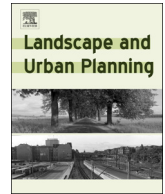




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Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research Paper

Investigating sense of place as a cultural ecosystem service in different landscapes through the lens of language

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ARTICLE INFO

Keywords:

Sense of place
 Cultural ecosystem services
 Landscape values
 Landscape descriptions
 Free listing tasks

ABSTRACT

The concept of ecosystem services is increasingly important for measuring both tangible and intangible benefits that humans obtain from ecosystems. Much research on ecosystem services focused on more tangible services. Intangible cultural ecosystem services, such as sense of place, are often neglected, but in the context of highly populated, increasingly urbanized countries, maintenance of cultural ecosystem services is an important policy objective. One of the challenges of integrating sense of place into the framework of ecosystem services is that it is not linked to abstract notions of ecosystems, but tied to perceived landscape features such as mountains, or rivers. In this study, we used free listings and interviews with visitors to investigate perceived landscape features and sense of place through the lens of language in five different landscape types in Switzerland. Within each landscape type, we selected two study sites to quantitatively and qualitatively compare landscape descriptions. Using text processing, we show that terms for landscape features were more similar within the same landscape type, suggesting that people perceive differences between these landscapes that they express in language. However, in general, elicited concepts related to sense of place were similar across landscape types. Thus, our results show that we can use free-listing descriptions to distinguish landscape types, but we found limited differences in the language used to describe sense of place. Our findings offer insights into exploring sense of place in different landscapes and contribute to ongoing efforts for refining the definitions and standardizing assessments of cultural ecosystem services.

1. Introduction

Ecosystems are essential for human well-being through the benefits that people derive, directly or indirectly, from ecosystem functions (Costanza et al., 1997). One, increasingly popular, way of quantifying these benefits, is through ecosystem services, defined as benefits provided by ecosystems that contribute to making human life both possible and worth living (MA., 2005). Research on ecosystem services has steadily increased (Costanza et al., 2014; Fisher, Turner, & Morling, 2009), partly driven by the recognition that such quantification may provide a useful tool in both monitoring and scenario development, and as an input to policy decisions, for example, in the European Union 2020 Biodiversity Strategy (EU Commission., 2014). Ecosystem services are commonly classified into four groups: *provisioning services* such as drinking water and food; *regulating services* such as erosion and flood control; *supporting services* such as nutrient cycling, and *cultural services*, defined as nonmaterial benefits obtained from ecosystems, including aesthetic beauty, recreation, cultural heritage value and, the focus of

this paper, sense of place (Chan, Satterfield, & Goldstein, 2012; MA., 2005). Although the importance of cultural ecosystem services (CES) is generally recognized, their assessment lags behind that of more tangible services (Benayas, Newton, Diaz, & Bullock, 2009; de Groot, Wilson, & Boumans, 2002; Feld et al., 2009; MA., 2005). In the Millennium Ecosystem Assessment, for instance, ten cultural services are defined, of which only three were assessed (spiritual values, aesthetic values, and recreation), while the other seven (including sense of place) were not (MA, 2005). Literature reviews (Hernández-Morcillo, Plieninger, & Bieling, 2013; Milcu, Hanspach, Abson, & Fischer, 2013) showed that where cultural services were assessed, studies often focused on cultural services that could be investigated through relatively easily quantifiable proxies, such as tourist visits for assessing recreation, or the number of images on social media as a measure of aesthetic beauty (Feld et al., 2009; Figueroa-Alfaro & Tang, 2017; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Tenerelli, Demšar, & Luque, 2016; Yoshimura & Hiura, 2017; Zoderer, Tasser, Erb, Lupo Stanghellini, & Tappeiner, 2016). One of the key challenges involved in CES research is linking

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<https://doi.org/10.1016/j.landurbplan.2018.03.021>

Received 30 March 2017; Received in revised form 23 March 2018; Accepted 24 March 2018
 Available online 06 April 2018

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CES to space. This has been attempted, for example, by counting georeferenced user-generated images on photo sharing sites as proxies for scenicness (Glozzo, Pettorelli, & Haklay, 2016; Yoshimura & Hiura, 2017), by participants entering points or polygons associated with certain CES on maps and in Geographic Information Systems (GIS) (Brown & Weber, 2012; Fagerholm, Käyhkö, Ndumbaro, & Khamis, 2012) or by assessing landscape types and associated values through visitor surveys that are mapped in a GIS (van Berkel & Verburg, 2014; Zoderer et al., 2016). However, moving beyond relatively simple proxies and developing a better understanding of CES such as sense of place requires complementary competencies and methods drawn from the social sciences and humanities (Chan, Guerry, et al., 2012; Daniel et al., 2012; Schaich, Bieling, & Plieninger, 2010).

One of the reasons why sense of place has remained an elusive concept that is often omitted from CES assessments may be that multiple theories, concepts and empirical approaches exist in different disciplines in the social sciences and humanities, even within a single field of research. However, this matter is only seldom touched upon when introducing sense of place (Hausmann, Slotow, Burns, & Di Minin, 2016; Williams, 2014).

Furthermore, studies investigating the links between landscape features and CES often assume the landscape features to which these services are attached to be culturally universal (Oteros-Rozas, Martín-López, Fagerholm, Bieling, & Plieninger, 2017), and less attention has been paid to describing and comparing terms for culturally recognized landscape features of different groups of people in different landscapes (Lofland, 1975; Stedman, 2003). Focusing on culturally recognized landscape features is important, as one of the major challenges in integrating cultural aspects into the framework of ecosystem services is that such values and meanings are not linked to abstract notions of ecosystems, but tied to perceived and culturally recognized landscape features, such as lakes, mountains, or rivers (Kirchhoff, 2012). Recent work in linguistics and landscape ethnology highlights however, how the terms people use to refer to features of the landscape are non-universal, often culture-specific, and difficult to translate, with implications for methods attempting to link CES to landscapes (Burenhult, 2008; Johnson & Hunn, 2010; Mark, Turk, Burenhult, & Stea, 2011). The focus of many linguistic and ethnological studies has mostly been on indigenous cultures and endangered languages, and relatively few studies have addressed variation of landscape terminology in European languages (e.g. Mark, Smith, & Tversky, 1999; Wartmann, Egorova, Derungs, Mark, & Purves, 2015; Williams, Kuhn, & Painho, 2012). One recent example, which has also resonated with the public, is work by Macfarlane (2015), who collected over a thousand ‘terms for the land’ used in different British dialects and languages. The terms range from those describing small-scale landscape features such as *smeuse* (‘the gap in the base of a hedge made by the regular passage of a small animal’), to entire landscapes, for example, the expression *gruffy ground*, referring to the surface landscape left behind by lead-mining in Somerset (Macfarlane, 2015). Such landscape terms thus carve out identifiable units from a landscape infused with cultural meaning and significance. Investigating landscape terms thus fulfills an important requirement of cultural ecosystem service assessments, namely, the identification of units based on local understandings of groups of people to which cultural, as well as other values can be assigned (Kirchhoff, 2012).

So far, little research has focused on identifying landscape terms and investigating differences in sense of place as a cultural ecosystem service between different landscapes. In this paper, we address this gap by investigating the following research questions:

- How are different landscapes described by visitors *in situ* and to what extent is sense of place expressed in these descriptions?
- What methods are suitable for eliciting and analyzing such information?
- To what extent do these descriptions capture formal landscape classifications?

In addressing these questions, we aim to develop and empirically test a set of methods for eliciting descriptions of sense of place and comparing those between different landscapes. The originality of our approach lies in the combination of qualitative and quantitative approaches revolving around language to compare different landscapes based on the identified landscape terms, and in building a semantically rich understanding of sense of place based on language. We explore these questions through empirical work studying visitors’ descriptions of five contrasting landscape types in Switzerland. Given the multitude of theoretical conceptualizations and empirical approaches for studying people-place relations, in the following, we provide an overview of related literature and outline the conceptual framework we adopted in this paper.

2. Background

The relation between people and places has received considerable attention in different research areas. A myriad of different concepts, definitions and approaches exist between and even within research fields. To situate our own research within the broader theoretical debate, we introduce concepts and approaches that have been applied for studying people-place relations. To aid readability, we broadly divide our literature review into three main research areas: environmental psychology, human geography and social anthropology.

2.1. Measuring place attachment, identity, dependence and sense of place in environmental psychology

In environmental psychology, there has been much debate about definitions and concepts of how people relate to place (Altman & Low, 1992; Droseltis & Vignoles, 2010; Hidalgo & Hernández, 2001; Jorgensen & Stedman, 2001; Kyle, Graefe, & Manning, 2005; Lewicka, 2011; Manzo, 2003; Proshansky, Fabian, & Kaminoff, 1983; Williams, 2014; Williams & Vaske, 2003). Four major concepts recur in this body of literature: place identity, place dependence, place attachment, and sense of place, which we briefly introduce in the following.

Place identity was defined as that part of our identity that relates to place (Proshansky, 1978). Other conceptualizations of place identity include the notion of ‘place-referent continuity’, the process by which people maintain continuity of their identity via specific places that are of emotional significance to them, and ‘place-congruent continuity’, as the generic and transferable characteristics of places that help maintain continuity (Twigger-Ross & Uzzell, 1996). The concept of place dependence captures how a place can be important because of its functional value (Stokols & Shumaker, 1981). For example, people may depend on a place because it allows them to realize particular recreational activities (Jorgensen & Stedman, 2001; Moore & Graefe, 1994). Altman and Low (1992) conceptualized place attachment as containing emotional components (affect, feeling, emotions), cognitive elements (thoughts, knowledges, beliefs) and practices (actions and behavior). The fourth concept, sense of place, was considered by Jorgensen and Stedman (2001) as an umbrella concept subsuming place identity, dependence and attachment.

Despite considerable theoretical and empirical work, the hierarchical organization of these concepts and their linkage remains controversial (Giuliani & Feldman, 1993; Hernández, Carmen Hidalgo, Salazar-Laplace, & Hess, 2007; Hidalgo & Hernández, 2001). One critique of this body of literature is that perhaps less attention has been paid to the concept of place with respect to the specific objects or features in a place or landscape to which people are attached (Hidalgo & Hernández, 2001; Jorgensen & Stedman, 2011; Lewicka, 2011).

2.2. Space, place and sense of place in human geography

Human geography has a long history of theorizing space, place, and sense of place (c.f. reviews by Campbell, 2016; Cresswell, 2006;

Hubbard & Kitchin, 2010). Early work by Tuan (1977) introduced the dichotomy of abstract space versus meaningful place, arguing that places can have a personality or a spirit (akin to the *genius loci* in Ancient Rome, c.f. Vergil's Aeneid (5, 95)), but that only people can have a sense of place (Tuan, 1977). For the affective bond between people and places the term 'topophilia' was introduced (Tuan, 1974). Although Tuan's interest was on people-place bonds, he focused less on the properties of places as such. Agnew (1987), puts more emphasis on these properties by defining three aspects: location as the site in space an object is located, locale as the setting where social life and interactions take place, and sense of place as the identification with a place and a strong sense of belonging (Agnew, 1987). In this literature, sense of place has often been associated with ideas revolving around a sense of belonging developing over time. Massey, however, cautions against interpretations of place as belonging to seemingly homogenous 'local communities', because such thinking can lead to the exclusion of people considered outsiders (Massey, 1994). Instead, she introduces the notion of a 'global sense of place', where places are 'moments in networks of social relations and understandings, but where a large proportion of those relations, experiences and understandings are constructed on a far larger scale than what we happen to define for that moment as the place itself, whether that be a street, or a region or even a continent.' (Massey, 1994, p. 154).

2.3. Between space and place: The notion of landscape and sense of place in anthropology

Research in social and cultural anthropology has also theorized notions of space and place (Low, 2009; Low & Lawrence-Zúñiga, 2003). The concept of landscape has in this context been the subject of both theoretical and empirical work, as it occupies an intermediary position between abstract physical space and place imbued with meanings. Here the focus is on the experienced landscape as constituting and being constituted by cultural processes (Feld & Basso, 1996; Hirsch & O'Hanlon, 1995). Feld and Basso (1996, p. 11) thus define sense of place as: '[...] the experiential and expressive ways places are known, imagined, yearned for, held, remembered, voiced, lived, contested and struggled over [...]'. Apart from theoretical considerations of landscape, social and cultural anthropologists have empirically explored concepts of space, place, and sense of place through ethnographic work (Basso, 1996; Hirsch & O'Hanlon, 1995). For example, Basso (1996) describes the intricate relationships Western Apache people foster with landscapes, highlighting the links between landscape features (such as hills, trees and trails), and the cultural notions people attach to these features. In his ethnography, Basso pays attention to the importance of language in the form of stories and narratives in giving cultural meaning to landscape features recognized in the local language (Basso, 1996). It is this intersection between language, landscape and culture that is the focus of study for landscape ethnoecologists (Johnson & Hunn, 2010), where landscape is seen as encompassing both the biological and physical aspects of the land such as soil, rocks, vegetation and water bodies, as well as people's perception, interpretation and interaction with these landscape features (in part, through the language used to identify and communicate about them), and the cultural notions ascribed to these landscape features (Johnson, 2000; Johnson & Hunn, 2010).

2.4. Conceptual framework for this study

Given our focus on the terms people use to describe different landscapes and the cultural and personal meanings these landscapes have for them, we use the notion of landscape as an intermediary between the concepts of space and place, a referent having both a *physical materiality* consisting of perceived landscape features (mountains, hills, trails etc.) and the *meanings* that people ascribe to these features. This notion reflects Agnew's tripartite concept of place containing material

properties and the meanings people ascribe to them, and is consistent with the definition of landscape by Johnson and Hunn (2010, p. 1):

"We emphasize landscape as perceived and imagined by the people who live in it, the land seen, used and occupied by the members of a local community. It is a cultural landscape".

However, in our case, we focus on the landscape as perceived and described not by a defined 'local' community, but by visitors to a landscape, who are directly experiencing a place (and not, for instance, talking or writing about it after their visit). In line with previous empirical studies (Jorgensen & Stedman, 2001; Kyle & Chick, 2007) we use sense of place as an umbrella concept that subsumes a variety of related concepts previously reported in the literature, such as place identity, dependence and attachment. By explicitly including the physical environment, our theoretical framework is commensurable with theoretical approaches of place meaning that consist of the poles 'self-others-environment' (Gustafson, 2001), or 'personal-social-physical' (Sixsmith, 1986). The novelty of our approach lies in using the lens of language to investigate which terms people use to express their sense of place, and how these differ in different landscapes. In the following, we now describe how we implemented this conceptual framework for an empirical study in Switzerland.

3. Methods

3.1. Study sites

We chose five landscape types informed by the official landscape typology for Switzerland (ARE, 2011a). This typology is mostly based on geological, geomorphological and land cover criteria that were defined by experts and modelled in a Geographic Information System to arrive at a map of landscape types for Switzerland (ARE, 2011b). Based on this typology consisting of 38 fine-grained landscape types, we defined five broad landscape types at a more aggregated level that capture a variety of Swiss landscapes: mountain, moor, hill, river and urban lake landscape. For each type of landscape, we selected two locations as study sites, which had to be accessible by public transport and hiking paths. Site selection was based on our knowledge of sites offering vistas of the surrounding landscape that were also popular with visitors. In a pilot study, we tested whether visitor frequencies on sunny summer days were above a threshold of 5 visitors in one hour of presence at the study site to be able to conduct our interviews in a time and cost-efficient manner. Using this threshold, we replaced one study site with visitor numbers below our threshold. As this study focuses on descriptions in Swiss German, a continuum of Alemannic dialects spoken in the German-speaking part of Switzerland (Ris, 1979), we selected ten sites in the German-speaking part of Switzerland. Our study sites (Table 1, Fig. 1) thus allow us to compare how people describe landscapes and their sense of place in different landscape types.

3.2. Data collection

Fieldwork took place between 28th of June and 2nd of September 2016 on sunny and mostly cloud free days between 9AM and 6PM. All interview locations provided views at the *vista space* scale of perception (Montello, 1993), that is a space comprehended from a single vantage point without locomotion. At each site, we pragmatically selected 30 visitors, while attempting to sample different age groups and achieve gender-balance. Most participants in our sample were walking, hiking or strolling, and a few people were cycling. We included only speakers of Swiss German dialects in our sample, excluding native speakers of other languages. In every location, we approached visitors and asked them if they were willing to take part in the study. Given oral consent, we first conducted a free-listing task, followed by a structured interview on sense of place. To ensure consistency, all interviews were conducted in Swiss German by the first author who is a native speaker. Using this

Table 1
Study locations and formally defined landscape types according to ARE (2011a).

Location	Landscape type
Oeschinensee	Limestone mountain landscape of the Alps
Seetalpsee	Limestone mountain landscape of the Alps
River Reuss, Bremgarten	River landscape
River Thur, Thurauen	River landscape
Robenhuserriet, Pfäffikon	Moor-influenced landscape
Ägerried, Rothenthurm	Moor-influenced landscape
Ufshötti, Lake Lucerne	Urban landscape [with lake]
Zürichhorn, Lake Zurich	Urban landscape [with lake]
Hochwacht, Lägern	Landscape of hills of the Central Plateau with a focus on forage production
Hochwacht, Pfannenstiel	Landscape of hills of the Central Plateau with a focus on agricultural production

protocol, we conducted free-listing tasks and interviews with a total of 300 participants (156 men and 144 women, Table 2).

3.2.1. Free-listing tasks on landscape terms

Free listing is a common method in cognitive psychology for eliciting terms for a cognitive domain and has been successfully applied to elicit terms related to landscapes (Mark et al., 1999; Williams et al., 2012) as well as cultural ecosystem services (Bieling, Plieninger, Pirker, & Vogl, 2014). Based on a previous study using free listing for eliciting landscape terms in Switzerland (Wartmann et al., 2015), we used the Swiss-German elicitation statement: ‘Was hätts für Sie i dere Landschaft?’ (lit. ‘what is there for you in this landscape?’). Participants were instructed to list anything that came to their mind, and that there were no right or wrong answers. The interviewer transcribed all terms listed. Participants indicated when they had finished the task. From the free-listing task, we expected mostly terms for landscape features and perceptual aspects. However, previous research showed that participants use memory search strategies during free listing tasks that involve associations between terms (Wartmann et al., 2015). Thus, we expected participants to also list terms related to sense of place they associated with particular landscape features (Bieling et al., 2014; Wartmann et al., 2015).

3.2.2. Interviews on sense of place

After the free-listing task, we conducted structured interviews with participants to elicit information about sense of place. We first asked participants to describe the meanings they attached to the landscape they found themselves in. A second question focused on feelings they had while being in the landscape. The interviews concluded with a set of questions about their place of residence, the frequency of their visits, (classified as 1st time visitor, one or more visits per week, per month, per year, or every other year and less), and the activity they were doing in the landscape the day of the interview. Finally, participants indicated the age class they belonged to (Table 2). Once again, the interviewer transcribed the interviews.

3.3. Data analysis

We analyzed our data using a combination of qualitative and quantitative approaches. In the following, we describe the methods used for analyzing the data from the free-listing tasks on landscape terms as well as the interviews on sense of place. We used non-parametrical statistical tests with a significance level of $\alpha = 0.05$ to assess the significance of differences between multiple groups. In case of significant differences, we used a post hoc test, correcting for multiple comparisons of means using an adapted significance level p^a after the Bonferroni method (Dunn, 1961).

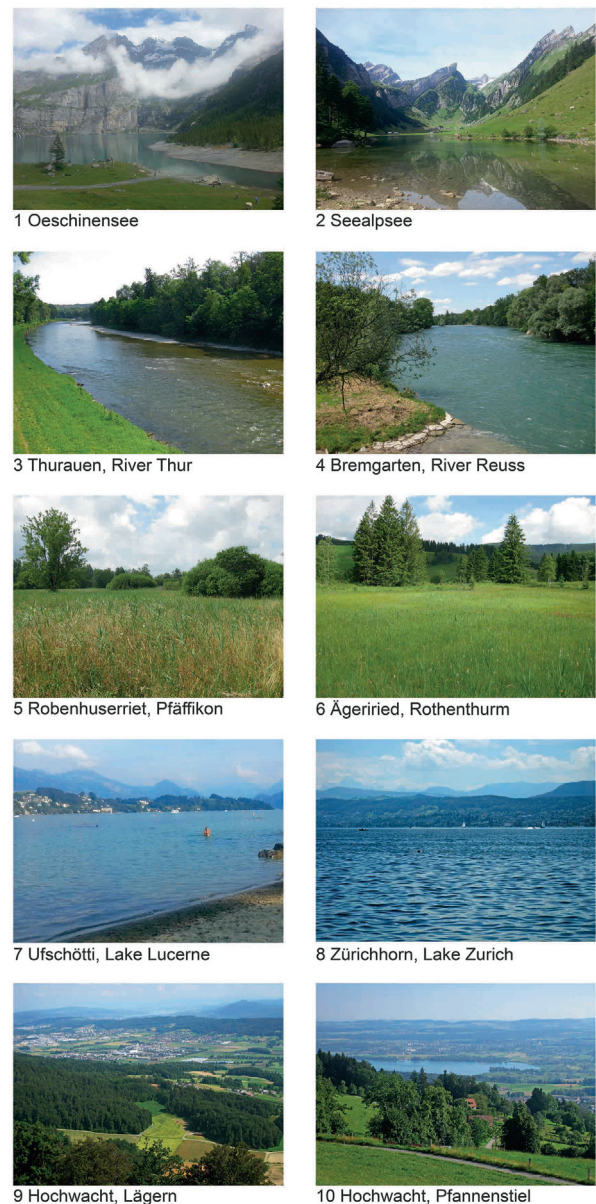
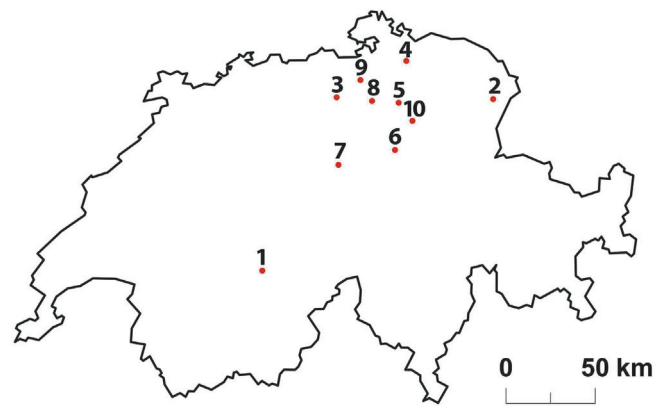


Fig. 1. Map of the distribution of study sites in Switzerland.

3.3.1. Comparing free-listing data on landscape terms

We first assessed the influence of the factors of gender, visitation frequency and age group on the number of terms listed. We then tested for differences between different formally defined landscape types. To

Table 2
Age and gender distribution of interview participants.

Age group	Male	Female	Total
18–24	6	11	17
25–34	18	25	43
35–44	33	23	56
45–54	26	24	50
55–64	30	21	51
65+	37	30	67
Age not indicated	5	11	16
Total	155	145	300

analyze the free listing data in more detail we calculated Sutrop’s index, which combines frequency and mean rank of terms into a single measure of cognitive saliency (Sutrop, 2001) calculated as

$$S = F/(NR) \tag{1}$$

where F is term frequency, N is the number of participants, and R is the mean rank. Terms mentioned by many participants and always at the beginning of a list thus approach a maximum salience value of 1, whereas terms mentioned only by few participants towards the end of free lists approach a salience value of 0. Sutrop’s index has been used as a quantitative measure for analyzing free lists from different domains related to landscape and cultural ecosystem services (Bieling et al., 2014; Wartmann et al., 2015). To quantitatively compare landscapes based on terms from free lists we used cosine similarity from statistical natural language processing (Manning & Schütze, 1999). We first filtered out common stop words such as prepositions, pronouns, definite and indefinite articles and conjunctions (Koch, 2007). To calculate cosine similarity, the text in a document is represented as a vector of terms, which is compared to the vector representing another text document using the cosine of the angle as a numeric measure of similarity, calculated as

$$\frac{AB}{|A||B|} \tag{2}$$

where A and B are two vectors representing term presence. A cosine similarity values of 1 means the two vectors are identical and a value of 0 that no terms overlap between the vectors (Singhal, 2001). We then compared the documents representing the ten sites, resulting in a 10 × 10 matrix and tested for significant differences in free listing descriptions within and between landscape types.

3.3.2. Comparing interview data on sense of place in different landscape settings

Comparing sense of place descriptions using term frequencies proved difficult, because synonymous or semantically strongly related terms were considered separately, leading to low term frequencies of single terms despite their semantic relatedness. Using qualitative analysis, we therefore identified recurrent topics (‘facets’) from semantically related themes in the data through open coding followed by structured coding (Crang & Cook, 2007). Such an approach has been applied for conceptually structuring interview data on place meanings before, resulting in 27 topics identified from the data (Gustafson, 2001). Our approach was similar, in so far as in the open coding phase, we read the interview transcripts several times and coded their content to arrive at themes that emerging from participants’ descriptions of sense of place. In this initial phase, the coding was highly descriptive and the codes were often terms used by the participants (e.g. ‘home’, ‘relaxation’, ‘meeting friends’). After several iterations, the codes were gradually merged into broader, more analytical categories. For example, the interview statements ‘contrast to stressful everyday life’, ‘meditation’ and ‘local recreation’ were aggregated into the facet of ‘sense of relaxation for spirit and mind’. Following this process, we identified twelve facets of sense of place (Table 3). We label these facets with

Table 3
Identified facets of sense of place.

Facets of sense of place
Sense of tranquility
Sense of awe, wonder and appreciation
Sense of nature, connection to nature and landscape
Sense of a living landscape
Sense of a wild, pristine and enduring landscape
Sense of relaxation for spirit and mind
Sense of identity and belonging
Sense of community
The sensed landscape
Sense of joy, happiness and pleasure
Sense of freedom
Other

English expressions that we believe best reflect their content. We then used these facets for structured coding of all our interview data, and compared mentions of different facets as an indicator of category strength across sites.

In a final step, we compared descriptions of sense of place between sites based on the terms they contained, without imposing the conceptual structure of the facets of sense of place. For each site, we thus aggregated all interview transcripts to the questions on meanings and feelings associated with the landscape from all participants into one document. We then again used stop word filtering and the measure of cosine similarity to compare these documents between sites (Manning & Schütze, 1999).

4. Results and interpretation

In the first part of the results section, we describe the results from the free listing task, focusing on cognitively salient landscape terms and comparing landscape descriptions with text processing. In the second part, we highlight how people in different landscape settings describe their sense of place. We present different facets of sense of place that emerged from the data and compare those across sites, before also quantitatively comparing cosine similarity of sense of place descriptions between sites.

4.1. Comparing free listings between landscapes

Mountain landscapes had the highest mean number of free listing terms per participant, followed by river landscapes (Table 4). The moor and lake landscapes had the lowest mean number of free list terms, and differences between landscape types were significant, $H(4, N = 300) = 17.90, p = .001$. Mountain landscapes contained significantly more terms than moor landscapes, $U = 3.05, p = 0.002$, and lake landscapes, $U = -3.72, p < .001$. This shows that for visitors, mountain landscapes seem to bring about more associations and terms than other landscapes such as moors or lakes.

At all study sites, the cognitive salience values showed a Zipfian distribution with few highly salient terms shared among participants and a long-tail of low saliency, with many terms being mentioned by only one participant. The most salient terms for each study site contained many terms for landscape features, such as *Berg* (mountain),

Table 4
Mean values of free list terms per participant across landscape types.

Landscape type	Mean	N	St.Dev.	Sum
Mountain landscapes	11.82	60	4.073	709
River landscapes	10.67	60	4.201	640
Moor landscapes	9.63	60	3.645	578
Lake landscapes	9.23	60	5.561	554
Hill landscapes	10.33	60	4.394	620
Total	10.34	300	4.483	3101

Table 5
Ten terms with highest cognitive salience index (after Sutrop, 2001) per study site.

Oeschinensee	Seelipsee	Bremgarten	Thurauen	Pfäffikersee
See (lake)	Berge (mountains)	Wasser (water)	Wasser (water)	Bäume (trees)
0.1141	0.1399	0.2013	0.1605	0.1500
Felsen (rocks, cliffs)	See (lake)	Fluss (river)	Steine (rocks)	Schiff (reed)
0.0840	0.1233	0.1846	0.0667	0.1452
Wasserfälle (waterfalls)	Schnee (snow)	Bäume (trees)	Vögel (birds)	Blumen (flowers)
0.0771	0.0949	0.1444	0.0621	0.1186
Gletscher (glaciers)	Wasser (water)	Mücken (mosquitoes)	Bäume (trees)	Vögel (birds)
0.0602	0.0821	0.0667	0.0595	0.1047
Berge (mountains)	Kühe (cows)	Wald (forest)	Natur (nature)	Moorlandschaft (moor landscape)
0.0672	0.0751	0.0500	0.0571	0.0667
Hohlrüli*	Säntis*	Welle (wave)	Fluss (river)	Sträucher (shrubs)
0.0667	0.0686	0.0490	0.0481	0.0595
Wald (forest)	Felsen (rocks, cliffs)	Brücke (bridge)	Wald (forest)	Tiere (animals)
0.0553	0.0569	0.0474	0.0444	0.0593
Steine (stones)	Ruhe (tranquility)	Asylheim (refugee center)	Ruhe (tranquility)	Natur (nature)
0.0750	0.0517	0.0444	0.0397	0.0571
Wasser (water)	Seealpsee*	Vögel (birds)	Tiere (animals)	grün (green)
0.0508	0.0500	0.0347	ruhig (quiet, tranquil)	Pflanzen (plants)
Bäume (trees)	Natur (nature)	Sand (sand)		
0.0398	0.0410	0.0333		

Rothenurm	Lake Lucerne	Lake Zurich	Lägern	Pfannenstiel
Blumen (flowers)	See (lake)	Berge (mountains)	Weite (vastness)	See (lake)
0.1090	0.1742	0.1307	0.0889	0.1707
Moor (moor)	Wasser (water)	Wasser (water)	Wald (forest)	Wald (forest)
0.0960	0.1524	0.1067	0.0840	0.0926
Orchideen (orchids)	Berge (mountains)	See (lake)	Zürichsee*	Greifensee*
0.0646	0.1053	0.0646	0.0771	0.0833
Bäume (trees)	Hügel (hills)	Bäume (trees)	Berge (mountains)	Berge (mountains)
0.0643	0.0522	0.0521	0.0747	0.0762
Birken (birches)	Wald (forest)	Schiffe (ships)	See (lake)	Bäume (trees)
0.0583	0.0509	0.0444	0.0730	0.0742
Vögel (birds)	Schiff (ship)	Fische (fish)	Uetliberg*	Seen (lakes)
0.0495	0.0500	0.0444	0.0529	0.0710
Wald (forest)	Stadt (city)	Walken (clouds)	Aussicht (view)	Dörfer (villages)
0.0441	0.0439	0.0381	0.0500	0.0563
Moorlandschaft (moor landscape)	Sstrand (beach)	Himmel (sky)	Albberg*	Hügel (hill, hills)
0.0429	0.0403	0.0333	0.0429	0.0500
landscape	Baustelle (construction site)	Alpen (Alps)	Hügel (hill, hills)	Wälder (forests)
0.0417	0.0333	0.0333	0.0397	0.0444
Hochmoor (hill moor, raised bog)	frische Luft (fresh air)	bewaldete Hügel (forested hills)	besonders (special)	Zürichsee*
0.0400	0.0333	0.0333	0.0333	0.0379

terms marked with * are vernacular place names

Fluss (river), See (lake), Wald (forest), terms describing fauna and flora, including Vögel (birds), Tiere (animals), or Orchideen (orchids), but few of the highly salient terms related to sense of place (Table 5). At the sites Lägern and Pfannenstiel, some place names were also salient (Table 5).

According to the cosine similarity measure that compares how similar free lists from one site were to another site based on the terms they contained, the hill landscape at Lägern and the river landscape at River Reuss were the least similar in terms of the free lists, while the two hill landscapes Lägern and Pfannenstiel were most similar (Table 6). Across all study sites, mean cosine similarity values from sites within the same landscape type were significantly higher ($M = .62$, $SD = .02$) than between sites from different landscape types ($M = .34$, $SD = .12$), $U = -3.61$, $p < .001$, demonstrating that free lists, which appear to commonly contain terms for physical features of a landscape, capture well variation between formally defined landscape types.

4.2. Comparing descriptions of sense of place from interviews between landscapes

We assessed differences in the total number of terms mentioned in interviews about sense of place and found no significant differences between men and women, $U = -.184$, $p = .85$, or between groups with different visitation frequencies $H(4, N = 300) = 4.06$, $p = .40$. However, in contrast to free lists, the number of terms in interviews about sense of place differed significantly between age groups $H(5, N = 300) = 11.14$, $p = .049$. Participants aged 25 to 34 used significantly less terms ($M = 2.88$, $SD = 1.61$, $n = 42$) than participants aged 55 to 64 ($M = 4.18$, $SD = 2.16$, $n = 51$), $H(5, N = 300) = -3.06$, $p = .002$ to describe their sense of place.

Some terms were consistently mentioned across study sites and with high frequency (Table 7). For example, Ruhe (tranquility) was among the ten most frequent terms in all ten study sites, and at four sites it was the most frequently mentioned term in interviews. Heimat (home, belonging) was prominently mentioned in eight of ten study sites, as was Erholung (relaxation).

To analyze the content of interviews in more detail, we consolidated twelve categories from our data that encompass different facets of sense of place. We first illustrate the identified facets with examples from interviews, which serves both as a way of structuring the semantically rich content and to compare facets of sense of place between different landscapes. Finally, similar to the free listing descriptions, we quantitatively compare sense of place descriptions using text processing between sites in the same and in different landscape types.

4.2.1. Comparing landscapes based on facets of sense of place from interviews

In the following, we outline the identified facets of sense of place, illustrating each with examples from interviews (Table 8) and comparing them across sites (Fig. 2). We now describe briefly some key

properties of five prominent facets identified in our interview data.

As can be seen in Fig. 2, the facet capturing a sense of relaxation, and a landscape appealing to spirit and mind is perhaps the most pronounced, encompassing terms including Energie tanken (recharge one's batteries), Entkommen von der Realität (escape from reality), or Meditation (meditation). It was the facet containing most terms at all study sites except at Seealpsee (mountain landscape) and Lägern (hill landscape). There were no significant differences between number of terms coded as this facet between landscape types, $H(4, N = 300) = 6.79$, $p = .15$.

The facet of a sense of identity and belonging was prominent across study sites. Many interviews included the term Heimat, which can be best translated as a sense of home or belonging, ein Stück weit Heimat (a bit of home), and Heimatgefühle (feeling of home, feeling of belonging). Others relate to how the landscape makes participants feel patriotic or reminds them of traditions. Some participants used the term urchig, which expresses a sense of a local rootedness. At Seealpsee and at Lägern, this facet was the one containing most interview terms (Fig. 2). The mean number of terms per participant for this facet was highest in the mountain landscapes, followed by the hill landscapes, and lowest in the moor landscapes. Differences between landscape types were significant $H(4, N = 300) = 30.541$, $p < .001$. Mountain landscapes were described with significantly more terms for this facet than river, $U = -3.39$, $p < .001$, or moor landscapes, $U = -4.49$, $p < .001$. Interviews in mountain landscapes often contained references to Switzerland, or 'typically Swiss', which highlights the role of iconic mountains in shaping visitor's sense of identity. Lake landscapes contained significantly more mentions of a sense of identity and belonging than moor landscapes $U = -3.66$, $p < .001$. Also, hill landscapes had higher mentions of sense of identity than river landscapes, $U = -2.98$, $p = .003$, and moor landscapes, $U = -4.09$, $p < .001$.

The facet of a sense of tranquility was prominent at all study sites. This facet contains terms that relate to quietness, silence, the absence of traffic and other noises perceived as disturbing, as well as a feeling of solitude. Participants often contrasted those aspects of a landscape to their own stressful everyday life. Examples for this facet include Oase der Ruhe (oasis of tranquility) and Stille der Berge (silence of the mountains). Terms relating to this facet were most frequently mentioned by visitors to the moor landscapes at Ägerried and Robenhuserriet (Fig. 2). Differences between landscape types in the facet of sense of tranquility were not significant $H(4, N = 300) = 4.96$, $p = .29$.

The facet of the sensed landscape includes perceptual aspects of landscapes that contributed to sense of place, ranging from landscapes perceived as lovely or beautiful with examples such as landschaftliche Schönheit (landscape beauty), and lieblich (lovely). Other expressions that allude to perception include Harmonie von der Landschaft (harmony of the landscape), or eine Augenweide (a feast for the eyes). Differences between landscape types were not statistically significant $H(4, N = 300) = 1.63$, $p = .80$.

Table 6 Matrix of cosine similarity values between free listings across different sites.

	Oeschinensee	Seealpsee	River Reuss	River Thur	Robenhuserriet	Ägerried	Lake Lucerne	Lake Zurich	Lägern	Pfannenstiel
Oeschinensee	1	0.6469 [†]	0.2673	0.2568	0.2520	0.1980	0.5973	0.5247	0.4114	0.5227
Seealpsee	0.6469 [†]	1	0.3111	0.3379	0.2683	0.2493	0.5521	0.5048	0.3583	0.4701
River Reuss	0.2673	0.3111	1	0.6577 [†]	0.3961	0.3968	0.3409	0.3243	0.1744	0.3213
River Thur	0.2568	0.3379	0.6577 [†]	1	0.5064	0.4416	0.3452	0.2864	0.1832	0.3471
Robenhuserriet	0.2520	0.2683	0.3961	0.5064	1	0.6159 [†]	0.2792	0.2724	0.1321	0.2960
Ägerried	0.1980	0.2493	0.3968	0.4416	0.6159 [†]	1	0.2598	0.2571	0.2418	0.3625
Lake Lucerne	0.5973	0.5521	0.3409	0.3452	0.2792	0.2598	1	0.6831 [†]	0.5808	0.6494
Lake Zurich	0.5247	0.5048	0.3243	0.2864	0.2724	0.2571	0.6831 [†]	1	0.4923	0.5816
Lägern	0.4114	0.3583	0.1744	0.1832	0.1321	0.2418	0.5808	0.4923	1	0.7085 [†]
Pfannenstiel	0.5227	0.4701	0.3213	0.3471	0.2960	0.3625	0.6494	0.5816	0.7085 [†]	1

In each row, the highest value is marked with [†].

Table 7
Ten most frequent terms in sense of place descriptions per study site.

Oeschinensee	Seealpee	River Reuss	River Thur	Robenhuserriet	Ägerried	Lake Lucerne	Lake Zürich	Lägern	Pfannenstiel
<i>Heimat</i> (home, belonging)	5 <i>Ruhe</i> (tranquility)	11 <i>Ruhe</i> (tranquility)	6 <i>Erholung</i> (relaxation)	7 <i>Ruhe</i> (tranquility)	8 <i>Ruhe</i> (tranquility)	7 <i>Heimat</i> (home, belonging)	9 <i>beruhigend</i> (relaxing)	3 <i>Heima</i> (home, belonging)	6 <i>Heimat</i> (home, belonging)
<i>Ruhe</i> (tranquility)	4 <i>Erholung</i> (relaxation)	9 <i>Natur</i> (nature)	4 <i>Heimat</i> (home, belonging)	6 <i>Erholung</i> (relaxation)	7 <i>Erholung</i> (relaxation)	4 <i>Ruhe</i> (tranquility)	7 <i>Entspannung</i> (relaxation)	2 <i>daheim</i> (at home)	4 <i>Erholung</i> (relaxation)
<i>Erholung</i> (relaxation)	3 <i>Heimat</i> (home, belonging)	9 <i>ruhig</i> (tranquil)	4 <i>Ruhe</i> (tranquility)	4 <i>abschalten</i> (unwind)	3 <i>Natur</i> (nature)	4 <i>Erholung</i> (relaxation)	4 <i>Erholung</i> (relaxation)	2 <i>Ruhe</i> (tranquility)	3 <i>Ruhe</i> (tranquility)
<i>typisch für die Schweiz</i> (typical for Switzerland)	3 <i>Natur</i> (nature)	5 <i>entspannt</i> (relaxed)	5 <i>Naherholungsgebiet</i> (local recreation area)	3 <i>Frieden</i> (peace)	3 <i>ruhig</i> (tranquil)	4 <i>ein Teil vom Zuhause</i> (a part of home)	2 <i>Freiheit</i> (freedom)	2 <i>Weite</i> (vastness)	3 <i>Heimatgefühl</i> (feeling of belonging, of home)
<i>heile Welt</i> (ideal world)	2 <i>ein bisschen Heimat</i> (a little bit home)	3 <i>beruhigend</i> (calming)	2 <i>Natur</i> (nature)	3 <i>fridlich</i> (peaceful)	3 <i>Naherholung</i> (local recreation)	3 <i>Freizeit</i> (leisure)	2 <i>Freude</i> (joy)	2 <i>befreiend</i> (relieving)	2 <i>beruhigend</i> (calming)
<i>einfach schön</i> (just beautiful)	2 <i>Freiheit</i> (freedom)	3 <i>bin hier aufgewachsen</i> (grew up here)	2 <i>ruhig</i> (tranquil)	3 <i>auffanken</i> (recharge)	2 <i>beruhigend</i> (calming)	2 <i>keine</i> (none)	2 <i>frische Luft</i> (fresh air)	2 <i>beruhigend</i> (calming)	2 <i>Erholungsgebiet</i> (recreation area)
<i>Kindheits Erinnerungen</i> (childhood memories)	2 <i>Freude</i> (joy)	3 <i>entspannend</i> (relaxing)	4 <i>Entspannung</i> (relaxation)	2 <i>Entspannung</i> (relaxation)	2 <i>Entspannung</i> (relaxation)	2 <i>schön</i> (beautiful)	2 <i>gesundheitslich gut</i> (beneficial healthwise)	2 <i>Heimatgefühl</i> (feeling of belonging, of home)	2 <i>Freiheit</i> (freedom)
<i>Kraftort</i> (spiritual site, place of power)	2 <i>schön</i> (beautiful)	3 <i>Erholungsgebiet</i> (recreation area)	2 <i>Feierabend</i> (after work time)	2 <i>Erholungsgebiet</i> (recreation area)	2 <i>Heimat</i> (home, belonging)	2 <i>fast Ferien</i> (almost holidays)	2 <i>Heimat</i> (home, belonging)	2 <i>Kindheit</i> (childhood)	2 <i>Natur</i> (nature)
<i>Kuhgebimmel</i> (ringing of cowbells)	2 <i>Schweiz</i> (Switzerland)	3 <i>Erholungszone</i> (recreation zone)	2 <i>fühl mich wohl</i> (feel comfortable)	2 <i>Erholungsraum</i> (recreation space)	2 <i>schön</i> (beautiful)	2 <i>zweiter Garten</i> (second garden)	1 <i>Kindheits Erinnerungen</i> (childhood memories)	2 <i>schön</i> (beautiful)	2 <i>Frieden</i> (peace)
<i>Naherholung</i> (local recreation)	2 <i>Zufriedenheit</i> (contentment)	3 <i>finde es schön</i> (find it beautiful)	2 <i>idyllisch</i> (idyllic)	2 <i>Heimat</i> (home, belonging)	2 <i>wild</i> (wild)	2 <i>abschalten</i> (unwind)	1 <i>Ruhe</i> (tranquility)	2 <i>abschalten</i> (unwind)	1 <i>frische Luft</i> (fresh air)

Table 8
Examples of facets of sense of place from interview data.

Facets of sense of place	Transcribed examples in German from interview data	English glosses
Sense of tranquility	<i>Berge sind ein Ruhepol</i>	mountains are a calm anchor
	<i>einsam Einsamkeit für sich sein alleine sein Oase der Ruhe Ruhe Stille der Berge stille Plätze Stille</i>	alone, lonely solitude, loneliness to be with oneself to be alone oasis of tranquility tranquility silence of the mountains silent, tranquil spots silence
Sense of awe, wonder and appreciation	<i>Dankbarkeit, dass wir das sehen dürfen Ehrfurcht einzigartig fasziniert mich Staunen überwältigt sein Überwältigung ungewohnt wertvoll wie klein der Mensch im Vergleich zur Natur und zu den Bergen ist</i>	gratefulness that we can see this awe unique fascinates me astonishment to be awed overpowering unusual precious how small a person is compared to nature and the mountains
	<i>die Landschaft gehört zu mir dazu Gefühl in der Natur zu sein Natur wie sie ist Naturbeobachtungen Naturverbundenheit ohne Landschaft kann ich nicht leben viel Natur</i>	the landscape is a part of me feeling of being in nature nature as it is nature observations connection to nature I cannot live without the landscape a lot of nature
Sense of a living landscape	<i>kraftvolle Natur Landschaft mit Seele launisch Lebensfluss Macht der Berge</i>	powerful nature landscape with soul fickle stream of life the power of the mountains
	<i>ein Stück Ewigkeit</i>	a piece of eternity
Sense of a wild, pristine and enduring landscape	<i>etwas Ursprüngliches das noch erhalten ist heile Welt Natur erhalten Naturschutz nicht verbaut Schutz schützenswert unberührt Unberührtheit unveränderter Ursprung Ursprung ursprünglich wild Wildnis</i>	something pristine that is still conserved ideal world conserve nature nature conservation not built in protection worthy of protection pristine unspoiled state unchanged origin origin original wild wilderness
	<i>beruhigend Energie tanken Entkommen von der Realität Entschleunigung vom Alltag Entspannung geistiger Wert Gelassenheit gute Energie Kontrast zum stressigen Alltag Kraft Meditation Naheholung</i>	relaxing, calming recharge one's batteries escape from reality deceleration from everyday life relaxation mental value, spiritual value serenity, calm good energy contrast to stressful everyday life energy, strength, power meditation local recreation

Table 8 (continued)

Facets of sense of place	Transcribed examples in German from interview data	English glosses
Sense of identity and belonging	<i>Schöpfung Spirituelles tut der Seele gut weg vom Alltag Wohlfühloase zum Nachdenken</i>	creation spiritual good for the soul away from everyday life oasis of well-being for contemplating
	<i>ein bisschen Heimat ein Stück weit Heimat Heimat Heimatgefühle identifizierend für den ganzen Kanton kam als Kind schon hierher, jetzt komme ich mit meinen eigenen Kindern kenne diesen Ort schon sehr lange Kindheitserinnerungen meine Eltern sind von hier Patriotismus Stolz, hier aufgewachsen zu sein</i>	a little like home a bit of home home, sense of belonging sense of home, sense of belonging identifying for the entire canton came here as a child, now I come with my own children already know this place for a long time childhood memories my parents are from here patriotism proud to have grown up here part of Switzerland utterly Swiss tradition typical for Switzerland (idiom) locally rooted
Sense of community	<i>Teil der Schweiz total schweizerisch Tradition typisch Schweiz urchig</i>	
	<i>bin gerne mit Kollegen hier Familie Freunde freundliche Menschen Gefühl von Gemeinschaft Jugend mit Kollegen Mentalität der Leute Vielfältigkeit der Leute Völkerverständigung</i>	like to be here with my friends family friends friendly people sense of community youth together with friends mentality of the people diversity of people understanding among nations
The sensed landscape	<i>eine Augenweide einfach schön frische Luft Geruch Harmonie von der Landschaft Idylle Kuhglocken landschaftliche Schönheit lieblich Schönheit abwechslungsreich sinnlich Vogelgezwitscher wohltuend fürs Auge</i>	a feast for the eyes just beautiful fresh air smell harmony of the landscape idyll cowbells landscape beauty lovely beauty varied sensual twittering of birds soothing for the eyes
	<i>Feriengefühle Ferienstimmung Freude Genuss fröhlich geniessen Glücksgefühl gutes Gefühl positiv wohl Wohlbefinden Wohlgefühl zufrieden Zufriedenheit</i>	holiday feelings holiday mood joy enjoyment happy to enjoy feeling of happiness good feeling positive well wellbeing sense of well-being content contentedness
Sense of freedom	<i>alles frei befreiend befreit ein bisschen Freiheit</i>	everything free relieving freed, relieved a little bit of freedom

(continued on next page)

Table 8 (continued)

Facets of sense of place	Transcribed examples in German from interview data	English glosses
Other	<i>Freiheit</i>	freedom
	<i>Freiheitsgefühle</i>	feelings of freedom
	<i>beängstigend</i>	frightening
	<i>bedrohlich</i>	threatening
	<i>Berge</i>	mountains
	<i>Bewegung</i>	exercise
	<i>Freizeitpark</i>	leisure park
	<i>herausfordernd</i>	challenging
	<i>man kann zwei Stunden Auto fahren und ist in den Bergen</i>	one can drive for two hours and be in the mountains
	<i>nahe</i>	near
	<i>nichts Spezielles</i>	nothing special
	<i>Sandbänke sind speziell</i>	sand banks are special
	<i>Sommer</i>	summer
	<i>Sport</i>	sport
	<i>Trinkwasserspeicher</i>	drinking water reservoir
	<i>UNESCO Weltnaturerbe</i>	UNESCO World heritage – natural site
	<i>Wasser</i>	water
	<i>Wehmut</i>	melancholy
<i>Wiesen</i>	meadows	
<i>zum Laufen</i>	for walking	
<i>zum Wandern</i>	for hiking	

The facet of sense of nature, and a sense of a connection to nature and landscape is comprised of terms such as *Naturverbundenheit* (connection to nature). Differences in the frequency of mentions of sense of nature were not significant between landscape types $H(4, N = 300), = 8.049, p = .90$.

4.2.2. Comparing terms used in descriptions of sense of place from interviews between landscapes

Again using text processing on the sense of place descriptions from interviews, the descriptions were most similar between the hill landscape at Pfannenstiel and the mountain landscape at Seealpsee, and least similar between the mountain landscape at Oeschinensee and River Reuss (Table 9). The differences in cosine similarity between landscapes of the same type and between different types were not statistically significant $U = -.795, p = .45$. Sense of place descriptions from similar landscape types were thus not more similar than sense of place descriptions from different landscape types, contrasting with the result for landscape terms elicited in our free lists.

5. Discussion

5.1. Comparing landscapes based on free listings of landscape terms

Using a free listing approach with visitors *in situ*, we elicited landscape terms that allowed us to differentiate between landscape types. This differentiation is largely based on differences in how people describe bio-physical and cultural features of landscapes. As results from previous free-listing studies have shown, lists are dominated by terms for bio-physical and cultural landscape features, but may also include activities and terms related to sense of place, although participants were not asked to list such terms in the elicitation statements (Bieling et al., 2014; Wartmann et al., 2015). However, through the memory retrieval process involved in a free-listing task, semantic associations are activated and people may list terms they broadly associate with landscapes, going beyond listing landscape features such as hills, houses or trails (Wartmann et al., 2015). Since these associated terms are listed more towards the end of lists, they are less salient and form part of the long-tail of the distribution of terms ordered by their cognitive saliency index (Sutrop, 2001). We observed that at each site, a few terms were highly salient, typically terms for physical landscape features. These

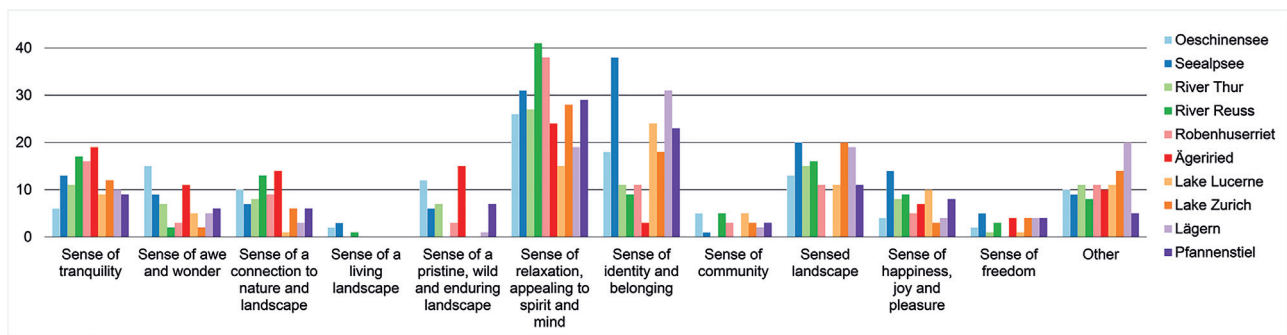


Fig. 2. Number of terms per facet of sense of place at ten different study sites.

Table 9

Matrix of cosine similarity values between sense of place descriptions from interviews at different study sites.

	Oeschinensee	Seealpsee	River Reuss	River Thur	Robenhuserriet	Ägeriried	Lake Lucerne	Lake Zurich	Lägern	Pfannenstiel
Oeschinensee	1	0.5571 [†]	0.2997	0.4300	0.3170	0.3760	0.4178	0.3703	0.3860	0.4402
Seealpsee	0.5571	1	0.4658	0.6230	0.5131	0.6131	0.6427	0.4551	0.4805	0.6747 [†]
River Reuss	0.2997	0.4658	1	0.4163	0.3717	0.4830	0.3439	0.4430	0.4248	0.5204 [†]
River Thur	0.4300	0.6230 [†]	0.4163	1	0.4802	0.5525	0.4604	0.3265	0.4628	0.5715
Robenhuserriet	0.3170	0.5131	0.3717	0.4802	1	0.4809	0.4758	0.4213	0.3134	0.5398 [†]
Ägeriried	0.3760	0.6131 [†]	0.4830	0.5525	0.4809	1	0.4594	0.4110	0.3966	0.4737
Lake Lucerne	0.4178	0.6427 [†]	0.3439	0.4604	0.4758	0.4594	1	0.4268	0.4647	0.5755
Lake Zurich	0.3703	0.4551	0.4430	0.3265	0.4213	0.4110	0.4268	1	0.3620	0.5065 [†]
Lägern	0.3860	0.4805	0.4248	0.4628	0.3134	0.3966	0.4647	0.3620	1	0.5410 [†]
Pfannenstiel	0.4402	0.6747 [†]	0.5204	0.5715	0.5398	0.4737	0.5755	0.5065	0.5410	1

In each row, the highest value is marked with [†].

terms are likely good candidates for characterizing landscapes.

Regarding the absolute number of terms in free lists, those from mountain landscapes contained significantly more terms than moor, lake or hill landscapes. This result is in accordance with previous research on landscape categorization in Switzerland, where mountain landscapes were described with more terms than urban park landscapes (Wartmann et al., 2015). Using text processing, we showed that free listings from sites classified as the same landscape type were significantly more similar than sites in two different landscape types, suggesting that this approach can be used to distinguish types of landscapes based on people's perceptions and descriptions. Furthermore, this result indicates that the five investigated broad landscape types seem to reflect differences that are also perceived by people. Such distinctions based on perception could offer novel ways of defining the objects to which cultural ecosystem services are attached, taking into account variations in how people speaking different languages refer to the features that constitute a landscape (Mark et al., 2011). This is particularly important for cultural ecosystem services, because these services may be associated with cultural landscape features that are often not represented in globally defined land cover/land use classes that are rooted in a Western-scientific understanding of landscape (Robbins, 2001; Wartmann & Purves, 2017). Eliciting descriptions of landscape features is thus a first step towards including cultural ecosystem services into models that require spatially explicit input (van Berkel & Verburg, 2014; van Zanten et al., 2016), where the spatial referents are linguistically grounded and directly linked to how people talk about and refer to landscape. Derungs and Purves (2016) showed how such descriptions extracted from text may be generated as a spatially continuous layer, providing a possible bridge between our empirical approach and more data-driven methods, which may also take into account existing unstructured text data about landscapes from sources such as hiking blogs and social media (Wartmann, Acheson, & Purves, 2018). Few studies have investigated cultural services from this angle, often focusing on indigenous societies and languages (Cocks, Dold, & Vetter, 2012; Schnegg, Rieprich, & Pröpper, 2014). Our work is thus novel in its focus on language for studying how landscape features are expressed in a dialect of a European language, as the basis for identifying objects to which sense of place is attached.

5.2. Comparing sense of place descriptions from interviews between landscapes

Several studies have analyzed to which locations in a given area people attach a sense of place (Brown & Weber, 2012; Fagerholm et al., 2012; Jorgensen & Stedman, 2011). For this study we instead selected sites for which we assumed, based on visitor numbers, many people fostered some sense of place, and documented the rich and variegated meanings and feelings people described through interviews complementary to our free-listing. Our method echoes approaches from qualitative empirical studies (Basso, 1996; Cresswell, 2006; Kyle & Chick, 2007), which have also been applied to study cultural ecosystem services (Bieling, 2014; Urquhart & Acott, 2014). Using text processing we compared how similar descriptions of sense of place in interviews were between different landscapes based on the terms they contained. The comparison of cosine similarity values showed that descriptions of sense of place in the same landscape type were not more similar than in different landscape types. Furthermore, we assessed the influence of landscape type, visitation frequency, gender and age on the number of terms used in sense of place descriptions. We found no significant differences between landscape types, gender or between people with different visitation frequencies, but younger people described sense of place with significantly less terms than elderly people. However, we

suggest caution in interpreting this result. The assumption that a stronger sense of place leads to more terms listed would need to be specifically tested using interviews in combination with psychometric measures of strength of sense of place (Jorgensen & Stedman, 2001). If this assumption holds true, observed differences may indicate that sense of place develops with age (Hay, 1998). Alternative explanations for this difference are that older people are more familiar with certain types of landscapes and describing their relation to a place in more detail. It may, however, also simply reflect the willingness of particular groups to engage with the interviewer and their time budgets for doing so.

In a more detailed analysis, we coded recurring themes in our interview data, which we termed 'facets' of sense of place. This empirically grounded approach offers insights into the vocabularies people use to describe the feelings and meanings they associate with different landscapes, without imposing *a priori* a scheme or definition of certain components of sense of place. Our approach resonates with other exploratory studies on meanings of place, where descriptions of sense of place were coded and organized into a tripartite model of sense of place consisting of the poles *self-others-environment* (Gustafson, 2001) and provide a characterization of sense of place at an aggregated level constituted by twelve facets. We then used this conceptual organization to compare the strength of different facets of sense of place across study sites. Using such an approach, we go beyond listing activities as a 'shared sense of place' (Jenkins, Croitoru, Crooks, & Stefanidis, 2016), which we argue are more akin to affordances *sensu* Gibson (1977). In a quantitative comparison of these facets between different landscape types, again assuming number of terms in a facet reflects its strength, we found that sense of relaxation and sense of identity were most commonly mentioned across all landscape types. However, we did not find significant differences between landscape types in the number of terms for most facets. The exception was the facet of a sense of identity and belonging, which was expressed with more terms in lake and in mountain landscapes than in moor or river landscapes. This finding is in keeping with the importance ascribed to iconic mountains and mountain landscapes in Switzerland (Backhaus, Reichler, & StremLOW, 2007; Reichler, 2005). Thus, while mountain landscapes may be particularly important in fostering a sense of identity in the Swiss context (Marchal & Mattioli, 1992), our results showed how landscapes composed of different bio-physical and cultural elements did not result in large differences between number of terms for different facets of sense of place. Furthermore, comparing cosine similarity values from terms used to describe sense of place showed that sites in the same landscape type were not described more similarly. However, in contrast to previous studies (e.g. Kyle & Chick, 2007), we do not suggest that the physical environment has little influence on sense of place, as in interviews participants often strongly expressed the relation between the physical environment and their sense of place. Rather, our results suggest that a broad range of Swiss landscapes that are perceived as natural are constitutive for a sense of place composed of facets that are similar across the investigated landscape settings at the level of the twelve facets we coded. Indeed, some of the terms interview participants repeatedly mentioned, which we used as labels for facets of sense of place, are concepts found in the literature. For example, many participants in our study used 'wild' or 'wilderness' as terms to describe landscapes heavily influenced by humans, but that they associated with wilderness, probably because human impact was not directly visible (e.g. in a moor landscape or an extensively managed mountain pasture that are the products of decades of human management). This notion of wilderness is in accord with wilderness mapping based on criteria such as distance to settlements and visibility of human impact (Carver, Comber, McMoran, & Nutter, 2012; Carver & Fritz, 2016). Another example is

tranquility (Jackson et al., 2008). In our study, visitors often mentioned tranquility related to lakes in an urban setting, highlighting how such feelings may be related to geographic features, and in particular water bodies, at very busy locations that would not typically be considered particularly tranquil in traditional models (Hewlett, Harding, Munro, Terradillos, & Wilkinson, 2017; Jackson et al., 2008). This finding is in line with studies showing a strong preference for landscapes with water bodies (Pitt, 1989; Wherrett, 2000), which in our study seemed to instill a sense of tranquility despite many people being present.

Our twelve facets also include aspects that would not usually be considered part of sense of place. For instance, many participants mentioned perceptual aspects when asked about their sense of place, such as visual impressions, sounds or smells. These aspects have been considered to contribute to a sense of place, for example in Landscape Character Assessments in the UK (Swanwick, 2002), rather than as part of the concept itself. Our results from interviews on sense of place include responses as diverse as solitude, wonder, meditation, freedom, and many more, in line with other empirical studies that report a wide range of responses to open questions aimed at eliciting cultural ecosystem services and sense of place (Bieling et al., 2014; Gee & Burkhard, 2010; Gould et al., 2014; Gustafson, 2001; Urquhart & Acott, 2014). This in turn highlights how people do not appear to compartmentalize different aspects of their holistic experience of place, which makes it challenging for researchers to disentangle the myriad of experiences into categories, where the categories themselves depend on the theoretical standpoint of the researchers and their domain (Ardoin, Schuh, & Gould, 2012). An example is the mixture of mentions relating to different cultural ecosystem services in our interview data. For instance, perceptual aspects mentioned by study participants as part of their sense of place would be considered 'aesthetic values', and spiritual aspects would be considered 'spiritual values' in the Millennium Ecosystem Service definition (MA, 2005). Eliciting information about a holistic sense of place therefore requires remaining open to unexpected or unprompted associations of respondents and incorporating such novel and important aspects into research, and not excluding this information from reports (Gould et al., 2014). Because we did not exclude any answers from participants, but considered all as part of an experience of sense of place and used those to build up our categories, instead of using predefined categories, we included a wider variety of facets and a more holistic view than if we had based our study on predefined components of the concept of sense of place (Jorgensen & Stedman, 2001). Such an approach to building categories from interview data through open and structured coding can lead to more empirically grounded theories of place meanings (Bieling et al., 2014; Gustafson, 2001), but still imposes categories without knowing the intention behind the listing of individual terms, and thus homogenizes notions of sense of place to some extent.

5.3. Limitations and further work

Eliciting cultural ecosystem services through language is based on four assumptions. First, that such values exist, second, that they can be adequately remembered and third, that people express them honestly when interacting with researchers (Oskamp & Schultz, 2005). Particularly relevant for our study is a fourth assumption that sense of place can be comprehensively expressed through language. While we acknowledge that some emotions or sentiments may be less suitable for expressing in words, our study shows that people are able and willing to describe aspects of *their* sense of place in interviews, providing us with semantically rich information about meanings and feelings associated with certain landscapes.

Our study is limited by several factors. One is the selection of days when we conducted our interviews. Different weather conditions than

sunny summer days, with, for instance, snow or rain, would potentially lead to contrasting results on sense of place. The influence of weather conditions and seasonality can be assessed in further studies that consider temporal changes in sense of place. Another limitation is that we pragmatically selected our participants and aimed to achieve gender balance and a distribution across age groups. Other potential influences on sense of place may be educational, cultural, language and professional background, as well as personal preferences for certain landscape settings and recreational activities. We did not collect behavioral data (e.g. intentions, past experiences, behavioral preferences) other than the activities respondents were engaged in, which were mostly hiking or strolling. Consequently, we can make no statements about whether sense of place experiences differ between landscape settings where people engage in different activities (Williams, Patterson, Roggenbuck, & Watson, 1992). Furthermore, by conducting *in situ* elicitations in a mostly recreational setting in rural landscapes, we excluded certain groups of people from our sample who are known to be under-represented in visiting such areas (Byrne & Wolch, 2009; Suckall, Fraser, Cooper, & Quinn, 2009), and who might have a markedly different sense of place than the people in our sample. Indeed, this may be to some extent reflected by the lack of negative references to places and associated activities in our facets (e.g. only a few terms in the other facet reflect feelings such as threats or fear).

Another important assumption we made is that the number of mentions in a facet (e.g. sense of identity) is an indicator for the strength of this facet, which would need to be tested empirically using interviews in combination with psychometric measurements. Such quantitative measures could then be used as input for building models to quantitatively assess cultural ecosystem service provisioning, which would combine more qualitative, exploratory methods for investigating sense of place with psychometric approaches. Furthermore, the choice of a conceptual framework inevitably guides the interpretation of results. For this study, we choose to explore sense of place as an umbrella concept to allow for a holistic interpretation of place meanings. In a next step, focusing on certain aspects of sense of place, such as place identity, would allow to more closely investigate certain place meanings. And finally, we investigated sense of place within a cultural ecosystem service framework. Recognizing this framework has been criticized (Cote & Nightingale, 2012; Daniel et al., 2012; Kirchhoff, 2012; Winthrop, 2014), our approach is a first attempt to explore ways in which we can gather and analyze information to address some of these criticisms pragmatically.

Despite these limitations, our findings offer insights into sense of place and contribute to the ongoing efforts for refining the definitions and standardizing the assessment of sense of place as a cultural ecosystem service. Such research on sense of place and other intangible cultural ecosystem services is important, because, while assessment methods are lacking, we risk inadvertently fostering landscape policy-making and planning that takes into account ecosystem services that are more easily quantifiable and measurable, but may be difficult to perceive for the general population, while ignoring cultural values that are widely perceived by people but not easily measured.

6. Conclusions

In this paper, we combine qualitative and quantitative methods to explore the link between sense of place as a cultural ecosystem service with identifiable bio-physical and cultural features that constitute the perceived landscape. Using *in situ* elicitation with visitors in ten different settings in Switzerland we set out to investigate three specific research questions. Firstly, how are different landscapes described by visitors and to what extent is sense of place expressed in these descriptions? Secondly, which methods are suitable for eliciting and

analyzing such descriptions of landscapes and sense of place? And thirdly, to what extent do these descriptions capture formal landscape classifications, and thus serve to compare landscapes and ecosystems based on this semantically rich information? We found that free lists capture representations of landscape terms, which reflect mainly biophysical features, and differences between free lists capture well the variation between official landscape types. Although free lists contain only limited information with respect to sense of place a rich set of facets of sense of place was elicited through interviews, with facets mapping well onto existing notions of sense of place. However, in contrast to free lists, the number of terms for different facets of sense of place did not vary strongly between landscape types, with the exception of sense of identity and belonging.

This paper contributes to research on cultural ecosystem services in three ways. First, by showing that using a simple and potentially easily scalable free-listing task we can elicit landscape terms that distinguish different landscapes and identify features to which cultural ecosystem services can be attached. Second, by highlighting that descriptions of sense of place did not differ markedly between mountain, moor, river, lake and hill landscapes, suggesting that different bio-physical landscape settings may instill, at least using our conceptual model, similar place experiences and meanings. And third, by describing a set of facets of sense of place that may be used as an empirical basis for developing linguistically grounded structured interview guidelines to assess sense of place as a cultural ecosystem service.

In future research we will link this empirically grounded approach with more data-driven methods that include the use of both active crowd-sourcing, where people are actively invited to participate in research through online platforms (as ‘citizen scientists’) as well as passive crowd-sourcing, which makes use of the increasing volumes of data from user-generated content in the form of travel blogs and traces in social media to arrive at region or nation-wide, language-based, people-centered descriptions of landscapes and sense of place.

Acknowledgements

We are grateful for the comments and feedback of three anonymous reviewers. We thank Olga Chesnokova for her help in calculating cosine similarity measures. The research on which this paper is based was financially supported by the cogito foundation through the project ‘How language shapes our sense of place’, grant no. 15-129-R.

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