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Expanding the suite of Cultural Ecosystem Services to include ingenuity, perspective, and life teaching

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ABSTRACT:

Cultural ecosystem services (CES) are a crucial but relatively understudied component of the ecosystem services framework. While the number and diversity of categories of other types of ES have steadily increased, CES categories are still largely defined by a few existing typologies. Based on our empirical data, we suggest that those typologies need updating. We analyzed data from interviews conducted in adjacent Hawaiian ecosystems — one agricultural and one forested. We found that current categories of CES do not capture the diversity and nuance of the nonmaterial benefits that people described receiving from ecosystems. We propose three new CES categories: ingenuity, life teaching, and perspective. We discuss issues of lumping and splitting CES categories, and advocate that creating categories for these emerging themes will help us to more fully capture nonmaterial benefits in ecosystem services research and policy.

1. INTRODUCTION

The ecosystem services framework (ES) is one of the most prevalent discourses in 21st century conservation. It is found in prioritization documents for NGOs, academic literature, public media, and government policy (Ruhl, 2016). Yet the field of ecosystem services consistently marginalizes cultural and social aspects (Kunz et al., 2011). Starting with, and probably influenced by, the Millennium Ecosystem Assessment (MEA, 2005), ecosystem services research has been heavily skewed toward biophysical processes (Rey Benayas et al., 2009). Scholars have identified scores of types of biophysical services, most of which are encapsulated by the Millennium Ecosystem Assessment's categories of provisioning, regulating, and supporting services. In comparison, conceptualization and operationalization of the nonmaterial components of ecosystem services (i.e., cultural ecosystem services or CES) is severely limited.

The conservation community has recognized the criticality of CES since the entrance of the ES concept into mainstream discourse; the MEA conceptualized CES as one of the three primary types of services (i.e., Provisioning, Regulating, and Cultural). Researchers, following that lead, have developed a body of CES research that, although small in comparison to biophysical ES research, is growing. Multiple definitions of CES exist; in this paper, we follow a widely used conceptualization of CES as “ecosystems’ contribution to the nonmaterial benefits (e.g., experiences, capabilities) that people derive from human–ecological relations” (Chan et al., 2011, p. 206).

In roughly a decade, scholars have produced over a dozen typologies of CES; creating typologies is complicated by many factors. Some of these factors are common to all ES, but perhaps particularly complex for CES; two such features are (1) the interdependence of many types of nonmaterial benefits (e.g., heritage and identity are often closely related) and (2) relationships between services, benefits, and values (e.g., is “recreation” a service, or a benefit?) (Chan et al., 2012; Gould et al., 2014b; Satz et al., 2013). Other primary challenges are unique to CES: the need for sometimes dramatically different research methods to understand CES, and the difficulty of articulating, and therefore studying, the abstract concepts encompassed by CES.

Despite these challenges, we, along with scores of other researchers and practitioners, still find it helpful to organize the body of experience and benefits encompassed by the CES concept. Figure 1 portrays and compares some of the more commonly used typologies of CES.

Current approaches to categorization display a few patterns. First, there is notable consensus; overall, the typologies present a fairly coherent cohort of widely agreed upon CES. This consensus almost certainly does not result from convergent evolution of thought, but rather from scholars building on and modifying previous theory. The prevalence of specific categories may offer insight as to what are widely considered core CES: recreation and spirituality are included in all typologies, and aesthetic and artistic services in all but one typology. After these four, inclusion is quite variable. Cultural heritage and education are in roughly half of the typologies. The remaining categories (e.g., cultural diversity, sense of place, bequest) are

included in two, three, or four typologies (Figure 1). Typologies also condense categories in different ways, which speaks to the interrelatedness of services and the somewhat poor agreement as to which services deserve their own categories and which are subsets of other categories. Further, some constellations of related services are described by different terms, or only partially addressed in individual typologies; in some cases we have lumped categories with different names, but this may be inappropriate. The concepts of knowledge, education and science provide one example of a set of ideas that are related but distinct.

This paper uses data from two independent studies on adjacent land use types in the same region to ask the question: do current categories adequately capture individuals' expression of CES? Below we describe our two studies and how we combined and compared results. We then present our findings, merging insights from both studies. We conclude by discussing how our emergent categories are situated within existing interdisciplinary literature and why the addition of distinct CES categories might be useful.

Figure 1. Coverage of existing typologies of CES. Included are nine sources that present lists, or typologies, of CES categories. Sources used slightly different categories for names; the Appendix provides the exact wording used in each source for each category.

	Costanza 1997	deGroot 2002	Mill. Ecosys. Assess. 2005	Boyd 2006	Raymond 2009	deGroot 2010	U.K. Nat. Ecosys. Assess. 2011	Chan 2012	CICES 2013	Milcu 2013
Spiritual	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recreation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Aesthetic	✓	✓	✓	✓	✓	✓		✓		✓
Artistic	✓	✓	✓		✓	✓		✓	✓	✓
Cultural heritage			✓		✓	✓	✓	✓	✓	✓
Education	✓	✓			✓	✓	✓	✓		
Social capital/relations			✓		✓			✓		✓
Sense of place			✓		✓			✓		✓
Existence				✓	✓			✓		✓
Knowledge systems			✓		✓					✓
Cultural diversity			✓		✓					✓
Identity			✓			✓		✓		
Bequest				✓						✓

2. METHODS:

2.1 Study site and projects

This paper arises from two research projects that explored CES and human-environment relationships in the same geographical area, but focusing on adjacent ecosystems: one agricultural and the other forested. Both projects took place on the leeward side of Hawai‘i Island, in the district of South Kona. Both studies initially chose this region because of the diverse socio-cultural makeup of the area. The region was settled over a millennium ago by voyaging Polynesians who, over centuries of interaction with the land, became a distinctly native Hawaiian population. Native Hawaiians hold a familial relationship with the land; plants and animals are kin. Hawaiians intensively developed the Kona landscape for agriculture below ~850m elevation. Hawai‘i was connected to the Western world with the landfall of Captain James Cook in 1778. Subsequently, a small number of Europeans and Americans moved to Hawai‘i as Hawaiian nationals who swore allegiance to the Hawaiian monarchy and way of life. These immigrants brought with them new tools and ways of thinking that incorporated economic opportunities, a concept foreign to the natives. They promoted ranching and plantation agriculture, which further altered the landscape up to ~1500m. This new wave of agriculture also required a large labor force, which led to immigration from the Philippines, China, and Japan. In 1893, the United States claimed Hawai‘i as a territory (illegally overthrowing the Hawaiian monarchy), and in 1959 it became the 50th state. With Statehood, Hawai‘i changed rapidly. In particular, the state has seen huge shifts in demographics over the last 30 years. Today Hawai‘i is home to a diverse population; in Kona, people identify with multiple backgrounds, most notably Native Hawaiian descent (~20%), Asian descent (~25%), and European descent (~80%), among other ethnicities (~15%) (U.S. Census Bureau, 2011).

2.2. Data Collection

We collected our two data sets independently. Table 1 summarizes relevant characteristics of both sets of respondents.

Table 1. Characteristics of respondents. Relevant characteristics of respondents in both the agricultural lands study and the forested lands study are provided.

Characteristic	Forest Study	Agricultural Study
Number of Respondents	30 individuals	128 individuals
Gender	13 women 17 men	82 women 46 men
Age	26 to 72 (mean = 52) yrs	Age range 31-78, mean 53

Native Hawaiian or Not Native	13 Native Hawaiian 17 Not Native Hawaiian	29 Native Hawaiian 107 Not Native Hawaiian
Hawaiian Ethnicity		
Time in Hawai‘i	6 recent arrivals (< 10 yrs) 5 long-time residents (> 10 yrs, not whole life); 19 lifetime	32 recent arrivals (< 10 years) 40 long-time residents (> 10 years, not whole lifetime) 56 lifetime
Relationship to Land	7 work in land management 6 have recognized cultural position related to forest or land (e.g., hula practitioner, cultural specialist) 2 work on Hawaiian cultural issues related to forest or land, but without a formal “cultural expert” position 2 have artistic relationship (painter, photographer) 1 has volunteer relationship (restoration volunteer) 3 have organizational relationship (part of an organization with forest relationship (hiking or hunting)) 9 have no formal relationship with forest (yet most of these people interact with the forest in various ways)	37 classic farmers depend on farm income and grow traditional cash crops (coffee, macadamia nuts) 18 progressive farmers depend on farm income and grow newly established cash crops 31 subsistence farmers grow food for themselves, family, and community, but are primarily dependent on outside income 31 hobby farmers engage in some level of farming, but rarely (if ever) use or sell their products 11 leisure farmers do no substantial agricultural maintenance (other than the minimum required to meet agricultural requirements)

Agricultural lands project: The interviews that supplied the data for this paper comprised part of a project focused on relationships between farmers’ personal values, sense of place, and farming practices. We conducted on-site verbal surveys with 128 individuals between June 2010 and February 2011. Surveys lasted 45 to 210 minutes and consisted of several open-ended questions that allowed for detailed and contextual explanations. We recorded and transcribed all dialogue. We recruited participants by attendance at community events (e.g., community meetings, farmer’s markets, farmer education events) and through telephone contact with a random selection of individual farmers. The first 100 surveys were administered to all willing farmers within the study area. The final 28 participants were selected to account for gaps we identified in the initial sample through mapping and demographic analysis. In this second set we targeted, for

example, Native Hawaiians and other ethnic minorities, as well as geographic areas that were underrepresented in our initial sample. The open-ended questions that prompted most replies relevant to CES were “what benefits or values do you or others derive from the agricultural lands in Kona?” (we clarified that “benefits” referred to non-economic assets), and “how does the agricultural landscape promote well-being?” Other questions also prompted discussion of CES, including “what benefits do you get from farming?” and “has farming the land taught you anything?” See Lincoln and Ardoyn (2016a, 2016b) for further detail.

Forested lands project: The semi-structured interviews supplying the data for this paper comprised part of a project that investigated the cultural ecosystem services related to Kona’s forests. The larger project involved participant observation, surveys, and the interviews discussed here. We interviewed 30 individuals in 2011 and 2012. In qualitative studies, many factors affect the number of interviews needed; 20 to 30 interviews often achieve the common goal of concept saturation – a point at which new interviews no longer introduce new themes (Maxwell, 2005). Interviews lasted between 90 and 240 minutes. All interviews were transcribed. We chose interviewees using a purposive selection approach: We identified a number of key characteristics for which variation was likely to be important for our study questions, and sought representation in those characteristics. The primary dimension along which we sought variation was relationship with the forest (e.g., hunting, recreation, collecting, no apparent relationship); the second was ethnic background (notably, Native Hawaiian and non-Native Hawaiian). Data relevant to the present study emerged from throughout these interviews, particularly from questions such as “do you think that the forest is related to your well-being?” (asked after the respondent had defined well-being) and “have you ever had the experience of the forest teaching you something?” See Gould et al. (2014a) for further detail, including the full list of interview questions.

2.3 Data Analysis and Modified Grounded Theory

We used a modified grounded theory approach to understand and categorize the way people think about the benefits nature provides them. Grounded theory emerged as a response to an “overemphasis in current sociology on the verification of theory, and a resultant de-emphasis on the prior step of discovering what concepts and hypotheses are relevant for the area that one wishes to research” (Glaser and Strauss, 2009, pp. 1–2). Our study, similarly, responds to the tendency of CES research to emphasize previously identified CES (i.e., “existing theory”) and thereby de-emphasize discovering potential additional CES. The central idea of the grounded theory approach is to develop theory based on empirical data. Our approach is distinguished from pure grounded theory (which ideally starts only with data) because we start with a theoretical framework (Cultural Ecosystem Services). Our aim, however, is not to verify this existing theoretical framework, but to discover if additional concepts may be relevant for the study of CES. Our approach thus aligns with the essence of grounded theory: we are highly

responsive to our empirical data and allow our suggested additions to theory to grow from concepts that those data suggest.

We used a “directed content analysis” approach; this entailed starting with coding for relevant themes, then looking for themes to emerge from the data (Hsieh and Shannon, 2005). In both studies, we began by coding open-ended responses to previously identified categories of cultural ecosystem services. While scouring the data for these pre-determined (*a priori*) categories, we were open to other possible types of benefit not encapsulated by those categories. When we noticed themes related to a benefit not yet identified or named, we began to code for that theme, and subsequently returned to previously coded responses to code for the newly identified themes.

We identified three strong themes that we felt current categories of CES did not well encapsulate: ingenuity, perspective, and life teaching. The concept of ingenuity arose initially from the agricultural lands data, that of perspective first emerged from the forested lands data, and that of life education developed independently in both studies.

After our independent coding was complete, our process was as follows: We first discussed our emerging themes to explore their existence and prevalence in our two data sets. We then conducted a literature review to clarify whether and how these categories were addressed within the current CES literature. After determining that our emerging themes were not adequately addressed by existing typologies, we reanalyzed our data to enrich our understanding of them. This reanalysis included review of existing coding for the three themes and new coding for the themes that were not identified in a given data set in the first round (specifically, we coded for “perspective” in the agricultural lands data and “ingenuity” in the forested lands data). Finally, we used that combined body of evidence to describe the emerging themes, based on their expression with respect to distinct ecosystem contexts, and to discuss the current categories and potential future of categories of CES. In all of this work we had multiple quality control measures: several researchers contributed to original coding of existing CES themes, allowing for refinement of coding protocol; once new themes were identified, the co-authors shared sub-sets of data within each theme to ensure that coding was comparable across studies; and we shared coding with a subset of interviewees to verify if themes adequately represented their perspectives (i.e., we engaged in participant checking).

Table 2 presents a summary of the primary CES found in our data. We offer definitions of each theme (i.e., each CES) and counts that indicate their prevalence in each study. For the Agricultural lands study, counts are presented as the number of respondents that mentioned a topic; for the forested lands study, counts indicate the number of times a topic was mentioned throughout all interviews. We chose these metrics to best represent the prevalence of discussion of each topic by our respondents, taking into account differences in instrument type (survey vs. semi-structured interview); sample size (128 vs. 30); and length of responses that were analyzed (on average, 24 minutes (for responses to relevant questions in the Agricultural study) vs. 126 minutes (for entire interviews in the Forest study, as references to CES appeared throughout)).

Though our emerging CES were not the most frequently mentioned services, discussion of them was meaningful and relatively common.

Table 2. Counts of occurrence of CES in our data. Cultural ecosystem services most frequently addressed by our interview respondents. For the Agricultural study, numbers represent the number of respondents addressing that theme. For the Forest study, numbers represent the total mentions of the topic throughout all interviews. These different metrics appropriately capture the shorter but more numerous interviews in the Agricultural study and the longer but less numerous interviews in the Forest study. Asterisks represent the themes we suggest adding.

Theme Name	Theme Description	Respondents (Ag. study)	Mentions (Forest study)
Spiritual	Forces larger than oneself, connecting to something bigger, energies, and/or established religion.	64	393
Heritage	Traditional practices. References to kupuna or ancestral connection. Places important because of past events or stories. Meanings of place names.	89	385
Identity	Identity as it relates to ecosystems. Mention of "who I am," "part of me," etc.	74	144
Recreation	Outdoor activities in leisure time, or done purely for their intangible benefits (e.g., hiking [appreciated for being enjoyable?])	104	87
Life Teacher*	When an ecosystem teaches bigger life lessons	73	90
Bequest	Value of ecosystems for future generations	33	106
Aesthetic	Related to appreciation of beauty, the pleasing aspect of an ecosystem.	78	53
Artistic	Producing art that is inspired by the ecosystem, or appreciating art related to the ecosystem that is produced by others	54	81
Social Capital	Ecosystems' contributions to forming or strengthening social bonds or relationships	92	52
Perspective*	Talking about gaining perspective on one's place, seeing where one fits. "Putting things back in perspective".	31	61
Ingenuity*	Ecosystems' aid in developing innovative ideas, approaches, or practices	42	7
Learn About Place	When an ecosystem teaches the respondent about itself or about ecological principles (vegetation patterns, winds, rains, cycles, etc.)	(not coded for)	102

Ceremonial	Specific mention of ceremony (formal or ritualistic practices) both individual and collective	(not coded for)	85
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3. RESULTS:

Our analysis of free responses from the two research projects resulted in three categories of CES not encompassed by current typologies. Below we describe these categories using examples from both projects.

3.1 Ingenuity

We define “ingenuity” as a CES as: ecosystems’ aid in developing innovative ideas, approaches, or practices. Both cases provided evidence that ecosystems inspired ingenuity, but we observed this CES more frequently from agricultural systems. In our data, ingenuity stemmed from two pathways: one in which a natural phenomenon was observed and mimicked, and one in which a natural phenomenon was observed and elicited a response. In both cases the end result was a creative solution to a problem.

Observation and mimicry of the natural world provided ideas and insights that led to design or engineering innovation. For instance, one farmer related a story about how he observed that his ‘bellflower’ (Angel’s Trumpet, *Brugmasia x candida*) “had water [dripping out] every time in the morning, ‘cause the way it hangs, the flower protects all the dew.” Inspired by this idea, the farmer “took all our old beer bottles and put ‘em upside-down on sticks like the flowers. We put bottles around every coffee plant, like five or six. Now the plants get extra water every day, and they stay greener even in the wintertime when it’s dry.” Others expressed similar sentiments, explaining, for example, how their wires don’t break in storms because they install them to run “the same way a vine does [grows],” or how they tried to “copy the way [the hala tree] funnels the water to one spot.” One farmer offered a reflection that succinctly summarizes this concept: “it’s [i.e., nature is] probably where all our great ideas come from.”

A second pathway to ingenuity was as a response to a particular challenge created by nature. In the forested lands study, one respondent summarized this idea with the comment that being in the forest “teaches you self-reliance, and to a certain extent sort of the ‘boy scout virtues.’” A woman in the agricultural study explained how close interaction with nature led her to be more inventive in her approach to pest control:

“[Interaction with the land] makes you be creative in how you deal with problems. As my papa would say ..., ‘you have to work smarter, not harder.’ And working with the land

teaches you that every day. There is always new problems [sic], but you get out there and figure them out. When we moved here we had a big problem with the beetles. We didn't want to spray anything, so we watched them when they came out and saw how they climbed up the stalks. To stop them we just cut open plastic water bottles and wrapped them around the stalk so when they climb up they got stuck."

A participant in the forested lands study expressed similar ideas of close interaction inspiring appropriate solutions, but in more general terms: "You've got to be hands on; you've got to be on the land. ... You've got to be involved with it. You can't just read about it or hear somebody say this or that. You have to be there. ... That's how [past generations] learned. They had to practice and then learn, experience and touch it, and look, and do until they got it and realized what was the best thing." This idea of past generations learning how to survive and address challenges through deep, mindful relationships with the land was woven throughout many interviews in the forested lands studies.

Distinction from other CES: To assess whether our concept of "ingenuity" is encapsulated by currently identified CES, we explored the current CES of "inspiration." We reviewed 19 papers identified by Milcu (2013) that mention inspiration as a service (see Appendix for list of papers). In all but one of these studies, inspiration related to artistic sensibilities: nature provides inspiration for painting, books, plays, and other art forms. Although these studies occasionally mention "design," further description draws connections to artistic interpretation; for example, mentions of architectural design — a term that can evoke thoughts of engineering and problem-solving — are related only to the artistic, aesthetic portion of the building, rather than to its underlying structure. Only a single paper clearly discussed inspiration as ingenuity or engineering design:

"Finally, the study of bat echolocation and locomotion has provided inspiration for novel technological advances in such fields as sonar systems, biomedical ultrasound, sensors for autonomous systems, wireless communication, and BATMAVs (bat-like motorized aerial vehicles). Although extremely difficult to quantify, it is important to recognize the extraordinary value of bats to ancient and contemporary traditions and science (Kunz et al., 2011, p. 23)."

Russell et al. (2013), in a review of nature's nonmaterial impacts on wellbeing, clearly identify nature as spurring human ingenuity; the concept is explored under the category of Learning and Capability, and rests on the notion that "knowledge of natural systems enhances human capabilities" (p. 485). What we call ingenuity is thus identified as one way that nature affects well-being, but this benefit has been poorly incorporated into ES work.

While it may be argued that ingenuity for design is equivalent to, or a subset of, artistic inspiration, we see it as a unique construct. Conceptualizations of inspiration have focused almost exclusively on art and beauty. These phenomena are distinct from (though clearly related

to) the ideas of creativity and innovation found in our data. Art and beauty are also deeply impacted by a person's background and culture; what is a "good" product of inspiration will be subjective. In artistic inspiration, emotional interpretation is important; the mood or "feel" of a place or ecosystem may be critical (de Groot and Ramakrishnan, 2005). Ingenuity, on the other hand, is closely related to our need to address puzzles. Functional aspects of a place or ecosystem are critical. In other words, inspiration has been interpreted largely as role ecosystems play in creating beauty; we suggest that ingenuity is about the role ecosystems play in solving problems.

3.2 Life Teaching

We define "life teaching" as occurring when an ecosystem provides opportunities for learning life lessons and personal values. The idea of nature as a teacher of life lessons arose independently within each study. Numerous respondents referred to ecosystems as a 'personal trainer' of sorts: an entity encouraging, and at times pushing, individuals to develop and draw on personal values, continuously improve themselves, and adapt to their surroundings.

Interviews from both sites referenced the idea of a trainer who demands full attention. One farmer succinctly quipped how the land "keep[s] you on your toes [laughs]. You have to always be ... aware of your surroundings." Similarly, another respondent described how the forest taught her about "being aware. ... [it] taught me something very specific, and it was the environment that taught me. It was the environment saying, 'this is what's happening. You're not paying attention!'" Another respondent in the forest study shared ecosystems' lessons of mindfulness: "If you let your sleeping bag get wet up above 6,000 feet ... you're taught the lesson of mindfulness [laughter] by the weather."

The idea of nature teaching critical life lessons and values was prevalent in both sites as well. As one farmer said, "never get cocky; if [you do], guaranteed the land goin' [*sic*] humble you." Others shared that they learned that "you gotta be tenacious ... because everything in nature is," or that "carrying yourself well all the time is a good thing. It makes me feel better and perform better. I don't think I could have ever learned that without being on the land alone." Another reflected on a general principle the land has taught him:

"To me the land is something more than just a resource. It's something you form a relationship with, that you learn from. Sometimes I really think [the land] does things to teach me a lesson. Like, I don't know, I'll see something I need to do, but I won't do it and then it comes around to kick me in the ass. You understand? Like I had a big branch fall across the path down to my shed. I saw it and said I'd better move that before I trip on it. But I didn't. And the next day I'm walking down to the shed and get distracted by some birds and yup, go down on that branch. I almost feel like it was a conspiracy to teach me to follow through on my thoughts."

One respondent implicitly referenced societal discussions about the fact that Native Hawaiians have a unique connection to the island ecosystems. She described the idea of nature teaching critical life lessons by emphasizing that it is thinking and experience, rather than genetics, that impact relationships to nature and what they mean for education. “It’s not about the koko [blood],” she said. “It’s not about the genetics. It’s about the thinking. So how do we change human behavior? We change human behavior by what we feed the human mind and how we educate it, and what we educate it towards. And so [we should] treat Nature Deficit Disorder as the serious flat-out epidemic that it is.” Another respondent described teachings from the forest with specific reference to the instructive power of observing natural processes, particularly with respect to excess. He observed that “there was the dying leaves, the whole succession, the whole idea of integration, the whole idea of ‘too much.’ What does the forest do when there’s too many trees? Some die out, right? I mean, it’s ... a very useful tool for teaching about life, about the future, about how things operate in the natural world that we are part of, right?” A third respondent referenced her identity as a hula practitioner in describing multiple basic virtues that the forest teaches. Interaction with the forest, she said, “teaches us hula people, that [pause], you know, so many lessons. Humility. Non-attachment. Reverence. Respect. ... It’s so deep. So multi-layered. And like, that’s why we need the forest as an important teaching tool.”

Distinction from other CES: The life teaching category is most closely connected to the “education” category that appears in a few typologies. Conceptualizations of education in these CES typologies, however, are either undefined or refer to the surprisingly limited service of learning about the natural world itself. Costanza et. al (1997) do not define “education,” but simply list it as a CES. Similarly, Chan et al. (2012) list but do not define “Education and Research (nature-based).” DeGroot et al. (2002, 397) provide two examples of “science and education” goods and services from ecosystems: “Use of natural systems for school excursions, etc. Use of nature for scientific research.” Raymond et al. emphasize the role of ecosystems in creating understanding about nature itself. All of these instances of education portray the environment as a tool that enhances the ability of human educators to teach about ecology. This differs substantially from the idea found in our data: that interaction with nature can teach individuals in many ways, not only about ecology but also about life lessons much more broadly.

The proposed CES of “life teaching” also relates, though less directly, to the “knowledge systems” item included in a few current CES typologies. Gee and Burkhard (2010) summarize the Millennium Ecosystem Assessment’s portrayal of knowledge systems, and consequently other uses of the term, as “appreciating that ecosystems influence the types of knowledge systems developed by different cultures” (p. 350). Raymond et al. group “knowledge systems” with “education values” “to reflect the interaction of landscapes and people in the development of knowledge” (2009, p. 1304). The concept of knowledge systems is subtly present in some of our data, but differs substantially from what we call “life teaching.” The Hawaiian way of thinking mentioned above (“It’s about the thinking”), for instance, relates to a knowledge system. The Hawaiian knowledge system is clearly important to this respondent (and is encapsulated by the “knowledge systems” CES). This quotation, however, introduces an

additional concept: that interaction with ecosystems is central to encouraging desirable, pro-social human behavior. We thus see the value of a separate category that focuses on the benefit of the life education, of “life teaching,” that ecosystems provide.

3.3 Perspective

We define “perspective” as a CES as when ecosystems help people to gain perspective on their place in the world, to see where they fit, or to “put things back in perspective” (this idea was introduced in Gould et al., 2014a). As many respondents described it, this CES has the flavor of a “reality check” — a return to what the respondent sees as a more accurate sense of where he or she fits and what is important.

Both cases provided ample instances of people gaining perspective from ecosystems. Numerous comments from the forested system interviews directly addressed this idea of perspective. One man, for instance, provided the vocabulary for naming the theme and expressed its core sentiment — the idea that ecosystems remind us that humans and our problems are relatively small: “When I get out of here [the more developed area], things are put back into perspective, you know — what is important. Walking around up there on the mountain, it makes my problems seem small in the big scenario.” Another provided language used in our definition: when in the forest, “you’re coming deeper at peace within yourself, you see your place in the system of things. You become more accepting of your own frailty, your own mortality.” Similarly, in the farming systems, individuals commented that interaction with the ecosystem serves as a reminder that human problems are not always as massive as they seem. As one interviewee remarked, the plants “remind me that it’s all going to be okay.”

In both cases, respondents often mentioned that gaining perspective inspired a sense of humility — it provided a sort of “reality check” about what they considered a sometimes inflated sense of self-importance. As one respondent said, being in the forest “reminds me of my own, and I don’t want to say insignificance, but my own significance as just another thing in the forest, right? So I’m actually enhanced even though I’m minimized, right?” On agricultural lands several respondents discussed how the resilience and perseverance of nature helped them to remain humbled and thankful. One respondent encapsulated this idea of humility: “We [humans] like to think that we are so great. We build all this stuff. We control all the other life. But it is all so fleeting. When you see a banyan root crack through the cement, or you see a vine taking over your building, or even seeing the weeds come back again and again you realize that all our efforts are really not so amazing after all. Nature can undo it all so quickly.”

In numerous instances, a sense of perspective of the temporal expansiveness of the non-human world inspired this humility; numerous respondents reflected on the humility inspired by how relatively short human lives are. One participant in the forest study said:

“You come and look and you see the lava and ... you start to realize that humans aren’t the big dude. Humans are not calling the shots. We like to think we are, and we’re not. ... We’re just busy going around this [makes whirring noise, moves hand in a circle],

and it's just a snap in time. We think we're so important and when you look at the mountain, how long it took the mountain to get to that, [pause] you know, a half million years, and even that's young [for a mountain]."

Another participant described the importance of geological layers with a similarly modest sentiment: we should "know that this isn't the only layer. Like, this is a lava flow; know that there is a layer below this, and who knows what went on there? Who knows who lived there, who knows what grew there? It's, you know, 15 feet under now, but it's still there. To have the presence of mind, that you have layers below you." When asked why that was important, she continued, "because people have a tendency, seemingly, to think of things as always new. And in reality, I think that we've done very little new. And that, most of the time we're repeating something." This idea was also expressed with respect to a tree and a 300-year timescale: "It all puts it into perspective as to how important humans are, and I think we overrate ourselves. We overrate our intelligence, we overrate our 'master of the universe' stuff. It's just all overrated. ... when you can look at an 'ōhi'a tree that's 300 years old, it kind of makes you think, 'Wow, that tree was there *when?*' Before the United States was born. Then all of a sudden you go, 'Whoa.'" This sentiment was echoed regarding the agricultural lands when a respondent said, "it's funny that we put so much emphasis on our little tasks." He continued, "Like we need to rush to and fro to make the plants grow, you know. It's so easy to forget that it takes tens of thousands of years for the soil to develop. And before that it took hundreds of thousands of years for the island to be built. And, god, before that how many millions did it take for the Earth to get to where it is today? You know what I'm saying? We forget that our little tasks are built upon these things that are way beyond us. And you have to respect that. Working on the land reminds me of that, you know."

Perspective was, for our participants, frequently associated with gratitude. They expressed this in many ways. Being in the forest, one said, is "not a rush [an intense, adrenalin-related state], but it's serious; it makes me appreciate what I have, you know, whether it be a lot or a little. It makes you appreciate, you know, life." Another reflected on how time in the forest "increases your appreciation; going back there increases my appreciation for the time I have left being alive." A participant in the agricultural lands study expressed a similar sentiment, sharing that "it's easy to get frustrated, but we are lucky to work on the land." He added, "Sometimes I just stop and look around and remember what I have. What we all have. Life is a gift. You have to appreciate that." Our results suggest, in sum, that nature's benefit of providing perspective encourages people to get out of themselves and to situate their problems within a larger framework. This often makes those problems seem small, and therefore makes people grateful for what they have.

Distinction from other CES: The most likely critique of perspective as a novel contribution is that it can be considered a subset of spirituality. We, however, see perspective as a unique construct: The concept of perspective can relate to spirituality, but certainly does not always have a spiritual component. While definitions of spirituality are as complex as they are

numerous, many include elements of the sacred, the metaphysical, or both (Taylor, 2009). The concept of perspective is neither metaphysical nor connected to considering something sacred; it involves becoming aware of relationships and how a person fits into them. Some people discussed these things in a spiritual way (and these comments were coded as spiritual as well as “perspective”); some people discussed these realizations without implying spirituality. A response referencing spirituality (via praying) and perspective (via “thinking about things”), for instance, was: “Sometimes I’ll go *mauka* [upland, to a largely undeveloped area], and more far *mauka* to pray or to get — you know, think about things and make decisions.” One respondent articulated the distinction in a response coded as perspective but not spirituality; after describing spiritual aspects of her relationship with the forest, she noted how ecosystems help us in “being mindful of our place in the hierarchy. ... I suppose even if you were just a flat-out atheist, humanist, chances are there’s still a sheriff or a president or a richer man than you, so there’s a hierarchy at play really everywhere we turn.”

4. DISCUSSION

In our data, we found three categories that respondents repeatedly identified as important, yet that are not discretely represented in existing typologies of CES. In an approach informed by grounded theory, we built upon these emergent findings to suggest additions to current frameworks of CES.

4.1 Why is it important to identify new categories of Cultural Ecosystem Services?

To conceptualize, understand, and articulate the ways that nature benefits people is a core strategy in current discussions of environmental action. Intertwined with these efforts is the development of language to discuss the various facets of these benefits. The overarching concept of ecosystem services provides an example; the concept and its terminology, while controversial (Spash, 2008), has arguably played a role in focusing research and practice around its central claims: that ecosystems provide critical benefits to humans, and decision-making should incorporate those benefits. We argue that a microcosm of that phenomenon is relevant to a subset of the field, namely, *cultural* ecosystem services (CES).

The entire task of developing and refining categories of cultural ecosystem services (as with ES more generally) can be criticized as an effort at reductionism inappropriate to a topic so fundamental and vast. Our approach, however, is embodied by the aphorism “all models are wrong, and some are useful.” Categories of CES are constructions — artificial divisions — imposed onto an enormous body of meaning. The same, however, could be said of most theory that seeks to characterize most aspects of the world (e.g., theory in ecology, physics, human social interaction). Our approach aligns with that of Levins and Lewontin, who suggest that we not abolish reductionism entirely, but rather infuse study of ‘the parts’ we chose to investigate with unfailing, constant consideration of their context (Lewontin and Levins, 2007).

We see categories (i.e., those created by reductionism) as helping to make sense of, and importantly, to investigate and properly contextualize, this vast area. The categories of ecosystem services are imperfect, but they are useful. The names are arbitrary, but they are reminders of important dimensions to consider. We (the authors) have worked with large landholding organizations to incorporate nonmaterial values into their decision-making; this work has taught us that the *process* of ecosystem valuation is as important as the outcomes — i.e., as any ultimate value that might be placed on ecosystems (Norton and Noonan, 2007; Satz et al., 2013). Increased identification of CES categories will increase the likelihood that valuation processes address a diversity of meaningful CES, and thus more thoroughly consider what might be gained or lost through our management of ecosystems.

Millennia of language formation across our planet demonstrate the inextricability of language and thought: when we name phenomena they become more comprehensible to us, and when phenomena are more salient to us we name them. The facts that the Hawaiian language has over 20 names for ocean waves (www.wehewehe.org), and that the Norwegian language has at least nine names for snow (www.engelsknorskordbok.com) emphasize this point. Our wish is that by naming these three new constructs, we help to bring them more fully into our conceptualization of nature's benefits.

We do not suggest that the list we present here is in any way final. We simply suggest that current lists of CES may not be complete, and that the new subcategories we discuss are important enough to warrant designation and consideration alongside more frequently analyzed subcategories. We suggest these categories because we hope that future research can include them, and thus explore if and how they may offer additional insight into the diversity and nuance fundamental to the nonmaterial benefits inherent in human-ecosystem relationships.

4.2 The “lumping” vs. “splitting” debate

We recognize that our additions could be seen as not being substantially different from currently identified CES, but rather as enrichments or more specific definitions of them. In the Results section, we describe the current CES categories most closely related to the new categories we suggest. Some may find these descriptions accurate portrayals of gaps in current conceptualizations in CES, and thus become convinced of the need for our new categories. Others, however, may prefer a more parsimonious list of CES, with greater nuance within each category. There is logic in this critique: The concept we label as ingenuity could be delineated as a type of inspiration; the concept of life teaching as an expansion of the current education category; and the concept of perspective as a part of an expanded spirituality.

We see that discussion as an example of centuries-old debates of scientific classification related to “lumping” versus “splitting” (Endersby, 2009), and, more fundamentally, classification of the world around us (Zerubavel, 1996). We perceive two directions in which definitions of CES could proceed: one in which services are amalgamated into a few broad categories (“lumping”), and another in which services are broken down into increasingly fine distinctions

(“splitting”). There is, for instance, considerable overlap between artistic, inspirational, creative, and, possibly, aesthetic services. Taking the first direction (“splitting”), the definitions of these four services could be refined to elucidate distinctions. Taking the second direction (“lumping”), individual categories could be combined into a single one with a broader definition.

Both directions have positive and negative implications. Splitting may lead to excessive overlap between closely related values, exacerbating the infamous problem of double-counting (Fu et al., 2011). A lumping approach could help to avoid double-counting if bundles of CES (i.e., CES that tend to co-occur (Klain et al., 2014)) were lumped together and considered jointly. For lumping to be effective in this way, however, its details would likely need to be determined based on context, as the CES that co-occur vary between cases. On the other hand, splitting, despite the potential drawback of double-counting, facilitates a more complete view of the different services that an ecosystem might provide and may thus enable more accurate measures of individual services. This may be particularly relevant if different services are related to different ecosystem characteristics and processes. Connecting services to ecosystem types, functions, and processes is often a critical step in including ES in decision-making; if increased refinement of service categories facilitates clearer connections between services and ecosystem properties, “splitting” could facilitate more accurate and comprehensive of CES in decision-making.

Proper accounting will require consideration of lumping versus splitting of services. Regardless of the path, we argue for the importance of continuing to identify and define services that enrich possibilities to articulate these tricky but crucial phenomena. Perhaps decision-making bodies that use, or plan to use, CES information (e.g., the Intergovernmental Panel on Biodiversity and Ecosystem Services) could provide direction on whether lumping or splitting would be more useful to their work.

4.3 Ingenuity, life teaching, and perspective in the literature

The concept that nature provides avenues to ingenuity, life teaching, and perspective is far from new. Below, we contextualize our three suggestions for new CES within existing scholarly literature outside of the CES literature. We suggest how our results build on prior understanding and may inspire future research.

4.3.1 Ingenuity

The most straightforward embodiment of this service is captured in biomimicry, “the practical use of mechanisms and functions of biological science in engineering, design, chemistry, electronics, and so on” (Vincent et al., 2006, p. 471). This obvious service provided by nature is surprisingly underrepresented in ES frameworks. Though the contribution to the economy by products that benefit from biomimicry is difficult to quantify, the Da Vinci Index was created to measure the impact of biomimicry via the number of scholarly articles, patents

and grants related to biomimicry. The index grew by an order of magnitude, from 100 to over 1000, between 2000 and 2011 (Ivanić et al., 2015). Hundreds of high profile examples of biomimicry exist, from self-cleaning paints inspired by plant leaves (Barthlott and Neinhuis, 1997), to dry stick tapes based on gecko feet (Geim et al., 2003), to arguably the most famous example: Velcro® based on seed burrs (Velcro, 1955). Today the field of biomimetics explores a range of options, from cellular and molecular scale designs to improve materials and information transfer (Ball, 2001) to landscape level features that improve the built environment and climate change adaptations (Zari, 2010). We find it surprising that this direct and well-publicized service provided by ecosystems and biodiversity is not well articulated or encapsulated in current CES dialogue.

We noted more instances of ingenuity in the agricultural lands study than in the forested lands study, and existing literature offers potential insight into why. The two potential explanations relate to two important areas for future research: how type of activity affects CES, and how ecosystem characteristics affect CES. First, the difference could result from differences in activity type in our two study areas. Almost all agricultural interviews related to a productive activity in which respondents actively sought design solutions; activities on agricultural lands thus often emphasized problem-solving forms of creativity. Discussions of forested lands, in contrast, seldom addressed the need to construct devices or manipulate an ecosystem. Forest study participants still mentioned ingenuity in ways that indicate the existence of important and strongly held values, but these discussions most often referred to more active problem-solving activities, which were not as common in the forested lands study as in the agricultural lands study. Research with New Zealand's Maori provides insight into the important relationships between different types of activities and characteristics of the environment (Tipa and Nelson, 2008); this work offers a potentially fruitful avenue for deeper exploration into the importance to CES of 'what we are doing' in ecosystems.

Another potential explanation for the greater prevalence of ingenuity in the agricultural system relates to the interactions between CES and ecosystem characteristics; other studies have found some such interactions (e.g., van Berkel and Verburg, 2014). In our study region, biodiversity is, perhaps surprisingly, generally higher in agricultural areas than it is in the upland forests; this is largely due to the greater number and larger distribution of introduced vs. native species in Hawai'i (Wagner et al., 1999). Given the creative nature of ingenuity, we wonder whether it may be inspired by interaction with a variety of different organisms and systems – i.e., whether species diversity may be related to CES (as suggested for ES more generally in Díaz et al. (2007)). Philosopher Bryan Norton has suggested that the core value of biodiversity is what he calls "nature's creativity" – the processes by which ecosystems provide opportunities for human growth and invention (Norton, 2000). Though Norton does not explicitly make this connection, an extension of his idea is that more biodiversity may mean more observable phenomena, and thus potentially greater ingenuity. It is also likely, of course, that activity type and ecosystem characteristics interact in rich and complex ways. As mentioned below, our findings thus pave the way for further research into these topics.

4.3.2 Life teaching

The idea of nature as a teacher is found in multiple fields. We focus on perspectives from indigenous epistemologies and environmental education.

Perhaps the most well-developed conceptualizations of nature as a teacher are found in indigenous epistemologies; the idea of ecosystems as active partners in a society's educational system is embedded in many indigenous traditions. Robin Wall Kimmer describes the viewpoint of the Potawatomi nation, and many other indigenous groups: Because plants and animals inhabited the earth before humans, they are clearly the instructors, and we humans the learners. Her book's subtitle, "Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants" makes evident the centrality of this idea of nature as teacher (Kimmerer, 2013). Gregory Cajete writes of Native American education that "knowledge could be received directly from animals, plants, and other living and non-living entities" (1994, p. 75). His description of the embedded social-natural system as teacher is highly consistent with our emergent finding that "life education" from ecosystems manifests as imparting personal values and the more practical skills often intertwined with them (in one of our respondent's words, the "boy scout virtues"). Cajete writes: "Tribal education ... unfolded through mutual, reciprocal relationships between one's social group and the natural world. This relationship involved all dimensions of one's being, while providing both personal development and technical skills through *participation* in community life." [emphasis in original] (Cajete, 1994, p. 26). This concept is well represented in Hawaiian culture, where the idea of kinship with plants and animals is central (Handy et al., 1974); plants and animals are relatives who have as much knowledge to share as another person.

The idea of nature serving as a teacher is also found in environmental education research and practice, especially as it interacts with indigenous epistemologies. As one example, the work of an adult environmental education center in Toronto, Canada, presents nature as both a teacher and a site of learning (Hall and Clover, 1997); these two portrayals parallel the idea of our suggested "life teaching" CES and the current "education" CES. As a second example, the idea of nature as teacher is articulated very clearly in anthropological research, conducted with aboriginal people, to develop environmental education initiatives. This research describes nature as a teaching partner. The authors advocate, for Western thinking, a more large-scale "shift from the other-than-human-world as backdrop for education to active co-teacher for our students and even ourselves" (Blenkinsop and Beeman, 2010, p. 27); the idea of an active co-teacher is consistent with the aboriginal view. The team responsible for this work established a school in Western Canada whose mission states that they "cultivate learning in natural settings, where we listen for what the more than human world has to teach us" (Environmental School Project, 2016). These are just a few examples of how some educational initiatives consider the environment as a teacher rather than solely a site for or subject of learning.

4.3.3 Perspective

Research related to the idea we label as “perspective” crosses academic fields and epistemologies. Below we review a few notable discussions of the topic.

Environmental ethicists discuss how experience with the nonhuman world facilitates a broader view of self. One researcher, Lisa Gerber, explained how an experience in nature helped her to “set aside my preoccupation with self and my day-to-day concerns” and provided “a reminder of what is important” (Gerber, 2002, p. 40). This ethical standpoint connects “perspective” closely with humility, and makes the important distinction between humility as self-denigration and, by contrast, as a more realistic sense of how we and our problems relate to others. In fact, Gerber’s three-part description of humility essentially mirrors our definition of perspective: “First, humility involves an overcoming of self-absorption; the object of attention is not oneself. Second, humility involves contact with a larger, more complex reality; nature is one example.” Third, “humility involves a sense of perspective on oneself and the world ... [so that] a person can understand his place in nature ...” (Gerber, 2002, pp. 40–1). Ethicist Matthew Piantalo makes a similar argument about the commonality of humbling experiences in nature, and discusses how that feeling of humility contradicts anthropocentric views of nature (Piantalo, 2013). His insight highlights an important, if potentially ironic, aspect of our addition of perspective to CES typologies: we suggest adding a “benefit” that is intertwined with breaking down anthropocentrism to the anthropocentric ecosystem services framework.

Discussion of the idea of perspective is not limited to the field of ethics. Recent neuroscientific work has explored mechanisms behind the cognitive benefits of exposure to nature, which have now been repeatedly observed (as reviewed in (Bratman et al., 2012)). One likely mechanism relates to nature’s effect on rumination, which is defined as negative self-talk or a mental focus on undesirable personal characteristics. This egocentric internal dialogue is associated with depression and negative mood. A study comparing both brain activity (via MRI) and self-reported rumination found that rumination was lower for subjects randomly assigned to walk in a “natural area” than for subjects assigned to walk in an “urban area” (Bratman et al., 2015). The self-absorbed focus that characterizes rumination contrasts sharply with the principles of perspective; perspective helps people to see where they fit with respect to others, whether human or not, and to gain a sense of the relative insignificance of their own problems and discomforts. Our results, in other words, corroborate this experimental work, and indeed suggest a potential meta-mechanism: gaining perspective could be a mechanism that underlies decreases in rumination, which in turn underlie the observed cognitive benefits of nature exposure. The decrease in rumination from exposure to nature can be a conscious one; some people recognize and can be quite articulate in describing it. Their reflections may help us to understand the phenomenon.

The perspective service we suggest also relates to the psychological concept of perspective-taking — the ability to adopt another human’s perspective. Perspective-taking ability correlates with the closely connected concept of empathy; less obviously, it also relates to levels of happiness (Rueda et al., 2014). Researchers have also applied this idea to assuming the

perspective of non-humans. Though this differs slightly from what we mean by “perspective,” we believe the concept to be highly relevant, and to represent a subset of, or perhaps part of the cognitive process related to, our construct of perspective. Taking on the perspective of non-humans has been shown to increase concern for the non-human world (Schultz, 2002), but has not, to our knowledge, been tested for its relationship to happiness or general satisfaction. Our results suggesting that the construct of “perspective” is important to people’s well-being indicate that this may be a fruitful area for future research.

4.4 Our suggested CES and recent advances in ES research

In addition to finding grounding in centuries of scholarly work from multiple fields, the three additional CES we suggest relate to current intellectual discussion of ecosystem services and the field of conservation.

A nascent trend in ES research suggests expanding from, or reframing, the study of CES to consider the cultural and social dimensions of all ES — to account for the fact that many, if not most, material ES services have cultural and social components (Scholte et al., 2015). This expansion is highly logical; when one mentally digs into the topic of CES and tries to orient it within the ES framework, inconsistencies and complications quickly arise. To describe a nonmaterial benefit as the output of a unidirectional flow from ecosystem to people often does not accurately represent a more multidirectional, relational reality (Raymond et al., 2013). Work in this vein has suggested the importance of relational values — a third alternative in the intrinsic vs. extrinsic debate (Chan et al., 2016). The concept of relational values posits that rather than conceiving of ecosystems as providers of instrumental or intrinsic benefits, a strong consideration for people is how they relate to others, whether human or not. The idea of relational values encompasses both relationships themselves and virtues often associated with relationships (e.g., responsibility). A similar suggestion arises from the United Kingdom National Ecosystem Assessment experience (Fish et al., 2016).

Our suggested additions to the CES framework make space for these more interactive benefits from nature. Ingenuity and life teaching can be thought to be about student-teacher relationships: nature as valued teacher, humans as diligent, if frequently frustrated, students. Perspective can also be viewed as largely about relationships; this benefit is experienced by making salient appropriate connections. Perspective involves realizing that respect and humility often characterize human-ecosystem relationships; it also involves recognizing “what is important” in one’s relationships with others.

4.5 Limitations and future directions for research

Our data are drawn from two systems that are adjacent geographically and are frequented by people of similar demographics, but which are biophysically different, and with which people have quite distinct relationships. Though this diversity could be seen to present challenges to our

approach, we see it as a central source of richness and validity for our findings. Specifically, that we found evidence of our three emerging categories in studies of these biophysically distinct places, with which people have different types of relationship, strengthens the argument that these can be considered core CES that should be added to generally applicable typologies.

An important critique of our proposed categories is that they do not lend themselves to easy measurement; they do not necessarily offer a solution to the problem of CES being notoriously difficult to measure or otherwise characterize. We agree, and see addressing this problem as a fundamental goal of current and future research on these services and the values associated with them. Much CES research, including the new area of relational values, focuses on issues of measurement; it directs current research attention to the development of techniques to measure these values and thus facilitate their incorporation into policy. Suggestions of measurement techniques for our suggested services are beyond the scope of this article; our goal is to identify these concepts and thus open the door for future work focused on developing and refining characterization methods.

Along with the need for creative measurement techniques, this work suggests two additional directions for future research, both of which would also benefit from studies involving distinct study sites. One need is to determine which ecosystem components or characteristics are associated with which CES; for example, is there evidence for our idea that more biodiverse systems, such as those in our agricultural study, are more strongly associated with ingenuity as a CES? This same observation (more discussions of ingenuity in our agricultural study), which arose from our similar studies in two systems that are adjacent geographically and culturally but quite different biophysically, leads to a second potential future direction for research: what affect do people's actions in an ecosystem have? That is, how are CES affected by whether people's relationships with the ecosystem are productive, interactive, consumptive, or of some other type?

4.6 Conclusion

The benefits of creativity, perspective, and life learning arose repeatedly in our open-ended questioning and find nuanced support from a long history of scholarly work. We hope that naming them will encourage innovation in how to characterize and subsequently incorporate them into more studies and practitioner efforts. The ultimate goal of ES work is to allow decision-making based on more complete information; we argue that, when the three new bodies of meaning we suggest are included, the information provided will be just a little more complete.

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