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How certain is 'certain'? Exploring how the English-language media reported the use of calibrated language in the Intergovernmental Panel on Climate Change's Fifth Assessment Report

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Abstract
This article presents findings from an analysis of English-language media reports following the publication of the fifth Intergovernmental Panel on Climate Change Assessment Report in September 2013. Focusing on the way they reported the Intergovernmental Panel on Climate Change's use of 'calibrated' language, we find that of 1906 articles relating to the issuing of the report only 272 articles (14.27%) convey the use of a deliberate and systematic verbal scale. The Intergovernmental Panel on Climate Change's carefully calibrated language was rarely discussed or explicated, but in some instances scientists, political actors or journalists would attempt to contextualise or elaborate on the reported findings by using analogies to other scientific principles or examples of taking action despite uncertainty. We consider those analogies in terms of their efficacy in communicating (un)certainty.

Keywords
calibrated language, climate change, mass media, metaphor, uncertainty

1. Introduction

Conveying scientifically assessed risks, uncertainties and certainties is a major challenge to science communication, especially in the context of climate change. It has become clear that scientists, politicians, journalists and the general public use and understand the words 'risk' and 'uncertainty' in very different ways (Budescu et al., 2009; Campbell, 2011; Erkwurzel et al., 2011; Harris et al., 2013), which can lead to miscommunication and misunderstanding. Contrasting what some call 'school science' (where students are taught solid facts) and 'research science' (which explicitly acknowledges uncertainty as inherent to and as an incitement for more work), Painter (2013) refers to the former as a model which leads many members of the public to understand

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'uncertain' as 'incomplete' or as an admission of ignorance. Put simply, climate scientists associate the word uncertainty with 'probability, confidence intervals and margins of error' (Corner, 2014) while members of the public may associate it with ignorance, doubt and anxiety (Nerlich, 2012).

There is also a growing gap between increasing scientific certainty regarding climate change (including a growing knowledge about uncertainties) and public perception of uncertainty in the sense of an overall deficiency in scientific knowledge about climate change. As Patt and Weber (2013) report,

> Public opinion polls reveal that the perception of climate change as an uncertain phenomenon is increasing, even as consensus has increased within the scientific community of its reality and its attribution to human causes. At the same time, the scientific community has sought to improve its communication practices, in order to present a more accurate picture to the public and policy makers of the state of scientific knowledge about climate change. (p. 259)

'Moreover, climate communication faces new challenges as assessments of climate-related changes confront uncertainty more explicitly and adopt risk-based approaches to evaluating impacts' (Pidgeon and Fischhoff, 2011: 35). Academics have strived to offer a theoretical distinction between 'risk' and 'uncertainty' for nearly a century (Knight, 1921; Leroy and Singell Jr, 1987) and the terms are understood differently across disciplines. Our intention is not to resolve this theoretical distinction, but to observe how 'uncertainty' has been articulated in relation to climate change discourse and how the concept of 'risk' is used in relation to climate change mitigation. As such, we discuss 'uncertainty' in relation to unknown outcomes and 'risk' in relation to action that has some sense of foreseeable outcome.

In a context where climate scientists are increasingly open, explicit and transparent about scientific uncertainty and in a context where, at the same time, uncertainty in a different sense is used to challenge climate science, it is important to understand how efforts to communicate uncertainty play out at the interface between climate science and the public sphere.

Over the last 20 years or so, a growing body of literature has examined the communication of climate change in the mass media (Boykoff, 2011). Many articles have focused on the communication of risk in this context (Carvalho and Burgess, 2005; Sterman, 2011), others have examined media representations of uncertainty (Corner, 2014; Poortinga et al., 2011; Whitmarsh, 2011; Zehr, 2000), but only a few have tried to understand the communication of scientific uncertainty or probabilistic information in the context of climate change (Patt and Dessai, 2005; Stephens et al., 2012), and none so far have attempted to examine how this plays out in the mass media.

We examine the most recent Intergovernmental Panel on Climate Change (IPCC) Assessment Report published in September 2013, more precisely the Fifth Assessment (AR5) report entitled 'Climate Change 2013: The Physical Science Basis, Summary for Policy Makers (SPM)', as a case for studying how uncertainty language is used (or not) in the press. This is an important case study, as since 2007 all IPCC reports have adopted a 'calibrated language' approach to communicating scientific uncertainty in order to, in a sense, 'reduce doubt about uncertainty' (Moss, 2011). This calibrated language is based on verbally paraphrasing numerical degrees of 'certainty', 'confidence' and 'likelihood'.

The work on calibrated language within the IPCC reports is largely for the benefit of the authors themselves and the policy makers for whom the report is written. Within the report authors follow these now settled guidelines on how to represent uncertainty very closely, with varying degrees of success (see Harris et al., 2013). However, for the majority of the public – and for many politicians – the findings of the IPCC reports will be accessed through media reporting. Given that so much attention has been paid to the careful use of terms in relation to degrees of 'certainty', 'confidence'

and 'likelihood' in the findings of AR5, this article considers whether this effort is reflected in the media. If it is not, we question the value of such efforts and consider the limitations of these efforts for communicating scientific uncertainty to mass audiences. We show that in the mass media, journalists often use alternative ways of presenting the same messages, specifically through the use of analogy. We consider the effects of this additional representation of the IPCC's findings and whether such strategies could be used to supplement the IPCC's own reports.

We focus on news items in English speaking countries, such as the United Kingdom, the United States, Australia, Canada and so on. However, we do not home in on any country in particular. Some studies are beginning to carry out such research into the interpretation of the IPCC's calibrated language in different languages and cultures (Harris et al., 2013), while others are starting to explore media representations of calibrated uncertainty language in specific countries, such as India (see e.g. Kahn, 2014), and we hope that more such studies will follow.

2. Background

Creating a calibrated language

The IPCC publishes special reports on climate change which have the agreement of leading climate scientists and the consensus of participating governments. The first report was published in 1988 with subsequent reports appearing in 1995, 2001, 2007, and the first instalment of the Fifth Assessment Report in 2013. Subsequent chapters on impacts and mitigation were released on 31 March 2014 (WG2) and 13 April 2014 (WG3) (http://www.ipcc.ch/report/ar5/#.UxyJa1Pz0-Y). A year before the third IPCC report, two climate scientists, Moss and Schneider (2000), recommended a seven-step approach for describing uncertainty based on their observations of a lack of consistent criteria for assigning probabilities and characterising levels of confidence in the Second Assessment Report (Moss and Schneider, 1997). Their recommendations included the use of specific qualitative language in conveying uncertainty in these reports so that the general public and policy makers may understand them better.

The Guidance Note for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties provides a detailed description of how uncertainty is treated in IPCC reports (Mastrandrea et al., 2010):

> Where uncertainty is assessed *qualitatively*, it is characterised by providing a relative sense of the amount and quality of evidence (that is, information from theory, observations or models indicating whether a belief or proposition is true or valid) and the degree of *agreement* (that is, the level of *concurrence* in the literature on a particular finding). This approach is used by WG III through a series of self-explanatory terms such as: high agreement, much evidence; high agreement, medium evidence; medium agreement, medium evidence; etc.
>
> Where uncertainty is assessed more *quantitatively* using expert judgement of the correctness of underlying data, models or analyses, then the following scale of *confidence* levels is used to express the assessed chance of a finding being *correct*: very high confidence at least 9 out of 10; high confidence about 8 out of 10; medium confidence about 5 out of 10; low confidence about 2 out of 10; and very low confidence less than 1 out of 10.
>
> Where uncertainty in specific outcomes is assessed using expert judgment and *statistical* analysis of a body of evidence (e.g. observations or model results), then the following *likelihood ranges* are used to express the assessed probability of occurrence: virtually certain >99%; extremely likely >95%; very likely >90%; likely >66%; more likely than not > 50%; about as likely as not 33% to 66%; unlikely <33%; very unlikely <10%; extremely unlikely <5%; exceptionally unlikely <1%. (Emphasis added)

In recent years, some scholars have studied the usefulness and effectiveness of this calibrated language (Budescu et al., 2009, 2012), and one study has come to the conclusion that 'while it is possible to develop a vocabulary that conveys the intention of the IPCC, the recipient of the communication is likely to belong to another practice community and, thus not use the terminology as intended' (Landström et al., 2015). One such practice community is that of mass media journalists.

Reporting the calibrated language of the IPCC

The first line of the main body of the AR5 press release reads, 'It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century' (http://www.ipcc.ch/news_and_events/docs/ar5/press_release_ar5_wgi_en.pdf). However, it is not until the closing paragraph that the document explains the deliberate and specific use of a term such as 'extremely likely'. Previous research has found that media reporting of the IPCC has neglected the use of calibrated language. Painter (2013) reports that although 44% of articles reporting on three IPCC reports across six different countries incorporated the concepts 'confidence' and 'likelihood', only 27 of 177 (15%) included an explanation of what they meant. Of those published in the United Kingdom, '[t]he IPCC concepts of likelihood and probability were present in 13 of the 29 articles, but in only two of them were the concepts explained' (Painter, 2013: 122). Kahn (2014) found that 'the English-Indian print-press does not utilize the technical terminology employed by the IPCC' and that 'The majority of articles using this language did so in providing direct quotes from the report and most were quantitative measures' (p. 24). Bailey et al. (2014) reported an increase in the use of numerical ranges and the adjective 'likely' in the US media coverage of climate issues, suggesting that the IPCC's calibrated language had been appropriated by the media. However, they also observed a sustained use of mitigating terms that hedged any claims of scientific certainty.

3. Conceptual background

As Boykoff (2011) has pointed out, '[m]edia representations of climate issues – from news to entertainment – are powerful and important links between people's everyday realities and experiences, and the ways in which they are discussed by scientists, policymakers and public actors' (front matter). Public perceptions of climate change are shaped by media representations, and public perceptions in turn influence policy making. Both the mass media and institutions like the IPCC play a crucial role in the 'cultural circuit' of climate change communication (Carvalho and Burgess, 2005). The purpose of the IPCC is to 'provide rigorous and balanced scientific information to decision makers' and to the general public alike, while the mass media report on this regularly delivered scientific information and, in a sense, digest it for public consumption.

Gamson (1999) noted that influential scientific institutions such as the IPCC can be seen as 'primary' validators of science, while influential media institutions, such as prestigious broadsheets for example, can be seen as 'secondary validators' (pp. 23–24; see also Kahn, 2014: 6). Both are involved in framing scientific information and making it available to policy makers and the general public. Such framing has, since 2007, been supported by the creation of a calibrated language through which the IPCC attempts to convey scientific and probabilistic information in everyday language. Both institutions the IPCC and the mass media are, as Carvalho (2007) has pointed out, 'authorized "agents of definition" of science matters' (p. 223). However, while the IPCC, as an organisation at the interface between science and policy, uses numbers and a calibrated language, the mass media, as well as those who talk to the mass media, tend to use stories and figures of speech that make the unknown and unfamiliar accessible to their readers and audiences.

Humans rely on metaphor, comparison and analogy to develop understanding of relatively unfamiliar concepts by likening them to more familiar concepts. Burton-Jeangros et al. (2013) found that pregnant women would translate the risks they came across in prenatal screening, understanding a risk of 1-in-30 of chromosomal abnormality to be like having one in a classroom of children, or a probability of 1 in 7000 as one piece in a jigsaw. Researchers have examined the way that politicians use metaphorical tools to incite action in that '[a]nalogy may be a powerful way of mapping emotional connotations on to previously neutral objects and events' (Blanchette and Dunbar, 2001: 735). Analogies are chosen for their comparable features, but they are extricated from their origin and located in an unfamiliar domain, so inevitably there will be aspects that are incongruous with the new context. Put simply, 'metaphors also involve a potential trade-off between the creation of greater understanding and the risk of dangerous misappropriation' (Reisfield and Wilson, 2004: 4026). Kueffer and Larson (2014: 722) offer the following criteria in assessing the appropriateness of metaphors for science communication: factual correctness, socially acceptable language, neutrality and transparency. This highlights the importance of considering the accuracy, potential offence, use of emotive language or rhetoric, and making explicit when metaphorical or analogous language is being used. The use of similes in place of metaphor, using an 'X is like Y' statement, has been shown to decrease the risk that assertions will be taken literally (Carolan, 2006). In addition to the use of calibrated language and associated numerical scales, we therefore examine the use of analogy in reporting the findings of AR5 and consider their efficacy in conveying (un)certainty. If calibrated language does not 'work' in media settings while analogical language does (within limits), this might provide some indications for the IPCC of where to look for better communication tools in the future.

4. Methods and data

A search was conducted through Nexis® for English-language publications using the terms 'IPCC' or 'Intergovernmental Panel on Climate Change', excluding articles referring to the Independent Policy Complaints Commission (IPCC). This search covered the timeframe between Saturday 21 September 2013 and Friday 4 October 2013 to accommodate the news pieces published in the week preceding and the week following the official release of the IPCC AR5 on Friday 27 September 2013. Details of the report were available online as early as December 2012 (http://www.theguardian.com/environment/2012/dec/14/ipcc-climate-change-report-leaked-online), and in the days leading up to the official release, the media were reporting on the 'headline' findings of the report, hence the inclusion of those days' publications in our search.

A total of 1906 news items amounting to 1,965,396 words were collected across this 14-day period. These news items were tagged for their use of terms relating to the calibrated language of the IPCC report and uncertainty. This included the following:

- Certain/certainty/certainties;
- Uncertain/uncertainty/uncertainties;
- Probably/probability/probabilities;
- Likely/likelihood/unlikely;
- Confidence.

Since we were primarily concerned with the use of the IPCC's calibrated language, those articles which did not contain both 'IPCC/Intergovernmental Panel on Climate Change' and at least one of the certainty terms were removed. Thus, our search would only identify the use of alternative phraseology such as 'a 66% chance' if it was used in addition to the use of the specified terms.

Of the original 1906 articles, 1330 articles (69.8%) included both the 'IPCC' and at least one of these 'certainty' terms. However, a number of publications operated as summary reports of the various news items of the day so in many instances, issues of certainty were not discussed in relation to the report but in relation to some other news event. Furthermore, 'certain' is often used to mean 'particular, specific' and therefore not relevant to the purpose of this inquiry. As such, 407 articles were removed because of this irrelevance, leaving 923 publications that reported on issues of 'certainty' in relation to the IPCC report.

The use of analogy as a form of metaphorical language was identified manually through a close reading of the sample and as such, only accounted for the use of analogy when there was also reference to the IPCC's calibrated language. At this stage, we were concerned only with the explicit use of comparative reports of scientific certainty, such as '[The IPCC] is now as sure that human beings are causing climate change – 95 per cent – as that cigarettes cause cancer'. Such a construct is consistent with Kueffer and Larson's (2014) criterion of 'transparency' and therefore understood to be an attempt to provide clarification of the findings of AR5. This approach did not account for the use of more embedded metaphors, which have been shown to be prominent in climate change discourse (Nerlich et al., 2010), nor did it account for the use of analogous terms in lieu of reference to the IPCC's calibrated language. Nevertheless, in examining this relatively transparent type of construct we can critically examine the effect of analogy in offering further clarification of scientific (un)certainty.

6. Findings

Use of the IPCC's calibrated language

The purpose of this research was to determine whether the news reports of the release of AR5 made reference to or acknowledged the use of the calibrated language in relation to (un)certainty. Those remaining 923 articles were read closely to examine how the certainty reported by the IPCC, in the terms 'extremely likely' and the corresponding figure of >95% certainty, for example, were represented as existing on a clearly defined scale. Of 923 articles, 225 (11.80% of the original 'IPCC' search; 24.38% of the sample) were deemed to have made *implicit reference* to the existence of a quantifiable scale. This included the following:

- References to a numerical increase in certainty, for example 'up from 90% in 2007';
- References to a qualitative increase in certainty, such as '"extremely likely" rather than "very likely", as the last report in 2007 concluded';
- The inference of being synonymous by collocation, for example: 'extremely likely (95%–100% probability)'

However, 84 of these 225 articles were duplications that appeared either in another format (such as both in a print and online version) or in another publication in the same publishing group, leaving 141 original news items that made implicit reference to the IPCC's use of calibrated language. In contrast, 47 news publications (2.47% of 'IPCC' articles) *explicitly* acknowledged that the terms 'extremely likely' and so on were used deliberately, that the use of such terms by those involved differed to that of the lay person and that the qualitative terms 'extremely likely' and so on corresponded to a statistical quantity. Thus, the *explicit references* incorporated the following:

- References to the IPCC's definition of terms, such as 'In the IPCC's lexicon, "extremely likely" equates to 95 per cent certainty';

- References to the use of specific terms, though not specifically identified to be those of the IPCC authors, such as, '"extremely likely", a term meaning it was 95-percent convinced';
- Acknowledgement that the use of such terms differs to that of the lay person: 'There's a mismatch between what scientists say about how certain they are and what the general public thinks the experts mean, specialists say'.

A total of 17 of these articles were duplicates of those that had already appeared elsewhere, leaving 30 (1.57% 'IPCC' articles) original news items that made explicit reference to the IPCC's use of calibrated language. This is summarised in Table 1.

Among the 923 news items that used 'certainty' terms as listed above (certain/uncertain/likely etc.) in relation to the IPCC, the term 'likely' appeared 1649 times, preceded by 'extremely' 449 times and by 'very' 288 times. For the most part (374 of 449 instances, 83.3%), the use of 'extremely likely' appeared in quotation marks and in a further 59 instances (13.1%), 'extremely likely' was presented as the words of the report, of the IPCC, or of scientists in general. There were 16 instances (3.6%) in which the journalists reported the findings of AR5 as 'extremely likely' but with no indication that this was a term that was used deliberately and with an associated statistical value. Furthermore, although the use of quotation marks indicated that the use of the terms was by someone other than the journalist, this did not indicate the use of a calibrated language. Thus, the readers were given little to no indication that when the authors used these terms they had a specific statistical value in mind. The prevalence of other 'certainty' terms in the data is indicated by the values in Table 2.

In addition to the reported claim by the IPCC authors that it is 'extremely likely that human influence is the dominant cause of the observed warming since the mid-20th century' many news items quoted the use of the term 'unequivocal' in the IPCC press release (https://www.ipcc.ch/news_and_events/docs/ar5/press_release_ar5_wgi_en.pdf). 'Unequivocal' appeared 147 times across the 923 articles that referenced certainty in relation to the report. The term was referenced exclusively as a quotation, either of the press release of the report itself or as part of a commenter's paraphrasing of the report, such as by Adriana Mugnatto-Hamu, Climate Change Critic for the Green Party of Canada (http://www.greenparty.ca/media-release/2013-09-27/world-s-leading-scientific-climate-body-confirms-99-100-certainty-human-cau). This was not a term that formed part of the calibrated language of the IPCC authors but perhaps was preferred for being synonymous with 'certainty', for leaving no doubt. There was a tendency to substitute the word 'certainty' for 'sure'; 135 instances of 'sure' were observed in the 923 articles, and this was often treated synonymously with 'certain'. In 84 of those instances (62.2%), the word 'sure' was preceded by a percentage (66%, 90%, 95%, 100%) corresponding to those levels identified in the calibrated language of AR5: 'In 2007 they were 90% sure, and now they are 95% sure'. Much like 'certain', 'sure' often appeared in the phrasal construct 'as sure as', occurring 23 times in the 923 articles ('as certain as' appeared 17 times). This is necessarily a comparative construct and generally preceded some form of analogy such as 'as sure as scientists are that smoking causes cancer'. Given that the difference between 'sure' and 'certain' is not a matter of technical vocabulary and is unlikely to be preferred as a matter of literacy, we can speculate that this indicates that journalists might be more comfortable using 'sure' when discussing a gradated form of certainty as opposed to a more binary use of 'certain' and 'not certain'. Although journalists may feel that the term is synonymous, this does not reflect the IPCC authors' aims of using a consistent form of language when discussing their findings and therefore undermines their attempts to perpetuate a calibrated language.

There were 449 instances of 'extremely likely' across 923 news items, but references to 'certainty' terms were likely to appear clustered into the same news piece, as with the Climate News Network's thorough explanation (http://www.rtcc.org/2013/09/30/un-climate-report-what-are-the-ipccs-main-messages/). Of those 46 (29 non-duplicate) news items that made explicit reference to

Table 1. News items referring to Intergovernmental Panel on Climate Change's (IPCC) 'calibrated language'.

	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	01-Oct	02-Oct	03-Oct	04-Oct	Total
Original 'IPCC' search	40	44	106	112	91	114	464	264	70	149	127	120	123	81	**1906**
With 'certainty' terms	30	32	65	69	62	76	331	214	54	97	93	78	83	46	**1330**
Removed as irrelevant	14	12	28	29	30	35	54	41	16	33	21	31	36	27	**407**
'IPCC' and 'certainty'	16	20	37	40	32	41	277	173	38	64	72	47	47	19	**923**
Calibrated language															
Implicit reference	4	9	8	11	5	6	62	63	8	11	13	12	8	5	**225**
Quantitative increase	2	3	4	7	4	4	30	40	2	10	8	7	5	2	**128**
Qualitative increase	1	6	0	1	1	0	7	3	1	1	0	0	0	0	**21**
Coterminous collocation	0	0	0	0	0	0	37	28	2	3	3	7	2	3	**85**
Non-duplicate articles	4	6	6	7	5	7	39	33	4	7	6	8	5	4	**141**
Explicit reference	0	0	0	4[2]	4[2]	7[5]	13[11]	9[3]	1[1]	2[2]	1[1]	2[1]	3[1]	1[1]	**47[30]**
IPCC definition	0	0	0	3[1]	3[0]	3[2]	8[7]	7[2]	1[1]	2[1]	1[1]	2[1]	3[1]	0	**33[17]**
Non-IPCC definition	0	0	0	0	1[1]	5[3]	5[3]	3[1]	0	0	0	0	0	0	**14[8]**
Cites 'mismatch' in terms	0	0	0	3[2]	2[0]	0	0	1[0]	0	0	0	0	0	0	**6[2]**

Numbers in square brackets refer to non-duplicate news items.

Table 2. Instances of the use of 'certainty' terms.

Likely	1649	**Certain**	629	**Certainty**	518	**Confidence**	438	Certainly	88
Extremely –	449	95% –	178	95% –	147	High –	73	Confident	42
It is extremely –	229	More –	165	Greater –	40	Medium –	29	Consensus	79
Very –	288	More – than ever	97	More –	35	Low –	11	Likelihood	83
More –	51	Virtually –	78	Increased –	14	95% –	33	Uncertainty	206
Most –	24	As –	17	Near –	12	Increased –	19	Uncertainties	123
Is –	269			Virtual –	10	Greater –	13	Unlikely	90
Are –	101			Scientific –	24	Increasing –	6		
Was –	66								
Will –	45								
Were –	27								

the IPCC's use of a calibrated language, 33 (71.7%) contained little more than a single line definition of 'extremely likely' and/or 'very likely' with the corresponding percentage. In two cases, scientists were quoted explaining the IPCC's approach to a calibrated system of language. The first case came in the form of a transcript of a CNN news broadcast on 28 September 2013 (http://transcripts.cnn.com/TRANSCRIPTS/1309/28/cnr.01.html) in which guest Michael Oppenheimer, Director of Princeton University's Science programme and long-standing IPCC author, is quoted as saying, 'This isn't politics. This is scientific calibration'. Similarly, in a blog article published on 4 October 2013 by Responding to Climate Change, Peter Stott, who leads the Climate Monitoring and Attribution team at the Met Office Hadley Centre and who was a lead author of AR5 was quoted as saying,

> We have very importantly and very carefully calibrated that system [used in AR5] against previous assessments. We deliberately took the lead in the fourth assessment report to do the same type of analysis and of course use the same type of calibrated language, use the same kind of robust and rigorous approach, in order to compare our assessments. (http://www.rtcc.org/2013/10/04/ipccs-growing-confidence-is-not-a-question-of-grade-inflation/)

Responding to Climate Change is accredited as 'official observers to the United Nations Framework Convention on Climate Change (UNFCCC) and run a TV studio for the UN at its climate, biodiversity and desertification talks' (http://www.rtcc.org/about-us/), and so we would anticipate a greater level of detail in relation to the IPCC reports. There were no other mentions of 'calibration'/'calibrated language' across the 923 articles.

One letter appearing in The Telegraph demonstrated how the reported figure – and the concepts of 'confidence' and 'consensus' – could be misunderstood, writing,

> SIR – So the IPCC is 95 per cent certain that mankind has been the main cause of climate change. Do they simply mean that 19 out of every 20 of their scientists agree? (http://www.telegraph.co.uk/comment/letters/10345159/George-Osbornes-dole-scheme-will-help-instil-a-work-ethic-in-jobseekers.html)

This demonstrated that even with a dual numerical and verbal scale, the findings were still open to misinterpretation. There will inevitably be different levels of scientific and mathematical literacy in the public, and so journalists, scientists and politicians are charged with the task of communicating at these multiple levels of understanding. Perhaps anticipating this, there were instances where journalists would supplement the reported findings of AR5 with an analogy.

Use of analogy to make sense of the findings of AR5

There were 42 news items that contained an analogy used in reference to the findings of AR5, though only 27 of these were non-duplicates (see Table 3). Those news items that contained 'explicit' (as opposed to 'implicit') references to the calibrated language of the IPCC were more likely to also include an analogy. The most common comparison of the certainty of the findings of AR5 was to the harmful effects of cigarettes, accounting for exactly half of the analogies in the data. Although all the analogies reported here were used in reference to the IPCC assessment report, they referred to different aspects: be it the question of (un)certainty, the value of the opinion of those who contributed to the report, or the idea of acting despite uncertainty. The relevance of the analogy was generally transparent, but we must also consider the implications of the analogy that could potentially obfuscate meaning.

In a news item published 3 days before the report (http://bigstory.ap.org/article/what-95-certainty-warming-means-scientists), one author incorporated multiple science-based comparisons to convey the 95% degree of certainty reported by the IPCC. After stating that scientists are not 100% but 95% certain about the threat of anthropogenic climate change, the author cites a number of scientists to demonstrate that, in the words of epidemiologist Thomas Burke, '[u]ncertainty is inherent in every scientific judgment'. The comparisons provided were as follows:

- Top scientists from a variety of fields say they are about as certain that global warming is a real, man-made threat as they are that cigarettes kill;
- They are as sure about climate change as they are about the age of the universe;
- They say they are more certain about climate change than they are that vitamins make you healthy.

The author then quoted the following scientists:

- Johns Hopkins University epidemiologist Thomas Burke: 'Will the sun rise in the morning? Scientists know the answer is yes, but they can't really say so with 100-per-cent certainty because there are so many factors that are not quite understood or under control'.
- Climate change 'is not as sure as if you drop a stone it will hit the Earth', said Princeton University climate scientist Michael Oppenheimer. 'It's not certain, but it's close'.
- Arizona State University physicist Lawrence Krauss said the 95% quoted for climate change is equivalent to the current certainty among physicists that the universe is 13.8 billion years old.
- The president of the prestigious National Academy of Sciences, Ralph Cicerone, and more than a dozen other scientists said the 95% certainty regarding climate change is most similar to the confidence scientists have in the decades' worth of evidence that cigarettes are deadly.

The findings of AR5 were compared with arguably more commonly accepted scientific principles. This is useful in characterising science as a discipline in which uncertainty is ubiquitous, but tolerable. In introducing and quoting scientists directly, the author adds validity to the analogies in that they come from people working in the discipline, alluding to a factual correctness. Furthermore, there is an inference of neutrality here in that these are not the assertions of the journalist themselves.

The role of scientists as a voice of authority was emphasised in the following two examples, which appeared in letters to the respective publications:

Table 3. Instances and type of analogy used in reference to the findings of AR5.

	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	01-Oct	02-Oct	03-Oct	04-Oct	Total
Implicit reference	4	9	8	11	5	6	62	63	8	11	13	12	8	5	225
Analogies	1[1]	0	2[2]	2[2]	0	2[1]	6[5]	6[4]	4[1]	2[1]	4[2]	0	2[2]	0	31[21]
Cigarettes/smoking harmful	0	0	0	1[1]	0	0	4[4]	4[2]	1[1]	2[1]	1[0]	0	1[1]	0	14[10]
Doctor diagnoses illness	0	0	0	0	0	2[1]	1[1]	1[0]	2[0]	0	1[1]	0	0	0	7[3]
Insurance	0	0	0	1[1]	0	0	2[1]	1[1]	1[0]	0	1[1]	0	0	0	6[4]
Rain	0	0	0	0	0	2[1]	0	0	0	0	0	0	0	0	2[1]
95% = 19/20	0	0	0	0	0	0	0	0	0	0	2[1]	0	0	0	2[1]
Business	0	0	0	0	0	0	0	0	0	0	0	0	1[1]	0	1[1]
Central heating	1[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	1[1]
Pesticide	0	0	1[1]	0	0	0	0	0	0	0	0	0	0	0	1[1]
Elvis is alive	0	0	1[1]	0	0	0	0	0	0	0	0	0	0	0	1[1]
Explicit reference	0	0	0	4[2]	4[2]	7[5]	13[11]	9[3]	1[1]	2[2]	1[1]	2[1]	3[1]	1[1]	47[30]
Analogies	0	0	0	3[1]	2[0]	2[2]	2[2]	2[1]	0	0	0	0	0	0	11[6]
Cigarettes/smoking harmful	0	0	0	3[1]	2[0]	1[1]	0	1[0]	0	0	0	0	0	0	7[2]
Getting on a plane	0	0	0	3[1]	2[0]	1[1]	0	1[0]	0	0	0	0	0	0	7[2]
Vitamins	0	0	0	3[1]	2[0]	1[1]	0	0	0	0	0	0	0	0	6[2]
Insurance	0	0	0	3[1]	2[0]	0	0	1[0]	0	0	0	0	0	0	6[1]
Age of Earth	0	0	0	3[1]	2[0]	0	0	1[0]	0	0	0	0	0	0	6[1]
The sun coming up	0	0	0	3[1]	2[0]	0	0	1[0]	0	0	0	0	0	0	6[1]
Gravity	0	0	0	3[1]	2[0]	0	0	1[0]	0	0	0	0	0	0	6[1]
Age of universe	0	0	0	3[1]	2[0]	0	0	0	0	0	0	0	0	0	5[1]
Rain	0	0	0	0	0	0	1[1]	1[1]	0	0	0	0	0	0	2[2]
Gambling	0	0	0	0	0	0	1[1]	0	0	0	0	0	0	0	1[1]

Numbers in square brackets refer to non-duplicate news items.

> Nobody likes bad news, but if 97 mechanics say my car is overheating because it has been mistreated and three others – plus the butcher, the baker and the candlestick maker – say it's just a glitch and it'll fix itself, who should I listen to? (http://www.theaustralian.com.au/opinion/letters/a-welcome-call-for-an-open-debate-on-climate-change/story-fn558imw-1226724689999)

> If one of my daughters was gravely ill, and 95 per cent of surgeons said she needed urgent surgery, and the other 5 per cent were convinced she didn't, I certainly wouldn't be going to shock jocks or politicians for their opinion. (Michael Sydney Jones, *Hobart Mercury* (Australia), 4 October 2013)

Scientists are seen as professionals who have technical expertise and, by likening them to mechanics and surgeons, the users of these analogies position scientists as people from whom the general public might accept advice. The analogy of the car mechanic allows the individual to refer to both 'overheating' and 'mistreatment' in comparison to the global climate, to give greater detail to their comparison. Both examples, however, demonstrate a misunderstanding of what the '95%' represents and confuse confidence with consensus. In their understanding, there are competing voices who are not seen to be qualified or equipped to offer advice but who do so anyway and they are seen as the obstacle to achieving '100%'. In this respect, the analogies are incongruous with the report and create a pejorative representation of those believed to represent the imagined 5% (or 3%). These individuals are written off as 'shock jocks' and as figures of a nursery rhyme ('The butcher, the baker, the candlestick maker'). Another form of ridicule came from former Prime Minister Tony Blair, who was quoted as saying,

> 'Ninety-five per cent certain is a pretty large degree of certainty – I recall that the number of people who think Elvis is still alive is round about five per cent', he added, to laughter. (http://www.telegraph.co.uk/news/worldnews/northamerica/usa/10329520/No-serious-person-should-doubt-man-behind-climate-change-says-Tony-Blair.html)

This analogy draws upon a number of elements built around the mythology of Elvis Presley, who has been described as being an extra-terrestrial being and whose supposed 'death' was part of a government conspiracy, neither of which has been treated as having real credibility. Despite another misrepresentation of confidence as consensus, the effect of this is to undermine the significance of 5% uncertainty which in this exchange became laughable.

The EU's Commissioner for Climate Action, Connie Hedegaard was quoted as saying,

> What would you do if your doctor was 95 per cent sure you had a serious illness? Whose side are you on? Those who want to act on 95 per cent certainty or those who gamble on the remaining 5 per cent? (http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=11132042)

IPCC lead author Professor Steve Sherwood was quoted as making a similar analogy:

> if the diagnosis is the patient is going to die, but there is some uncertainty on exactly when, you do not just throw out the initial diagnosis of death. (http://newsstore.fairfax.com.au/apps/viewDocument.ac;jsessionid=F9FE41E5B03B3CBA71B9C3BB928E84EF?sy=afr&pb=all_ffx&dt=selectRange&dr=1month&so=relevance&sf=text&sf=headline&rc=10&rm=200&sp=brs&cls=1463&clsPage=1&docID=SHD130922265H26995CH)

There is some merit in characterising the planet as a living human being, in so far as complex biological processes can be compared to complex climatic processes. In this context one can, for example, compare unnatural levels of carbon emissions to the over-production of cells associated

with cancer. But in the first example, the issue is presented as an either–or scenario when in fact there are multiple courses of action that could be taken in relation to climate change. Thus, even if we 'side' with the scenario about which scientists are 95% certain this does not provide us with an idea of what to do. When commentators discussed taking action despite uncertainty, there was a greater consideration of 'risk'. A somewhat mundane example came from J Marshall Shepherd, President of the American Meteorological Society: 'most people would grab an umbrella if you said there was a 95 percent chance of rain' (http://transcripts.cnn.com/TRANSCRIPTS/1309/28/cnr.01.html). Another publication quoting Climate Change Commissioner Connie Hedegaard wrote,

> If your doctor was 95% sure you had a serious disease, you would immediately start looking for the cure. Why should we take bigger risks when the health of our planet is at stake? (http://europa.eu/rapid/press-release_MEMO-13-827_en.htm)

In quoting some anonymous 'risk experts', a newswire author made the following analogy:

> After all, most people wouldn't get on a plane that had only a 95-per-cent certainty of landing safely, risk experts say. (http://bigstory.ap.org/article/what-95-certainty-warming-means-scientists)

Prime Minister David Cameron and the David Suzuki Foundation science and policy manager Ian Bruce were quoted as using analogies that referred to the act of buying insurance as a precaution against one's house burning down (http://www.telegraph.co.uk/news/politics/david-cameron/10341422/David-Cameron-a-Prime-Minister-in-a-hurry.html; http://www.davidsuzuki.org/media/news/2013/09/david-suzuki-foundation-calls-on-canadians-to-support-climate-action-in-response/). As early as 2006, climate scientists were exhorted to use the home insurance analogy when communicating the risks of global warming to policy makers (Schwartz, 2006). Painter (2013) has advocated the 'insurance' analogy since it represents an everyday consideration of risk that most people can relate to. In an interview, he pointed out that 'More risk language helps to shift the public debate away from the idea that decisions should be delayed until absolute certainty is obtained – something that may never be achieved' (http://www.politics.ox.ac.uk/index.php/news/james-painter-on-climate-change-as-risk.html). However, there is much more of an individualistic emphasis in these analogies, and it is much more straightforward for people to make decisions about their own actions in relation to risks to themselves. As far as individual agency is concerned, we cannot suitably compare the threat of a terminal illness to the unforeseen consequences of climate change at an individual level. The analogies in the examples above are chosen to demonstrate that 100% certainty is not required in order for us to accept the reality of certain phenomena and convey a more 'risk'-oriented discourse in which we have some expectation of what the outcomes could be.

7. Discussion

In assessing the suitability and efficacy of the analogies reported here, we can refer back to Kueffer and Larson's (2014) criteria for the use of metaphorical language in science communication: factual correctness, socially acceptable language, neutrality, and transparency. The analogies were identified by their explicit construction and as such, could be defined by their transparency. Their function as a form of metaphorical language is arguably unequivocal, but there are questions about their factual correctness and neutrality. Perhaps the most prevalent incongruence of the analogies reported here is the over-emphasis on individual risk and individual consequences for the incitement to individual action.

Researchers have suggested that the IPCC reports should be discussed in terms of risk, rather than uncertainty (Painter, 2013; Pidgeon, 2012; Pidgeon and Fischhoff, 2011). Uncertainty is associated with passivity and the precautionary principle; risk implies to some extent that the outcome is foreseeable and somewhat predictable and as such, we can make decisions on how to act (Heyman, 2010). Adopting a discourse of risk is seen to have greater potential for public understanding since 'risk is an essential part of everyday experience' (Painter, 2013: vii) and insurance, betting/investment and health care are seen to be everyday examples of where such risks are assumed to be well understood by the general public.

However, the implications of buying insurance, for example, are largely incongruous with the threat of climate change. The uncertainty the IPCC deals with is the Knightian uncertainty (under which the exact probabilities of future events are not known). Such a notion cannot be accurately captured by the insurance analogy, as an insurance normally presumes known probabilities of future outcomes. The term itself 'insurance' denotes an agreement that somebody will indemnify the holder in the event of the specified catastrophe. By contrast, scientists and policy makers propose mitigation, which is more akin to 'fireproofing' than fire insurance. Thus, despite its aptness in demonstrating how people take action on low probability/high impact events, the added implication of compensation makes the insurance analogy unsuitable as a comparison to the threat of anthropogenic climate change and actions that might be taken to deal with it. Another problem associated with the use of this analogy lies in the fact that we are not often made aware of the 'successes' of mitigation. That is to say, when a natural disaster strikes, we rarely acknowledge the thousands of lives saved by the implementation of precautionary measures, as we understandably focus much more on the lives lost and the damage done. As such, the benefits of such precautionary measures are not fully recognised. Most people have some awareness or experience of the rewards of an insurance policy and can therefore appreciate the value in investing in one. Similarly, most people will have experienced some treatment of an illness and can relate to analogies that refer to the health-care domain. But this again is a much more personal experience and one that carries with it highly emotive inferences in prompting individuals to consider their own mortality. That is not to say that likening this threat to the threat of climate change to the planet is inappropriate, but we must be conscious of a loss in neutrality when comparisons with such highly emotive issues are made. It has been argued that affect-based decisions about climate change are not only unlikely to motivate significant action but may also have unintended negative effects if they are perceived as 'scare tactics' (Weber, 2010).

The expectation that some members of the public would struggle to comprehend the scientific understanding of 'uncertainty' through concepts of confidence and consensus was evident in the data. Readers were shown to misunderstand '95% certainty' as a 19-out-of-20 consensus and former Prime Minister Tony Blair used the terms interchangeably. We can expect that a disparity in the scientific literacy of the public will endure, but this does emphasise the need for scientists and politicians to communicate in response to different levels of understanding, particularly given the subjectivity of 'meaning'. Journalists themselves did not venture to reinterpret the figures themselves (whether this was a question of understanding or authority) but consistently quoted others – primarily scientists – to translate the findings of AR5. If not as 'translators', however, journalists do play a significant role in selecting which commentators are referenced in order to provide some clarification of the science. Thus, it was predominantly scientists themselves who were providing metaphorical interpretations of the data (see also Nerlich and Halliday, 2007). But it was unclear in what context they were provided and for whom.

Having identified the need for a variety of communication strategies in light of disparate levels of understanding, the scientists who engage with the public – via the media or otherwise – must consider an appropriate strategy based on their presumed audience which includes weighing up the

use of calibrated or analogy-based language. The scientists quoted in the data may have been selected because they were the ones to make public statements, but in the context of the articles, they are employed as an authority, as having expert knowledge on the subject and therefore as someone who has the understanding to translate scientific findings and whose opinion 'matters'. This effect was shown in the data by readers who commented upon the value of the opinions of scientists, rather than 'the butcher, the baker and the candlestick maker'.

8. Conclusion

A recent study examining the IPCC's calibrated language comes to the conclusion that

> [t]hrough the publication of probabilistic statements about climate risks and impacts, the IPCC has had a powerful influence on the concept of climate change in public and media discourses […] It is essential, therefore, to understand how the information that the IPCC conveys is understood by members of the public.

This would indicate a 'win' for the IPCC as a primary 'validator of scientific information' (see Carvalho, 2007; Gamson, 1999). Our analysis has shown a less powerful influence of the IPCC over media discourses and therefore a less powerful influence, perhaps, on public and policy perceptions of climate change and less influence on political decision making. The English speaking news media we surveyed both quantitatively and qualitatively show some awareness of the IPCC's calibrated language but prefer to use a type of framing of uncertainty through, sometimes flawed, analogies. Such metaphorical framing is widespread not only in journalistic discourse but also in political and scientific discourse. It is almost the only type of language that all the spheres involved in the cultural circuits of climate change have in common: science, politics and publics. They are the go-to messengers of meaning in science communication (Maasen and Weingart, 1995), and the IPCC might therefore want to reflect on their use and abuse in the future when recalibrating their communication efforts.

The authors of the IPCC Assessment Reports have recognised the need for clarification when it comes to discussing scientific uncertainty in relation to the threat of anthropogenic climate change, and a calibrated language system has been developed in order to standardise conditions of certainty and likelihood. This has provided a context in which to understand the claim that it is 'extremely likely' that human activity is responsible for changes in the climate, a context to convey the confidence in this claim and a context which was largely absent in the media reports of AR5. Only 14.27% of news items made reference (11.80% 'implicit' and 2.47% 'explicit') to the IPCC's use of calibrated language in reference to (un)certainty. This is comparable to Painter's (2013) reported finding of 15% of news articles explaining the meaning of 'confidence' and 'likelihood' in relation to previous IPCC reports.

Instead of this semantic context, journalists often quoted scientists and other public figures who had offered metaphorical and comparative explanations of the strength of the findings of AR5, referring to the discourse of medicine, of insurance and to other well-established scientific claims. Analogy was often used to demonstrate that the public is familiar with and accepting of scientific claims despite uncertainty and that scientists, politicians and members of the public all take action despite uncertainty. In this respect, the analogy of buying insurance was often referred to and introduced more risk-oriented concepts.

However, some attempts at reinterpreting AR5's 'headline' finding demonstrated that there is potential for misunderstanding in translating the claim of 'extremely likely' and its associated '95% certainty', such as the confusion between 'certainty' and 'consensus'. We have also

commented on the potential for misapprehension in the use of metaphorical language, where the appropriation of a more familiar concept introduces dimensions that are incongruous with the original claim, such as the compensatory dimension of the insurance analogy. The greatest challenge for science communication and public understanding of climate science may be in relating anthropogenic climate change as a global concept to the decisions and behaviours of individuals. In this article, we found that this is exactly where the greatest incongruity lay in the analogies found in the data.

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