SPECIAL FEATURE: ORIGINAL ARTICLE

Theoretical traditions in social values for sustainability

Integrating social values with other value dimensions: parallel use vs. combination vs. full integration

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Abstract

The need to link different valuation methods, especially beyond disciplinary realms, has been discussed at least since the 1990s, and recently it has gained special attention. In the present contribution to this debate, we analyse the prospects for integrating different valuation methods representing three areas of disciplinary knowledge or value dimensions: social, monetary and ecological. We present a framework building on two key factors deciding the integration potential: logical commensurability of values, and technical compatibility of valuation methods. Using this framework, we analyse the integration potential in the case of social and monetary, and social and ecological valuation methods, along with the relevant empirical examples. Our conceptualization of social values refers principally to contextual values and value indicators. Our analysis shows that there is untapped potential for co-developing methods specifically to obtain more specific, integrated results. If full integration is not meaningful, the combination of different valuation methods can still support the analysis and interpretation of those methods' results. At the very least, parallel use of the different valuation methods produces a more comprehensive picture than using any of those methods alone. In conclusion, integrated valuation gives a nuanced picture of what is valued, but even parallel use of valuation methods is useful in highlighting the different perspectives on what is valuable and why.

Keywords Integrated valuation · Integrated assessment · Value of nature · Urban · Commensurability · Compatibility · Contextual values

Introduction

“In order for something to be seen as having a value, there need to be actors who can describe that something and explain its value” (Ernstson 2013, p. 12). Different actors may be used for different ways of expressing value grounded in different areas of disciplinary knowledge, for example in social terms, monetary terms or with regard to the ecological

value. This may be so because of their cultural or professional background, ontological orientation, level of education or a broader cultural context within which the values are expressed. Indeed, even the same individuals may express the values they hold in different value dimensions with regard to specific situations or specific values. To obtain a comprehensive and balanced view of the value of nature, we need to move beyond unidimensional approaches and fit together multiple value dimensions.

Among others, Norton and Noonan (2007), Dendoncker et al. (2013), Hubacek and Kronenberg (2013), Kronenberg (2014), Martín-López et al. (2014), Gómez-Baggethun et al. (2016) and Jacobs et al. (2018) have recently called for integration of different valuation methods, in particular emphasising the need to connect social/cultural, monetary/economic and ecological perspectives. At the same time, researchers have advocated a pluralistic value framing, addressing not only contextual and instrumental values, but also intrinsic values, anthropocentric values, relational values, transcendental values and many other value

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perspectives (Gómez-Baggethun and Martín-López 2015; Kenter et al. 2015; Gómez-Baggethun et al. 2016; Chan et al. 2016; Kenter 2016a; Raymond and Kenter 2016; Pascual et al. 2017). Pluralistic value framing acknowledges that no single metric can capture the importance of nature because it is valuable for many different reasons. These reasons may be expressed in different terms, sometimes very difficult to compare, and yet acknowledging value pluralism is a key to integrated valuation. Although this discussion has proliferated recently, the issues of integrating different value perspectives have been addressed already at least since the beginning of 1990s, especially within the field of ecological economics (Martinez-Alier et al. 1998).

So far, integrated valuation has primarily taken the form of multi-criteria analyses (Zoppi 2007; Munda 2008; Frame and O'Connor 2011), but also more specific integration experiments (Jacobs et al. 2018). These attempts were meant to: (i) defeat the shortcomings of specific methods, in particular with regard to the monetary; and (ii) capture a broader representation of value, including its different aspects. Multiple attempts have been made to validate the results of one monetary valuation method with a different method (Zawojcka and Czajkowski 2017). For example, to better do justice to the broader social and political context of eliciting monetary values, monetary valuation has been extended with discourse analysis (Wilson and Howarth 2002) and deliberative (Spash 2007; Kenter 2016b) and participatory methods (Fontaine et al. 2014). Such approaches resulted in a more appropriate depiction of social and shared values (Kenter et al. 2015). Others have independently worked with monetary and non-monetary valuation methods, eventually standardising and comparing their results to test the consistency and complementarity of the obtained information (e.g. Martín-López et al. 2014).

To advance the above exploration, we put forward a framework for integrated valuation focusing on whether or not value dimensions are logically and axiologically commensurable, and whether the methods are technically compatible. Contrary to some other approaches, we assume that we can never integrate all value dimensions and values, which some researchers expect to do to capture the elusive total value of nature (Jacobs et al. 2018), or include all stakeholders and decision-makers to include hidden values and power asymmetries (Jacobs et al. 2016). Instead, we see the purpose of integrated valuation as refining the methods already in use by capturing more than one dimension at a time, and thus providing more nuanced information on what is valued (such as trade-offs between how values are understood within the different dimensions). To exemplify the application of the framework we take social values—arguably to many the most intuitive, and typically the basis people use for valuing things (Heberlein 2012)—as our starting point and explore how they may be integrated with the two

other value dimensions: monetary and ecological. More specifically, we analyse: (i) the integration potential of different value dimensions and pairs of valuation methods, including which characteristics of value are especially well/ill-suited for integration; and (ii) the advantages and disadvantages of integration.

In what follows, we first explain the basic terms used in this article, including values and valuation, and outline 21 examples of social, monetary and ecological valuation methods. We then move to our framework for integrating valuation methods, with three potential levels of integration, which we illustrate with an overview of the potential pairing of methods. This overview is complemented by empirical examples of integration exercises. Finally, we discuss the potential for the application of our framework.

Theoretical background

Values and valuation

Values are understood differently in different areas of research, and these understandings are not necessarily consistent (Dietz et al. 2005; Brosch and Sander 2016). We follow the most common convention of dividing values and valuation methods into three dimensions: social, monetary and ecological (Gómez-Baggethun and Martín-López 2015; Gómez-Baggethun et al. 2016) (Table 1).

Furthermore, we focus on the concepts of contextual values and value indicators, as defined by Kenter et al. (2015). Contextual values represent opinions about worth or importance given to different options in specific situations (time and place specific, hence contextual). Value indicators represent measures of the worth or importance of something, expressed in monetary or non-monetary terms. Note that value indicators are influenced by the broader contextual values, which—in turn—are influenced by the even broader concept of value—transcendental values, i.e. guiding principles that transcend specific situations (Kenter et al. 2015; Kendal and Raymond 2019).

Valuation represents the process of eliciting the value of a given aspect of nature, with the use of different methods. Valuation can be related to declarations made by individuals, and then generalised to broader social groups with the use of statistics, or stated by experts whose opinions are taken to represent selected social groups. Values can also be derived from the observation of individual or group behaviour, as well as social and political processes. Nevertheless, values articulated by different actors tend to be qualitatively different and even inconsistent. With attention paid to who performs valuation and the values of whom are reflected, one can study trade-offs between values of the different

Table 1 Understanding of value and valuation in different areas of disciplinary knowledge: social, monetary and ecological

	Social	Monetary	Ecological
Definition of value	Value can be linked to how much a given aspect of nature contributes to satisfying a selected personal or social policy objective	Values are often associated with how much people are willing to pay for a certain aspect of nature	Valuation may refer to the role that different components play in an ecosystem. The definition we use focuses on rate or magnitude of the effect
What is being valued?	People may value certain aspects of nature for their contribution to people's happiness, quality of life, health, social cohesion, but also aesthetics and recreational use	Values are most easily elicited in the case of goods subject to market exchange, but they can also be elicited in the case of the so-called non-market goods and services	The importance may be considered from the perspective of how many other species depend on selected ecosystem components or features in a trophic chain or for providing habitat
Examples of methods	Several social valuation methods (which are sometimes presented as social perception rather than valuation) refer to the multifunctional value of nature or the value of multifunctionality of green spaces. Specific examples include sociotope mapping (Stähle 2006) and the so-called participatory mapping (Pietrzyk-Kaszyńska et al. 2017). Alternatively, valuation in social terms may be based on expert judgements and predictions, and not necessarily on directly asking people about their perceived values	It is possible to estimate the cost of potential losses or the cost that could have been avoided had some aspect of nature been available, as well as the potential flow of benefits related to a certain aspect of nature, and use such cost or benefit estimates as a proxy of those aspects' value	Keystone species denote special value or importance of certain species (Kronenberg et al. 2017). More broadly, value may be considered in biophysical terms, following methods such as various types of energy–energy analysis, emphasising the differences in the value of different energy types and sources, and the fact that value can be defined by the amount of energy required to produce a product or a service (Odum and Odum 2000)

stakeholders (Ernstson 2013; Raymond et al. 2014) and explore biases and inequalities.

Valuation methods: examples

To illustrate the diversity of social, monetary and ecological methods followed in the context of valuing nature, we provide an overview of twenty-one examples (Tables 2, 3, 4). Clearly, this overview is not complete. To obtain more detailed information on such methods, one might resort to the following publications: Christie et al. (2012) and Kelemen et al. (2014) provide good overviews of non-monetary social valuation methods; Champ et al. (2003) describe monetary valuation methods, and Noss (1990), Carignan and Villard (2002), and Petchey and Gaston (2002) present examples of ecological valuation methods. In the case of ecological valuation, we provided examples of different spheres of elicitation rather than just the methods for collecting data (surveys, biophysical measurements and experiments), but this also positions the three dimensions (monetary, social and ecological, respectively) along a gradient from very specific methods and values to the more open-ended.

The respective methods can be differentiated primarily based on the underlying units or value dimensions, and not on the value elicitation processes themselves, which can often be similar. Especially, the non-monetary methods, such as surveys, citizen juries and transect walks, can sometimes serve to depict monetary values if the format of questions is adjusted to the monetary dimension. Interestingly, non-monetary valuation is highly heterodox and in its case one cannot expect methodological consistency similar to monetary valuation (Kelemen et al. 2014).

Integrated valuation framework

Integration vs. combination vs. parallel use of different valuation methods

Theoretical ground for integrated valuation can be found in suggestions on how to design mixed-method evaluation/research protocols (Greene et al. 1989; Brannen 2005; Teddlie and Tashakkori 2009). One of the key requirements in this context refers to the complementarity of the methods and underlying data, i.e. their ability to fit together and contextualise each other. A mixed-method approach does not per se require being designed in advance. However, as we suggest below, integration will in most cases need pre-study alignment of the methods.

It is possible to discuss the integration of both value dimensions and valuation methods. The former could be associated with deliberating more than one value

Table 2 Examples of social valuation methods

Method	Brief description
Rankings, including Q sort and conjoint analysis	Values are derived from comparisons that people make between different aspects of nature or statements regarding environmental management
Observation, including participant observation, time use, role-playing	Values are derived from people's behaviour—the observation of how people behave, how they spend their time, what roles they adopt in certain circumstances, in certain situations that involve their interaction with the environment
Storytelling, photo elicitation	Values are derived from how people represent reality in their stories or through their pictures and photos. Such studies may involve asking respondents additional questions regarding why certain things are of importance
Content/document analysis	Values are derived from the analysis of different documents, including official documents, legal texts, newspaper articles etc., based on the different representations of nature and nature protection in those documents
Non-monetary deliberative and participatory methods	Deliberative and participatory processes where participants reveal their values and contrast them with those of other participants. As a result of such interaction, they arrive at a joint value statement. Specific methods include citizen juries, focus groups, Delphi surveys, participatory mapping, participatory rural appraisal (PRA), participatory action research (PAR)
Psychometric methods	Values can be revealed based on the study of people's emotions and physiological responses to different stimuli (e.g. with the use of eye movement or brain scans), often referred to as experiential values
Health-based methods	Values can be derived based on the influence of nature on people's health. The more positive are such health impacts, the higher is the value of the associated aspects of nature. Specific methods include clinical measurements and census data

Table 3 Examples of monetary valuation methods

Broader approach	Method	Brief description
Revealed preferences—existing markets	Market price	Value estimates are based on prices available in the market (available only when a given aspect of nature is subject to market exchange)
	Avoided or replacement or substitute cost	Value estimates are based on how much damage can be avoided thanks to a given aspect of nature, or how much one would have to pay to replace it
Revealed preferences—surrogate markets	Hedonic pricing	Value estimates are based on how much a given aspect of nature contributes to the value of a market good, most commonly in the case of the real estate market
	Travel cost method	Value estimates are based on how much people pay to reach a certain destination which is attractive for environmental reasons
	Productivity method	Value estimates are based on how much a given aspect of nature contributes to the production of commercially marketed goods/services
Stated preferences	Contingent valuation	Value estimates are based on how much people declare they would be willing to pay for a given aspect of nature in the context of hypothetical scenarios (or how much they would be willing to accept as compensation for the loss of this aspect)
	Choice experiment	Similar to contingent valuation, but value estimates are derived from choices that people make in hypothetical market situations (trade-offs which they make between the different attributes), rather than upon a direct request to state their willingness to pay

dimension at a time, highlighting the diversity of values. The latter is far more intricate and it constitutes the focus of our integration framework. Opportunities to meaningfully bring different methods together rely on whether they speak of commensurable values and whether they are technically compatible (Fig. 1).

Commensurability requires that different value scales use similar logics and make sense relative to each other. We follow the distinction of the four different levels of commensurability made by O'Neill (1993) and then followed in the literature on valuation (e.g. Martinez-Alier et al. 1998; Munda 2008). The highest—strong—commensurability requires

Table 4 Examples of ecological valuation methods

Method	Brief description
Number of species surveys and models	The most basic form of ‘ecological/biological valorisation’ within which the perceived value increases with the number of species that use a given ecosystem
Phylogenetic analysis	The ecological value of an ecosystem depends on the taxonomic diversity and thus different evolutionary pathways of species (more distant taxa translate into higher diversity/value as it reflects higher evolutionary processes). Such an analysis is usually based on genetic information
Functional diversity analysis (assigning and quantifying traits)	Ecological value depends on the diversity of niches, which in turn reflects the different traits of species or their life history characteristics. Again, the higher diversity, the higher value
Functional performance analysis	Measurements of performance (speed, magnitude, efficiency) of specific processes and functions, such as pollination, decomposition, nutrient cycling, soil stabilisation. In principle, the better performance, the higher value
Spatial heterogeneity analysis	Ecological value depends on variation among species assemblages (based on species lists or subpopulations, genetic information etc., analysed at different levels of biodiversity: alpha, beta, gamma diversity). The higher the diversity of an ecosystem compared to selected geographical reference points (for example, a similar but larger ecosystem with a larger pool of species), the higher is its value
Conservation status surveys and models	Ecological value is sometimes assessed based on population sizes and trends, and the more threatened a given aspect of nature is, the higher is its value
Focal species identification(expert assessment)	Ecological value is sometimes perceived through the lens of the role that a species plays in an ecosystem (such as keystone, umbrella, indicator species). One of the reasons for this might be that the protection of such species often translates into the protection of the whole habitat. The more important a species is for an ecosystem, the higher is its value

Fig. 1 General integration framework. Commensurability refers to whether value dimensions and more specific approaches to capturing value within those dimensions are logically commensurable, and compatibility refers to whether valuation methods are technically compatible

that the different options be compared using a common measure based on a cardinal scale of measurement. In other words, there needs to be “a particular single property that all objects possess which is the source of their value, and that our evaluative measure indicates the amount or degree to which that property is present” (O’Neill 1993, p. 99). Weak commensurability only requires that the common measure is based on an ordinal scale of measurement. The third level, called weak comparability, describes the situation when the

options are not formally commensurable but still possible to compare in terms of more or less valuable (without being able to produce a general ranking of different items). Finally, incomparability indicates that one cannot rationally choose between the compared items. Values are often commensurable within the same value dimension in that a dimension represents a relatively homogenous perspective on what is more or less valuable/desirable. Nevertheless, values originating from different dimensions can also be considered commensurable, at the very least in the sense of weak comparability.

Compatibility refers to whether it is possible to technically join the underlying data (e.g. if they denote a similar relational aspect, such as geographical coordinates or resolution) and meaningfully use the different methods together. Typically, this may be linked to whether the methods in question refer to the very same object, such as a given type of urban green space. Compatibility can be conclusively guaranteed by co-design—i.e. adapting the methods to make sure that they fit together and form a consistent basis for analysis (as opposed to those tools being applied separately and used independently).

Full integration can be achieved when both methods are commensurable and compatible, including when they are specifically attuned to provide a consistent output, both responding to a similar, specific question. Already before a study starts, both methods have to be planned as mutually complementing each other, or one of them has to be adjusted to the other so that together they provide a logically meaningful output.

For combination—the second level of integration—it is enough that one method helps to interpret the other. This does not require full commensurability nor compatibility, neither do the methods need specific adjustments to fit together. Quite the opposite, the different valuation studies may be combined to generate a more comprehensive picture of what is valued when they refer to the same object and when the level of technical compatibility allows for their consistent interpretation. Most often, this is the case when one of the two methods is used to support the implementation (and interpretation of results) of the other. Note that combination does not require that the integrated values are reduced to the same value dimension but that they are in some way brought to a common ground. For example, this is often the case in the context of multi-criteria analyses. Note that some other authors used terms such as ‘parallel use’ and ‘parallel track analysis’ (Teddle and Tashakkori 2009; Hattam et al. 2015) to describe their attempts to bring different methods together in a way similar to what we describe as ‘combination’; however, for us ‘parallel use’ represents an even less integrated structure.

Parallel use of more than one method generates separate bits of information that refer to the same object. In this case, it is not necessary to adjust the methods nor their interpretations; the different studies are simply brought together to describe the same object in different ways. Although separate, these different studies using different methods together provide a more comprehensive picture than individual approaches. At the very least, they highlight the plurality of approaches to depict value. Note that this approach may be associated with what others call the triangulation of research methods (Greene et al. 1989).

Full integration requires that the integrated methods form one consistent model, but combination and parallel use allow the methods to continue as distinct. However, even within combination and parallel use, the integrated methods can still reliably show the ‘high’ or ‘low’ value of a given aspect. All three—integration, combination and parallel use—can potentially also involve studies carried out sequentially. In this sense, a new study would need to be integrated with the one carried out before and complement it with new information. In particular, this may refer to the use of the results of the earlier study as input into the later one. Finally, full integration is the highest level of bringing the different methods together, and when it is feasible, then the combination and parallel use of the same methods are also automatically feasible.

Exploring integration potential: examples

To investigate the prospects of integrated valuation of nature, in the following subsections, we examine pairs of

methods mentioned in Tables 2, 3, 4 as relevant for the different value dimensions.

Our analysis was based partly on our own empirical experience with many of the described methods (some of which has not been published yet) and partly on literature review. Overall, where direct references are not available, the analysis is grounded in our understanding (i.e. indirectly inferred from the literature) of the individual methods, the data they use and the areas where they have been applied. Our examples sketch out potential ways for integration and do not necessarily refer to thorough empirical studies; hence, further research is needed to underline how each of these potentials can be fully utilised.

Given the breadth of the methods, the values and value articulation they are meant to capture, and the type of data they use, we have not followed a fixed and predetermined analytical protocol. Instead, we used a set of guiding questions to assess each method (such as how ‘value’ is understood in a given context, what information a given method brings, whether it is spatially explicit, what type and resolution of data a method requires, whether it is expert-based or directly/indirectly reflects human preferences, to what different goods/services it has been applied and in which contexts).

Social and monetary

Social and monetary valuation methods are related to the extent that their integration is in most cases feasible (Table 5). Technical compatibility of these methods is relatively high because they are based on similar tools, including surveys and questionnaires. Logical commensurability is also often the case as both sociology/psychology and economics are social sciences, especially if one moves beyond mainstream economics and its simplistic view on the rational and utilitarian nature of humans. Relatively, many integration examples are available, especially involving stated preference methods and deliberative processes.

Rankings are very typical for non-monetary valuation, and—in principle—they are also compatible with monetary valuation. However, note that especially market prices cannot necessarily be associated with a ‘ranking of value’, as reflected in the fact that people do not always choose the priciest nor the cheapest items (which might be expected to be the best and the worst, respectively, based on market prices). Likewise, the productivity method seems to be poorly commensurable with rankings, because it refers to a very specific issue: an analysis of production functions of different commercial processes, thus not having much in common with the valuation of nature with the use of social valuation methods. Nevertheless, rankings are much closer to all of the other monetary valuation methods listed in Table 5. For example, rankings can be integrated with the

Table 5 Opportunities to link social and monetary valuation methods indicating potentially the highest level of integration

	Rankings	Observation	Storytelling	Content analysis	Deliberative	Psychometric	Health-based
Market price	C	C	C	C	C	I	I
Cost methods	I	I	I	I	I	P	I
Hedonic pricing	I	I	I	I	I	I	C
Travel cost method	I	I	I	I	I	I	I
Productivity method	P	P	P	P	P	P	P
Contingent valuation	I	I	I	I	I	I	I
Choice experiment	I	I	I	I	I	I	I

/ Integration, C combination, P parallel use

travel cost method to indicate the most preferred locations and validate these results with the use of monetary valuation. Studies by Czembrowski et al. (2016a) and Daams et al. (2016) illustrate the integration of rankings of green spaces based on participatory mapping and hedonic pricing. A similar study focused on the integration of hedonic pricing and sociotope mapping which was used as a source of ranking of the functionalities of urban green spaces in Stockholm (Czembrowski et al. 2019).

Observation of people's behaviour, content analysis, storytelling and deliberative methods follow a similar pattern. They can hardly be integrated with market pricing (at best allowing for combination) or productivity method (parallel use), but they can relatively easily be integrated with other monetary valuation methods listed in Table 5. When combining these social valuation methods with market pricing, it is possible to study the differences between what is indicated by the market (in the limited number of cases where markets exist for the selected aspects of nature) and how people consider nature more broadly. The respective results can shed light on inconsistencies between people's behaviour and the standard, neoclassical economic models. Similarly, parallel analysis with the use of social valuation and productivity method indicates the consistencies and inconsistencies between these social and monetary value dimensions. Other monetary valuation methods may potentially be compatible with social valuation, and both of these disciplinary foci can support each other, for example by providing information from a different angle on the selected aspects of nature. Assessing the recreational potential of natural sites with such social valuation methods provides an immediate example of what can then be integrated with the travel cost method, stated preferences methods or even with hedonic pricing. In particular, much experience has already been gained in integrating deliberative approaches with monetary valuation (Howarth and Wilson 2006; Spash 2007; Zografos and Howarth 2008; Kenter 2016b). Also, as already shown in practice, additional analyses might help to test

the consistency of different valuation methods (Zawojcka and Czajkowski 2017).

Psychometric and health-based methods are easier to integrate with market prices but again not with the productivity method (at best allowing for parallel use). An example of integrating psychometric methods and market prices comes from the private sector, where managers choose where to place products in a shelf based on studying people's feelings and reactions (a similar approach could be followed to explore the effects of introducing fees for entering a park). Psychometric methods are also not commensurable with cost-based methods as cost methods (similar to the productivity method) refer to a different type of value. Meanwhile, health-based methods often rely on the avoided cost or the replacement cost approaches (e.g. Kan and Chen 2004), thus allowing for a successful integration. An obvious caveat here is that it remains ethically debatable to express health benefits in monetary terms and to assume commensurability of health and monetary values, although of course this is often practiced in real-life situations. In other cases, integration of psychometric and health-based methods is feasible and meaningful, and it provides useful information on what effect things valued in monetary terms may have on the well-being and human health.

Social and ecological

As showed in Table 6, in the case of integrating social and ecological valuation methods parallel use and combination are more numerous than in the case of the social–monetary. This potential hinges on the partly subjective nature of commensurability, i.e. whether both values can be weighted and used together in decision-making. While ecological valuation methods can provide useful measurements or characteristics, these can only be picked up or used in social valuation methods if the ecological information makes sense to those whose values are meant to be represented. Some of the ecological characteristics we deemed were more broadly recognised, others will only be

Table 6 Opportunities to link social and ecological valuation methods indicating potentially the highest level of integration

	Rankings	Observation	Storytelling	Content analysis	Deliberative	Psychometric	Health-based
Number of species	I	I	I	I	I	P	P
Phylogenetic diversity	I	C	I	I	I	P	P
Functional diversity	I	C	I	I	I	P	P
Functional performance	I	I	I	I	I	I	I
Spatial heterogeneity	I	I	I	I	I	I	P
Conservation status	C	I	I	I	I	P	P
Focal species	C	I	I	I	I	P	P

I Integration, *C* combination, *P* parallel use

understood or appreciated by some, thus making the potential for integration variable. Combinations can be done the other way around as well, e.g. using social perceptions to prioritise ecosystem functions or to understand their potential as ecosystem services.

This is clearly the case for ranking. It is relatively easy to integrate with different ecological methods (Botzat et al. 2016) as long as their results contain attributes that can be re-evaluated and ranked by people when provided with additional information. The deeper integration can be promoted by choosing a set of attributes that make sense for the general public. For example, if one works with functional diversity and plants in different green spaces and regions, one can select the kind of functional traits that people recognise rather than those that would perhaps be chosen for their ecological significance (Goodness et al. 2016). Along with other combinations, working with expert opinions will likely increase the opportunities for combining ranking with more abstract ecological valuation methods and metrics such as phylogenetic diversity. Only in the case of conservation status and focal species, combination with rankings would be more relevant. For example, from the point of view of ecology, it would not be meaningful to rank and value species based on their rarity or conservation status, but—in practice—this is how priority is often negotiated. The problem here is that people usually focus on the rarest and the most abundant species, neglecting others in between (Kronenberg et al. 2017).

Observational studies of people's behaviour, used in ethnography to provide information on human–nature relations, moral commitments, everyday resource use decisions and practices etc., have the potential to capture multiple aspects of value (including contextual values). Even a narrow interpretation of observation may be used as an indication of concern about a specific issue or aspect of nature (e.g. demonstrations in support for or protesting something). Thus, integration is feasible in most cases, perhaps except for those that refer to very specific ecological aspects of value which could be beyond what can be observed (is the issue even

recognised by people and how much of the ecological scale is perceived).

Similar to the above, storytelling can bring up any topic, as long as the person telling the story can connect to the issue and has the language to articulate and relate its importance—or that, as the case may be, the researcher has the capacity to understand what the respondent is saying. For many of the more colloquial value framings, we expect that integration should be relatively easy to achieve, e.g. aspects of functional performance, focal or emblematic species and conservation status. Conservation biology has long used certain ways, for example species lists or focal species, mainstreaming this way of framing value. For the more technical valuation methods, e.g. vague indices on phylogenetic or functional diversity or the more abstract measure of functional performance, it will be more difficult and may only work under special circumstances. One such example is the recent interest in old heirloom or landraces where people recognise and are concerned with genetic variations, although this interest is framed by cultural significance and loss of heritage (Veteto and Skarbø 2009) and thus limited to a specific segment of phylogenetic information. Finally, spatial heterogeneity is usually easy to relate to and position relative to, for example history or experience and appreciation of the general backdrop to your daily life.

Different approaches to content analysis, on the other hand, could be integrated with any ecological valuation method—they rely to some extent on expert interpretation and could, thus, elicit also very indirect articulations of value. Content analysis can study any type of material (policy documents, photographs, social media etc.) belonging to any sphere. The analysis can reveal both the opinions held and value articulation and framing by different groups. Depending on which ecological value one studies more or less active translation might be needed—people may not talk about phylogenetic diversity but they will talk about different species and taxa.

Similar to storytelling, it seems feasible to integrate deliberative and ecological valuation. However, they also have

the potential advantage of drawing on multiple perspectives and outlooks; deliberative methods are discursive and give the respondents opportunity to discuss the problem and thus potentially draw on and combine different knowledge. Deliberation does not only elicit a collective opinion; by listening to and learning from others, people may reflect on their own perceptions and may change their values. Depending on group composition, this may help make sense of more complex concepts like phylogenetic diversity.

We expect psychometric and health-based studies to be difficult to integrate with ecological valuation methods. While technical compatibility may be possible in some cases, the domains the methods address seem largely incommensurable, which means that parallel use would be the most common situation. The clearest exception is functional performance where both health-based and psychometric have clear linkages to environmental qualities like microclimate and shade, qualities directly informed by the functional performance of biodiversity. In addition, psychometric methods and spatial heterogeneity can also be linked, in particular if spatial heterogeneity is expressed in terms of the setting of our lives and experiences. Less directly, it may also be possible to connect health-based methods to landscape heterogeneity as the landscape composition is one of the factors informing, for example, our choice of transportation (Sener et al. 2009).

Discussion

Our review of the construction and application of different valuation methods indicates that the potential for integration is considerable. For most of the pairs, we evaluated integration as possible at least under certain circumstances, and—when it is not—either combination or parallel use could still be worthwhile. With regard to technical compatibility, social valuation methods are compatible with other methods as long as they provide output that can be understood by and is meaningful to those whose preferences we are interested in, and this especially in non-facilitated elicitation processes. For example, we cannot expect social media users or (in an extreme case) the illiterate respondents in a photo elicitation survey to use or reflect on complex ecological or monetary expressions of value (at least when presented as results of ecological or monetary valuation studies). In terms of logical commensurability, the range of possible interpretations of social values is potentially very wide, covering many aspects that would not be commensurable with those considered in this article (justice/equity or religious concerns provide immediate examples). Within our framework, this would only allow for parallel use.

While the potential for integrated valuation is reflected in the growing number of studies using integrated pairs (or

more) of methods (Christie et al. 2012; Castro et al. 2014; Czembrowski et al. 2016a, b, 2019; Xu et al. 2016; Daams et al. 2016; Kenter 2016b) or combining diverse valuation methods (Iniesta-Arandia et al. 2014; Martín-López et al. 2014; Hattam et al. 2015; Langemeyer et al. 2015; Vollmer et al. 2015), there seems to be scope for more. We focused on the potential to join social valuation methods with monetary and ecological valuation methods, respectively, but the same reasoning can be extended to the integration of monetary and ecological methods. Relative to social valuation, both ecological and monetary values are more specific and less flexible, which limits the chances of finding an overlap that will provide sufficient commensurability for integration. However, commensurability means that if the different options are to be put on the same scale, separate approaches and datasets need to reciprocally supplement each other, and result in a more complete representation of a given study object.

Judging from the existing examples of integrated valuation, it allows for a nuanced, high-resolution depiction of people's preferences. Moreover, clusters of values—or indeed implicitly integrated holistic values—improve our understanding of people's preferences and viewpoints, and would, thus, be better suited for complex policy judgment contexts (Satterfield et al. 2000). Integrated valuation, both the results and the process of generating them, highlights trade-offs between how values are understood within the different dimensions, as well as between the preferences of diverse groups of actors. Recognition and appreciation of multiple perspectives and framings allow us to broaden the traditionally unidimensional and thus limited character of normative conclusions, where decisions are based solely on 'utility information' (Beckerman and Pasek 1997; Satterfield and Slovic 2004).

In our analysis, we were open to any ideas on how valuation methods could be integrated. However, and as indicated above, some of our examples may be unique, and may not well represent some of the challenges to integrated valuation. Limited or contextual commensurability of different value dimensions (Funtowicz and Ravetz 1994; Martinez-Alier et al. 1998; Aldred 2006) constitutes the main challenge. This has been particularly evident in our attempts at integrating the monetary productivity method with any of the social valuation methods. Along with the commensurability and compatibility, integration also requires that one accepts the legitimacy of the different methods and the assumptions they come with, plus the additional assumptions that support the integration itself.

An important advantage of the framework we have presented in this article is that it recognises that there are different lenses and views on value, and that they do not always have to be fully integrated. Even parallel use opens up opportunities for broader, more inclusive discussions on the

value and meaning of nature and how quality of life can be understood. Contrasting values may be quite as interesting as integrated, streamlined values. For example, this may be the case when investigating Indigenous and Western approaches to the value of nature, where the reductions needed (if at all possible) for integration would lose the value and richness of the different perspectives (Arias-Arévalo et al. 2018). Again, this highlights that investigating different value dimensions and different value concepts, including the transcendental ones, such as living in harmony with the environment, health and equity, can provide a more nuanced understanding of value.

This research has important implications for sustainability science and practice:

- integrated valuation recognises the different preferences of different stakeholders, giving a voice (potentially) to those whose preferences are difficult to capture with the use of some valuation methods;
- analysis of commensurability and compatibility allows for flexible interpretation of the idea of integrated valuation, highlighting the importance of knowledge, framings, context and tools for connecting different value dimensions;
- moreover, the underlying framework of commensurability and compatibility can help to inform more comprehensive, fair and coherent policies, and integrated valuation tools could help measure and monitor their implementation;
- the improved understanding of linkages between value dimensions and their tools and measurements helps to relate and connect diverse knowledge systems for enhanced ecosystem governance (cf. Tengö et al. 2014);
- finally, a clear guiding framework that outlines the integrative potential of different methods and metrics will also help to describe both potential and problems with integrating and aligning different policy targets (such as within the Sustainable Development Goals). Thus, it may support the implementation of the different guidelines of the intergovernmental science-policy platform on biodiversity and ecosystem services with regard to valuing nature's contributions to people (Pascual et al. 2017).

Further challenges and how to overcome them

Future exploration of the opportunities for and utility of integrated valuation needs to acknowledge that a synthesis is burdened with the idiosyncrasies and limitations of the integrated parts. This problem can be solved if the integrated parts can negate or compensate for the limitations of each other (Czembrowski et al. 2016a). Most of the potential pairings we present would bring in streams of different information and thus complement each other. However,

complement does not equate compensate, and some methods tend to dominate and require that other methods are adjusted to their needs (Czembrowski et al. 2016a), which does not necessarily support a balanced design. In practice, the supporting methods are used to provide input in terms of refined or specific data that are meant to feed into the dominant method. While this reduces some of the added value of opening up discussions of the meaning of the different values, it can still support the core valuation method with additional information and interpretation opportunities (Langemeyer et al. 2015; Vollmer et al. 2015; Czembrowski et al. 2016a; Daams et al. 2016; Kenter 2016b). In particular, we see that to date, many integrated valuation studies rely on the use of monetary valuation methods as their core. For example, even when built on green space attributes derived from social or ecological assessments, a hedonic pricing study remains as an expression of the monetary value of urban green (Czembrowski et al. 2016a). This shows that practice often goes against the idea that integrated valuation follows a broader, non-monetary paradigm in attempt to represent multiple value perspectives.

Relative to integration, combination of different methods allows for more flexibility. The less specific results are even more multi-dimensional as they continue as distinct (e.g. communicated in different units) and are barely meant to support the interpretation of each other's results. Understanding the potential for integration and what outcomes would be most useful in a particular situation is important; especially given that integrated valuation is more time consuming and data intensive, compared to valuation based on a single dimension, making it more expensive in practice.

Furthermore, even though integrated valuation provides a more comprehensive picture compared to single-dimensional valuation studies, it still fails to consider many issues, such as non-linearity and thresholds. The importance (or consequences) of such ecosystem features may not be well understood at present, which shows the limitations of human perceptions of complex phenomena. Typically, people are not able to articulate their preferences regarding relatively abstract phenomena, unless these phenomena become more relevant to their everyday lives (e.g. threatening). Until we find methods and measures appropriate for concepts such as resilience, we still lack proper backing for decision making.

Moreover, social, monetary and ecological values mutually influence each other in any case. All three value dimensions addressed here involve social and ecological aspects, albeit to a varying degree. Ecological value is based on social knowledge, cultural norms and values. Meanwhile, the socially oriented valuation frameworks involve at least some level of ecological knowledge, at the very least on the part of those who frame survey questions (Kronenberg et al. 2017). Ultimately, this complexity translates into a need for a more comprehensive, social–ecological approach to valuation, as

reflected in integrative frameworks, such as biocultural value (Vierikko et al. 2017) or insurance/resilience value (Green et al. 2016). Future exploration of integrated valuation needs to consider broader arrangements of valuation dimensions and methods, compared to pairs analysed in this article.

Finally, different valuation methods perform differently in terms of capturing the values of the different actors (cf. Kendal and Raymond 2019; Rawluk et al. 2019), which links to environmental justice. This indicates a need for a broader understanding of commensurability, including who expresses value, within which situations and under what influence (Vatn 2005; Ernstson 2013). As noted above, values can be derived from members of the broader society but also from experts, both with the relevant limitations. In particular, value of nature is often too abstract and complex for the public to grasp, and different groups of actors have not only different preferences, but also different ability to express those preferences and to benefit from the environment, which has implications for how they may understand ‘compatibility’. However, at least partly, these issues can be accounted for by allowing for more reflexive (deliberative) approaches to valuation, offering more time and the opportunity to know the different perspectives already during the process of valuation.

Conclusions

The understanding and use of even the ‘same’ values are framed by ontological standpoints, and depending on valuation context, these differences may be more or less decisive for the potential to integrate different valuation methods, or to make use of the results from such integration. There is no one approach to capture value that will solve all problems, or provide the answer to what nature means to us. Sometimes we need to highlight incommensurability and conflicting values and sometimes we may be better served by integrated values. Any effort to value an individual, singled out aspect of nature with the use of a single method is necessarily overly simplistic and distorts the representation of other values. Indeed, valuation provides partial information only, and the result of valuation exercises must be treated with care and caution (Kallis et al. 2013). The main contribution of integrated valuation in the examples we have studied is that it provides a way to capture increasingly detailed and specific issues; it helps to understand specific and locally unique situations, only this knowledge is not necessarily relevant outside its context or for a broader discussion on the value of nature to people. Integrated valuation can help to highlight the interlinkages between seemingly independent ideas and values, but still other complementary valuation methods are needed to highlight the more elementary notion of people’s dependence on nature, such as assessments of political

priorities and relational values (Kronenberg 2014; Chan et al. 2016). There are many aspects of value that align more closely with multidimensional understandings of nature, for example, sustainability or biocultural values, than with the popular concepts of instrumental values (nature conservation for our own benefit) and intrinsic values (nature as inherently valuable), that have been the focus of this study.

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