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Grounding IPBES experts' views on the multiple values of nature in epistemology, knowledge and collaborative science

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ABSTRACT

This study identifies and analyses the underlying assumptions of experts involved in the first author meeting (FAM) of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)'s *Values Assessment*, and how they shape understandings of the multiple values of nature. We draw from survey data collected from 94 experts attending the FAM. Respondents self-report the tendencies and aims they bring to the assessment (i.e. motivation), the type and amount of evidence they require for knowledge to be valid (i.e. confirmation) and their epistemic worldviews (i.e. objectivity). Four clusters emerged that correspond to Pragmatist, Post-Positivist, Constructivist and Transformative epistemic worldviews. This result clarifies how different knowledge claims are represented in science-policy processes. Despite the proportionately higher number of social scientists in the *Values Assessment*, compared with previous IPBES assessments, we still found that fewer experts have Constructivist or Transformative worldviews than Pragmatist or Post-Positivist outlooks, an imbalance that may influence the types of values and valuation perspectives emphasised in the assessment. We also detected a tension regarding what constitutes valid knowledge between Post-Positivists, who emphasised high levels of agreement, and Pragmatists and Constructivists, who did not necessarily consider agreement crucial. Conversely, Post-Positivists did not align with relational values and were more diverse in their views regarding definitions of multiple values of nature compared to other clusters. Pragmatists emphasized relational values, while Constructivists tended to consider all value types (including relational values) as important. We discuss the implications of our findings for future design and delivery of IPBES processes and interdisciplinary research.

1. Introduction

Conceptualisation of the multiple values of nature has a rich scholarly history across multiple academic disciplines and traditions, including economics, geography, philosophy, and psychology (Chan et al., 2018; Dietz et al., 2007; Kenter et al., 2019; Raymond et al., 2019). These academic traditions have devoted much effort to explaining this diversity of nature values in terms of gradients across: i) the level of value contextualization from fine to broad values (Rawluk et al., 2019), ii) the forms of value elicitation from social, economic and ecological perspectives (Kronenburg and Andersson, 2019), iii) the value provider's scale from the individual to the community or culture (van Riper et al., 2019), and iv) the temporal stability of values from relatively constant to rather malleable (Kendal and Raymond, 2019). Despite this growing body of literature, historically, values plurality did not garner much attention and was not central to environmental

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governance or sustainable development; rather research was predominantly focused on ecological and economic values alongside scientific-technological knowledge. Therefore, a crucial knowledge gap today concerns how to identify and integrate more plural values and valuation techniques into institutions that inform environmental policy and decision-making.

New environmental governance institutions, like the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), recognize the importance of incorporating diverse worldviews, knowledge systems and values into policy-making, which in turn requires achieving gender, geographic and discipline/knowledge system balance in their work programs and assessments (Montana and Borie, 2016; Pascual et al., 2017). For example, in an explicit attempt to be more ontologically and epistemologically inclusive, IPBES proposed expanding the ecosystem services concept to "nature's contributions to people" (NCP) to be more amenable to other ways of thinking that are not based on (or even reject) economic terminology and concepts (Díaz et al., 2018). Furthermore, in 2018, IPBES commenced an assessment on the multiple ways nature and NCP can be valued, selecting as authors diverse experts engaged in the conceptualization of values and their expression in decision-making contexts. In this way, IPBES brings forward fundamental challenges regarding values plurality and environmental governance, acknowledging the wide-ranging perspectives on values, their dynamics, and valuation methods, as well as the normative underpinnings of the latter (i.e. the methods create the values) (Muradian and Pascual, 2018).

Ultimately, IPBES' efforts will be conditioned by successfully engaging diverse stakeholders, knowledge(s) and value systems (Vohland and Nadim, 2015). Consequently, there is a pressing need to collaborate across worldviews and knowledge systems to account for the diversity of values and corresponding valuations that different stakeholder groups hold regarding biodiversity, nature and NCP (IPBES, 2016; Martinez-Harms et al., 2018; Pascual et al., 2017). Indeed, in the preliminary guide regarding the diverse conceptualizations of the multiple values of nature, IPBES (2016) notes the importance of nature's multiple values and benefits for different stakeholders and the need for transparency when these are handled in decision-making. To shift the focus away from value monism and bridge across value and knowledge systems (Pascual et al., 2017), IPBES adopts a multiple evidence-based approach (Martinez-Harms et al., 2018; Tengö et al., 2014, 2017). However, the balancing act of knowledge exchange and appropriate representation of knowledge along value plurality requires negotiating what is deemed to be credible and legitimate knowledge, as well as facilitating deliberation among people with different values systems (Eriksson et al., 2019). This process of co-production eventually results in social learning (Muradian and Pascual, 2018; Vogel et al., 2007).

Returning to the context of environmental governance, we know that policy-relevant knowledge is dependent on the constructions of expertise (i.e. epistemic authority), which itself implicitly shapes understanding of the environmental problems being addressed (Gustafsson and Lidskog, 2018). Perceptions about scientific information's legitimacy, credibility and salience are often used to navigate and conceptualise the science-policy interface and to understand if and how scientific information is used in actual policy-making (Cash et al., 2003; Clark et al., 2016). Yet, it is frequently overlooked that assessments of the multiple values of nature are themselves value-laden, meaning that the methods are part-and-parcel of creating the values (Muradian and Pascual, 2018).

Despite the ongoing ambition of opening up decision-making to diverse knowledge systems (Cornell et al., 2013), less attention has been paid to the range of scientific worldviews that scholars themselves actually bring to bear on environmental research and management, including such contrasting positions as i) Post-Positivism, ii) Constructivism, iii) Pragmatism and iv) Transformationalism (Creswell, 2014). Post-positivist thinking frequently uses a reductionist approach to verify theory and determine supposedly objective facts about an object or process of study, while Constructivism seeks to develop a better understanding of such phenomena, often generating theory on a social and historical approach that recognizes multiple meanings and significances of the same "facts." For its part, a pragmatic worldview in research is oriented towards real-world problem-solving and applies a pluralistic approach to concepts and methods. Finally, transformativism is also collaborative and practical, but contrasts from the former approaches by explicitly taking on a political and power-explicit perspective that seeks to not only conduct research, but affect change. This gradient of philosophical assumptions will influence the choice of research priorities and questions, valuation methods, and the involvement of other stakeholders and may reflect a scientist's respective field or disciplinary tradition (e.g., natural or social sciences, Eigenbrode et al., 2007).

These distinctions of scholarly worldviews are important in the context of plural valuation assessments because different research choices emerge from divergent understandings of reality (i.e. ontology) and what counts as knowledge and how we know what we know (i.e. epistemology) (Moon and Blackman, 2014; Stone-Jovicich, 2015). Also, divergent ontologies and epistemologies not only lead to different research, but additionally constitute one of the main barriers to the integration of knowledge(s) across value and knowledge systems (Jerneck et al., 2011). Therefore, academic research and science-policy interfaces should not only pay particular attention to the diversity of values found in nature or broader society, but also to the diversity of their own participants and practices. A paucity of research has asked scholars to reflexively analyse how their own philosophical assumptions influence their understanding of the multiple values of nature. Doing so, however, is crucial to build empathy and shared understanding across different disciplines and scholarly traditions that are seeking to integrate multiple values to inform environmental policy and decision-making.

Researchers involved in sustainability science generally acknowledge how the various external, epistemic and personal factors (hereafter "epistemic worldviews") shape scientific inquiry (van der Hel, 2018). There is broad consensus among this group of scholars on the importance of transparency, reflexivity and awareness around the relationship between research and political context, and epistemic and normative positionality (Scholz, 2017; Wittmayer and Schäpke, 2014). For instance, accounting for and appreciating the diversity of knowledge systems have been noted in the field of social-ecological research (Turner et al., 2016), and knowledge co-production has become the *modus operandi* of sustainability science, which is widely characterized as a transdisciplinary field (Miller, 2013). Moreover, the socio-cultural and environmental contexts determining the co-creation, sharing and use of societal knowledge heavily influence transformation processes in complex systems (Berkes, 2009). The way a science-society interface is structured and managed, such as a having a just and empowering collaborative environment or implementing interdisciplinary methods like promoting reflexivity, positionality and dialogue (Eigenbrode et al., 2007; Jerneck et al., 2011), plays a major role in improving sustainability outcomes.

Eigenbrode et al. (2007) divide such philosophical challenges faced by interdisciplinary research teams into two groups: epistemological and metaphysical. Epistemological issues relate to questions about inputs from society and policy-makers and validation of evidence. By distinguishing motivation and confirmation, we seek to shed light on the epistemological perceptions of IPBES experts. Motivation is defined as the overall goals a researcher brings to their research (e.g., increasing theoretical knowledge, aiming to produce applied knowledge), and confirmation refers to the type and amount of evidence that a researcher requires for knowledge (Eigenbrode et al., 2007). Metaphysical challenges relate to different ontologies. Objectivity is an indicator of how a researcher perceives the world and can be used to distinguish the different notions of existence of a fully objective world or one constructed to different degrees by different actors (Eigenbrode et al., 2007).

In this paper, we seek to contribute to the effective engagement of different understandings of sustainability by identifying and analysing epistemic worldviews found in the experts participating in the IPBES *Values Assessment* (2018–2021). Specifically, we explore the relationships between philosophical factors affecting collaborative research (objectivity, motivation and confirmation) (Eigenbrode et al., 2007), and how they shape experts' views on nature's multiple values. From these findings, we suggest future directions for improving IPBES and similar science-policy processes, as well as broader social-ecological systems (SES) research teamwork. In so doing, we hope to overcome an emphasis on consensus and instead ensure that teams are formed in ways that allow interpretive flexibility, promote organizational structures for social learning, and manage different philosophical perspectives and interests (Dunkley et al., 2018).

2. Methods

2.1. Sampling

In October 2018, we conducted a census of all experts, including co-chairs, coordinating lead authors, lead authors and fellows involved in the *IPBES Methodological Assessment regarding the Diverse Conceptualization of Multiple Values of Nature and its Benefits, including Biodiversity and Ecosystem Services* (hereafter the IPBES *Values Assessment*). In total, the IPBES *Values Assessment* involves 94 experts divided across Chapter 2 – values concepts and conceptualizations (18 %), Chapter 3 – valuation and evaluation methods (22 %), Chapter 4 – values and decision-making (22 %), Chapter 5 – values and sustainable futures (25 %) and Chapter 6 – capacity-building (13 %).

2.2. Survey technique

On day one of the IPBES *Values Assessment*'s First Author Meeting (12th November 2018), we sent an email inviting all authors to complete an online survey. The survey was comprised of the following sections: 1) Expectations of the IPBES *Values Assessment*; 2) Views on the multiple values of nature; 3) Views on knowledge and understanding of reality in science, and; 4) Background information (see Supplementary Material 1 for full survey). The survey took approximately 30 min to complete.

2.3. Analyses

A series of descriptive statistics, including cross-tabulations with chi-square tests, were used to examine the sample characteristics. To evaluate how representative our sample was of the broader population of 94 IPBES experts involved in this assessment, we compared across demographics, academic background, institutional affiliation, and role within IPBES. Aggregate population data were provided by the IPBES *Values Assessment* Technical Support Unit (TSU) in Morelia, Mexico, and anonymity was maintained. Respondents were clustered based on their understanding of objectivity in science. To avoid making *a priori* assumptions, clusters were identified using an agglomerative average linkage cluster analysis, as these algorithms have been shown to be more robust than alternative methods of hierarchical cluster analysis (Kaufman and Rousseeuw, 1990). All quantitative analyses were conducted in Stata version 15.

We used a qualitative thematic analysis to identify themes and sub-themes for respondents' understandings of motivation, confirmation and the multiple values of nature. Using NVivo 12 qualitative analysis software, we completed four rounds of coding (i.e. open, axial and thematic), encompassing all three concepts. Each theme was linked to the underpinning code and then reviewed and revised, checking to ensure the emergent themes fit well with the data. Themes were then revised by coding and collating more data from the original interview transcripts. Presences or absences of data were recorded for each theme or sub-theme, together with the number and percentage of interviews clustered within each particular theme. In keeping with thematic qualitative analysis, predominance was not the sole measure of thematic significance; rather, the importance of minority viewpoints was also considered.

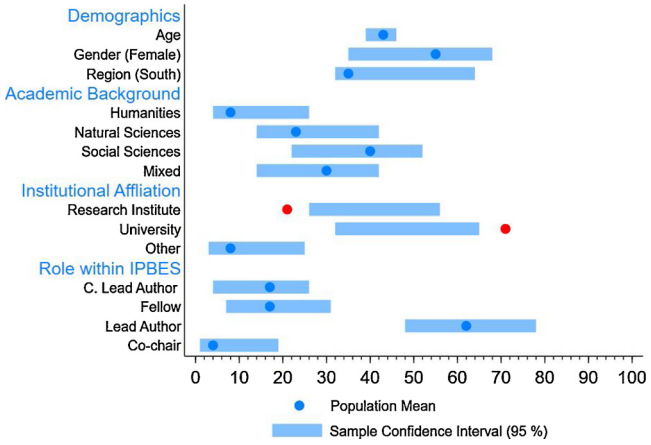

Fig. 1. Socio-demographic characteristics of the sample in relation to the IPBES database for the entire population of experts involved in the *Values Assessment*.

3. Results

3.1. Sample characteristics

More than half (48 of the 94, or 51 % response rate) of the IPBES *Values Assessment* experts completed the survey. In general, our sample's demographics were statistically similar to the broader population's data (Fig. 1). The majority of respondents were from the Global North (71 %) and had a lead author (LA) role in the assessment (64 %). Other roles included fellows (17 %), coordinating lead authors (CLA, 12 %) and co-chairs (7 %). Gender representation was balanced (48 % female, 45 % male, and 5 % preferring not to answer). The respondents represented a variety of academic fields:

- Economics (26 %)
- Biology and Ecology (21 %)
- Sustainability and Systems Science (19 %)
- Geography and Planning (14 %)
- Psychology and Philosophy (12 %)
- Interdisciplinary Social Science (7 %).

A majority of respondents were either employed in a university (49 %) or a research centre or institute (41 %).

3.2. Clusters characteristics according to different worldviews

Four clusters emerged from the survey responses on objectivity, which we related to Creswell's (2014) characteristics of scientific worldviews: Pragmatism, Post-Positivism, Constructivism, and Transformativism (Table 1). The majority (n = 18) was classified as Pragmatists (Cluster 1), embracing problem-centred, pluralistic and real-world practice-oriented characteristics. This cluster was less aligned with objectivity and more aligned with induction. Post-Positivists (Cluster 2, n = 11) instead referred to the importance of determination and reductionism, as well as theoretical verification, empirical observation and measurement. This cluster was more aligned with objectivity, hypothesis testing, and multiple methods. Constructivists (Cluster 3, n = 10) emphasised multiple participants' meanings, social and historical construction and theory generation. This cluster is less aligned with objectivity and hypothesis testing methods. Only one of

Table 1
Average values for survey items with clusters mapped to Creswell's (2014) scientific worldviews.

Survey items	Cluster 1 Pragmatism	Cluster 2 Post- Positivism	Cluster 3 Constructivism	Cluster 4 Transformativism	Total
The natural world is external and objective	2.2	3.8	1.6	3.0	2.5
Researchers should formulate hypotheses and then test them	4.2	3.7	2.2	1.0	3.5
Researchers should use multiple methods to establish different types of data	4.7	4.6	4.4	4.0	4.6
Researchers should try to develop ideas through induction from data	4.1	3.3	3.5	5.0	3.8
n	18 (45 %)	11 (28 %)	10 (25 %)	1 (3 %)	40 (100 %)

Table 2
Overview of themes and their frequency by clusters.

Theme	Pragmatist	Post-Positivist	Constructivist	Transformative
Motivation				
Understanding different values	33 %	36 %	20 %	
Informing policy	17 %	18 %	20 %	
Synthesising current knowledge	11 %	9 %	10 %	
Integrating diversity of values	56 %	36 %	50 %	100 %
Developing methodologies	28 %	9 %	10 %	
Evaluating the role of values in decision-making	11 %	18 %	30 %	
Consensus and collaboration	6 %		20 %	
Transformative change	17 %		20 %	
Confirmation				
Scientific knowledge with other types of knowledge	50 %	18 %	30 %	
Empirical observations, case studies	6 %	36 %	20 %	
Broad Evidence Base	22 %		20 %	
Published, data, experts	17 %	36 %	20 %	
Transparency	6 %		20 %	
Other	6 %	9 %	20 %	100 %
Definitions of multiple values of nature				
All value types	11 %	36 %	50 %	100 %
Economic	17 %	18 %		
Ecological	11 %	9 %		
Socio-cultural	11 %	9 %		
Intrinsic	17 %		20 %	
Instrumental	28 %	18 %	30 %	
Relational	50 %		40 %	
Meaning of nature		9 %	10 %	
Socially or culturally constructed	11 %	18 %		

the respondents held a Transformative worldview (Cluster 4) that indicated intentions toward change, politics, collaboration, and justice. This individual responded negatively to hypothesis testing. Given the low sample size of this cluster, we excluded it from further analyses.

3.3. Thematic analysis

3.3.1. Overall motivation

Participants were asked what they considered to be the main purpose and pressing issues of the IPBES *Values Assessment*. *Integrating diversity of values* was the most prominent theme (53 % of respondents), referring to including diversity of values and/or the importance of recognising multiple values of nature in decision-making, and therefore having an action-oriented notion of motivation. It is important to note that not all respondents preferred to use the word "integrating," but instead referred to including or incorporating different values. The second-most prominent theme was *Understanding different types of values* (27 %) that included assessing values and developing an understanding of them, particularly referring to conceptual and theoretical development without calling for greater societal engagement. Other emerging themes were *Informing policy* (18 %), *Evaluating the role of values in decision-making* (18 %) and *Developing methodologies* (18 %). Less prominent themes included *Transformative change* (13 %), *Consensus and collaboration* (9 %) and *Synthesising current knowledge* (9 %).

3.3.2. Motivations in different clusters

In both the Pragmatist and Constructivist clusters, *Integrating diversity of values* was coded most frequently (56 %, 50 %, respectively). For example, Pragmatists' answers included *"The main purpose, in my view, is to help policy and decision making systems to reach a level that constraints then to not build any program that in not nature' multiple values integrated* […]." Also, *Understanding different types of values* was mentioned relatively often among Pragmatists (33 %). *Evaluating the role of values in decision-making* was the second-most frequently identified theme by Constructivists (30 %).

Post-Positivists most frequently identified the motivations of *Understanding different types of values* and *Integrating diversity of values,* which were each mentioned by 36 % of respondents in this cluster. The following comment combines both approaches: "*I see the main purpose of IPBES* Values Assessment *as creating a better understanding of different values of nature from different social, economic, and cultural contexts as well as different academic disciplines. Ultimately, such a deeper and richer understanding of the values of nature is expected to yield better science and policy at local, national, and international levels*." The chosen quote also exemplified the similarities between individuals across clusters, in which some respondents expressed multiple themes, such as assessing values to be able to incorporate them in decision-making. However, more frequently in all the clusters, respondents related either only to more passive themes, such as understanding values or synthesising knowledge, or more action-oriented issues, such as informing policy and integrating diversity of values, instead of a mix of these two. This indicated differing levels of perceived engagement with society even within the respondent classified with similar worldviews.

In summary, motivation overall and within clusters followed similar paths in which *Integrating diversity values* and *Understanding different values* were the most prominent themes with the exception of

Constructivists, who also referred to evaluating current use of values in decision-making (see Table 2 for an overview). Furthermore, in the Post-Positivist Cluster, integration of values was not as strongly indicated as in other clusters and in motivation overall.

3.3.3. Confirmation

In the survey, we asked participants to report what constitutes valid knowledge for them. The most frequently coded theme related to confirmation was *Scientific knowledge with other types of knowledge* (38 %), which entails that the respondent mentioned scientific knowledge as crucial, but also emphasised the involvement of other types and sources of knowledge for the constitution of valid knowledge. The second most frequently coded theme was *Published, data, experts* (20 %), which included answers that referred to different types of published material, either peer-reviewed or not, grey literature, numerical evidence and information from different kinds of organisations. The theme thus referred to more formalised sources of information and knowledge.

Relating to scientific confirmation, *Empirical observations and case studies* were believed to constitute valid knowledge by 16 % of respondents. *A broad evidence base* was coded to a similar degree (16 %), referring to all kinds of values and knowledge without particularly mentioning scientific knowledge. Only a few respondents (7 %) considered *transparency* to be a crucial aspect in the creation of valid knowledge.

We asked survey participants to describe what they believed was the level of agreement needed in values constructs to constitute valid knowledge. This question was only answered by 18 respondents. A total of 39 % of these said that agreement needed to be high, and 50 % considered that no agreement was needed to constitute valid knowledge.

3.3.4. Confirmation in clusters

The most-prominent themes of confirmation for Pragmatists were *Scientific knowledge with other types of knowledge* (50 %) and *A broad evidence base* (22 %), which covered the most diversity of sources in constitution of valid knowledge. The former theme indicated different knowledge types, such as "*Scientific knowledge but also not published and oral ILK. We need to be transparent in which knowledge type is supporting the different sections or statements in the assessment.*" The latter was even more inclusive, indicating *"all kinds, multiple values of nature are contextual and all voices need to be heard."*

In contrast, for Post-Positivists, the most-coded themes were *Published, data, experts* (36 %) and *Empirical observation, case studies* (36 %), demonstrating a preference for more scientific validation of knowledge than expressed by Pragmatists. The division of themes related to confirmation in Pragmatist and Post-Positivist Clusters related closely with Creswell's (2014) characteristics of scientific worldviews, where Pragmatists valued pluralism and Post-Positivists emphasised empirical observations and measurement. For Constructivists, all the themes were almost equally represented: *Scientific knowledge with other types of knowledge* covers 30 % of responses, whereas all the other themes 20 %.

Pragmatists and Constructivists indicated an orientation mostly geared towards not needing agreement to produce valid knowledge in the assessment, whereas more Post-Positivists emphasised a high level of agreement as being crucial. However, due to a low rate of responses, it was difficult to draw stronger conclusions. In summary, the main differences in confirmation overall and between clusters related to Pragmatists' tendency to consider multiple knowledge sources as crucial for valid knowledge, whereas Post-Positivists leaned more towards scientific or other formal sources of knowledge than indicated in confirmation overall (Table 2).

3.3.5. Definitions of multiple values of nature

Survey participants were asked to define multiple values of nature. *All value types* (31 %) and *Relational* values (31 %) were the most prominent themes in terms of definitions of multiple values of nature. The former theme covered answers that did not indicate any restrictions or further conceptualisation for a definition, such as *"[a]strict definition would be all the values held by any person or institution on this planet."* Relational values were coded for answers that specifically named relational values or indicated them through defining multiple values of nature via relationships or interaction with nature, and also acknowledged the diversity of these kinds of interactions. *Instrumental* values (24 %) were coded relatively often, which included either mentioning instrumental values or indicating a preference towards instrumental values, such as nature's contribution to human well-being. Other emerging themes included established value types like *Intrinsic* (13 %), *Economic* (11 %), *Socio-cultural* (9 %), and *Ecological* (7 %), which were present in different kinds of combinations. Also, few respondents mentioned multiple values of nature as *Socially or culturally constructed* (9 %) or based on *Meaning of nature* (4 %).

3.3.6. Definitions of multiple values in clusters

In the Pragmatist Cluster, *Relational values* was the most frequent theme (50 %), whereas none of the Post-Positivists mentioned relational values. Relational values were expressed, for example, as follows: *"the very different ways in which different people, or one individual under different circumstances, relate to nature, and attribute importance and significance to it."* Furthermore, *Instrumental* values was also a theme mentioned relatively often by Pragmatists (28 %).

All value types was the most prominent theme for Constructivists (50 %), as well as for Post-Positivists (36 %). For example, a constructivist respondent embraced a wide range of values, such as "*I like to use "nature" as largely non-human influenced; then "multiple values" cover all human notions of importance of any aspects of nature*". Also, *Relational values* was mentioned by 40 % of Constructivists. For Post-Positivists, *Economic, Instrumental* and *Socially or culturally constructed* values were equally coded themes (18 %).

In summary, the main difference in definitions of the multiple values of nature overall and between clusters related to frequency of *All value types* and *Relational* values, which were differently emphasised between clusters. Pragmatists referred to *Relational values* and Constructivists *to All value types*, compared to definitions overall in which themes were equally prominent (Table 2).

3.3.7. How the IPBES processes can be improved

A total of 36 respondents replied to the question about how the IPBES process could be improved. Twenty-two percent believed involvement of more stakeholders could be elicited through dialogue (e.g., "*With ILK dialogues and stakeholders (such as policy-makers and practitioners) dialogues*" or "[…] *it would be nice to ensure representation or coverage of previously side-lined groups of people such as tribal peoples and others with a more intimate and dependent interaction with nature*"). Also, more transparency was valued by 14 %, as indicated by the following passage: "*By being aware and explicit about the interests that are associated with using different knowledge systems.*" Similarly, 14 % of respondents also believed more interaction with authors via such activities as more brainstorming time or meetings could improve the process. Moreover, focusing on the process was mentioned by 11 %, referring to such actions as identifying procedures for integration or separation: "*by not forcing us to work towards an "integration" but by recognizing multiple ways in which different types of values originating from different knowledge systems can interact together.*" Other answers to this question included involving more disciplines, such as critical social sciences (8 %), and providing more training and learning for authors (8 %). Moreover, 14 % of respondents considered it to be too early in the assessment to say how to improve the process, while 6 % thought the current process was adequate.

4. Discussion

By exploring the different worldviews of experts participating in the first author meeting of the IPBES *Values Assessment*, we advanced understanding about how to support interdisciplinary and cross-cultural knowledge weaving processes into academic and policy settings by identifying and elucidating the perspectives that scholars bring to the nature valuation process itself. Focusing on three philosophical aspects of collaborative research (i.e. objectivity, motivation and confirmation), we described how these aspects shape experts' views on the multiple values of nature. While efforts have been made to address issues concerning the underrepresentation of the social sciences in IPBES assessments (see Gustafsson and Lidskog, 2018 for overview of issues), our results point to the need to also consider multiple stances on evidence in the context of the multiple values of nature. Importantly, all respondent clusters, which were defined by their stances on objectivity, were strongly motivated by the need to understand the multiple values of nature and include/integrate them into decision-making. However, transformative change and collaboration-related motivations were less frequently identified, which may be related to the low representation of respondents that were classified as Transformativists and Constructivists. Differences in views toward confirmation existed across clusters, whereby Pragmatists emphasised a broad evidence-base while Post-Positivists prioritized published papers, data and expertise collated through more formalised scientific processes.

Although the importance of a wide range of disciplines is recognised for the process of bridging expertise in IPBES (Jetzkowitz et al., 2018; Löfmarck and Lidskog, 2017), our results indicate that the increased disciplinary diversity achieved by the *Values Assessment* may not necessarily translate into the inclusion of different epistemic worldviews. The concerns about epistemic challenges, such as differing views on knowledge validation in IPBES, have been pointed out previously (Díaz-Reviriego et al., 2019; Löfmarck and Lidskog, 2017), but this study shows that attention to disciplinary diversity as a stand-alone indicator within the process will not necessarily support plurality in perspectives. During the expert recruitment process, we encourage that science-policy platforms pay greater attention to the philosophical assumptions that underpin disciplinary identity and how they manifest in the process and practice of interdisciplinary institutions, such as IPBES. This consideration goes beyond the conformation of working groups, but also how they interact, collaborate and manage themselves (Turner et al., 2016).

The absence of the Transformative worldviews from our sample might be explained by the fact that science typically seeks to understand the complex causal dynamics underpinning sustainability problems in a descriptive, analytical (Wiek and Lang, 2016), deductive (Fazey et al., 2018), or even retrospective way. It is often about detecting, studying, and explaining change, and very rarely about making change happen or being the change (Hedlund, 2010). Additionally, the dearth of transformative perspectives could be attributed to the underrepresentation of indigenous and local community experts and an overrepresentation of academic experts in the *Values Assessment*, like all IPBES assessments that have preceded it. For transformative worldviews to be included in future IPBES processes, we recommend that IPBES' organizational rules of procedure be widened to include frequent evaluation of the epistemic worldviews present or absent in these processes, in addition to disciplinary and geographic representation. At the same time, we acknowledge that IPBES has other mechanisms to incorporate indigenous and local knowledge (ILK), such as the ILK Task Force, and these efforts to engage ILK holders in the *Values Assessment* were not fully reflected by this study.

Inter- and trans-disciplinary research on biodiversity and ecosystem services science-policy processes highlight the need for a broader view of knowledge as a process that involves a high level of reflexivity among multiple stakeholder groups; and being aware that power and control over the object of study is derived from the social position of researchers (Carmen et al., 2018; Fazey et al., 2014; Rosendahl et al., 2015). It also requires researchers to reflect on the concept of 'strong objectivity' emphasising the locatedness and the positions of the involved subjects of knowledge, in particular researchers involved in the process (Rosendahl et al., 2015), and a commitment to developing a common understanding of the problem (Carmen et al., 2018). We advance this literature by presenting an approach for systematically assessing how and to what extent different perspectives are included in the inter-disciplinary research process, which links objectivity, motivation and confirmation. Reflexivity not only requires an appreciation for what is perceived by the researcher to constitute valid knowledge, but also the aims that the researcher has in relation to the inter- or trans-disciplinary process and an appreciation of the type and amount of evidence they require for knowledge to be valid.

We also challenge the common belief that the integration of different knowledge sources within inter- and transdisciplinary are geared towards building consensus between different actors (Hoffmann et al., 2013; Klein, 2010). The pressure to pursue consensus in IPBES constrains diversity and inclusiveness and can overlook different voices and power imbalances (Díaz-Reviriego et al., 2019; Dunkley et al., 2018). Our results suggest that a road towards greater inclusivity requires a systematic consideration of different epistemic worldviews early in the science-policy process and increased appreciation for the philosophical aspects of collaborative research.

If IPBES succeeds in bringing together different knowledge systems, it has a chance to answer the call for producing policy-relevant environmental knowledge(s) to challenge predominant conceptions of nature(s) (Turnhout, 2018). Nonetheless, widening the space for more worldviews may simultaneously challenge IPBES' epistemic authority. Contrary to the science that is often practiced in the so-called ivory tower, the building of new conceptual and normative foundations in social institutions happens through learning by doing, through iterative cycles (Freeth and Caniglia, 2019). Conversely, avoidance of combining incompatible knowledge systems can contribute to more meaningful engagement (Dunkley et al., 2018). To manage this tension, we encourage IPBES to devote more resources to promoting a culture of epistemological agility (Balvanera et al., 2017; Haider et al., 2018). In such an environment, notions like 'consensus' or 'failure to reach consensus' might need to be relaxed and altered towards expression rather than synthesis, or even towards accepting blunt contradictory states. In addition to consensus-building techniques, dialectical trainings and processes for acknowledging and reasoning around existing diversity, while budgeting time and space for self-reflection might need to be put into place.

Our approach shines a spotlight on potential tensions around different views of reality prior to conflict. This addresses an important gap in knowledge concerning how to identify social and conceptual value conflicts in assessments on the multiple values of nature (Raymond et al., 2019). For example, a divergence regarding what constitutes valid knowledge (objectivity) was detected between Post-Positivists, who emphasised high level of agreement, and Pragmatists and Constructivists, who did not necessarily consider agreement crucial. Regarding definitions of the multiple values of nature, Pragmatists emphasised relational values, while Constructivists embraced a greater diversity of values, including relational and other value types. On the contrary, Post-Positivists did not align with relational values and were more heterogeneous in their views. In line with previous studies (Miller, 2013; Scholz, 2017; Wittmayer and Schäpke, 2014), we propose that illuminating these similarities and differences in scientific worldviews early in the research process supports the building of transparency, reflexivity and awareness around the relationship between research and researcher and between researcher and normative positionality. Responsibility for this reflexivity not only rests with science-policy institutions, but also with individual researchers, given the multiple value traditions at play (Raymond et al., 2019) and that there are no simple and straightforward approaches to real-world problems involving

ecosystem services (Jax et al., 2018). To navigate diverse theoretical perspectives on values, researchers are encouraged to consider which theoretical starting point the values are grounded in, and then be reflexive about the particular lenses of value that they plan to assess, including both epistemic and procedural. It also requires recognition and management of unequal power relations that surface during the analysis and application of multiple values of nature, informed by different perspectives and lenses of worth (Raymond et al., 2019). Transparency and reflexivity in-turn build trust in the scientific process, particularly in the documentation, monitoring and publication of findings (Freeth and Caniglia, 2019; Horcea-Milcu et al., 2019).

At the same time, we acknowledge that our approach has some limitations. Here, we lack qualitative data on objectivity, which makes it difficult to contextualise beliefs concerning different forms of evidence. Also, we are making an assumption that the length of participation in IPBES processes (i.e. prior IPBES work before the *Values Assessment*) does not inform nor change epistemic worldviews, understandings of value or value integration. Furthermore, changes in understandings of values through deliberation have been found elsewhere (e.g., Eriksson et al., 2019), pointing to the important need of assessing the potential for changes in objectivity, motivation and confirmation longitudinally. We plan to address these issues in on-going research by examining how self-reports on objectivity, confirmation and the multiple values of nature change across the IPBES *Values Assessment* process (2018–2021). Future work will include devoting more attention to questions of objectivity and establishing a control group, which plans to involve experts on values who are not part of IPBES assessments. By focusing such detailed attention on the IPBES assessment-process itself, we aim to make recommendations that affect how plural values are taken into account in transdisciplinary teamwork, including the clarification of the normative orientations, the co-construction of the research question and practical problem situation, and the balancing of power asymmetries (Herrero et al., 2018). At the same time, achieving such advances is germane more broadly to environmental decision-making and the emerging paradigms of environmental governance that recognize stakeholder diversity. In this way, IPBES has the potential to act as an international organization that disseminates not only the idea of the plural values of nature, but also the practices that allow it to be operationalized in public and private decision-making contexts (see Sommerer and Tallberg, 2019).

5. Conclusion

In this paper, we outlined a novel approach to analysing interdisciplinary teams, using motivation, confirmation and objectivity, to understand IPBES experts' epistemic worldviews and their implications for conceptualising multiple values of nature. Our results highlight an under-representation of Transformativist and Constructivist experts, compared to Pragmatists and Post-Positivists. Also, we detected a tension between different worldviews regarding what constituted valid knowledge, whereby Post-Positivists were more apt to emphasise agreement and scientific and expert sources of information, compared to Pragmatists and Constructivists. In turn, Pragmatists and Constructivists related all value types, and particularly relational values, to definitions of multiple values of nature, whereas Post-Positivists did not explicitly express relational values.

This article adds to understanding on how expertise is constituted in the IPBES *Values Assessment*, which ultimately can shape the outcome of which values and valuation perspectives get emphasised in the assessment. Therefore, we suggest specific attention and analysis on the epistemic worldviews that are being included or excluded in such science-policy or interdisciplinary research processes. Moreover, we recognised potential tensions, including differences in levels of agreement to constitute valid knowledge or differences in definitions of values of nature, between different worldviews. Therefore, the administrators of these types of assessments need to take such differences into account early in the process. Doing so will allow efforts to be made to avoid future conflicts and improve the process by building teamwork, based on transparency, reflexivity and awareness of the relationships between a researcher and research, as well as their normative positionality. The approach presented here also creates an important baseline for a longitudinal study to analyse changes in perceptions during the process of the *Values Assessment* itself.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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