Synthesizing a Policy-Relevant Perspective from the Three IPCC "Worlds" – a comparison of topics and frames in the SPMs of the Fifth Assessment Report
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Abstract The paper investigates topics, emphases, frames and absences in the *Summary for Policymakers* parts of the three Working Group reports in the IPCC 5th Assessment Report and the *Summary for Policymakers* of the Synthesis Report. It explores similarities and differences by using various tools of lexical and discourse analysis, combining quantitative and qualitative methods. The main results are these: First, each Working Group's Summary reflects not only the Working Group's distinctive mandate but also a distinctive intellectual framing. Second, although there are some significant differences in the emphases given to different themes from the Working Groups, the Synthesis Summary covers the main topics of the three other Summaries, and constitutes a relatively integrated Summary of the complete Assessment Report. In addition, third, we find though that the Synthesis Summary centrally follows up the risk framing and language which are prominent in Working Group II but semi-absent in the other Working Groups, as part of constructing a policy-relevant statement from the three distinctive reports. In addition, the Synthesis Summary makes use of linguistic devices which contribute to 'amplify' the strength of statements, as part of transferring messages effectively from the scientific context to a policy-maker audience. Fourth, we find that the style and tone of the IPCC Summaries conduce also to important absences and imbalances in emphasis: main victims of climate change (particular groups of vulnerable people) remain virtually invisible in the Summaries, unlike the impacts in nature and ecological systems or the aggregate economic impacts, and correspondingly the challenges, options and opportunities for action remain relatively underdeveloped in the analysis.

1. Introduction: field, methods, materials, and questions

This paper explores similarities and differences between the *Summary for Policymakers (SPM)* parts of the three Working Group (WG) reports in the IPCC 5th Assessment Report (AR5) and the SPM of the Synthesis Report. Using various tools of lexical and discourse analysis, combining quantitative and qualitative approaches, we unpack topics, emphases, frames and absences in these four IPCC texts. We explore how the Synthesis Report SPM's selections respond to the challenges involved not only in spanning vast and diverse bodies of literature but in seeking to be policy

relevant by drawing out the human significance of the trends identified, while yet operating within the intense constraints of an inter-governmental exercise and without explicit value-priorities to guide the focusing of attention and the interpretation of risks and uncertainties.

The discussions around IPCC work have moved from evaluation of the accuracy of the science to include also now more subtle aspects of its messages: the choices of topics, concepts, framing, communication style, and implicit "story" structures. In addition, the science-policy literature has taken the IPCC as an object of analysis (e.g., Bjurström & Polk, 2011; Dilling & Lemos, 2011; see also Sundqvist et al. 2015; Yearley et al. 2015). These shifts in focus are consistent with the evolution of climate change science, increased public attention, and the need for climate policy decisions to be informed by science. As the reality of anthropogenic climate change has become more and more strongly established scientifically, attention increasingly moves to how to interpret its significance and how to make the science meaningful and understandable to multiple audiences, including not only policy makers. The communicative qualities of IPCC summary products are then of fundamental importance. The shift in the focus of attention, beyond only communication between natural sciences and policy-makers, reflects the opening up of the space of public discourse (Moser & Dilling 2011). There are now more readers for IPCC work and the summary products need to respond to a greater variety in their audience, and be more engaging of other types of knowledge (Viner & Howarth 2015; Whittington 2016)

We see increased attention to tracing the likely impacts of climate change and how these interact with existing vulnerabilities, and to possible solutions. Here the framing of the issues acquires key importance—notably the range of topics that are included and the choice of concepts that are used to describe them—for it determines a problem space, influences understandings of the realities therein, and guides identification of possible courses of action. The notion of framing in science policy literature and the academic field of Science and Technology Studies refers to how issues are defined, interpreted and organised. According to Wynne the framing of science-related issues is often left to scientific experts by default and this reduces rather than increases the capacity of scientific knowledge to be meaningful and actionable (Wynne 2003).

Within the increased scholarly research focused on climate change discourse much work now has considered the framing of studies (e.g., Berkhout et al. 2002; Nisbet & Scheufele 2009; O'Brien & St.Clair 2010). Existing literature has shown how problem representations each contain a particular framing (see e.g., Boykoff et al. 2010 on 'climate stabilization'). The chosen framing provides a focus, for example catastrophe or opportunity, that may influence affective and behavioral responses (Moser & Dilling 2011; Gifford & Comeau 2011). Such choices in framing guide the work of IPCC author teams too and entail value judgments (Farrell et al. 2001; de Boer et al. 2010). A large part of the literature is focused on the role that specific framings play in the

articulation of arguments and stories in a particular direction and on how this influences chances of successful knowledge uptake; thus Hulme (2009) describes how various frames such as scientific uncertainty, national security, 'polar bear', monetized cost-benefit evaluation, catastrophe, and justice/equity can influence different people according to their values and interests; Boykoff et al. (2010) demonstrate how a stabilization-based discourse has become dominant, and propose that it is destined to fail; Budescu et al. (2009, 2014) show how a modified format for discussing uncertainty, supplementing the verbal terms used by the IPCC with numerical ranges, may increase the public's understanding; Gifford & Comeau (2011) present evidence that positive motivational frames rather than sacrifice frames may increase climate-related engagement of community members; and Spence and Pidgeon (2010) show similarly that gain frames may be superior to loss frames in increasing positive attitudes towards climate change mitigation. Much literature is then about communication of IPCC findings and the role of the media (including increasingly social media) as translator and creator of specific framings (Carvalho 2005, 2007; Dahl 2015; Dahl & Fløttum 2014; Diriks & Gelders 2010; Eide et al. 2010; Fløttum & Dahl 2014; Moser 2010; O'Neill et al. 2015; Painter 2011, 2013, 2015).

We suggest that fresh work is needed on the framing-choices in the IPCC reports that influence which issues receive attention and how. For doing this we further suggest, based on recent linguistically oriented research on climate change (e.g., Fløttum and Dahl 2011, 2014; Grundmann and Krishnamurthy 2010), that lexical, linguistic and discourse analyses of IPCC texts will help us to more clearly and thoroughly identify and reflect on the choices and emphases.

In our earlier work we have analysed climate change discourses in sources other than IPCC texts, with a main focus on linguistic polyphony (multi-voicedness) and narrative structure of policy documents and UN reports (Fløttum 2010, 2013; Fløttum and Dahl 2011, 2012; Fløttum and Gjerstad 2013a, 2013b) as well as on lexical choices in people's representations of the future in a climate change perspective (Fløttum et al. 2014). We have additionally explored framing in climate change studies through use of methods from interpretive policy analysis, identifying not just topics and agents that are included or omitted, but distinctive ensembles of concepts, terms, agent-characterizations, metaphors, methodological principles, inclusions and omissions, problem diagnoses, argumentative structures and action-orientations (Gasper et al. 2013a, 2013b; Gasper 2014). This paper takes such linguistic and discourse analysis further through applying various quantitative and qualitative methods (see Dörnyei, 2007; Baker et al. 2008; Alexander 2009) to the SPMs of IPCC's AR5, with attention too to considerations emerging from the institutional mandate of the IPCC. We analyse word frequencies, topics and frames, enabling us to get 'inside the box' of each of the four summary products and to assess the commonalities, differences and their significance. We are able thus to compare the cognitive and epistemological worlds of the three

working groups and then consider the selections, omissions and contributions in the Synthesis Report.

The mandate of the IPCC includes to produce policy-relevant information for multiple decision-making actors in a way that is understandable yet scientifically rigorous. The SPMs are fundamental in this work. The SPM is "a component of a Report, such as an Assessment, Special or Synthesis Report, which provides a policy-relevant but policy-neutral summary of that Report", states the IPCC Principles and Procedures (e.g., as cited at: www.ipcc-wg3.de/assessment-reports/fifth-assessment-report/summary-for-policy-makers). Each SPM is itself a major document of 12-15,000 words, intended to serve as an authoritative overview that reliably synthesises and makes sense from the wealth of work represented in the huge set of studies that it rests on. The SPMs are also important because they are the only parts of IPCC reports whose full text is directly subjected to the scrutiny of policymakers. Government delegations meet in plenary sessions to finalise and approve the SPM line by line and in doing so they accept the full report. The final SPM texts are thus produced through a science-policy interface that generates a commitment to the messages, a quasi-contract. At the same time, the close involvement from a large number of governments, and their insistence that the reports avoid policy prescription, produces particular challenges in yet producing reports that are policy relevant. Relevance can only be identified in terms of particular criteria for what is relevant, and yet explicit criteria are not given to or in the IPCC.

We will first study what topics are discussed in the SPMs, as reflected through quantitative frequencies and keyness of the words that are used (see Fløttum et al. 2014), and seek to identify and interpret the commonalities and differences (section 2). We then examine what this quantitative data invites us to study further, through in-context exploration of some leading terms, including looking at associated characteristic word combinations (section 3). In addition we will discuss possible absences in the frequency lists: missing topics or topics of low emphasis, as well as the topics with high emphasis (section 4). We explain our choices for identifying what seems missing— not least by reference to the declared values of the United Nations, under whose auspices the UNFCCC and the IPCC operate—and will discuss its import. We look in particular at the selections and emphases in the Synthesis Report SPM, as it aims to construct a policy-relevant overall line of argumentation from the three WG Reports (sections 4 and 5).

The materials for the study consist of the following four IPCC 5th Assessment Report (AR5) documents: Summary for Policymakers (SPM) of the three working groups (WG I, II, III) and of the Synthesis Report (SYR). The word count of the full text of each document (including notes, figures and boxes) is as follows:

WGI-SPM The Physical Science Basis (2013): 14,739 words

WGII-SPM Impacts, Adaptation & Vulnerability (2014): 12,735 words

WGIII-SPM Mitigation of Climate Change (2014): 14,512 words

SYR-SPM Climate Change 2014 Synthesis Report (2014): 14,894 words.

Our first research question is to what extent the three SPMs manifest different thought "worlds", reflecting the different mandates that the WGs are given and the different mixes of scientific disciplines and philosophies represented in the respective author teams. At the same time we investigate to what extent the SPMs have noteworthy shared features. To do this we seek to identify similarities and differences in concepts used and topics focused on. A second, related, aim is to identify topics given high emphasis and topics given low emphasis. So, we aim to explore what is included, in comparison to what is omitted.

A third question is to what extent the SYR SPM represents equally the three WG SPMs; or do any of the three WGs sometimes dominate? An additional possibility is that the SYR offers a distinct narrative that arises from the linking of the three WG reports.

A fourth question concerns then how the SYR SPM seeks to convey policy relevant messages within the political and epistemic constraints given for IPCC's work. This question emerged in the course of our study, as we reflected on contrasts between the word frequencies in the different SPMs, especially in relation to the term 'risk'. Use of this term and associated forms of giving emphasis are examined in sections 3 and 4.

More broadly, whereas some studies have concentrated on seeking to identify which of the generic framings suggested by Nisbet and Scheufele (2009) and/or others are found in particular reports on climate change, our exercise is different. Rather than trying to place the IPCC reports in terms of existing categories, we examine them afresh. For they are huge and internally diverse, and framing does not necessarily occur only in standard known formats; yet by exploring the reports with fine-teethed instruments from linguistic and discourse analysis we can look for possibilities not covered in pre-existing research and not even envisaged in advance by ourselves.

2. Lexical analysis: word frequencies

Analysis of lexical choices—the choices of terms and of combinations of terms—helps to identify frames: the structured systems of perception, of allocation of attention and of interpretations of key terms and issues. Hjerpe and Linner (2009), for example, analysed the SPMs of the IPCC Third and Fourth Assessment Reports, to explore the frequency of use of the term *sustainable development* and to identify what types of messages the framing conveyed in different working groups. (See also Nilsson (2007:173), for word frequencies in the AR3 reports.) Our lexical analysis of the four SPMs in the Fifth Assessment Report is presented in this section.

2.1. The three working groups: word frequencies

The following three tables (Tables 1, 2 and 3) show the 14 most frequent words in the SPMs for the three Working Groups (WGs). For each of these words they compare the absolute frequency and relative frequency across the SPMs. The word counts and the frequency lists have been done with AntConc version 3.2.4 and with version 3.3.5 for the SYR SPM. The word counts have been case sensitive; one reason for this is the fact that words starting with a capital letter may be the first word in a sentence and can thus have an important topic role. It should also be noted that the word counts are done on the total content of the SPMs, including notes, text boxes and figures. This was because these elements, not least the figures and textboxes, can all be equally or even particularly influential in terms of capturing audience attention. However, we also compared with analyses based on word counts excluding these components, and found that the patterns and contrasts that emerge are not significantly different.

The relative frequency is computed as (word frequency / total number of words in document) x 10,000. To maintain a topical focus, we have excluded grammatical and function words such as *the, a, and,* as well as numbers and acronyms (such as *AR5, SPM*), except for CO_2 and GHG.

Table 1. The 14 most frequent content words in WGI-SPM in comparison to the other SPMs

	WGI		WGII		WGIII		SYR	
	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000
confidence	124	84	103	80	41	28	105	70
Likely	100	67	8	6	11	7	66	44
Mean	95	64	12	9	2	1	33	22
Global	86	58	31	24	35	24	66	44
climate	83	56	160	125	64	44	144	96
sea	80	54	10	7	0	0	29	19
surface	77	52	5	3	3	2	31	20
century	74	50	25	19	14	9	47	31
ice	71	48	5	3	0	0	20	13
high	67	45	117	91	78	53	111	74
change	65	44	150	117	50	34	11	79
ocean	63	42	8	6	0	0	28	18
see	62	42	2	1	13	8	9	6
CO_2	60	40	3	2	54	37	88	59

Table 2. The 14 most frequent content words in WGII SPM in comparison to the other SPMs

	WGII		WGI		WGIII		SYR	
	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000
climate	160	125	83	56	64	44	144	96
change	150	117	65	44	50	34	119	79
high	117	91	67	45	78	53	111	74
confidence	103	80	124	84	41	28	105	70
adaptation	99	77	0	0	13	8	86	57
impacts	93	73	0	0	5	3	45	30
risks	93	73	0	0	15	10	53	35
medium	57	44	47	31	86	59	57	38
risk	54	42	0	0	2	1	21	14
systems	42	32	1	0	1	0	18	12
regions	39	30	22	14	8	5	36	24
projected	38	29	20	13	17	11	27	18
human	36	28	13	8	11	7	24	16
Climate	34	26	20	13	12	8	14	9

Table 3. The 14 most frequent content words in WGIII SPM in comparison to the other SPMs

	WGIII		WGI		WGII		SYR	
	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000	frequency	per 10,000
emissions	138	95	55	37	4	3	118	79
mitigation	124	85	1	0	26	20	106	71
energy	109	75	9	6	8	6	42	28
scenarios	99	68	19	12	15	11	96	64
medium	86	59	47	31	57	44	57	18
evidence	82	56	20	13	33	25	38	25
high	78	53	67	45	117	91	111	74
agreement	74	50	5	3	30	23	27	18
climate	64	44	83	56	160	125	144	96
GHG	60	41	0	0	0	0	27	18
CO_2	54	37	60	40	3	2	88	59
policies	54	37	1	0	5	3	21	14
change	50	34	65	44	150	117	119	79
carbon	46	31	32	21	5	3	28	18

The frequency lists in Tables 1–3 reflect the mandates of the different WGs. The WGI-SPM's focus on the physical science basis of climate change is shown through frequent use of words such as *global, climate,* and in particular *sea, surface, ice,* and *ocean*; the WGII-SPM's focus on impacts and adaptation in ecological and human systems shows in the prevalence of words such as *adaptation, impacts, risk(s);* and the WGIII-SPM's focus on mitigation emerges through words like *emissions, mitigation, energy* and *scenarios.* The discussion in WGI is at a broad geographical scale, focused on a *global* climate system and with a long-term perspective on its dynamics, seen in the prominence of the term *century.* The materials assessed by WGII discuss at a lower geographical scale. Impacts are studied in terms of *regions*, meaning large groupings such as conventionally distinguished by international organisations, including a region as enormous and diverse as 'Asia'. Within these regions the interaction of climate changes and eco-systems and their possible impacts on various *human systems* are assessed. WGIII's focus on *scenarios* and *policies* refers to intentional change and especially, implicitly, to policies mainly at *nation-state* level.

While the respective foci are broadly what one would expect, the comparisons indicate also a wealth of intriguing lines for investigation. Why, for example, is the language of *impacts, risk(s)* and *systems* not merely more characteristic of WGII but virtually unique to it; why is *scenarios* not prominent outside WGIII; why is *policies* not also prominent in WGII; why does *human* occur in

the policy-oriented WGIII with only the same frequency as in the physical-science oriented WGI, at a quarter of the frequency in WGII; and in each case, what are the implications? We explore some of these themes later in the paper.

The comparisons so far help to specify the topics that the different WGs examine. Also of interest is where groups examine the same topics but use different vocabularies. The WGs make different selections of terms from the pre-defined IPCC scales for conveying degrees of consensus (the scales are explained in each of the SPMs; see Budescu et al. 2009, 2014; Fløttum and Dahl 2011). Both the confidence scale and the likelihood scale are frequent in the WGI-SPM (see the frequencies of *confidence, likely*); they match a natural sciences style with focus on what is measurable and testable but also reflect IPCC standardisation of a calibrated language to convey uncertainties. The confidence terminology of WGI aims to convey the degree of robustness of the consensus among the scientific community on key climate system science findings, and the concept *likelihood* is given a purely statistical meaning. So for example an event that is assessed as having a likelihood of 10% is 'very unlikely'; this is in contrast to in many human contexts where a 10% likelihood of deaths would not be described in that way and where the usage of *likelihood* language depends partly on the contents of the discussion. We observe that the confidence scale is also frequently used in WGII-SPM, while the qualitative scale of *agreement* and *evidence* is used in both WGII and especially in WGIII. What we see in WGII is a coexistence of quantitative and qualitative calibrated language (Burkett et al. 2014). This is possibly the result of a coexistence of natural and social sciences in the literature assessed in WGII and in the author team backgrounds. The qualitative scale's prevalence in WGIII-SPM could reflect a concern for expressing uncertainties which are of a different nature than the uncertainties proper in the natural sciences.

2.2. Keyness analysis

We further identified distinctive lexical items by using the log-likelihood measure of *keyness,* which is a statistical measure of how much more often a word appears in one text compared with others (Oakes 1998). It shows the words that are characteristic of each SPM relative to the other ones. The following lists (Table 4) show the highest ranked keywords for each SPM.

Table 4. The 30 top ranked content keywords for each AR5 SPM (grammatical words, acronyms and numbers are removed)

WGI-SPM	mean, likely, ice, surface, sea, ocean, see, forcing, rise, century, Northern, Hemisphere, extent, period, Antarctic, precipitation, observed, global, radiative, decade, models, sheet, greenhouse, warming, changes, content, glaciers, mass, aerosols, model
WGII-SPM	impacts, adaptation, risks, risk, change, vulnerability, climate, systems, exposure, responses, species, Risks, food, ecosystems, coastal, Risk, Adaptation, resilient, water, areas, key, high, human, capacity, socioeconomic, adaptive, Background, crop, Impacts, decision

WGIII-SPM	energy, mitigation, GHG, emissions, scenarios, CO$_2$eq, policies, cost, agreement, buildings, costs, transport, electricity, Mitigation, supply, evidence, use, baseline, technologies, power, sector, fuel, demand, efficiency, industry, growth, benefits, side, sectoral, technology,
SYR-SPM	eq, limit, adaptation, mitigation, CO$_2$, scenarios, enhanced, industrial, emissions, warming, greenhouse, categories, Kingdom, levels, side, implementation, gas, shows, Gt CO$_2$, United, climate, Future, limiting, irreversible, Concern, ellipses, offs, Reports, whiskers, imply

This comparison confirms and extends the broad contrasts that were identified through the simple frequency comparisons. In a few cases it helps to deepen that picture. A surprising absence in the frequency list of WGII-SPM (Table 2) concerns the words *vulnerable, vulnerability* (part of the title of their report) or semantically related words. However, when we turn to the list of keywords, we observe that *vulnerability* itself, as well as related phenomena expressed through words like *exposure, species, food, water, human, capacity* are still among those that are characteristic in this text in comparison with the other two.

2.3. The character of the Synthesis Report's SPM

For investigating what topics are taken up in the *Synthesis Report* (SYR), we undertook a similar lexical analysis of its SPM. The frequency comparisons are shown in Table 5. It covers a slightly larger number of terms, to facilitate the comparison with the three WG SPMs.

Table 5. The 20 most frequent content words in SyR SPM

	SYR		WGI	WGII	WGIII
	frequency	per 10,000	per 10,000	per 10,000	per 10,000
climate	144	96 [75](2)	56	125	44
change	119	79 [65](1)	44	117	34
emissions	118	79 [45](3)	37	3	95
high	111	74 [63](2)	45	91	53
mitigation	106	71 [35](3)	1	20	85
confidence	105	70 [64](1,2)	84	80	28
scenarios	96	64 [30](3)	12	11	68
CO$_2$	88	59 [26](1,3)	40	2	37
adaptation	86	57 [28](2)	0	77	8
Figure	72	48 [41](2)	40	42	41
global	66	44 [35](1)	58	24	24
likely	66	44 [27](1)	67	6	7
levels	58	38 [25](3)	8	24	43
medium	57	38 [45](1,2)	31	44	59
warming	57	38 [21](1)	36	27	1

risk(s)	53	35 [28](3)	0	73	10
century	47	31 [26](2)	50	19	9
impacts	45	30 [25](2)	0	73	3
temperature	45	30 [29](2)	35	30	21
energy	42	28 [29](1,2)	6	6	75

[ ] = mean of frequencies per 10k words in the three WG SPMs.

( ) = which WG the SYR is closest to.

From this comparison we offer three initial observations. First, regarding the most prevalent topics in the SYR SPM, we see that, broadly speaking, they cover quite well the three worlds identified in the WG SPMs. In this sense, the SYR does not "construct" a new world; instead it brings together the three. The SYR does pick up many lead themes of the individual WG reports even where those are (almost) ignored by one or two of the other reports. *Emissions, mitigation, scenarios, adaptation* all come out much more strongly in the SYR than just at the level of the mean of the 3 WGs. Also *risks* and *impacts* get some serious attention in the SYR-SPM despite being near ignored by two of the WGs.

However, second, the word frequencies indicate a higher focus on certain WGIII topics, such as *emissions, mitigation* and *scenarios*, than on some of the main topics (*adaptation, risks, impacts*) in the WGII-SPM. Some key terms from WGII are also all less frequent in the SYR-SPM than several terms characteristic of WGI, namely: CO_2, *global, likely*. On the other hand, words like *sea*, and in particular *ice* and *ocean*, which were very frequent in WGI-SPM, have a low frequency in SYR-SPM. The word *system(s)*, characteristic of the WGII-SPM, occurs in relatively low frequency in the SYR-SPM; and the same tendency exists though less strongly for the word *human*.

The keywords analysis in Table 4 gives additional useful information about what is the distinctive content of the SYR-SPM in comparison with the three WG-SPMs. The SYR-SPM appears to increase the relative emphasis on notions such as *limit/limiting, industrial, implementation, irreversible* and *Concern*. The latter arises from the phrase 'Reasons for Concern', that is used to focus and orchestrate the arguments in the SYR-SPM, and refers to important risks. This leads to our third highlighted remark: the overall prominence in the SYR-SPM of risk thinking, which is central to the framing used in WGII, despite, as we saw, the term *risk*'s near-absence in the SPMs of WGI and WGIII. The risk frame is carried over strongly from WGII to the SYR-SPM, both explicitly and via 'Reasons for Concern'. We examine this further in section 3.

3. Words in context

Having observed frequency differences of words in the four SPMs under study, we need to examine the immediate co-text (i.e. the immediately surrounding text) for the uses of these words, and thus to see the concordances (the pairings with other words) and any larger recurrent lexical bundles. Lexical bundles are groups of words that occur repeatedly together within a particular type of discourse (or register; see Biber, Conrad and Cortes 2004). This helps us to explore which ideas the leading concepts are combined with and thus how they may be understood. Together with the frequency analysis it will provide inputs for identifying the framings used in the SPMs, including presence/absence of topics.

3.1. Risk

The first word we examine is *risk(s)*, given its striking prevalence in WGII, its striking absence in the other Working Groups, its adoption by the Synthesis Report, and its central role in directing attention according to implied or explicit criteria of human significance. The term *risk* is less likely to be used in relation to happenings which do not impact on matters of human value. The WGII-SPM definition or specification is this: 'the term risk is used primarily to refer to the risks of climate-change impacts' (p.5); and the definition of 'impacts' is 'Effects on natural and human systems', such as 'effects on lives, livelihoods, health status, ecosystems, economic, social, and cultural assets, services (including environmental), and infrastructure' (WGIIAR5-Glossary).

In Table 6 we see that the SYR-SPM does represent a major adoption of WGII risk language. It also strongly presents risk concerns via its language of 'Reasons for Concern', a key instrument that links critically important messages from across all Working Groups

Table 6: Frequency of *risk* (including all forms: risk, risks, Risk, Risks)

	WGI-SPM	WGII-SPM	WGIII-SPM	SYR-SPM
risk*	1 (referring to title of a report)	224	18	80

WGII-SPM uses *risk* not only with notable frequency but in many headlines and with other forms of emphasis. In as many as 31 instances the immediately preceding term is 'key'; indeed many of the headlines contain this combination: *key risk*. Another eight instances concern the combination *high risk*. In contrast, WGIII-SPM's relatively few usages involve very varied partner-terms; it has no persistent cumulative message of risk. The SYR-SPM too contains varied combinations; but some of those contain priority/intensifier terms like *key, new, emerging, future, overall,* and *disaster*.

The frequency of the term *risk* in the SYR-SPM gives a prominent risk framing to the AR5, which derives from WGII. There are multiple reasons for this risk framing, including that it is a substantive policy-relevant framing, that uses a well-known language of decision makers and conveys the potential loss of something valuable. Risk assessments are a common way to structure decision making processes in business, government and project work. A risk framing here calls for assessing and managing risks even if the specifics of climate change impacts are not, or cannot be, quantified; it calls for action also in the face of uncertainty (Barkemayer et al. 2015; Moser and Dilling 2011; van der Linden et al. 2015).

The present analysis of the use of the word *risk(s)* needs further investigation in order to capture the different contexts in which it is used, the different meanings it may convey and the influence of different disciplines involved in the IPCC work. It would also be necessary to include other words than the word *risk(s)* itself to do justice to this crucial question. (For relevant studies, see e.g. Painter 2013, 2015.)

3.2. Human

The judgement, by humans, of *risks* is typically related to possible impacts on humans, or on those groups of humans who receive attention. We observe in the frequency lists that the adjective *human* is present in all four SPMs, with the highest relative frequency by far coming in the WGII-SPM (WGI: 15; WGII: 43; WGIII: 13; SYR: 25; numbers not case sensitive). In WGII-SPM there are also 19 occurrences of the word *people* versus only 4 in WGIII-SPM, and 7 despite the space constraints in the SYR-SPM. Thus, *people* occurs considerably less than the more abstract term *human*, but is not absent.

In the WGI-SPM the majority of the 15 lexical bundles that involve *human* concern *human influence*. They relate to evidence of human influence on climate change, as in the following sentence: 'It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.' (p.17). Here *human* is a category implicitly contrasted with *non-human*.

In the WGII-SPM, the lexical bundles are considerably more frequent (43) and varied. We find combinations such as *human activities, human (and natural) systems* and *human health*. The focus now includes vulnerability and exposure of humans and *human systems* and the impacts of climate change on some people, including as expressed in 'loss of human lives' (p.19) and in the following: 'Impacts of such climate-related extremes include alteration of ecosystems, disruption of food production and water supply, damage to infrastructure and settlements, morbidity and mortality, and consequences for mental health and human well-being.' (p.6). The main contrast used remains *human/non-human*, as reflected in the term *human systems*, which is a way of talking

about human societies that is drawn from natural sciences, physical geography and engineering. Discussion of people remains generalised and abstracted, not much about specific types of persons (children, women, the aged, indigenous groups, …), with their different risks, exposures, vulnerabilities and responsibilities. Indeed WGII's SPM never mentions children.

In the WGIII-SPM, the relatively few (13) occurrences of *human* are not in recurrent fixed bundles, except for *human health* which appears four times. Why this frequency is less even than that in WGI-SPM might reflect that the authors and literature assessed by the AR5 WGIII remain predominantly from economics, engineering, and natural sciences (Corbera et al. 2015).

In the SYR-SPM, the occurrence of *human* (25) is roughly at a frequency that is the mean of those in the WGs, and is in bundles reflecting the topics of both WGI (human influence on the climate system, as in *human activities, human-induced*) and WGII (*human health, human systems*). In addition, a word combination appears which is not in any of the three WG-SPMs: *human mortality*: 'There is medium confidence that the observed warming has increased heat-related human mortality and decreased cold-related human mortality in some regions.' (p.40). On the special importance of "Casualties as a Moral Measure of Climate Change," see Nolt (2014).

3.3. Change, shifts, transition and transformation

In public debates and scientific literature on climate change the need for various kinds of other change is typically emphasised. The WG-SPMs all contain for obvious reasons numerous occurrences of *change* (respectively 145, 372, 92; we here include *changes*, *changed* and upper-case uses). Of these the bundle *climate change* constitutes respectively 29 (30%), 264 (71%), and 36 (39%) uses; the majority of the others seem to be climate- or weather-related instances of change (observed or projected), such as for temperature, precipitation, and sea level. We observe the same tendency in the SYR-SPM: of the 157 occurrences of *change*, 97 (62%) appear in the compound *climate change*. The massive difference in frequencies between WGII and SYR in comparison to the other two WGs is intriguing, especially if it were connected with WGII's greater orientation to risks. Indeed, WGII-SPM contains combinations such as *catastrophic changes*: '[…] many estimates do not account for catastrophic changes, tipping points, and many other factors.' (p.19); whereas the SPMs for WGs I and III hardly use *catastrophe* language.

WGIII-SPM contains five occurrences of *behavioural change*, a modest but possibly still significant presence; as in 'For developed countries, scenarios indicate that lifestyle and behavioural changes could reduce energy demand by up to 20% in the short term and by up to 50% of present levels by mid-century.' (p.24). In the SYR-SPM we observe only one occurrence where the term *change* is linked to lifestyles and behaviours: '…regionally appropriate changes in lifestyles or

behaviours.' (p.40). The SYR-SPM also employs the term *consumption* 11 times, almost three times the WGs' average; it echoes the importance given to it by WGIII.

We extend the search for possible change-orientation, since other words are semantically related to *change*: *shift, transformation, transition* (see Table 7; all forms included: singular, plural, not case sensitive). Their frequency of use is low however, except for *shift* and *transformation* in WGII-SPM; both these terms are adopted in the SYR-SPM.

Table 7: Frequency of words related to 'change'

	WGI-SPM	WGII-SPM	WGIII-SPM	SYR-SPM
shift	0	24 (12 in Suppl. Material, Table SPM.A1, p.30-31)	6	7
transition	2 (climate related)	0	4	2
transformation	0	13	1 (*system transformations*)	4

The bulk of WGII-SPM's uses for *shift*, as also in the SYR-SPM, concern shifts in species-distribution or climate patterns, and almost none concern behavioural change. WGIII-SPM has three uses of *modal shift*, including switches from one form of transportation to another. The SYR-SPM includes one more powerful instance: 'Delaying mitigation shifts burdens from the present to the future, and insufficient adaptation responses to emerging impacts are already eroding the basis for sustainable development.' (p.12).

Regarding the term *transition*, there are more occurrences in WGIII-SPM, but still only very few. The four uses are in relation to 'the transition to low longer-term emissions levels' (p.13, 18), including through 'transition away from the use of traditional biomass' (p.18), and transitional and long-term economic impacts of such shifts (Table SPM.2, pp.13-14). One of the two SYR-SPM uses echoes this.

Last, the boldest term, *transformation*, is specific to WGII and absent or virtually absent in the other WGs, although Working Group III makes references to energy transformations. It is defined (p.5) as: 'A change in the fundamental attributes of natural and human systems. Within this summary, transformation could reflect strengthened, altered, or aligned paradigms, goals, or values towards promoting adaptation for sustainable development, including poverty reduction.' The WGII-SPM contains several examples in headlines and related to figures; for example, above Figure SPM.9 we find: 'Transformations in economic, social, technological, and political decisions and actions can enable climate-resilient pathways (high confidence).' The SYR-SPM adopts this concept from WGII-SPM, declaring that:

> Restricting adaptation responses to incremental changes to existing systems and structures, without considering transformational change, may increase costs and losses, and miss opportunities. Planning and implementation

of transformational adaptation could reflect strengthened, altered or aligned paradigms and may place new and increased demands on governance […]. (p.15)

Words like "transition" and "transformation" can span different meanings, indicating different degrees of societal and technological change. O'Brien (2011) associates the term "transformation" with a deliberative choice about needed change. Referring also to the word "resilience", Pelling (2011) proposes a framework for understanding these differences, concerning various ways of undertaking necessary change (see Kates et al. 2012, on factors requiring transformational rather than incremental adaptations).

3.4. Opportunity/-ies / Option(s)

In contrast to, and response to, the discourse of *risk*, the terms *opportunity* and *option* are parts of upbeat solutions-oriented language. We find them used in WGII and III SPMs, and taken up in the SYR-SPM – especially *option*, less so for *opportunity*:

Table 8: Frequency of 'opportunity' and 'option'

	WGI-SPM	WGII-SPM	WGIII-SPM	SYR-SPM
opportunity/-ies	0	13	8	5
option(s)	0	18	22	18

Opportunity seems to be systematically used in an optimistic way, to mean beneficial options. The WGII-SPM speaks of 'livelihood opportunities' (p.8), 'opportunities for reducing impacts and managing risks through adaptation and mitigation' (p.11) and 'Opportunities to take advantage of positive synergies between adaptation and mitigation' (p.28). One of its three main chapter headings is 'Future Risks and Opportunities for Adaptation'. It should also be noted that five of these usages in WGII-SPM are as occurrences of *opportunity space* in Figure SPM.9, entitled "Opportunity space and climate-resilient pathways" (p.29), and there the meaning is close to 'option' rather than with an automatically favourable connotation. The WGIII-SPM speaks similarly, of 'opportunities for switching to low-carbon fuels' (p.23) and 'opportunities to stabilize or reduce global buildings sector energy use by mid-century' (p.24). The few uses within the SYR-SPM likewise present *opportunities* as beneficial options, as in: 'the potential for co-benefits and opportunities within wider strategic goals and development plans.' (p.18) and 'there are many opportunities to link mitigation, adaptation and the pursuit of other societal objectives through integrated responses (*high confidence*).' (p.21). Opportunity is also used to convey that there is still time to avoid the worst impacts and that science can inform a transformation to sustainability, as in the formulation of 'opportunity space' (p.29). Even though the IPCC does not have a mandate to develop these *opportunities* into more concrete measures since it would then enter policy

prescription territory, they can serve as a start for "new narratives" to be developed by decision makers.

   Option in contrast seems to refer to any possible choice and its results, not necessarily beneficial, as seen for example in the WGIII-SPM: 'There are multiple scenarios with a range of technological and behavioral options, with different characteristics and implications for sustainable development, that are consistent with different levels of mitigation.' (p.10). The term *options* is used to convey the multiplicity of responses to climate change and the different dimensions of the solution space. Like the term *opportunity/-ies*, however, many of those *options* are not elaborated further but could serve as entry points for policy-oriented thinking

4. Framing, including absences and emphases

The preceding discussion of word choices and uses-in-context provides us with a necessary basis for considering how the authors of the SPMs 'frame' their assessment: how they guide and organise attention. We look now at framing in more depth, including reference to dimensions such as the categorisations used to subdivide geographical space and distinguish social actors. We will compare the four SPMs in terms of what they share as emphases and absences, how they also differ in this regard, and how the especially important SYR-SPM constructs its red thread of highlighted points.

4.1. Shared emphases

The WG Reports share an IPCC-wide proscription of policy prescription, but an injunction to be policy-relevant. Thus the authors do not present much explicit reasoning towards policy proposals (such as 'if values 1 and 2, and realities x and y, then conclusions/suggestions @ and #'). But to be policy-relevant one must still be guided by some orienting criteria that reflect relevant general objectives and constraints. Given the impossibility of describing all impacts and all possible responses, one must focus on presenting estimated impacts in areas of assumed value importance and on examining responses of types that are conceivably politically feasible and ethically acceptable. If one considers impacts on economic production important, then one requires estimates in that area; similarly if one considers impacts on human life important, including impacts on unborn generations. Through considering the topics that are covered and those that are not, we gain some insight into what are the effective policy priorities.

   The WGs share also to some extent a standardised language about assessments of probability and confidence. This language seems derived from the work of WGI, which uses extensively both the probability and confidence scales. Its subject-matter lends itself to an impersonal focus on probability and confidence estimates about things that can be (more fully)

agreed in quantitative terms without requiring agreement on ethical values. The meaning and use of for example the term 'unlikely' may however appropriately differ when we apply it to the acidity of the ocean and when instead to human deaths; but the IPCC scale of terms aims for standardisation of usage across fields, so that, for example, a less than 33% chance in any field has to be called 'unlikely'. Thus a 30% chance of human deaths would be called 'unlikely', whereas in many social contexts this would be called 'extremely high risk', reflecting a principle that risk should be interpreted as (Probability x Damage), with damage measured in terms of human concerns (Hansson 1999). Inhibition about using language about human values could bring a danger of understating the risks faced by vulnerable poor people. The mandate of policy neutrality and the cognitive values from WGI could then lead to an overall downplaying of the human suffering that climate change imposes and could impose. The presumed neutrality of language can have negative consequences in terms of conveying urgency and the orientation needed for action (see Wynne 2009).

More generally, scientific language can come to mean different things when transferred to the everyday non-scientific world. Some SPM formulations inevitably become somewhat bland, generalised and vague, as they emerge from a vast process of aggregation and inter-disciplinary, inter-school and inter-governmental negotiation. But in addition, formulations that are definite within scientific communication can be vague and weak in everyday language contexts, including those of political debate and journalistic reporting. The SPMs take over the WGs' scientific terms/formats but these can now mean something different when read in the policy-talk/public arena. For example, what does the phrase "something is likely to happen" mean in everyday language? Interpretations can go in different directions according to the specific contexts (Budescu et al. 2014; Fløttum & Dahl 2014). This is the challenge facing especially the SYR-SPM, the key document which a wide range of policymakers, journalists and interested publics will actually read. We will see that the document goes some significant way towards righting the imbalances that can arise when scientific language is transferred to wider arenas, including through modulating its vocabulary to match its broader audience.

4.2. Shared absences

Human and social dimensions, including social differentiation and inequalities, receive little attention across the SPMs. Terms that are missing in relation to important themes in climate change discussions, and in much literature on climate change, include *humanity, children, grandchildren, future generations, the poor, the poorest, human rights, the international community*, etc. (Gasper et al. 2013a, 2013b). Such absences are important because the global debate on climate change and the

negotiations of the UNFCCC, the policy body to which the IPCC is mandated to provide scientific information, hinge substantially on those differentiations and inequalities.

Since the SPMs are summaries for policymakers, and since all policymakers around the world accept declarations about human rights (including in the UN Charter, under which umbrella the UNFCCC operates), it is relevant to consider how far the reports relate to that set of policy concerns. Human rights issues have salient importance for instrumental reasons too, for understanding political dynamics and for increasing the chances of reaching global agreements. Policy-relevant reporting will plausibly appropriately include attention to the impacts on human rights, as fundamental internationally endorsed criteria, and to impacts on the most vulnerable groups, not least children, who are the least responsible and sometimes the most affected. Children, especially small children, often form the bulk of those vulnerable to extreme weather events and health hazards associated with climate change. Eighty six percent of the estimated deaths attributable to climate change in 2000, according to a WHO report (2002: 223) were of babies and children younger than 5 years, essentially amongst poorer families in poorer countries (see also Gibbons 2014, and WHO 2014). The estimate already for the year 2000 was 150,000 deaths, after omitting all climate-health links for which large-scale quantitative studies were not available. The report noted that the omitted health consequences probably exceeded those it had estimated, where too it was conservative.

The SPMs do not differentiate explicitly between rich and poor countries. They assess and synthesise literatures that analyse largely at a global level, or in terms of very large multi-national regions, not in terms of countries or subnational regions (though some maps do show more breakdown) or different social groups. The implications of climate change for poor people thus remain obscure in the SPMs, even for WGII which had a chapter dedicated to poverty and livelihoods. As we saw, that SPM employs a bleached-out language of *human systems* far more than of *people*, and it never mentions *children*, who typically supply most of those at high risk. When, for example, the SPM-WGII mentions *large consequences* (p.10), it does not specify for whom, nor highlight the weakest, poorest groups, and notably their children; and p.11 only talks of variation across region and sector, not across class and age-group. P.12 does indicate that impacts are worse for *vulnerable communities*, but the term *community*, which this WG-SPM uses 11 times (far more than do the other SPMs), tends to conceal social divisions. Its p.13 takes one further step: risks are generally greater for *disadvantaged people and communities;* but it uses this idea equally for all countries, thus concealing life-and-death issues in some countries. In contrast to the more sustained attention given to non-human species and eco-systems, the poorest and weakest people remain near-invisible.

P.16 in WGII's SPM becomes specific about impacts on GDP of rising sea-levels but not about the impacts on poor people's lives. Pages 18 and 19 on impacts in urban areas and rural areas mention poor people as more vulnerable, but without specifics about what will be the costs – in terms of lives, livelihoods, and health; and p.19 gives far more detail on conventional economic measures of impact than the report has given on impacts in terms of lives. When p.20 comes to health impacts there are no figures, in contrast to the estimations for GDP (or to the 2014 WHO report on climate change and health). Overall, estimates of 'risk levels' are presented at length (e.g., in Box SPM 2), but the values and people that are at risk may be insufficiently considered; and while there is extensive, but rather unenlightening, attempted differentiation according to multi-national geographical regions, as in Box SPM 2 and many tables, there is no serious differentiation according to classes and ages.

Surprisingly little use is made of the 2012/13 IPCC Report on Extreme Events, with the exception of a brief summary and the use of a central risk figure by Working Group II, and there is little discussion of dealing with low probability very-high damage events/scenarios. The concept of *tipping-point* is ignored in all SPMs except for 4 uses in WGII's SPM; *threshold, crisis* and *catastrophe* are likewise virtually absent. The term *catastrophic* has been used in WGII outreach events and presentations to the media, and in general statements dedicated to convey future impacts within the business-as-usual scenario, as in *catastrophic and irreversible impacts*, where it refers to a long-term issue but is not applied to certain social groups in current and near-future situations.

In the SYR SPM, the term *irreversible* remains to help convey the urgency of future climate impacts especially in the high-end scenarios. As products of interdisciplinary and worldwide intergovernmental negotiation and with a declared objective of policy neutrality, the SPMs are not expected to be bold statements. Even so, as we will see, the SYR-SPM manages to rise to the challenge of conveying an appropriate policy-relevant message despite the various constraints. Indeed it adopts the term *challenge* as frequently as do the three other SPMs combined.

4.3. Differential emphases – the choices made in the SYR-SPM
The SYR-SPM is the AR5's concluding integrated message to policymakers. Many, perhaps most, readers will only read this component of AR5. It 'follows the structure of the longer [SYR] report, which addresses the following topics: Observed changes and their causes; Future climate change, risks and impacts; Future pathways for adaptation, mitigation and sustainable development; Adaptation and mitigation' (p.1). Although there are some significant differences of word frequencies in comparison to the other Summaries, section 3 above indicated that the SYR-SPM covers the predominant topics of the three other SPMs (Table 4) and in this sense constitutes a relatively integrated summary of the complete IPCC assessment of current climate change research.

We saw how it picks up some themes that are strong in only one or other of the WGs, as part of its role of building a meaningful integrated picture for policymakers to consider. In a few cases the SYR intensifies the foci from one or other of the WGs; the term *challenges*, for example, appears only 9 times in the three WG SPMs combined, but 8 times in the SYR-SPM, and it uses *sustainable* much more than do the WG SPMs (19 versus 0, 10, 13). We now consider more extensively what kind of language devices and framings are used in fulfilling its role.

The text of the SYR-SPM is broken up by 21 highlighted paragraphs/statements (distributed evenly between the four chapters: 5-5-5-6). These statements constitute the main narrative which the IPCC wants to convey to policymakers. Thus we give them special attention and assess the character and force of this narrative. We may assume that the seriousness of the climate change phenomenon in all its facets is intended to be emphasised here.

In addition to the scalar expressions technically defined by the IPCC concerning degrees of confidence and evidence/agreement, all the SPMs make use of linguistic devices (that are used too in everyday language) which contribute to 'amplify' or increase the strength of statements (expressing a stronger degree of intensity, certainty or emphasis). Table 9 notes that typical 'amplifiers' are on the whole used to a similar extent in SYR-SPM and in the other SPMs. But in a few cases certain amplifiers are used to a greater extent in the SYR-SPM, including in one extremely important case – the adjective *irreversible* – as a reflection of the importance of what is being conveyed and the responsibility of the SYR-SPM to communicate that. Irreversibility becomes worth stressing when the loss of things of great value, not least the loss of life, is at stake.

Table 9: Markers of emphasis

Word	SYR-SPM	WGI-SPM	WGII-SPM	WGIII-SPM
AMPLIFIERS				
many	30	17	30	23
more	52	42	31	42
most	18	25	12	18
multiple	6	5	7	5
magnitude(s)/-inal	11	8	10	3
highest	1	1	1	2
worldwide	2	2	0	1
substantial/-ly	22	17	10	19
irreversible	12	3	7	0
unprecedented	2	4	1	0
amplify.*	3	1	4	0
tipping points	0	0	4	0
threat.*	4	0	7	1
ARGUMENTATIVE INDICATOR				

but	25	16	17	22

Examples of amplifiers used more frequently by the SYR-SPM are the quantifier *many,* the comparative *more* (some of these are part of the scalar likelihood expression *more (un)likely than not),* the noun *magnitude,* the adjective and adverb *substantial/-ly* and, most distinctively and notably, the adjective *irreversible*. Here is an example:

> Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped.' (p.16).

The quantifier *many* lacks precision, but contributes to strengthening the statement in question. In a second example, the adverb *substantially* modifies *more,* giving a particular force to the following noun *impact*:

> Based on the available scientific literature since the AR4, there are substantially more impacts in recent decades now attributed to climate change. (Figure SPM.4, p.7)

These terms bring the language of the SPM-SYR somewhat closer to everyday policy language, and increase the chances it will be read and absorbed by its intended policymaker audiences in ways reasonably close to the conclusions of the IPCC panels.

The most noteworthy example is the frequent use of the forceful adjective *irreversible,* which appears 12 times in the SYR SPM, as illustrated in the following example, where *irreversible* is also related to the strengthening quantifier *on a multi-century to millennial time scale*:

> A large fraction of anthropogenic climate change resulting from CO_2 emissions is irreversible on a multi-century to millennial time scale, except in the case of a large net removal of CO_2 from the atmosphere over a sustained period. (p.16)

Four of the 12 occurrences of *irreversible* are found in some of the SYR-SPM's 21 highlighted statements. Here are two examples (including one of the four combinations of *abrupt* and *irreversible*):

> The risks of abrupt or irreversible changes increase as the magnitude of the warming increases. (p.16)

> Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread, and irreversible impacts globally *(high confidence)*. (p.16)

The force of the latter example rests on multiple elements, especially through the list of adjectives – *severe, widespread, and irreversible* – characterising *impact*, and by the preceding *high to very high risk* and the subsequent *high confidence.*

In general, the majority of the 21 highlighted paragraphs contain several concentrations of qualitative amplifiers, in particular in the two first chapters (on causes and risks), for example as in the following (italics added):

> Continued emission of greenhouse gases will cause further warming and *long-lasting* changes in all components of the climate system, increasing the likelihood of *severe, pervasive and irreversible impacts* for

> people and ecosystems. Limiting climate change would require *substantial and sustained* reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks. (p.8; emphases added)

In addition to such concentrations of forceful words, the same expressions are frequently repeated – another rhetorical device to ensure that the receivers of a message notice and remember it.

The highlighted statements in chapters 3 and 4 of the SYR-SPM (on future pathways and adaptation/mitigation) also contain examples of forceful amplifiers. However, they are different in the sense that they now contain implicit argumentation (for example marked by the contrastive connective *but*, which often conveys the instruction that what follows the *but* is more important than what precedes, even if that is accepted; see Fløttum & Dahl 2014). One form of the implicit argumentation observed conveys an encouragement to action, often conveyed by the modal verb *can* (as in … *can reduce climate risks ...* (p.17)), or to profiting from available knowledge.

> Effective decision making to limit climate change and its effects *can be informed by a wide range of analytical approaches* …. (p.17; emphasis added)

Another form of implicit argumentation involves conveying a warning about not doing anything:

> *Without additional mitigation efforts* beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread, and irreversible impacts globally (*high confidence*). Mitigation involves some level of co-benefits and of risks due to adverse side-effects, *but* these risks do not involve the same possibility of severe, widespread, and irreversible impacts as risks from climate change, increasing the benefits from near-term mitigation efforts. (p.17; emphases added)

Note the clear warning in the final clause, following the *but*-connector.

Thus, we see that the SYR-SPM makes effective use of tacit warnings and 'amplifying' language in order to draw out the human significance of the assessments presented in the WGs, despite the constraints set by the standardised decontextualised language about likelihood in the WG reports. This represents an appropriate response to the challenge of producing a non-prescriptive but policy-relevant report, meaningful in the broader arenas of policymaking discussion and public debate within which the SYR-SPM seeks to communicate.

5. Concluding remarks: Ensuring policy relevance while emphasizing policy neutrality

Our analysis has shown the following, which would not have been confidently identified through ordinary reading alone. The main points of the lexical, discourse and contextual analyses undertaken are these:

- Each Working Group's SPM reflects not only the WG's distinctive mandate but also a distinctive intellectual framing, reflected in differences in categories, vocabulary, and scope of attention. For example, WG I looks at the globe, in a time-frame of centuries; WGII looks at continental regions and 'human systems'; WGIII looks at scenarios and policy options at,

implicitly, primarily nation-state level. This finding is consistent with O'Neill et al (2015), as well as with Bjurström & Polk (2011)'s study of the Third Assessment Report.

- The Synthesis Report's SPM covers the three mental worlds presented in the three Working Groups, while being more than just a précis of the three. For example, it follows up the risk concerns which are prominent in WGII but quasi-absent in the other WGs; as seen not only in its use of the term *risk(s)* but especially through its highlighter language of 'Reasons for Concern'. *Risk* implies not just an unknown outcome but possible damage to important human values.

- This feature of the Synthesis Report—use of the language of 'risk' and 'Reasons for Concern'—can be seen as a response to the dilemma of how to convey the policy-relevant implications of the WG findings within the constraints set by the intellectual traditions of the IPCC, the extreme political sensitivity of the subject matter and the mandate and governance structure of IPCC, including the requirement that the reports be policy-neutral.

- In our analysis we observe a predominant tone and terminology derived from the natural sciences, in all three working groups as well as in the synthesis report. This reflects the history of IPCC and the inherited cognitive and epistemic dominance of the natural sciences in the IPCC community, as discussed in Bjurström and Polk (2010)'s dissection of the Third Assessment Report. Adoption of the assumptions, logics and certain language of the natural sciences is sometimes not optimal for the purposes of communicating policy-relevant messages to audiences with little time or inclination to engage with intricate texts or a complex, distant problem such as climate change. The use of a natural science style is at the expense of more human centered discourse as common in the social and the human sciences. It may also reflect that in the difficult and often controversial borderline between policy relevance and policy prescription a natural science tone and terminology is felt to offer a policy-neutral landscape in which agreement and consensus may be easier to attain, especially from the most powerful and most mobilised participating governments. Criticism of this orientation has been raised recently by many authors, calling for use of social sciences and humanities perspectives in framing IPCC reports, including to contextualise the meaning of climate change for people and communities (Hackmann et al. 2014; ISSC/UNESCO 2013; Tvinnereim & Fløttum 2015; Victor 2015; Weaver et al. 2014).

- The resulting style and tone of the IPCC reports conduces to important absences and imbalances in emphasis, as judged with reference to the centrality of issues of differential impacts on different groups, in international and national debates and negotiations on climate change. Our analysis shows that the main victims of climate change (consisting, not least, of children in the poorest families) remain virtually invisible in the reports, even in WGII-SPM, unlike the

impacts in nature and ecological systems or the aggregate economic impacts, and that, given the low degree of intra-social differentiation in the reporting, opportunities and options for action remain underdeveloped in the assessment.

- We found that, nevertheless, the AR5 SYR-SPM managed to fulfil its key role as the bridge from an exercise amongst scientists to communication to a broader audience. To connect the elements from the WGs into a policy-relevant picture that is meaningful and useful to its large audience of policymakers and their advisers and interested publics, the SYR concentrates on drawing out the interconnections of the most important elements. 'Most important' must mean, not least in an exercise under the United Nations umbrella, 'most humanly important'. The SYR-SPM takes the attention to risks, risks for vulnerable humans, from WGII and applies it to the overall synthesis narrative (section 3.1 above). It underlines in various ways the significance and severity of the risks, including emphasising the irreversibility of certain scenarios, and the consequent need for transformations beyond just marginal change as the implied requirements for sustainability (section 4.3 above). It highlights possibilities of choice and redirection, including through a language of *options*, *opportunities*, and *transformation*. While the language of the WGs is relatively divorced from human issues, the SYR bridges to wider audiences by moving away from only the standardised languages about degrees of certainty/likelihood, and employs additional tools of communication that reflect more effectively what is humanly important and endangered by the 'severe, widespread, and irreversible impacts [arising] as risks from climate change'.

We would like, finally, to consider what we have not covered or attempted, and to encourage further work. To fully evaluate the SPMs and make extensive suggestions on reorientations for IPCC requires considerable additional work; for example perhaps using tools such as Public Value Mapping, which seeks to systematically evaluate scientific research groups, proposals or programmes in light of specified public values (Bozeman & Sarewitz, 2011). Our paper has sought instead to empirically identify what the AR5 SPMs actually do, especially the SYR-SPM. However on that basis we have suggested that IPCC should rebalance its allocation of attention, not to shift out of its natural sciences foci but to give fuller and more differentiated attention to impacts on people and communities, including the differential impacts on individuals and countries, rich and poor, young and old. This is in line with, for example, the arguments of the World Social Science Report 2013 (ISSC/UNESCO, 2013).

Within our investigation of what the SPMs actually do, we have not focused on the (un)certainty terminology itself (Fløttum & Dahl 2014). Exploration of for example how the terms *agreement* and *evidence* are employed and function in context would be worthwhile. We have

chosen to focus instead on areas less well covered in existing literature, and have used methods that we believe show a rather high 'cost-effectiveness', combining accessibility with in-depth investigation. The analysis we have presented on a selected set of concepts, topics and issues can be expanded to others. Further work on selected key terms and families of terms may prove rewarding. For example, the terms *sustainable* and *sustainability* occur frequently in the SPMs for WG II, WG III and the SYR (18, 19, 19 respectively; 0 in WG I). In contrast to the solitary two references to *human mortality* (which arise in the SPM-SYR; together with six references to mortality in WGII-SPM), the current IPCC process more readily generates language like "sustainable development".

One can examine also the topic of how policy prescription is treated in the four reports. It is more prevalent (including through implicit avoidance of some issues) than is the awareness of it. The texts sometimes contain tacit policy models and other forms of tacit policy argumentation, which require careful linguistic dissection.

We have looked for patterns and contrasts amongst and between the four SPMs. Other comparisons could, for example, be of the SPMs in relation to the full WG reports, to see what if anything is screened out; the AR5 reports in relation to the AR4 and AR3 reports; the SPMs in relation to the subsequent journalistic coverage; and the SPMs in relation to major stakeholder representations of AR5, such as by various international agencies, national governments, or climate-sceptic groups. As the IPCC moves into its 6th Assessment cycle and after changes in the IPCC leadership, there have been many commentaries regarding potential changes to its mandate in order to make the organization more flexible, more receptive of the social sciences and humanities literatures, and better able to understand practitioners' knowledge (Schiemeier & Tollefson 2015; Victor 2015; Viner & Howarth 2014). There are also detailed recommendations for improved communication and knowledge uptake that IPCC itself has convened (Lynn 2016; St.Clair et al. 2016; IPCC 2016); Most point in the direction of enhanced participation of the social and human sciences. We hope that the present paper indicates the potential fruitfulness of these types of investigation.

References

Alexander, R.J. 2009. Framing Discourse on the Environment: A Critical Discourse Approach. Routledge, London.

Baker, P., Gabrielatos, C., Khosravinik, M., Krzyzanowski, M., McEnery, T., Wodak, R. 2008. A useful methodological synergy? Combining critical discourse analysis and corpus linguistics to examine discourses of refugees and asylum seekers in the UK press. Discourse & Society 19 (3) 273-306.

Barkemayer, R., Desai, S., Monge-Sanz, B., Renzi, B.G., Napolitano, G. 2015. Linguistic analysis of IPCC summaries for policymakers and associated coverage. Nature Climate Change, doi:10.1038/nclimate2824.

Berkhout, F., Hertin, J., Jordan, A., 2002. Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'. Global Environmental Change 12 (2) 83-95.

Biber, D., Conrad, C., Cortes, V. 2004. If you look at…: Lexical Bundles in University Teaching and Textbooks. Applied Linguistics 25(3), 371-405.

Bjurström, A., Polk, M. 2011. Physical and economic bias in climate change research: a scientometric study of IPCC Third Assessment Report. Climatic Change 108,1–22.

Boykoff, M. T., Frame, D., Randalls, S. 2010. Discursive stability meets climate instability: A critical exploration of the concept of 'climate stabilization' in contemporary climate policy, Global Environmental Change 20 (1) 53-64.

Bozeman, B., Sarewitz, D. 2011. Public Value Mapping and Science Policy Evaluation. Minerva 49, 1-23.

Budescu, D.V., Broomell, S., Por, H.-H. 2009. Improving the communication of uncertainty in the reports of the Intergovernmental panel on climate change. Psychological Science 20, 299–308.

Budescu, D.V., Por, H.H., Broomell, S.B., Smithson, M. 2014. The interpretation of IPCC probabilistic statements around the world. Nature Climate Change 4, 508–512.

Burkett, V.R., A.G. Suarez, M. Bindi, C. Conde, R. Mukerji, M.J. Prather, A.L. St. Clair, and G.W. Yohe. 2014. Point of departure. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 169-194.

Carvalho, A. 2005. Representing the politics of the greenhouse effect: Discursive strategies in the British media. Critical Discourse Studies 2 (1)1-29.

Carvalho, A. 2007. Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change. Public Understanding of Science 16, 223-243.

Corbera, E., Calvet-Mir, L., Hughes, H., Paterson, M. 2015. Patterns of authorship in the IPCC Working Group III report. Nature Climate Change 6, 94–99. doi:10.1038/nclimate2782.

Dahl, T. 2015. 2015. Contested Science in the Media: Linguistic Traces of News Writers' Framing Activity. Written Communication 32, 39-65.

Dahl, T., Fløttum, K. 2014. A linguistic framework for studying voices and positions in the climate debate. Text &Talk, 34(4) 401 – 420.

de Boer, J., Waardekker, J.A., van der Sluijs, J, 2010. Frame-based guide to situated decision-making on climate change. Global Environmental Change 20, 501-510.

Dilling, L., Lemos, M.C. 2011. Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. Global Environmental Change 21 (2) 680-689.

Diriks, A., Gelders, D. 2010. To frame is to explain: A deductive frame-analysis of Dutch and French climate change coverage during the annual UN Conferences of the Parties. Public Understanding of Science 19 (6) 732-742.

Dörnyei, Z. 2007. Research methods in applied linguistics. Oxford University Press, Oxford.

Eide, E., Kunelius, R., Kumpu, V. (Eds). 2010. Global climate, local journalisms. A transnational study of how media make sense of climate summits. Projektverlag, Bochum and Freiburg.

Farrell, A., VanDeveer, S.D., Jäger, J. 2001. Environmental assessments: four under-appreciated elements of design. Global Environmental Change 11, 311–333.

Fløttum, K. 2010. A linguistic and discursive view on climate change discourse. La revue du GERAS, ASp 58,19−37

Fløttum, K. 2013. Narratives in Reports about Climate Change. In Gotti, M., Guinda, C. S., (eds.), Narratives in Academic and Professional Genres. Peter Lang, Bern, pp. 277-292.

Fløttum, K., Dahl, T. 2011. Climate Change Discourse: Scientific Claims in a Policy Setting. Fachsprache 3-4, 205-219.

Fløttum, K., Dahl, T. 2012. Different Contexts, Different 'Stories'? A Linguistic Comparison of Two Development Reports on Climate Change. Language and Communication 32(1) 14-23.

Fløttum, K., Dahl, T. 2014. IPCC communicative practices: A linguistic comparison of the Summary for Policymakers 2007 and 2013. The LSP Journal - Language for special purposes, professional communication, knowledge management and cognition 5(2) 66-83.

Fløttum, K., Gjerstad, Ø. 2013a. Arguing for climate policy through the linguistic construction of Narratives and voices: the case of the South-African green paper "National Climate Change Response". Climatic Change 118(2) 417-430. DOI: 10.1007/s10584-012-0654-7.

Fløttum, K., Gjerstad, Ø. 2013b. The role of social justice and poverty in South Africa's national climate change response white paper. South African Journal on Human Rights 1, 61-90.

Fløttum, K., Gjesdal, A.M., Gjerstad, Ø., Koteyko, N., Salway, A. 2014. Representations of the future in English language blogs on climate change. Global Environmental Change, 29, 213-222.

Gasper, D., 2014. Future global ethics: environmental change, embedded ethics, evolving human identity. Journal of Global Ethics, 10(2) 135-145.

Gasper, D., Portocarrero, A.V., St. Clair, A.L. 2013a. The framing of climate change and development: A comparative analysis of the Human Development Report 2007/8 and the World Development Report 2010. Global Environmental Change 23(1) 28-39.

Gasper, D., Portocarrero, A.V., St. Clair, A.L. 2013b. An Analysis of the Human Development Report 2011 'Sustainability and Equity: A Better Future for All'. South African Journal on Human Rights, 29(1) 91-124.

Gibbons, E., 2014. Climate Change, Children's Rights, and the Pursuit of Intergenerational Climate Justice. Health and Human Rights, 16(1), 19-31.

Gifford, R., Comeau, L.A. 2011, Message framing influences perceived climate change competence, engagement, and behavioral intentions. Global Environmental Change, 21(4), 1301–1307

Grundmann, R.,Krishnamurthy, R. 2010. The Discourse of Climate Change: A Corpus-based Approach. Critical Approaches to Discourse Analysis Across Disciplines 4(2), 125-146.

Hackmann, H. Moser, S., St.Clair, A.L. 2014. The social heart of global environmental change. Nature Climate Change 4, 653–655. doi:10.1038/nclimate2320

Hansson, S.O. 1999. A philosophical perspective on risk. Ambio 28(6) 539-542.

Hjerpe M., Linnér, B-O. 2009. Utopian and dystopian thought in climate change science and policy. Futures, 2009, 41 (4) 234–245.

Hulme, M. 2009. Why we disagree about climate change. Cambridge University Press, Cambridge.

IPCC. 2013. Appendix A to the Principles Governing IPCC Work. http://www.ipcc.ch/organization/organization_procedures.shtml (consulted 08.10.2014)

IPCC. 2015. IPCC PRESS RELEASE (27 February2015). https://www.ipcc.ch/pdf/session41/150227_P41_closing_press_release.pdf

IPCC. 2016. PCC Expert Meeting on Communication (9-10 February 2016, Oslo, Norway) http://www.ipcc.ch/meeting_documentation/meeting_documentation_ipcc_workshops_and_expert_meetings.shtml

ISSC/UNESCO. 2013. World Social Science Report 2013 - Changing Global Environments. OECD-UNESCO Publishing http://unesdoc.unesco.org/images/0022/002246/224677e.pdf

Kates, R.W., Travis, W.R. Wilbanks, T.J. 2012. Transformational adaptation when incremental adaptation to climate change are insufficient. PNAS 109(19) 7156-7161.

Lynn, J. 2016. IPCC communications issues – constraints and opportunities. Available at http://www.ipcc.ch/meeting_documentation/pdf/Communication/160119_advance_paper_on_constraints-JLynn.pdf

Moser, S.C. 2010. Communicating climate change: history, challenges, process and future directions. Wiley Interdisciplinary Reviews: Climate Change. 1(1) 31–53.

Moser, S. C., Dilling, L. 2011. Communicating Climate Change: Opportunities and Challenges for Closing the Science-Action Gap. In: The Oxford Handbook of Climate Change and Society, R. Norgaard, D. Schlosberg, J. Dryzek (Eds.), Oxford University Press, Oxford.

Nilsson, A. 2007. A Changing Arctic Climate. Dissertation. Linköping: Linköping University.

Nisbet, M. C., Scheufele, D. A. 2009. What's next for science communication? Promising directions and lingering distractions. American Journal of Botany 96(10) 1767–1778.

Nolt, J. 2014. Casualties as a Moral Measure of Climate Change. Climatic Change. DOI 10.1007/s10584-014-1131-2.

Oakes, M. 1998. Statistics for Corpus Linguistics. Edinburgh University Press, Edinburgh.

O'Brien, K, St.Clair, A.L. 2010. The framing of climate change: Why it matters, in O'Brien K, A. L. St. Clair, B. Kristoffersen (Eds.) Climate Change, Ethics and Human Security. Cambridge University Press, New York.

O'Brien, K. 2012. Global environmental change II: from adaptation to transformation. Progress in Human Geography 36(5) 667-676. doi: 10.1177/0309132511425767

O'Neill, S., Williams, H.T.P, Kurz, T., Wiersma, B., Boykoff, M. 2015. Dominant frames in legacy and social media coverage of the IPCC Fifth Assessment Report. Nature Climate Change 5, 380–385.

Painter, J. 2011. Poles apart: the international reporting of climate scepticism. Reuters Institute for the Study of Journalism. Oxford University Press, Oxford.

Painter, J. 2013. Climate Change in the Media: Reporting Risk and Uncertainty. I.B. Tauris / Reuters Institute, University of Oxford, London.

Painter, J. 2015. Disaster, uncertainty, opportunity or risk? Key messages from the television coverage of the IPCC's 2013/2014 reports. METODE. Science Studies Journal. University of Valencia, Valencia.

Pelling, M. 2011. Adaptation to climate change. From resilience to transformation. Routledge, London/New York.

St. Clair, A. L., Painter, J. Hermansen, E., and Bjørnæs, C. 2016. Seven recommendations for improving IPCC communication and policy impact. Available at http://www.ipcc.ch/meeting_documentation/pdf/Communication/AR5_Europe_Usability_Framing_and_Communication_of_Scientific_Information.pdf

Schiermeier, Q., Tollefson, J. 2015. Four challenges facing newly elected climate chief. New leader of Intergovernmental Panel on Climate Change, Hoesung Lee, has a full in-tray. Nature 06.10.2015. doi:10.1038/nature.2015.18492

Spence, A., Pidgeon, N. 2010. Framing and Communicating Climate Change: The Effects of Distance and Outcome Frame Manipulations. Global Environmental Change 20, 656-667.

Sundqvist, G., St.Clair, A. L., Hermansen, E., Yearley, S., Tvedten, I., Wynne, B. 2015. One World or Two Worlds? Science and Policy Interactions in the Climate Field. Paper presented at "IPCC AR5 in Europe: Usability, Framing and Communication" international Seminar, University of Edinburgh, 1-2 June 2015, Edinburgh.

Tvinnereim, E., Fløttum, K. 2015. Explaining topic prevalence in answers to open-ended survey questions about climate change. Nature Climate Change. DOI 10.1038/nclimate2663.

Van der Linden, S., Maibach, E., Leiserowitz, A. 2015. Improving Public Engagement With Climate Change: Five "Best Practice" Insights From Psychological Science. Perspectives on Psychological Science 10 (6) 758-763. doi: 10.1177/1745691615598516

Victor, D. 2015. Climate change: Embed the social sciences in climate policy. Nature 520, 27–29. doi:10.1038/520027a

Viner, D., Howarth, C. 2014. Practitioners' work and evidence in IPCC reports. Nature Climate Change 4, 848-850. doi:10.1038/nclimate2362

Weaver, C. P. S. Mooney, D. Allen, N. Beller-Simms, T. Fish, A. E. Grambsch, W. Hohenstein, K. Jacobs, M. A. Kenney, M. A. Lane, L. Langner, E. Larson, D. L. McGinnis, R. H. Moss, L. G. Nichols, C. Nierenberg, E. A. Seyller, P. C. Stern and R. Winthrop, 2014. From global

change science to action with social sciences. Nature Climate Change 4, 656–659. doi:10.1038/nclimate2319

WHO (World Health Organization) 2002. The World Health Report 2002. WHO, Geneva.

WHO (World Health Organization) 2014. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Hales, S., Kovats, S., Lloyd, S. Campbell-Lendrum, D. (Eds.). WHO, Geneva.

Wynne, B. 2003. Seasick on the Third Wave? Subverting the hegemony of propositionalism. Social Studies of Science 33(3) 401-417.

Wynne, B. 2009. Uncertainty and Environmental Learning. In: The Earthscan Reader on Risk, R. Löfstedt, A. Boholm (Eds), 295-313. Earthscan/Routledge, London.

Yearley, S., St.Clair, A. L., Sundqvist, G., Hermansen, E. 2015. Analysing the implicit model of 'policy impact' for IPCC AR5: understanding and improving the impacts. Paper presented at "IPCC AR5 in Europe: Usability, Framing and Communication" International Seminar, University of Edinburgh, 1-2 June 2015, Edinburgh.