Climate Change Discourse: Scientific Claims in a Policy Setting

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Abstract The scientific knowledge associated with the phenomenon of climate change is presented and circulated in a variety of text and talk aimed at audiences with different knowledge backgrounds and agendas. Language is crucial in the presentation of scientific issues, but to date few climate change studies have taken a point of departure in linguistics. This paper explores some linguistic and discursive features of a text from the IPCC, the *Summary for Policymakers* of the *Fourth Assessment*'s *Synthesis Report* (2007). This document is based on scientific papers but addressed to policymakers, something which we argue makes it an example of knowledge asymmetry. It represents the formally agreed statement of the IPCC concerning key findings and uncertainties regarding climate change. We consider how this discourse is constructed, being situated somewhere between scientific and political discourse. We focus specifically on two features: the nature of knowledge claims and the use of polyphonic (multivoiced) constructions. Climate change knowledge is characterised by complexity and uncertainty. The discussion of knowledge claims takes its point of departure in these characteristics and focuses primarily on how the uncertainty aspect is mediated to a non-scientific audience. In the polyphonic analysis, we explore to what extent the linguistic form is multi-voiced, which voices are included, and to what extent the sources of the voices are made explicit. The purpose is to explain how claims and voices orient the discursive argumentation in climate communication.

Keywords scientific discourse, political discourse, complexity, uncertainty, knowledge claims, knowledge asymmetry, polyphony, voice

1 Introduction

In the current paper we undertake an explorative analysis of some important linguistic and discursive features of climate change communication, with a special focus on the presentation of knowledge claims and the manifestation of voices. The text we analyse is produced by the Intergovernmental Panel on Climate Change (IPCC), a panel that reviews climate change knowledge and presents it to policymakers and other interested parties. The term *climate change* refers to a scientifically very complex and long-term phenomenon which is global in nature, but which is experienced locally. This results in knowledge claims that are typically marked by a certain level of uncertainty. Climate change has repercussions for many aspects of human and social development (Giddens 2009, Hulme 2009, Malone 2009), and the complexities and uncertainties of climate science are presented, circulated and interpreted in a large variety of text and talk. In order to get a better understanding of the climate debate it is necessary to study both the production of climate change texts and their interpretation and reception in different contexts. This requires an interdisciplinary research approach. At present several research initiatives exist that combine insights from various disciplines (e. g. the Tyndall Centre for Climate Research in the UK). However, little such research seems to include linguistics-based studies (Nerlich/Koteyko/Brown 2010). The present study represents an attempt to address this gap by investigating what linguistic analysis of rhetorical and argumentative features of climate texts can contribute to a fuller

understanding of the climate change debate. This debate is particularly complex and multi-faceted, causing a range of communication problems.

Communication about the climate issue involving groups outside the science environment is currently much focused on by climate scientists, something which is reflected in the following quote from *Science*:

> […] it is imperative that we improve the exchange of information between scientists and public stakeholders […] we urge the broader science, communication, and funding community to support large-scale projects to translate scientific assessments into simpler, more useful terms. (Bowman et al. 2009: 36)

Surveys of the public's understanding of climate-related concepts (e. g. the one commissioned by Språkrådet, the Language Council of Norway, in cooperation with the Bjerknes Centre for Climate Research in 2010) and research into risk communication (e. g. Leiss 2004, Patt/Schrag 2003) have shown that even when the scientists define complex concepts and explain implications, the general public interpret them from their general knowledge of the language and the world (see also section 4 below). This may lead to interpretations which are not in accordance with the science.

In addition to the complexity and uncertainty of the science, the high number of stakeholders – climate scientists, economists, politicians, representatives of non-government organisations (NGOs), new and traditional media, as well as people in general – is a key characteristic of climate discourse (e. g. Weingart/Engels/Pansegrau 2000). In the current work, we therefore focus on two main issues: the scientific knowledge claims and voices representing various points of view in the texts. Our intention is to explain the status of the claims in terms of the level of uncertainty associated with them and to what extent other voices than the IPCC are present. The overall aim of our analysis is to explain how the interaction of claims and voices orients discursive argumentation related to the climate phenomenon.

The text we analyse is the *Summary for Policymakers*, part of the *Synthesis Report* of the IPCC's 2007 *Fourth Assessment Report*. The IPCC represents one of the most important (if not *the* most important) scientific actors in the climate debate.[1] The panel undertakes work to provide "a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts", at the same time aiming "to reflect a range of views", in a manner which is "policy-relevant and yet policy-neutral, never policy-prescriptive" (www.ipcc.ch/organization/organization.shtml).

Before going into the linguistic analysis, we relate our work to knowledge communication involving non-scientific audiences[2] (section 2). In section 3 we present our material and methods, while section 4 focuses primarily on knowledge claims, but also briefly considers policy issues. Section 5 deals with the phenomenon of voices. Section 6 sums up our findings with a focus on the interaction of claims and voices in knowledge communication which involves science, politics and the public at large.

2 Knowledge communication

As already indicated, there have been many calls for clearer and better science communication. One key approach to the relationship between the world of science and society at large is the Public Understanding of Science approach. Within this 'movement', the deficit model was for a long time the dominant one in conceptions and discussions of the communication of

knowledge. This model assumes (degrees of) scientific illiteracy in the general population and a one-way flow of information from scientists to the general public (Burns/O'Connor/Stocklmayer 2003). A later model is the contextual approach, a more complex model that instead focuses on the interaction between science and the public (Burns/O'Connor/Stocklmayer 2003, Gross 1994).

The calls for better science communication still often carry a flavour of the deficit model (see also Frewer et al. 2003, Nerlich/Koteyko/Brown 2010, Zehr 2000). We see reflections of this when expressions like "translate scientific assessments into simpler, more useful terms" are used, as in the quote from *Science* in the Introduction. In the same vein we find advice given in Hassol (2008: 106), for instance "stop speaking in code" and "[c]learly state the settled scientific conclusions. Do not overdo 'weasel words' and caveats" (Hassol 2008: 106). Hence, simplification is here the suggested solution to better knowledge communication to audiences that lack scientific expertise.

A concept that is also relevant for science communication is knowledge asymmetry. The notion is well known in business contexts, denoting situations where different levels and divisions within organisations have to interact, or where external professional assistance is required (e. g. Sharma 1997). Buy-sell transactions may also be characterised by asymmetrical information, where one party in a transaction has more or superior information than another. The notion is negative in nature and implies uneven distribution of both information and power (Sharma 1997). In its strictest sense, asymmetry implies lack of symmetry between two parts on either side of a dividing line. In the context of scientific knowledge communication, it might then be argued that the concept of knowledge asymmetry fits well with the deficit model approach, assuming a division between scientists and their (complete) scientific knowledge and a lay public with less or no scientific knowledge. However, even if we adhere to a contextual approach with a richer and more complex, non-linear and non-dichotomised communication model, we find the notion useful. It calls forth an image of imbalance, a feature which in our view is present in all knowledge communication involving discourse participants outside the original context for the knowledge (see also Dahl forthcoming). In the present case the asymmetrical situation arises from the communication about science-based knowledge between scientists and (primarily) policymakers. Knowledge in the shape of scientific research papers and reports serves as input to the IPCC assessment reports. The main audience specified for these reports is policymakers from all over the world, but even broader audience groups are indicated in the presentation of the reports on the IPCC website (www.ipcc.ch).

3 Material and methods

As stated in the Introduction, the text we have selected for our analysis is part of the IPCC's most recent assessment report, the *Fourth Assessment Report* (2007). These assessments consist of three reports produced by three Working Groups (WG I–III) and one *Synthesis Report*. The *Synthesis Report* starts with a 22-page *Summary for Policymakers*, and it is this *Summary* that we look at here (www.ipcc.ch/publications_and_data/ar4/syr/en/spm.html). This text represents the most condensed summary of current understanding of scientific, technical and socio-economic aspects of climate change. It is based on scientific documentation, and prepared by scientists from both natural and social sciences, government representatives and politicians, and is addressed primarily to policymakers. The text in this way represents an important link between science and politics in the climate debate.

The authors and reviewers of the IPCC assessment reports make selections from the primary sources (scientific articles and reports) through an extremely thorough negotiation process, described in detail on the IPCC website. In addition to this negotiation process, the information in the reports is adapted to a non-scientific audience. Textual evidence of the adaptation process is, for instance, explanatory comments, definitions and footnotes, as well as user guides, glossaries, lists of acronyms, chemical symbols and scientific units, all provided to "facilitate use of [the Fourth Assessment] report by as wide an audience as possible" (Annex I, User guide). Commendably, much attention is also given to the language of presentation, as witnessed e.g. by the document *Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties*, intended to help the authors, coming from different scientific traditions, to handle uncertainties in a consistent way across the full *Assessment Report*. Three approaches are established to convey the status of claims in terms of uncertainty (see section 4).

We focus on the body text of the 22-page *Summary*. For reasons of space, tables, figures, illustrations and footnotes have not been included in the analysis. They are important components of the complete information provided by the IPCC, but would have required a different approach from the one undertaken here. The body text of the *Summary* consists of sentences extracted verbatim from the *Synthesis Report* as well as condensed information from several statements. In the *Summary*, reference (in curly brackets) is given to the section of the *Synthesis Report* where the information is found, as in example (1):

(1)   Mountain glaciers and snow cover on average have declined in both hemispheres. *{1.1}*

These references have been deleted in the examples we discuss, as they were not considered to be relevant for the present analysis.

In our discussion of the knowledge claims (section 4), we focus primarily on the interlinked aspects of complexity and uncertainty – both key characteristics of climate knowledge – in an adaptation perspective. What is the status of the claims which have been selected for inclusion in the *Summary*? Since this text represents the most condensed form of current knowledge, are they all claims which can be posited with a high degree of confidence, or do we also find claims associated with more uncertainty or disagreement in the scientific community? We also briefly consider the policy issue. Are the statements policy neutral, as intended by the IPCC, or are there lexical traces of position taking?

The *Summary* represents the collective voice of the IPCC. Is this the only voice heard in the text or are there traces of other voices as well? This question will be addressed by means of a linguistic polyphony analysis based primarily on the ScaPoLine theory (section 5).

4 Knowledge claims

Knowledge claims may be considered as mental constructs which are verbalised in speech or writing and which relate to a specific field of knowledge. Knowledge claims are not necessarily epistemological in nature. They may also be individual and experience-based (e.g. Jakubik 2007). In the current context, we consider knowledge claims in the shape of research findings presented by the IPCC.

As already indicated, the special nature of the phenomenon of climate change makes it particularly relevant in discussions of climate communication involving non-scientific audi-

ences to consider how complexity and uncertainty are dealt with. In order to illustrate these two aspects, let us look at an example from the *Summary*:

(2)   There is observational evidence of an increase in intense tropical cyclone activity in the North Atlantic since about 1970, with limited evidence of increases elsewhere. There is no clear trend in the annual numbers of tropical cyclones. It is difficult to ascertain longer-term trends in cyclone activity, particularly prior to 1970. (p. 2)

This passage is in fact very typical of climate change knowledge and the forms used to express it. Along with clear results come uncertainties which may be due to an insufficient number of investigations, as well as references to the continuous development of new models and the long time perspective needed to establish clear trends. The linguistic structure of the claims, *There is …*, is seen in many of the examples given below, indicating an 'objective' and impersonal presentation.

As mentioned in section 3, in order to ensure uniform handling of uncertainty across the Working Groups, the IPCC in their *Guidance Notes for Lead Authors* suggested three different approaches – two quantitatively based taxonomies and one qualitative taxonomy of predefined scalar expressions – to describe knowledge claims in the reports (see below). This is an issue which is linked to the knowledge asymmetry aspect of the communication. Defined levels of uncertainty may potentially make it easier for non-scientific readers to assess the exact status of the claims. The scalar expressions appear in italics in the text, an added typographical effect to indicate their special status. The Working Groups involved in the *Fourth Assessment Report* chose different approaches to uncertainty. WG I (reporting on the physical science) and WG II (reporting on impacts, adaptation and vulnerability) used the quantitatively-based approaches, while WG III (reporting on the mitigation of climate change) used the qualitative approach. More specifically, WG I and WG II used mainly risk assessment expressions in the form of an 8-step scale, ranging the likelihood of outcomes which can be estimated probabilistically, from *virtually certain* (> 99%) to *exceptionally unlikely* (< 1%), and a 5-step confidence interval scale, expressing the confidence in the correctness of a result: *very high–very low confidence*. Here are four examples of the quantitative approaches:

(3)   Average Northern Hemisphere temperatures during the second half of the 20th century were *very likely* higher than during any other 50-year period in the last 500 years and *likely* the highest in at least the past 1300 years. (p. 2)

(4)   Human influences have […] *more likely than not* increased risk of heat waves, area affected by drought since the 1970s and frequency of heavy precipitation events. (p. 6)

(5)   There is *high confidence* that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change. (p. 18)

(6)   There is *medium confidence* that other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers. (p. 3)

This kind of standardised language to describe risk has been criticised (e. g. Leiss 2004, Patt/Schrag 2003). Patt/Schrag (2003: 18) claim that laypersons' subjective understanding of prob-

abilities depends on contextual factors, such as e. g. objective probability and the magnitude of the described event. For instance, while the probability of relatively infrequent events is overestimated, the probability of relatively frequent events is underestimated in lay audiences. Patt/Schrag (2003: 29) conclude that

> [t]he strategy of using specifically defined language to describe the probabilities of climate change risks achieves important objectives, but may also introduce bias into policy-makers responses. Intuitively, people use such language to describe both the probability and magnitude of risks, and they expect communicators to do the same. Assessors need to emphasize that the IPCC's use of this language departs from people's expectations. Unless policy-makers appreciate this fact, their response to the assessment is likely to be biased downward, leading to insufficient efforts to mitigate and adapt to climate change.

Similar conclusions have been drawn by Budescu/Broomell/Por (2009), who found large differences in people's understanding of the verbal probability terms used by the IPCC. Through various psychological experiments, they show that these terms may lead to confusion and in many cases to underestimation of the magnitude of problems. One of their findings was that it was easier for non-experts to understand such probability terms when numerical values were added.

In WG III, a qualitative two-dimensional, 3-step level-of-understanding scale expressing agreement and evidence was used. The level of agreement in the literature on a particular finding was ranged, from *high* to *low agreement*. This was combined with a ranging of the amount of evidence, from *much* to *limited evidence*. Examples (7) and (8) illustrate this approach:

(7) There is *high agreement* and *much evidence* that all stabilisation levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialised in coming decades […]. (p. 20)
(8) There is *high agreement* and *medium evidence* that Annex I countries' actions may affect the global economy and global emissions, although the scale of carbon leakage remains uncertain. (p. 18)

WG III explains that a quantitative approach was "judged to be inadequate to deal with the specific uncertainties involved in this […] report, as here human choices are involved" (WG III, Endbox 1). The InterAcademy Council in their 2010 review point to the readership of the summaries and recommend that

> [a]ll Working Groups should use the qualitative level-of-understanding scale in their Summary for Policy Makers and Technical Summary, […]. This scale may be supplemented by a quantitative probability scale, if appropriate. (p. 36)

This advice chimes well with the findings of studies of how non-experts perceive uncertainty (e. g. Budescu/Broomell/Por 2009, Leiss 2004, Patt/Schrag 2003) and may thus make it easier for the target audience of the IPCC reports to evaluate the scientific findings.

Tables 1–3 show the scalar distribution and number of occurrences of the claims which were presented by means of the three taxonomies in the *Summary*.

Table 1: Likelihood of the occurrence of a specific outcome

Scale	Occurrences
Virtually certain	-
Very likely	13
Likely	16
More likely than not	1
About as likely as unlikely	-
Unlikely	-
Very unlikely	2
Exceptionally unlikely	-

Table 2: Confidence in the correctness of a result

Scale	Occurrences
Very high confidence	2
High confidence	7
Medium confidence	3
Low confidence	-
Very low confidence	-

Table 3: Level of agreement and amount of available evidence with regard to a claim

Scale	Much evidence	Medium evidence	Limited evidence
High agreement	5	2	-
Medium agreement	-	-	-
Low agreement	-	-	-

As Tables 1–3 illustrate, nearly all the assessed claims in the *Summary* belong in the high end of the scales. It is either *very likely* or *likely* that the mentioned outcomes have taken place

or will take place (Table 1); the degree of confidence is typically given as *high* (Table 2); and the claims assessed qualitatively are mainly those where there is *high agreement* and *much evidence* (Table 3). Hence, the claims in the *Summary* clearly orient the discursive argumentation towards consensus. What, then, about claims where a higher degree of uncertainty might exist? It will be interesting to see in further studies to what extent such claims are found in the reports from the three Working Groups.

In another document describing the documentation processes of the IPCC, *The Preparation of IPCC Reports*, it is stated that "[d]isparate views for which there is significant scientific or technical support should be clearly identified in the IPCC reports, together with relevant arguments". Are any other disparate views included in the *Summary* than those potentially indicated in the very few examples of claims of likelihood of *more likely than not* and *with medium confidence*? Our analysis revealed very few overt linguistic traces of underlying disagreement in the research community. In section 5 we discuss how more implicit voices are heard in the text, but let us at this point take a look at an example which may imply diverging results in the research literature and contrasting points of view indicated by the connective *but*:

(9) Peer-reviewed estimates of the social cost of carbon in 2005 average US$12 per tonne of CO_2, but the range from 100 estimates is large (–$3 to $95/tCO2). This is due in large part to differences in assumptions regarding climate sensitivity, response lags, the treatment of risk and equity, economic and non-economic impacts, the inclusion of potentially catastrophic losses and discount rates. (p. 22)

However, we notice that a methodological explanation for the divergence is added: *This is due in large part to …* A few other text passages explicitly refer to knowledge gaps due to the lack of studies in specified geographical areas or methodological difficulties in carrying out the studies, both of which are aspects making it difficult to posit claims with a high level of certainty. Here are two such examples.

(10) There is no clear trend in the annual numbers of tropical cyclones. It is difficult to ascertain longer-term trends in cyclone activity, particularly prior to 1970. (p. 2)
(11) Limited and early analytical results from integrated analyses of the costs and benefits of mitigation indicate that they are broadly comparable in magnitude, but do not as yet permit an unambiguous determination of an emissions pathway or stabilisation level where benefits exceed costs. (p. 22)

To sum up, then, in the *Summary* the IPCC authors point their non-scientific audiences in the direction of high-confidence and high-agreement claims; the argumentation is oriented towards the most consensual claims.

Finally in this section, we briefly consider the policy aspect of the *Summary*. The mandate of the IPCC is to be policy relevant, but not policy prescriptive. Several of the examples cited above refer to policy considerations, but the following two examples deal specifically with policy:

(12) A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change. There are barriers, limits and costs, which are not fully understood. (p. 14)

(13) Societies have a long record of managing the impacts of weather- and climate-related events. Nevertheless, additional adaptation measures will be required to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades. (p. 14)

Even if the specific nature of any future action is not suggested, both examples indicate, *inter alia* through a contrastive connective (*but* and *nevertheless*, respectively) and the verb *require*, that measures so far implemented are not adequate. They may therefore be interpreted as criticism of current policies. The next three examples give indications of the consequences of acting or not:

(14) In several sectors, climate response options can be implemented to realize synergies and avoid conflicts with other dimensions of sustainable development. Decisions about macroeconomic and other non-climate policies can significantly affect emissions, adaptive capacity and vulnerability. (p. 18)

(15) […] however, they [adaptation and mitigation] can complement each other and together can significantly reduce the risks of climate change. (p. 19)

(16) Delayed emission reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts. (p. 19)

The word *significantly* gives these statements a flavour of urgency and of the severity of the issue, and example (16) refers explicitly to the time aspect (*delayed*) and the consequences of postponing action related to emissions.

An informal search of the text for words that might point to overt position taking revealed that there are only five additional instances of *require*, no other relevant examples of *significantly* and none of *must*, *should* (in its deontic meaning) or *ought to*. On the basis of this admittedly very simple lexically based analysis, the general impression created by the *Summary* is that, on the whole, the IPCC remains policy neutral. In three of the examples cited above there are, however, linguistic traces of argumentation and discussion between different points of view through the connectives *but* (12), *nevertheless* (13) and *however* (15). We discuss this kind of non-overt but underlying discussion and indirect position taking in section 5.

5 Voices

At the IPCC website it is stated that the panel "aims to reflect a range of views". This statement has been the point of departure for the research question related to whether and how different views or voices are manifested in the *Summary*. We know that the climate debate in general is particularly multi-voiced or polyphonic, and there are many important questions related to the voices participating in this debate, at different levels and in different contexts: Which voices are present, explicitly or implicitly, which ones are dominating, and which voices are absent (Fløttum 2010b)? In order to understand what is at stake, for scientists as well as for non-scientists, it is important to know who says or believes what. What is of key interest in the present study is to what extent different points of view within the scientific community are expressed in the *Summary*. It might be a dilemma for the IPCC to reflect differing viewpoints and at the same time present a consensus view.

Since the *Summary* represents the formally agreed statement of the IPCC, it seems relevant first to investigate to what extent the authors (40 in all) are present, as a collective voice. It is easy to make a first observation: there are no occurrences of the first person plural pronoun *we*, thus not a single direct reference to the collective voice of the 40 authors. This absence of personal pronouns is not surprising; it demonstrates that the text is closely related to the norms of scientific discourse (Fløttum/Dahl/Kinn 2006). However, since the *Summary* is addressed not only to policymakers but also to a broader public, one might expect a communication style characterised by more interaction through devices such as the inclusive *we*.[3] In fact, experimental research on climate change communication undertaken at the University of Exeter (Haddad/Morton/Rabinovich forthcoming) seems to indicate that the use of *we* is more engaging and more likely to increase intentions to act environmentally friendly. The involved researchers do not as yet know why, but early findings seem to suggest that the communicator is perceived as more trustworthy when using *we* (Haddad/Morton/Rabinovich forthcoming).

Even though there are no occurrences of explicit *we* in the *Summary*, the voices of the authors are present throughout the text; person manifestation may be mapped by other devices (such as adverbs and connectives; see also examples in previous sections). This will be the focus of the present section.

To justify the hypothesis of personal presence in a primarily scientific text, we may look to a number of recent studies clearly showing that the traditional conception of scientific discourse as objective or neutral is outdated (Fløttum/Dahl/Kinn 2006, Hyland 1998, 2000, Prelli 1989, Swales 1990). In most disciplines, scientific reporting is becoming increasingly more rhetorical (clearly stated by Berkenkotter and Huckin already in 1995), and thus possibly more similar to political discourse. However, there are differences between scientific and political discourse. One reason is that the key purpose of scientific discourse is (or should be) to describe and explain facts and findings, while the main purpose of political discourse is to convince or to persuade someone to take action (Charaudeau 2005, Fløttum 2010a, Gjerstad 2007, Wodak/Chilton 2005). For the text we analyse here, the context in which it is produced makes it reasonable to assume that it will display a mix of scientific and political traits.

We have seen that the authors comment on underlying voices by means of scientifically defined expressions (section 4). In addition, the text contains a high number of epistemic modifiers such as modal verbs like *may* (13 occurrences), *might* (1), *could* (11) and *would* (17). These words may convey quite different semantic content, but also the epistemic value of toning down the propositional content of the sentence in which they occur, marking some kind of hesitation. In the present context, this may be considered as an example of polyphony, where the authors add their point of view as a comment to the un-nuanced and underlying point of view, which may exist within the actual scientific community. Thus we have an internal discussion, with expressed uncertainty. Here is an example containing the modal verb *may*, where an underlying point of view – 'it is difficult ...' – is modified by a model point of view 'it may be difficult ...':

(17) Without substantial investment flows and effective technology transfer, it may be difficult to achieve emission reduction at a significant scale. (p. 20)

We will now turn to two specific linguistic devices which indicate mixed voices in constructions of refusal and concession, respectively. Our presentation will be limited to examples of markers of this kind of implicit polyphony, i. e. the negation marker *not* (in its polemic use) and

the contrastive connective *but* (in its concessive use). This limited selection is justified by the very frequent use of these specific markers in both political (Fløttum/Stenvoll 2009) and scientific discourse (Fløttum/Dahl/Kinn 2006) in general, and in the current text in particular.

The theoretical framework of the analysis is ScaPoLine, a theory of linguistic polyphony (Nølke/Fløttum/Norén 2004; ScaPoLine is short for La théorie scandinave de polyphonie linguistique). In a very simplistic way, we may say that this approach is based on a conception of language as fundamentally dialogic, presenting itself as an alternative to the established idea of the uniqueness of the speaking subject (inspired by sources as different as Bakhtine 1984 and Ducrot 1984). The main idea is that in one single utterance there may be several voices or points of view present, in addition to the one of the speaker/writer. The ScaPoLine theory may be used to clarify complex multi-voiced sequences with both explicit presence of different points of view (as in citations and different kinds of reported speech) and implicit presence (signalled by different markers such as adverbs, connectives and pronouns). We will now show how the theory can be applied, first by considering an example of negation (by *not*), with refutative meaning:

(18) The long time scales of thermal expansion and ice sheet response to warming imply that stabilisation of GHG concentrations at or above present levels would not stabilise sea level for many centuries. (p. 20)

pov 1: stabilisation of GHG concentrations at or above present levels would stabilise sea level for many centuries
pov 2: pov 1 is not valid

For practical reasons, we only consider the subordinated *that*-clause. In this clause, there are two points of view (pov): one stating that 'stabilisation of GHG concentrations at or above present levels would stabilise sea level […]' (pov1) and another qualifying this as not valid: 'stabilisation of GHG concentrations at or above present levels would not stabilise sea level […]' (pov2). While the speaker is responsible for pov2, the isolated utterance does not indicate who is the source of the first. The source might or might not be identified through contextualisation. The speaker instance corresponds to the authors of the *Summary*. The speaker's relation to the positive pov1 is one of refutation.

In the interpretation of an utterance, it is important to determine the various points of view which are manifested, and to try to identify their sources, be it the speaker him- or herself, another person or group of persons, more or less defined, or some general opinion or doxa. Our knowledge of the context makes it reasonable to interpret the underlying and refuted point of view here as belonging to a voice representing a point of view that is different from the consensual IPCC voice and which the IPCC voice refutes.

Thus the interpretation process consists of several steps. We need to identify not only the points of view, but also who is made responsible for each, to whom the points of view are attributed and the relation between the speaker and the different points of view presented.

Let us now turn to an example of the polyphonic marker *but* in its contrastive and concessive capacity. In simple terms, a construction with *but* can be formalised as

p but q

where p and q constitute two propositions – or arguments – in contrast: p represents the concession and q the argument that the speaker identifies him- or herself with. In the polyphonic

analysis these are treated as points of view. The following example constitutes an illustration of this construction:

(19) Such changes [in metres of sea level rise] are projected to occur over millennial time scales, but more rapid sea level rise on century time scales cannot be excluded. (p. 13)

It can be linguistically analysed as follows, in 4 povs:
> pov1: 'such changes are projected to occur over millennial time scales'
> pov2: pov1 is an argument in favour of the conclusion *r*
> pov3: 'more rapid sea level rise on century time scales cannot be excluded'
> pov4: pov3 is an argument in favour of the conclusion *non-r*.

Pov2 could also be represented as 'if pov1 then r', and pov4 as 'if pov3 then non-r'. The letter *r* symbolises a conclusion which is to be searched for in the interpretation phase of the analysis, i. e. in the context. In everyday language, the interpretation of example (19) could be translated as follows: The speaker accepts that 'such changes are projected to occur over millennial time scales'. Implicitly this pov also orients the discourse towards a conclusion (*r*) that there is 'no reason to worry now'. However, by the connective *but*, it is emphasised that what counts here and now is that 'more rapid sea level rise on century time scales cannot be excluded', with an implicit conclusion (*non-r*) saying 'Do worry!'.

This example contains in addition another signal of polyphony – the negation *not* in 'more rapid sea level rise on century time scales cannot be excluded'. We know from many public debates that sea level rise is a 'hot' topic. In (19), the IPCC official voice refutes that more rapid sea level rise can be excluded. This indicates that some researchers may have postulated that it *can* be excluded.

Let us return to the concession. A pertinent question to ask in the interpretation process is who is responsible for the conceded pov (pov1). The utterance alone does not tell us this. However, given the context of the IPCC work, this *but*-construction could be interpreted as a reflection of different viewpoints, an internal polyphonic exchange of pov. There are different voices because of different research results, because of different kinds of uncertainties, but also because there is a lack of research. The first pov has as its source some specific results and the second other results. It is nevertheless important to note that what matters here and now for the speaking voice is the proposition introduced by *but*.

Here is another example with the concessive *but*, also including the modal verbs *can* and *may*, adding a hesitating or uncertain point of view to the claim:

(20) Making development more sustainable can enhance mitigative and adaptive capacities, reduce emissions and reduce vulnerability, but there may be barriers to implementation. (p. 18)

This example shows some of the epistemic complexity (conveying uncertainty) and the underlying discussion (through the concessive *but*) which this kind of discourse represents.

Before concluding this section, let us just mention that the number of instances of the markers *not* and *but* in our text in fact is the same (13 of each in the body; in addition there are 20 occurrences of *not* and 2 of *but* in footnotes, illustration boxes, etc). However, this does not mean that there is an equal number of instances of this kind of refutation and concession.

In fact, concession wins over refutation. The reason is that many of the negations are of the descriptive kind, and thus not polemic, as in the following example:

(21) The projections do not include uncertainties in climate-carbon cycle feedbacks nor the full effects of changes in ice sheet flow […]. (p. 8)

The fact that concession wins over refutation in this document indicates only a mild form of polemic; the polyphonic argumentation is clearly oriented towards consensus.

    With these few examples we have shown that the polyphonic perspective may be relevant to the analysis of this kind of discourse. In order to explore the complexity of both scientific and political discourse, it is important to examine not only explicit but also implicit manifestations of voices involved. The polyphonic perspective helps to detect subtle interactions contributing to the negotiation of different relations, represented by different voices. An additional direct relevance for the present analysis is that the identification of such markers and voices can make the analyst sensitive to relevant contextual factors and thus be a good starting point for a broader socio-political analysis of the text.

6 Moving from scientific findings to policy

The main question underpinning the analysis in the present paper has been how the play of claims and voices may orient the discursive argumentation in a climate-related text. Our investigation showed that both knowledge claims and polyphonic constructions in the *Summary* clearly orient the argumentation towards consensus. The impersonal structure typically used to introduce knowledge claims (*There is …*) indicates a quite neutral and more or less non-committed voice, modified by various calibrated adverbial expressions. These expressions take different scalar forms related to the likelihood for the predicted occurrences to happen, the confidence associated with the claims and the degree of consensus about them. Even though the impersonal and quite categorical knowledge claims give the impression of agreement with regard to the various findings presented, we know that there are many different points of view in the discussions taking place in the thousands of scientific papers on which the *Summary* is based. These points of view manifest themselves to a certain degree through different voices indicated by polyphonic markers, which may express hesitation, concession and refusal. However, the most typical feature of the voices which are different from the speaker's voice is that their sources are not explicit in the *Summary*. In order to know who the real participants in this implicit polyphonic play are and to verify to what extent the points of view expressed correspond to specific research findings, we would have to go back to the different Working Group reports and perhaps also further into the scientific papers and reports they have used for their assessment. All in all, then, we may interpret the presentation in the *Summary* as given by a negotiated collective official IPCC voice.

    As regards the broader issue of climate communication, we note that what characterises the presented scientific findings is uncertainty. This reflects the very nature of climate change, an extremely complex natural phenomenon which it takes centuries to observe and measure, and which manifests itself differently across the world. These facts make it difficult for scientists to give clear recommendations about political actions related to adaptation and mitigation. IPCC texts are explicitly stated to be policy neutral, and the *Summary* represents only a

first step in the process of moving from scientific findings to concrete political measures. An interesting question then becomes how policymakers understand the IPCC message with its expressed as well as implicit uncertainty, and further, how and to what extent they turn the various findings into political action. The UN Climate Change Conference 2009 in Copenhagen (COP 15) demonstrated how difficult it can be to reach any agreement on this complex global issue.   •

Notes

1 The criticism recently levelled at the IPCC has not resulted in a weakening of the actual scientific basis for the work published by this organisation, as made clear in the InterAcademy Council's 2010 review of the processes and procedures of the IPCC.

2 Other dichotomy-based terms like *layperson* and *non-expert* are used in other communication studies. In reality, a continuum, with degrees of relevant knowledge gained through formal education or interest, is a better picture. For reasons of simplicity, we here use the term *non-scientific* to refer to people without a climate science background.

3 Interestingly, in the French translation, there is abundant use of the pronoun *on,* which in current French often corresponds to the first person plural (www.ipcc.ch/publications_and_data/ar4/syr/fr/spm.html).

References

Bakhtine, Mikhail (1984) [1952]: "Les genres du discours". *Esthétique de la création verbale*. Paris: Gallimard. 265–308.

Berkenkotter, Carol/Huckin, Thomas N. (1995): *Genre knowledge in disciplinary communication*. Hillsdale, N.J., US/Hove, UK: Lawrence Erlbaum Associates.

Bowman, Thomas E. et al. (2009): "Creating a Common Climate Language." *Science* 3: 36–37.

Budescu, David V./Broomell, Stephen/Por, Han-Hui (2009): "Improving Communication of Uncertainty in the Reports of the IPCC." *Psychological Science* 20.3: 299–308.

Burns, T.W./O'Connor, D.J./Stocklmayer, S.M. (2003): "Science communication: A contemporary definition". *Public Understanding of Science* 12: 183–202.

Charaudeau, Patrick (2005): *Le discours politique. Les masques du pouvoir*. Paris: Vuibert.

Dahl, Trine (forthcoming): "Knowledge claims". *The Encyclopedia of Applied Linguistic*s. Ed. Carol Chapelle. Oxford, UK: Wiley-Blackwell.

Ducrot, Oswald (1984): *Le Dire et le Dit*. Paris: Minuit.

Fløttum, Kjersti (2010a): "EU discourse: polyphony and unclearness." *Journal of Pragmatics* 42.4: 990–999.

Fløttum, Kjersti (2010b): "A linguistic and discursive view on climate change discourse". *La revue du GERAS*, ASp 58: 19–37.

Fløttum, Kjersti/Dahl, Trine/Kinn, Torodd (2006): *Academic Voices – across languages and disciplines*. Amsterdam: Benjamins.

Fløttum, Kjersti/Stenvoll, Dag (2009): "Blair speeches in a polyphonic perspective. NOTs and BUTs in visions on Europe." *Journal of Language and Politics* 8.2: 269–286.

Frewer, Lynn et al. (2003): "The views of scientific experts on how the public conceptualize uncertainty." *Journal of Risk Research* 6.1: 75–85.

Giddens, Anthony (2009): *The politics of climate change*. Cambridge, UK/Malden, MA, US: Polity Press.

Gjerstad, Øyvind (2007): "The Polyphony of Politics: Finding Voices in French Political Discourse." *Critical Approaches to Discourse Analysis Across Disciplines* 1.2: 61–78.

Gross, Alan G. (1994): "The roles of rhetoric in the public understanding of science". *Public Understanding of Science* 3: 3–23.

Haddad, Hebba/Morton, Thomas/Rabinovich, Anna (forthcoming): "The roles of 'tone of voice' and uncertainty when communicating climate change information". Presented at the British Psychological Society Social Section Conference, 2011, September, Cambridge.

Hassol, Susan (2008): "Improving how scientists communicate about climate change." *Eos* 89.11: 106–107.

Heffernan, Olive/Thorpe, Jo/Brown, Alistair (2011): "Whole-System Science". (Editorial). *Nature Climate Change* 1: 1.

Hulme, Mike (2009): *Why We Disagree About Climate Change*. Cambridge: CUP.

Hyland, Ken (1998): *Hedging in Scientific Research Articles*. Amsterdam: Benjamins.

Hyland, Ken (2000): *Disciplinary Discourses: Social Interactions in Academic Writing*. Harlow: Longman.

InterAcademy Council (2010): *Climate Change Assessments. Review of the Processes and Procedures of the IPCC*. Prepublication Copy. 04.08.2011. <http://reviewipcc.interacademycouncil.net/report.html>.

Jakubik, Maria (2007): "Exploring the knowledge landscape: four emerging views of knowledge." *Journal of Knowledge Management* 11.4: 6–19.

Leiss, William (2004): "Effective risk communication." *Toxicology Letters* 149: 399–404.

Malone, Elizabeth L. (2009): *Debating Climate Change*. London: EarthScan.

Nerlich, Brigitte/Koteyko, Nelya/Brown, Brian (2010): "Theory and Language of Climate Change Communication." *Wiley International Reviews: Climate Change* 1.1: 97–110.

Nølke, Henning/Fløttum, Kjersti/Norén, Coco (2004): *ScaPoLine. La théorie scandinave de la polyphonie linguistique*. Paris: Kimé.

Patt, Anthony G./Schrag, Daniel P. (2003): "Using specific language to describe risk and probability." *Climatic Change* 61: 17–30.

Prelli, Lawrence J. (1989): *A Rhetoric of Science*. Columbia: University of South Carolina Press.

Sharma, Anurag (1997): "Professional as Agent: Knowledge asymmetry in agency exchange." *Academy of Management Review* 22.3: 758–798.

Språkrådet/Respons Analyse (2010): Befolkningens forståelse av faguttrykk i klimadebatten. [The Population's Understanding of Scientific Expressions in the Climate Debate]. 04.08.2011. <http://www.sprakrad.no/upload/Terminologi/Rapport_Uttrykk%20innen%20klimadebatten.pdf>.

Swales, John M. (1990): *Genre Analysis*. Cambridge: CUP.

Weingart, Peter/Engels, Anita/Pansegrau, Petra (2000): "Risks of communication: Discourses on climate change in science, politics, and the mass media." *Public Understanding of Science* 9: 261–283.

Wodak, Ruth/Chilton, Peter, Eds. (2005): *A New Agenda in (Critical) Discourse Analysis: Theory, Methodology and Interdisciplinarity*. Amsterdam: Benjamins.

Zehr, Stephen C. (2000): "Public representations of scientific uncertainty about global climate change". *Public Understanding of Science* 9: 85–103.

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