ARTICLES

Climate Views and Information Sources*

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Abstract

As scientific knowledge about what we need to do to limit climate change and mitigate its negative impacts is now well established, climate change has mainly become a social and political problem. Effective communication is needed to build public support for climate action. However, in order to make climate communication effective, a comprehensive understanding of the public is needed. This includes recognising diversity in citizens' views towards climate change by distinguishing distinct climate segments and investigating what information sources these different climate segments rely on. Four climate segments are distinguished, ranging from the Engaged to the Doubtful, each with a distinct media diet.

Keywords: climate change, audience segmentation, public opinion, new media, social media, information sources.

1 Introduction

Climate change stands as a primary challenge of our time. There is scientific consensus that without severe measures to stop global warming the consequences will be disastrous (IPCC, 2023). In order to limit climate change, major technological, economic and behavioural changes across all sectors are needed. While our understanding of the science behind climate change and the measures required to combat it is now well-established, so far the political and societal responses to climate change remain too limited to stop the process. Hence, climate change has mainly become a social and a political problem instead of a scientific problem.

In this regard, public perceptions of climate change are vital as they shape how individuals react to climate change and, importantly, determine political decision-making in democratic societies where policy change depends on public opinion (Soroka & Wlezien, 2009). However, so far, public support for strong climate action is often lacking (Dabla-Norris et al., 2023), and this most likely co-explains why climate policies are insufficient. Therefore, it is important to understand how citizens think about climate change, what policies they support and how to differentiate different groups in that regard. Furthermore, and from a

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persuasion perspective, it is important to know how citizens (not) inform themselves about climate change and climate policy. In order to possibly create a more favourable public opinion towards climate policies, people need correct and useful information. Put differently, to make climate change communication truly effective, one needs to 'know one's audience' (Leiserowitz et al., 2009). Therefore, an essential first step for effective climate change communication involves gaining a comprehensive understanding of the public, especially of how different groups perceive climate change and how these groups inform themselves.

In this article, I focus on two aspects of 'knowing one's audience'. First, acknowledging heterogeneity in public opinion with regard to climate is vital. Various segments or groups in society perceive climate change differently and possess distinct levels of climate knowledge, concern and policy support. Identifying these segments, gauging their size and understanding their climate perceptions are essential. From a persuasive point of view, it is especially important to be able to identify the segments that are not supportive of potential climate policies and those that hesitate. While the number of countries in which such 'segmentation' studies have been conducted is growing, this work has revealed both similarities and numerous cultural differences between countries and indicated that the different climate segments that exist in a population are to a certain extent country-dependent (Kácha et al., 2022; Wonneberger et al., 2020). So far, no study on Belgium or Flanders exists. Therefore, this study looks at climate segments in the Flemish population. A number of studies find that different climate segments react differently to climate message framing and indicate that targeting audiences with tailored messages can be more effective than a 'one-size-fits-all' approach (e.g. Hine et al., 2016; Martel-Morin & Lachapelle, 2022). Hence, knowing who thinks what can help scientists, politicians, social movements and activists to tailor their climate communication to specific audiences.

Second, this study investigates what information sources the different climate segments rely on. Although some are directly experiencing the impacts of climate change already (IPCC, 2023), climate change is a complex phenomenon that is seldom directly visible (Metag et al., 2017). For such intangible issues, individuals' views are typically based on information provided by the news media. Yet, so far, the relationship between belonging to a specific climate segment and media use remains understudied, and there has not been any comprehensive segmentation study so far that includes an in-depth measurement of information sources, including both traditional news media *and* social media (Metag & Schäfer, 2018). Understanding these information sources can provide insight into the climate information to which different segments are exposed and can identify the communication channels that might contribute to increasing overall support for climate action.

The main contribution of this study lies in studying the relationship between the climate views different population segments have on the one hand and their information sources on the other and, particularly, in the understudied case of Flanders. Added to that, this study contributes by drawing on a fine-grained measurement of individuals' information sources, including both traditional news

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media and social media – social media rapidly becoming a much-used source of information (Newman et al., 2023). This study seeks to enhance our understanding of 'the public', allowing for effectively communicating to diverse audiences, ultimately advancing climate action.

Based on a cross-sectional, representative survey (N = 1,315) in Flanders and by use of latent cluster analysis, four climate classes are distinguished: the *Engaged* (16.8%), *Concerned* (37.5%), *Indifferent* (37.3%) and *Doubtful* (8.4%). These climate segments not only differ in their views on climate change; they also have a different media diet. The *Engaged* are the most frequent users of broadsheet newspapers and, together with the *Concerned*, the most frequent users of the public broadcasting services (PBS). The *Indifferent* are the most active users of all social media, but they also frequently rely on traditional news media to inform themselves. Last, the *Doubtful*, this class uses all traditional news media the least and seems to be the biggest 'news avoiders'. Facebook is one of their main information sources.

2 Climate Public Opinion and Audience Segmentation

The study of public opinion with regard to climate change is growing rapidly. There is a host of research from different disciplines (psychology, economics, communication, political science etc.), and it sails under different conceptual flags such as 'climate scepticism' (Hornsey, 2020) or 'pro-environmental behaviour' (Kollmuss & Agyeman, 2002). The relationship between climate knowledge, attitudes, policy support and behaviour has been subject to a lot of scholarly work. Although there is a clear relationship between these various aspects of climate-related public opinion (e.g. Drews & Van Den Bergh, 2016; Gifford & Nilsson, 2014) the classic linear model that posits that climate knowledge leads to climate-friendly attitudes and, in turn, automatically, to climate policy support and climate-friendly behaviour has been wildly criticised as being too simplistic (e.g. Hornsey et al., 2016; Kollmuss & Agyeman, 2002). In addition, scholars looked quite extensively at determinants of climate-related public opinion. An individual's climate views are affected by socio-demographics and ideology: women, higher educated, younger and left-wing citizens tend to have more climate-friendly stances (e.g. Drews & Van Den Bergh, 2016; Gifford & Nilsson, 2014). Other determinants are social and political trust (e.g. Drews & Van Den Bergh, 2016), the perceived personal cost of the policies (e.g. Hornsey, 2020), personal experience with the negative consequences of climate change (e.g. Gifford & Nilsson, 2014), and perceived self-efficacy (e.g. Bostrom et al., 2019).

However, that said, far lesser work has looked at which subgroups in society exist according to their climate views. Climate audience segmentation analysis is becoming increasingly popular in this regard, as it allows for identifying internally homogeneous climate change subgroups within the general public that have similar climate views (Hine et al., 2016). Audience segmentation analysis has long been used by social marketers to be able to target specific groups with specific messages, and, over time, it has been applied to health, politics and environment and, most recently, to climate change (Weller et al., 2020).

The oldest and best-known climate audience segmentation study was done in the U.S. by Leiserowitz and colleagues (2009). It distinguished six climate classes based on measures of climate knowledge, attitudes, policy preferences and behaviours. These six classes form a continuum ranging from the *Alarmed* to the *Dismissive*. The *Alarmed* are the most engaged with climate change: they are convinced that climate change is happening and human-caused, believe it poses an urgent threat, take personal action, and support strong climate policies. Next, the *Concerned* are also convinced that climate change exists and is a problem, but they take less personal action. Then follow the *Cautious* who are less certain about climate change and do not view climate change as a personal threat. The *Disengaged* do not give much thought to the issue and do not hold strong opinions on the issue. The *Doubtful* are not convinced anthropogenic climate change is happening and are not concerned about it. Last, at the very end of the spectrum, are the *Dismissive*, who firmly refuse to believe or recognise that climate change is real and, thus, are strongly opposed to any policy response.

Based on this framework, similar segment studies have been conducted in a number of countries, including amongst others Australia (Hine et al., 2016; Morrison et al., 2013), Canada (Martel-Morin & Lachapelle, 2022), New Zealand (Thaker, 2021), Germany (Metag et al., 2017) and the Netherlands (Wonneberger et al., 2020). These studies indicate varying degrees of climate change acceptance, concern and engagement across countries. Furthermore, the *Dismissive* segment was not identified either in Germany or in the Netherlands; hence, the acceptance of anthropogenic climate change seems more widespread in Western European countries than in Anglophone counties.

That said, it is tricky to draw such conclusions as these existing segmentation studies differ considerably in the measures and analytical procedures[1] they use. This makes cross-study comparison challenging (Martel-Morin & Lachapelle, 2022). Whereas, for instance, the *Alarmed* segment has been distinguished in a number of countries, its exact meaning and core characteristics differ between studies (e.g. Metag et al., 2017; Morrison et al., 2013). To counter this, recently a multinational segmentation analysis has been conducted including 22 European countries and Israel. It distinguishes four segments or 'four Europes'. The *Engaged* are those who share the highest belief that climate change is happening and is human-caused, are most concerned about the issue and are most likely to take action; the *Pessimistic* also believe climate change is happening but are less personally involved and are pessimistic about addressing climate change adequately; the *Indifferent* are less convinced climate change is happening and are not very involved; and finally, the *Doubtful* are characterised as having the lowest climate beliefs, concerns and willingness to take action (Kácha et al., 2022). Belgium was included in this pan-European segmentation analysis, and results show that 24% of the Belgian population can be described as *Engaged* (vs. 18% in Europe as a whole), 18% as *Pessimistic* (similar to 18% in Europe), 48% as *Indifferent* (vs. 42% in Europe) and 10% as *Doubtful* (vs. 21%). While such a large-scale comparative segmentation study is insightful, it also shows big variability in class composition and class proportion between countries. Moreover, patterns that apply to all 22 diverse countries can be hard to find. For instance, a recent Eurobarometer on

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climate change indicates that the European countries included in Kácha's study vary greatly in the extent to which citizens believe climate change is one of the main challenges of our time, as well as in the extent to which they believe their local governments are taking enough action to tackle climate change (Eurobarometer, 2023). Furthermore, Kácha et al. themselves conclude that country-specific studies may be more adequate and insightful for national-level practitioners and communicators (2022). Last, as discussed further, this study measures different aspects of citizens' climate views than the pan-European study does, measuring, for instance, citizens' climate policy support and climate-friendly behaviour instead of their efficacy beliefs. Therefore, the results of this study will not be directly comparable with the results of the pan-European study, and different labels will be partly used. With this in mind, the main aim of this study in Flanders (Belgium) is not to assess how the climate segments in Flanders compare to those found in other countries, but rather to provide context-relevant audience insights to better understand public opinion about climate change that can inform communication for specific audiences. My first research question, therefore, is:

RQ1: Which segments of the Flemish population can be distinguished regarding their climate views?

3 Information Sources and Climate Views

Because climate change is a complex, large-scale and not directly visible process, news media are crucial information sources for most individuals (Metag et al., 2017). The media's coverage can shape how people view and interpret climate change. Ample work in communication has shown that news media can influence public opinion (Metag & Schäfer, 2018), shaping *which issues* citizens think about and deem most important – referred to as agenda-setting (McCombs & Valenzuela, 2020); *what* the public thinks about an issue –referred to as frame-setting (de Vreese, 2005); and *which criteria* citizens use to evaluate politicians, which is referred to as priming (Iyengar et al., 1982). Public opinion, in turn, determines public action, political decision-making and which political parties are ultimately being elected to power (Soroka & Wlezien, 2009. That said, and knowing news coverage can impact people's views, this study does not have a causal ambition. The aim here is not to examine whether media coverage *causes* climate views but rather whether media use *correlates* with climate views and whether certain climate views are found among people who are exposed to certain media.

Quite some work has looked at climate views and their relationship with media use. And although results remain quite inconclusive, it seems that that some news media, in some cases, have a significant relation (positive and negative) with climate knowledge (Feldman et al., 2012; Taddicken, 2013), climate attitudes (e.g. Holbert et al., 2003; Taddicken, 2013), climate policy support (e.g. Thaker et al., 2017) and climate behaviour (e.g. Holbert et al., 2003). With regard to social media, a cross-national study finds a positive association between social media use and climate-friendly views in some countries (e.g., Russia, Philippines, Ukraine,

Indonesia and United Kingdom) whereas in other countries there is a negative association (e.g. U.S., Germany, Spain and South Korea; Diehl et al., 2021). However, these studies do not account for the fact that the public may be segmented in different climate classes and that the information sources of these classes may differ.

Few climate segmentation studies have included media in their analysis, and those that did often drew on a rather basic measurement of media use. The results of these studies are somewhat mixed. In addition, no studies have included social media as an information source. This is surprising as social media are rapidly rising in importance as a source of information (Newman et al., 2023). Knowing via which channels these climate segments inform themselves can tell us more about what information the different segments are exposed to and how these segments can (potentially) be reached.

The best-known study by Leiserowitz et al. in the U.S. (2009) included the most fine-grained measurement of individuals' information sources so far; it employed specific news media outlets and found that the different climate segments use to some extent different information sources. While the overall media use did not vary a lot between classes, their precise media use – that is, the specific news outlets they use – did. The *Alarmed* and *Concerned* preferred progressive news outlets such as MSNBC and CNN, whereas the *Doubtful* and the *Dismissive* preferred conservative news outlets such as Fox News. A later study in Germany also suggests different media consumption of the different climate classes, although the differences are less outspoken and less often significant (Metag et al., 2017). Overall, it seems that individuals who are on the sceptical side of the spectrum (*Disengaged* and *Dismissive*) use the different types of media (e.g. TV, radio, newspaper and Internet) the least, whereas the *Alarmed* use these media the most. Yet, as no measurement of specific outlets was included in the German study, possible differences might have been obscured. A climate segmentation study in the Netherlands measured exposure to media coverage of the 2015 United Nations Climate Change Conference in 2015 (COP21). This study suggested that, overall the segments most engaged with climate change where more exposed to COP21 coverage than the segments least engaged with climate change (Wonneberger et al., 2020). Last, in contrast, the pan-European study found no clear differences in the amount of political news consumption or Internet consumption of the four identified classes; yet, again, potential differences might have been obscured (Kácha et al., 2022).

Thus, while there is some indication for distinct media diets between segments, no clear pattern emerged. And whereas the study in the U.S. provides some indication that the precise media use – that is, the specific outlets used within a media type (e.g. TV) – is different between segments, results from the exceptionally polarised political context in the U.S. where climate change has become extremely politicised and polarised cannot be considered as generically valid (Smith & Mayer, 2019). In addition, the news media landscape in the U.S. is highly partisan (Stroud, 2011), and in conservative news outlets instances of climate-sceptic coverage questioning the existence of climate change often occur (e.g. Feldman et al., 2012; McAllister et al., 2021).

Remarkably, none of the abovementioned studies included social media as a source of information despite its rapidly growing use as a predominant information source worldwide (Newman et al., 2023). Social media is fundamentally different from traditional news media in the sense that it no longer contains only stories produced and selected by professional newsmakers; it also contains user-generated content (Beckers et al., 2021). Numerous studies find that online media information deviates significantly from the scientific view on climate change and that disinformation is omnipresent (Treen et al., 2020). In addition, social media content is more personalised based on individuals' previous information habits, leading to dangers of 'echo chambers' and 'filter bubbles' (Williams et al., 2015).

Due to the inconclusive results so far with regard to the relationship between media use and climate views, my second research question is:

RQ2: Do the different climate segments of the Flemish population use different media?

4 Method

4.1 Case

The study is conducted in Flanders, the largest region of Belgium.[2] Flanders presents a novel case that is probably more generalisable than the U.S. that remains, so far, the only climate audience segmentation study that has included a fine-grained measurement of individuals' media use, including specific media outlets (Leiserowitz et al., 2009). First, in Belgium and Europe as a whole, climate change is to a far lesser extent a polarised issue (Smith & Mayer, 2019). Second, in a lot of European countries, the partisan affiliation of media outlets is less outspoken (Castro, 2021) and, in Belgium, the formal ideological affiliation between outlets and parties has disappeared (Soontjens & Van Erkel, 2022). Third, previous scholarly work has indicated that inaccurate representation of climate change in the media is far less frequent in (continental) Europe than in the U.S. and other Anglophone countries (e.g. Dirikx & Gelders, 2010; McAllister et al., 2021; Painter & Ashe, 2012). Concretely for Flanders, earlier studies indicate that the mainstream media coverage of climate change aligns with the basic scientific facts on climate change (e.g. Moernaut et al., 2018; Pepermans & Maeseele, 2017), namely that climate change is happening, that it is human-induced and that the consequences will be catastrophic if left unmitigated (IPCC, 2023).

An often made distinction to categorise news outlets is that of 'elite or upper-market media' that contains more 'hard news' and 'popular or mass-market media' that contains more 'soft news' (Fraile & Iyengar, 2014). More concretely, PBS and broadsheet newspapers tend to focus more on political and economic hard news content, while commercial broadcasters and popular newspapers focus more on soft news topics. Hence, it is important to look at specific outlets (e.g. which newspaper) within a certain broader media type (e.g. newspapers). Comparatively speaking, Belgium still has large readership of newspapers and viewership of TV news (Newman et al., 2023). Last, just like in many other countries, social media is

widely used in Belgium as a source of information and encompasses the most used platforms for news such as Facebook, YouTube, WhatsApp, Instagram and TikTok (Newman et al., 2023).

4.2 Survey

A survey[3] was commissioned in February 2023 via the company Dynata with 1,350 respondents in total. Using nationally representative quota on age, gender and education, the sample is close to being representative. Yet, the sample has a slight bias in favour of the higher educated. This bias is corrected by applying weights.[4] The survey included 40 questions on different topics (e.g. political preferences, perceptions of crime etc.) and lasted in average about 15 minutes. After controlling for whether the respondents filled in all the relevant questions, the actual N for this study is 1,315

4.3 Measures

In terms of the climate measures used to identify climate segments, a series of climate-related public opinion measures are incorporated, encompassing climate knowledge, attitudes, policy support and behaviour. This is in line with most climate audience segmentation analyses (e.g. Hine et al., 2016; Leiserowitz et al., 2009). In terms of the exact question wordings (see Table 1), the climate variables are partly measured drawing on existing and validated questions from earlier segmentation studies (e.g. Wonneberger et al., 2020) and existing surveys (e.g. Eurobarometer). To this a number of new measures were added including different climate policies. A diverse mix of six mitigation policies is included that target various activities, actors, and behaviours widely recognized by scientists as demanding significant emission reduction (see IPCC report 2023). Because there is less scientific consensus on the efficiency of specific policy instruments in mitigating climate change, a range of policy instruments are incorporated, including taxes, bans, subsidies. Note that each of the selected policies, to various degrees, contributes to the mitigation of global greenhouse gas emissions. Also, with regard to climate behaviour, the selection was based on the 2023 IPCC report, and four personal behaviours that can have high mitigation impacts were selected. Note that for the variable *knowledge-specific causes* and *climate behaviour* the different items were combined into a sum scale. See appendix for the exact recoding (A1).

In total, 14 climate variables were selected to create a climate typology. No consensus exists on the number of indicator variables that should be included in a latent class analysis (LCA), but, in general, more indicators lead to better results (Weller et al., 2020). Studies exist that only use 4 indicators whereas others have used more than 20 (Leiserowitz et al., 2009).

Table 1 also shows the measures for information sources. All Dutch-speaking national newspaper and TV news were included. See A2 in Appendix for the distribution of all media variables. To create a broadsheet newspaper variable and a popular newspaper variable, the answer categories of the newspapers that are considered broadsheets (De Standaard, De Morgen, De Tijd) and the newspapers that are considered popular newspapers (Het Laatste Nieuws, Het Nieuwsblad,

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Gazet Van Antwerpen, Het Belang van Limburg, Metro) were summed up (see Beckers et al., 2021 for similar subdivision). This leads to four news media variables: *popular newspaper use*, *broadsheet newspaper use*, *PBS use* (VRT) and *commercial broadcaster use* (VTM).

Last, as previous work indicates that climate-related public opinion is affected by individuals' socio-demographics and ideology (e.g. Drews & Van Den Bergh, 2015; Gifford & Nilsson, 2014), an analysis of the distribution of these factors across climate segments is included. Therefore, respondents' *gender* (1 = male, 2 = female), *age, level of education*[5] and *ideology*[6] are measured.

4.4 Analysis Strategy and Model Comparison

LCA is used to investigate whether the citizens in Flanders can be classified into meaningful homogeneous groups, called latent classes, that are similar in their responses to the climate indicator variables (Nylund-Gibson & Choi, 2018). Following the standard procedure for LCA, I start with a one-class model and then specify the models with one additional class at a time (see A3). This allows for comparing the models based on a series of statistical and substantive criteria. A broad range of fit statistics are in use, but the Bayesian information criterion (BIC) is regarded as the most reliable. It rewards parsimony in models and is used to compare competing LCA solutions (Weller et al., 2020). Lower BICs indicate a better fit. The Akaike information criterion (AIC) works similarly and is also frequently reported (Kácha et al., 2022). In addition, entropy is a diagnostic statistic that should be taken into account, as it indicates how accurately the model defines the classes; a score above 0.8 is generally considered good (Nylund-Gibson & Choi, 2018). Last, one should consider the number of sample members in each class. There is no consensus on determining class size, but some scholars argue that class sizes with fewer than 50 cases or less than 5% are not advisable (Weller et al., 2020).

Taking all these factors into account, the 4-class solution is selected based on the relatively low-fit indices (both BIC and AIC), high entropy (well above 0.8), size of the smallest class (8.4%), and, importantly, it offered the most straightforward interpretation (see Figure 1; Weller et al., 2020). See A3 in Appendix for more detail on model comparison and selection.

Table 1 Measurement Climate Views and Information Sources

	Questions	Answer Possibilities
Knowledge human-caused	To what extent are you convinced that climate change is primarily human-caused?	7-point scale (0) 'I am totally not convinced' (3) 'in doubt' (6) 'I am totally convinced'
Knowledge-specific causes	What factors contribute to global warming? You can indicate multiple answers. Please do not look up the correct answer. If you do not know the answer, you can simply indicate it.	'emissions CO2 industry' 'emissions of CH4 (methane) by cows', 'plastic pollution oceans', 'deforestation', 'melting North Pole', 'extinction Black rhino', 'PFOS pollution', 'I don't know' *(sum scale together 0-8)*
Climate attitudes	To what extent do you agree with the following statements: 'I think climate change is one of the most important problems of our time' 'I am totally not concerned about climate change' (reversed) 'Climate change cannot be stopped by technological innovations alone, behavioural changes are necessary' 'The so-called "climate crisis" facing humanity has been greatly exaggerated' (reversed)	7-point scale (0) 'Totally not agree' (3) 'Neither agree nor disagree' (6) 'Totally agree'
	Some people think that our country is taking too few measures to prevent climate warming; others think that too many measures are being taken against climate warming. Where would you place yourself on this scale?	7 -point scale (0) 'Too many climate change measures' (3) 'Enough climate change measures' (6) 'Too few climate change measures'
Specific climate policy support	To what extent are you in favour or against the following climate policies: 'Extra taxes on meat' 'A ban on all woodstoves' 'European tax on kerosene (aircraft fuel)' 'Requirement for large farms to sharply reduce their greenhouse gas emissions' 'Reduced ability of municipal governments to stop the placement of wind turbines in their communities' 'A tax on CO2 (greenhouse gas) for industry' 'Subsidies to insulate private houses' 'Making all public transport buses electric'	7-point scale (0) 'Totally against' (3) 'Neither against nor in favour' (6) 'Totally in favour'

Table 1 (Continued)

	Questions	Answer Possibilities
Climate behaviour	During the last few years, to what extent have you done the following things for climate reasons: 'travelled less with the airplane', 'bought and ate less meat', 'drove less with the car', 'turned down the heating'	(1) 'Done' (0) 'Not done' *(sum scale together 0-4)*
Traditional news media	How often do you use these media to follow political news and current issues (on paper, television or online)? 'Het Laatste Nieuws', 'Het Nieuwsblad', 'Metro' ,'Gazet Van Antwerpen', 'Het Belang van Limburg', 'De Standaard', 'De Morgen', 'De Tijd', 'VRT' 'VTM'	4-point scale (0) 'rarely or never' (1) 'monthly' (2) 'weekly' (3) 'daily'
Social media	In your daily life, how often do you get information about political news and current affairs through the following channels? 'Facebook', 'Instagram', 'TikTok', 'YouTube', 'Twitter'	4-point scale (0) 'rarely or never' (1) 'monthly' (2) 'weekly' (3) 'daily'

5 Results

Based on the pattern of responses for each of the items and inspired by earlier climate segmentation analysis, four classes are distinguished and labelled: the *Engaged* (16.8%), the *Concerned* (37.5%), the *Indifferent* (37.3%) and the *Doubtful* (8.4%). Note that because this study measures different climate views than the pan-European study, slightly different labels are used. Most notably, in contrast to Kácha et al., who thoroughly measured climate efficacy beliefs, this study included no such measurements but measured climate policy support and climate-friendly behaviour instead. Therefore, rather than distinguishing a 'pessimistic group' with low levels of efficacy beliefs, this study finds evidence of a concerned group, much like the concerned groups distinguished in Germany (Metag et al., 2017) and the Netherlands (Wonneberger et al., 2020).

Figure 1 shows the estimated means per climate class for each climate indicator variable. Note that the scores for all items were rescaled to a 7-point scale ranging from 0 to 6 to make the interpretation more straightforward. The y-axis shows the 7-point scale, and the x-axis shows the 14 different indicator variables. Table A4 in the appendix summarises, for each indicator variable, the means of the total sample and the estimated means (not rescaled) with standard error and 95% confidence intervals for each climate class. Looking at the item responses per class (Figure 1), we can see the four classes differing considerably in their climate views. There are only three instances where the difference in means between climate classes is not significant and the confidence intervals overlap (see Table A4); namely this is the case for the difference in the means of the *Indifferent* and the *Doubtful* for the specific policies on meat, woodstoves and windmills.

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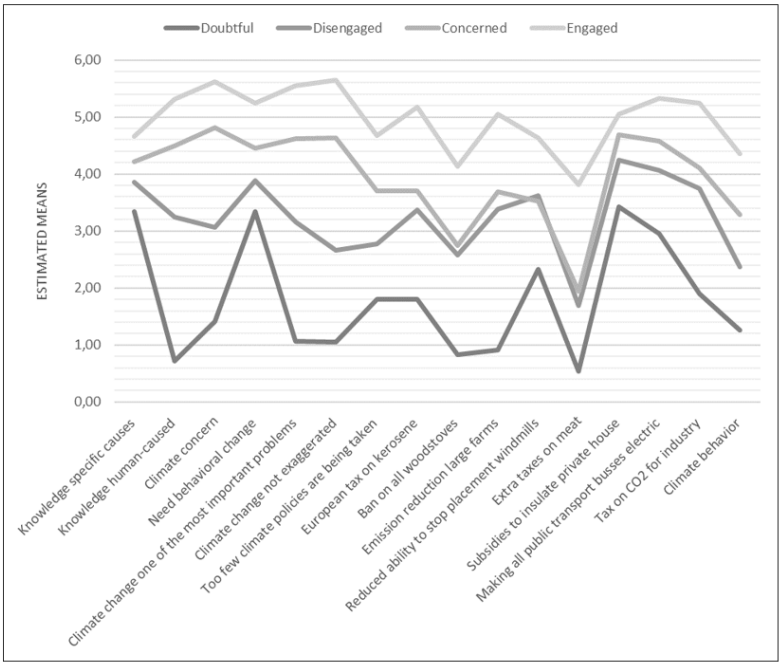
Figure 1 ***Estimated Means per Climate Class for Each Climate Indicator Variable***



The *Engaged* (16.8%) have the highest scores on all indicator variables. The *Engaged* are highly convinced of anthropogenic climate change, and they are well aware of its causes. They are very concerned about climate change; they consider it to be one of the most important problems of our time and are convinced that behavioural changes are necessary to stop climate change. This concern is mirrored in their climate policy support and climate behaviour. They believe too few climate changes are being taken and are (strongly) in favour of each climate policy. The *Engaged* have already changed their behaviour quite extensively for climate reasons by eating less meat and/or travelling less by plane, using their car less and turning down their heating.

Second, the *Concerned* (37.5%) are convinced climate change is human-caused; they are concerned about climate change and believe behavioural changes are necessary. The *Concerned* regard climate change as one of the most important problems of our time and are supportive of most climate policies, except for extra taxes on meat and a ban on all woodstoves. They have made some changes in their climate-relevant behaviour.

The *Indifferent* (37.3%) have less outspoken views on climate change. For most items, they tend to select the middle option of the scale. The *Indifferent* seem to be somewhat in doubt about whether climate change is human-caused and are neither concerned nor unconcerned about climate change. They believe it has been slightly exaggerated. This group seems to be quite undecided about most climate policies.

Yet, they are clearly in favour of subsidies to insulate private houses and making all transport buses electric; however, they are strongly opposed to levying extra tax on meat.

Though they are the smallest segment, a clear *Doubtful* (8.4%) group emerges. The *Doubtful* have the lowest scores on all indicator variables. They do not believe climate change is human-caused and are unconcerned about it; they believe it has been greatly exaggerated and are undecided about the need for behavioural changes. Correspondingly, they believe too many climate measures are being taken, and they are opposed to all specific climate policies, except for subsidies to insulate private houses. Unsurprisingly, the *Doubtful* have virtually taken no personal behavioural action to stop climate change.

These results indicate that levels of climate knowledge, attitudes, policy support and behaviour are tightly correlated. Concerning specific climate policy support, we see substantial difference between policies, and it seems that policies that entail a low personal cost and use 'pull measures' receive the highest support (i.e. subsidies for private house insulation and making buses electric), whereas policies that entail higher personal costs and use 'push measures' (i.e. ban on woodstoves and taxes on meat) receive the lowest support. These findings are in line with previous work (Drews & Van Den Bergh, 2016). Therefore, it appears that while the policy support of the *Engaged* is unconditional, the support from the *Indifferent* and *Concerned* is conditional on the characteristics of the proposed measures. The *Doubtful*, on the other hand, are generally not supportive.

Although caution is warranted when comparing the results with earlier segmentation studies, this study distinguishes similar segments: the *Engaged* or *Alarmed*, the *Concerned*, the *Disengaged* or *Indifferent*, and the *Doubtful*. In line with findings about Germany (Metag et al., 2017), the Netherlands (Wonneberger et al., 2020) and Europe as a whole (Kácha et al., 2022), no evidence of a *Dismissive* segment exists, who are completely unconcerned and strongly opposed to any (policy) response (e.g. Leiserowitz et al., 2009; Morrison et al., 2013). The most climate sceptical segment in this Belgian study, named the *Doubtful*, are not convinced climate change is human-caused, but they are not opposed to the idea that behavioural changes are needed to stop climate change and they are not against all climate policy measures that can help limit climate change (i.e. subsidies for private house insulation). In total, this most climate-sceptic group in Belgium presents 8.4% of the Flemish population, and this finding confirms that the acceptance of anthropogenic climate change is more widespread in (West) European countries than in Anglophone countries (Metag et al., 2017).

In a second step, this study examines whether the different climate segments use different information sources. In addition, I investigate whether the climate segments have different socio-demographics. For this purpose, a series of ANOVA tests are conducted. Table 2 shows for each climate class the estimated mean per type of information source and socio-demographic. The last column shows the results of the one-way ANOVA tests and indicates whether there are any significant differences between the means of the four climate segments. Last, I conduct the Bonferroni post hoc test to identify which classes are statistically different from each other. The corresponding superscript characters indicate significant

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differences; for example, the *Doubtful* and the *Indifferent* differ significantly from each other in their average PBS use, indicated by their corresponding superscript 'a'.

The climate segments differ substantially from each other with regard to their information sources and socio-demographics. Only with regard to Twitter, no significant differences are found (see Table 2 last column).

The *Engaged* are the highest users of the PBS and broadsheet newspapers, though their PBS use is not significantly higher than that of the *Concerned*. The *Engaged* also frequently use the commercial broadcaster and popular newspapers to inform themselves, but they are below-average users of all types of social media. The *Engaged* seem to prefer popular newspapers, the PBS and broadsheet newspapers as their sources of information. Note that comparison between information variables should be done with caution because of the different scales that are used.

The *Concerned* more often inform themselves via the PBS than the *Indifferent* and *Doubtful*. Their broadsheet newspapers use is lower than that of the *Engaged* but higher than that of the *Doubtful*. The *Concerned* use the commercial broadcaster and popular newspaper to a similar extent as the *Indifferent*. The *Concerned* are below-average users of all social media platforms, but they use Facebook more frequently than the *Engaged*. Their preferred information sources are popular newspapers, the PBS and the commercial broadcaster.

The *Indifferent* are frequent users of the commercial broadcaster and popular newspapers. They use the commercial broadcaster significantly more than the *Engaged*. Concerning social media, the *Indifferent* seem to be the most frequent users of all platforms (not Twitter). They differ significantly from all other classes in their higher TikTok and Instagram use. They use Facebook significantly more often than the *Engaged* and the *Concerned*, but the difference with the *Doubtful* is not significant. Last, the *Indifferent* use YouTube significantly more than the *Concerned*. The *Indifferent* most frequently use popular newspapers, the commercial broadcaster and Facebook to inform themselves.

Last, the *Doubtful* seem to be the biggest 'news avoiders'. They use all types of traditional news media the least, though for commercial broadcaster use and broadsheet newspaper use the difference between them and the *Indifferent* is not significant. Except for Facebook, they use all social media platforms less than the total sample average. The *Doubtful* most frequently use popular newspapers, Facebook and the commercial broadcaster to inform themselves.

This said, it is important to note that although the climate classes have a significantly different information diet (see Table 2), the standard deviations are in some cases quite big indicating considerable variation within climate classes.

With regard to the socio-demographics, the *Engaged* are significantly the oldest and most highly educated group.[7] The other differences between classes for age, education and gender are not significant. Ideology differs significantly between all climate classes – the *Doubtful* are the most right-wing and the *Engaged* the most left-wing.[8] The findings for level of education and ideology align with previous work (e.g. Drews & Van Den Bergh, 2015; Gifford & Nilsson, 2014). However,

unlike earlier studies, age does not appear to significantly influence individuals' climate views.

To sum up, this analyses shows that the climate segments differ not only in their views on climate change but also in their media diet. The *Engaged* use traditional news media a lot, and they are the most frequent users of elite media (PBS and broadsheet newspapers). Comparatively, they are low social media users. The *Concerned* group's media diet is similar to that of the *Engaged*, though they less often use broadsheet newspapers and more often use Facebook to inform themselves. The *Indifferent* are the most active users of social media, but they also frequently rely on traditional (popular) news media to inform themselves. Last, the *Doubtful* – this group seems to be the biggest news avoiders and uses all traditional news media the least. Facebook is one of their main information sources. Twitter is the only information source for which no significant differences between any of the climate classes is found.

6 Discussion and Conclusion

This aim of this study was to provide a thorough understanding of how different groups in society perceive climate change and how these groups inform themselves. The main contribution of this study lies in studying the relationship between the climate views of different population segments and their information sources, and this in the understudied case of Flanders (Belgium). Added to that, this study draws on a fine-grained measurement of individuals' information sources, including both traditional news media *and* social media.

The results indicate that four climate segments can be distinguished: the *Engaged* (16.8%), *Concerned* (37.5%), *Indifferent* (37.3%) and *Doubtful* (8.4%). The *Engaged* have the highest level of climate knowledge, attitudes, policy support and behaviour and the *Doubtful* the lowest. In addition, these segments have a different media diet. The *Engaged* are the most frequent users of broadsheet newspapers and, together with the *Concerned*, the most frequent users of the PBS. The *Indifferent* are the most active users of social media, but they also frequently use traditional (popular) news media to inform themselves. Last, the *Doubtful* – they seem to be the biggest news avoiders and use all traditional news media the least. Facebook is one of their main information sources.

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Table 2 *Means of Information Sources and Socio-Demographics per Climate Class*

	Mean Total Sample (SD)	Class 1 Doubtful Mean (SD)	Class 2 Indifferent Mean (SD)	Class 3 Concerned Mean (SD)	Class 4 Engaged Mean (SD)	F-test
Public broadcaster (0-3)	1.746 (0.042)	1.162[a,b,c] (1.304)	1.646[a,d,e] (1.288)	1.943[b,d] (1.246)	2.195[c,e] (1.149)	***
Commercial broadcaster (0-3)	1.740 (0.040)	1.568 (1.339)	1.914[a] (1.221)	1.744 (1.259)	1.606[a] (1.340)	**
Broadsheet newspaper (0-9)	1.184 (0.062)	0.640[a,b] (1.506)	1.112[c] (0.2055)	1.221[a,d] (2.051)	1.864[b,c,d] (2.499)	***
Popular newspaper (0-15)	3.744 (0.092)	2.559[a,b,c] (2.571)	4.016[a] (3.098)	4.000[b] (2.864)	3.679[c] (2.841)	***
Facebook (0-3)	1.623 (0.041)	1.640 (1.313)	1.829[a,b] (1.290)	1.521[a,c] (1.311)	1.240[b,c] (1.322)	***
Twitter (0-3)	0.330 (0.025)	0.288 (0.743)	0.347 (0.830)	0.246 (0.668)	0.376 (0.934)	
TikTok (0-3)	0.388 (0.029)	0.225[a] (0.709)	0.466[a,b,c] (0.971)	0.303[b] (0.782)	0.190[c] (0.674)	***
Instagram (0-3)	0.752 (0.036)	0.532[a] (0.980)	0.878[a,b,c] (1.214)	0.661[b] (1.072)	0.597[c] (1.081)	***
YouTube (0-3)	0.858 (0.036)	0.775 (1.101)	0.967[a] (1.144)	0.717[a] (1.054)	0.760 (1.040)	**
Age	49.913 (0.604)	49.468[a] (15.562)	50.499[b] (16.134)	50.004[c] (16.323)	54.430[a,b,c] (15.469)	**
Gender (1 = male; 2 = female)	1.505 (0.0159)	1.495 (0.502)	1.611 (0.488)	1.533 (0.499)	1.566 (0.497)	*

Table 2 (Continued)

	Mean Total Sample (SD)	Class 1 Doubtful Mean (SD)	Class 2 Indifferent Mean (SD)	Class 3 Concerned Mean (SD)	Class 4 Engaged Mean (SD)	F-test
Education (1-5)	3.190 (0.038)	3.252[a] (0.858)	3.297[b] (0.773)	3.394[c] (0.814)	3.579[a,b,c] (0.868)	***
Ideology (0-10)	5,476 (0.066)	6.748[a,b,c] (2.266)	5.851[a,d,e] (1.990)	5.256[b,d,f] (1.954)	4.405[c,e,f] (2.220)	***

Note: p = 0.05 *, p = 0.01 **, p = 0.001 ***; the corresponding superscript characters – a, b, c, d, e, f indicate significant differences based on Bonferroni post hoc test.

Based on insights from earlier work, some potential explanations for these findings can be put forward. As climate change in Flanders is never questioned and regarded as a serious threat in the mainstream news media (Moernaut et al., 2018; Pepermans & Maeseele., 2017), it is quite unsurprising that the *Doubtful* are the least often exposed to this information as this stands in stark contrast to how they perceive the issue. However, on Facebook and other social media, they might find information that is more in line with how they think about climate change, as previous work indicates that misinformation on social media regarding climate change is widespread (Treen et al., 2020). Similarly, the *Indifferent* are still somewhat in doubt about the reality of anthropogenic climate change; this might be due to, or reinforced by, their high social media usage. Last, the *Engaged* are the most frequent users of broadsheet newspapers and, together with the *Concerned*, the most frequent users of the PBS. As these (elite) media types include more hard news (Fraile & Iyengar, 2014), they can be assumed to report more about climate change topics than the commercial broadcaster and popular newspapers. This might provide part of the explanation for the varying results between popular and elite news media.

The results of this study can be a useful starting point for effective climate communication. As earlier work indicates that the different climate segments in a population react differently to climate messages (Martel-Morin & Lachapelle, 2022), it is insightful to know what segments exist in society, how they perceive climate change and what their information sources are. In terms of generalisability of the study's findings, especially those pertaining to the classes it identified, the climate segments distinguished in Flanders are similar to the segments found in earlier studies, especially with regard to the studies conducted in Europe (Kácha et al., 2022; Metag et al., 2017; Wonneberger et al., 2020). Flanders is thus not exceptional but rather seems to be a quite representative case. Also the findings for the relationship between media use and climate segments might be quite generalisable, at least to the European context where similar climate segments have been found. Although every country has its own media landscape, the distinction between 'elite' and 'popular' media that proved to be informative is broadly applicable (Fraile & Iyengar, 2014). In addition, the use of social media as a distinct information source is widespread and not unique to Belgium (Newman et al., 2023). Still, these findings should be confirmed in a different setting.

This study has a number of limitations. First, with regard to support for specific climate policies and climate behaviour, a set of climate policies and behaviours were chosen (see Table 1). However, a big variety of possibilities exist, and it is plausible that my choice for this specific set of policies and behaviours influenced the results. Second, it is possible that the period in which the survey was commissioned distorted the results. In February 2023, the energy crisis was still in its midst, and this might have led to fewer people being concerned about climate change than before the energy crisis. Big real-world events influencing people's attitudes, however, is part of reality, and almost every study on public opinion is to a certain extent time-bound. Third, the results of this study are descriptive in the sense that the relationship between climate segments and media use was investigated without making claims about causality; hence, it is possible that

spurious relationships exist. Fourth, this study did not include an analysis of the content of information sources, so we do not know the exact information or media coverage to which the different segments are exposed. Future research could address this by including a qualitative media content analysis to investigate the climate frames used in different media outlets. This would allow for a more in-depth study of the relationship between certain segments and their information sources. Finally, the next step should be to experimentally test whether the different climate segments respond differently to climate messages and which messages are most effective for which climate segments.

7 Disclosure Statement

The author reports there are no competing interests to declare.

Notes

1 For example, latent class analysis (e.g. Kácha et al., 2022; Leiserowitz et al., 2009) or cluster analysis (e.g. Hine et al., 2016; Metag et al., 2017).
2 Given that the Belgian media and political system is split along linguistic lines, we can study it as a separate case (see for recent studies that similarly focus solely on Flanders, for example, Beckers et al., 2021).
3 Fieldwork for the survey was done by Dynata between 10/02/2023 and 21/02/2023. Ethical approval for the survey was granted on 08/02/2023 by the Ethics Committee for the Social Sciences and Humanities (EA SHW) of the University of Antwerp under file code SHW_2023_14_1.
4 Iterative proportional fitting (IPF) is used, max adjustment factor = 5.2.
5 1= none, 2 = primary school, 3 = secondary education, 4 = higher non-university education, 5 = university education.
6 "In politics, people sometimes talk about 'left' and 'right'. Where would you place yourself on this scale, where 0 means left and 10 means right?"
7 An additional Spearman correlation test indicates a significant correlation between education and climate class; however, the correlation is weak (0.115, p = 0.000).
8 An additional Spearman correlation test indicates a significant correlation between ideology and climate class; however, the correlation is rather weak (−0.274, p = 0.000).

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