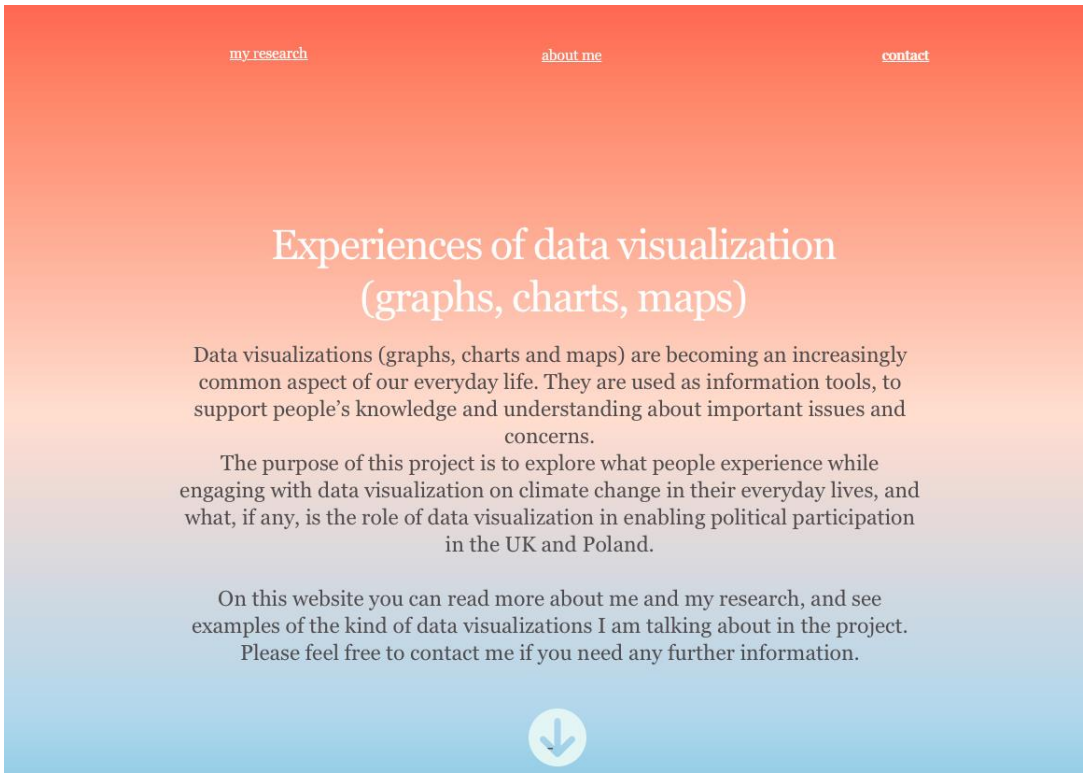
Name	Quotations from the interviews (examples)	Files (participants)	References
	did make me think." George "Yeah, now I know what eight million hectares looks like in comparison to the UK. Well I was thinking it would be bigger." Hawa "Not especially, but it made me realise that the fires had covered a bigger area than I imagined. I didn't think they'd damaged that much land." Mark "I would say it has helped to reinforce my belief that action does need to be taken. These figures always surprise me, which is precisely what it should do and I hope it does the same for other people too." Alan		
29. (M) dataviz provides information for action	"And if there's any major earthquake let's say 7.5 above, around the Tonga Trench, it only takes five or ten minutes for the first wave to arrive into our … That is when we – we're talking about here the local Tsunami event. And data visualisation, I tell you from experience here, is what we use to move people, what we do to get the message across. It's what we do to tell the people not to wait for an official warning because of the time. It's data visualisation that we show them the impacts, we show them the travel times, we show them how big the waves are being, how it will amplify as it	1	3

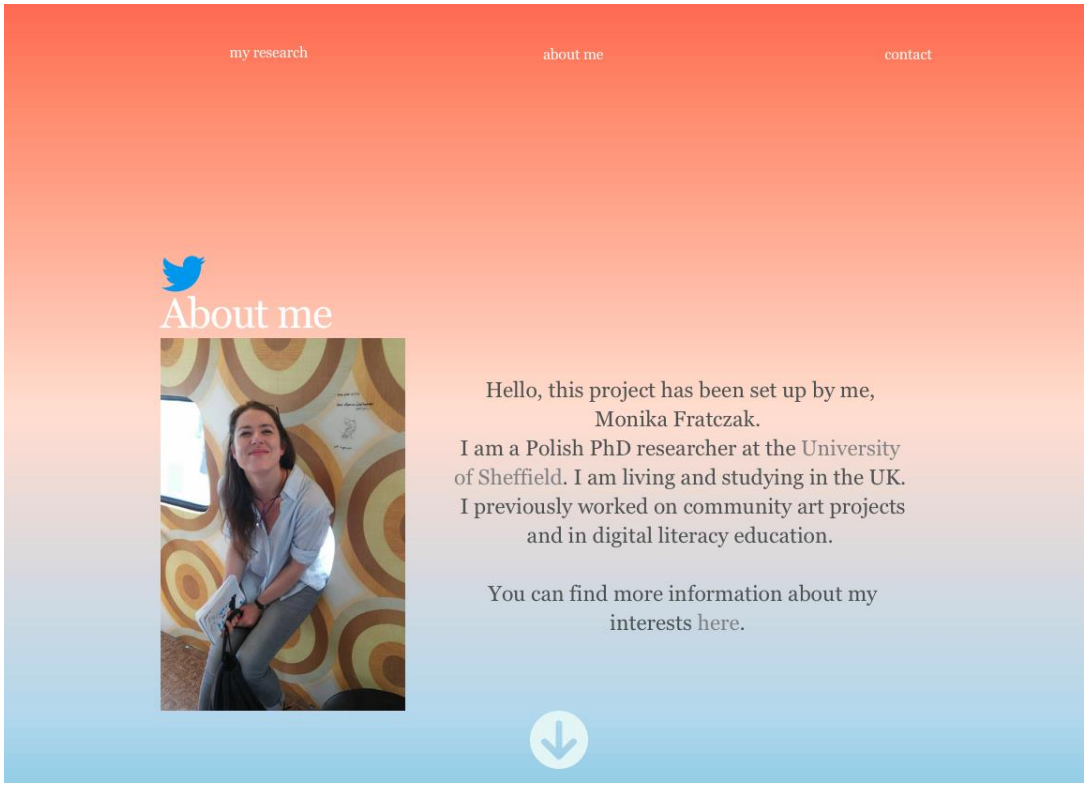
Feb 7, 2021 33

Name	Quotations from the interviews (examples)	Files (participants)	References
	comes into our shallow bathymetry of our shores. So it's all these technical issues that we bring into the centre of data visualisation, especially local source Tsunami for Tonga is our number one threat at the moment. And of course, yes, cyclone and then we have earthquake, volcanic eruption. Because as I mentioned earlier on data visualisation has power based on the issue. For example, data visualisation that we're using for local source Tsunami event would be much more heavier to the ears of our local people when we use data visualisation, to climate change which is it takes fifty and more years, you know. I mean they are still both interesting and very, very, um, useful for us. But, you know, the severity of these hazards has an impact on the data visualisation that we use. But of course back to our question, yes the using of data visualisation to mobilise our people, yes it is very effective. Whilst we also use data visualisation to, um, to put up information, brochures to where evacuation centres are, the evacuation rota, you know, the supplies in terms of our preparedness before, during and after the event here in the Islands. And as I mentioned earlier on, yes, data visualisation is a tool that we – I would say personally agree that it has to move people physically and emotionally, you know, on different scales." Angelo		
30. (M) dataviz reinforces environmental practices	"I would say that yes, because although I couldn't particularly – like particularly point out any elements of specific things that I've seen, I would say that – let's say David Attenborough's recent film. There's a lot of good visual, data visualisation on that, and that helps re-affirm, A, what I already know, but also that it's worth acting on, there is like an	14	32

Feb 7, 2021 34

Appendix 14 – Research website





my research about me contact

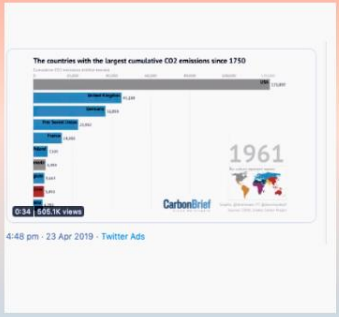
Contact

Monika Fratczak

mefratczak1@sheffield.ac.uk

07713839649

@fratczak_monika



The University Of Sheffield. Economic and Social Research Council White Rose Social Sciences DTP