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Sensory, motor, and emotion associations for landscape concepts differ across neighbouring speech communities

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ABSTRACT

A long-standing debate centres around our mental representation of landscape: is it experienced in largely the same way across all humans or is it shaped to some extent by cultural and linguistic experience? Previous research supporting differences across cultures has often relied on introspection or qualitative ethnolinguistic methods. Departing from this, we collected systematic sensory, motor, and emotion ratings for different landscape terms from 289 native speakers of German, English and French. The results show that speakers within and across groups agree to a large extent in their ratings of landscape terms, particularly in their sensory and motor associations. However, there is cultural shaping too. This suggests more caution is required when extrapolating findings about landscape understandings and preferences across cultures and languages.

KEYWORDS

Landscape; landscape terms; lexical semantics; ethnophysiography; emotion norms; sensorimotor norms

Introduction

The idea that landscapes are not simply objectively measurable arrangements lies at the centre of contemporary scientific and policy discussions. For example, the European Landscape Convention (Council of Europe, 2000) places human perception of landscapes at its core, while recent IPBES work on values and nature (Pascual et al., 2022) emphasises the importance of recognising different world views and knowledge systems. This suggests culture may influence particular ways of perceiving landscapes—its sounds, sights, or even smells—and may also affect how we experience them, as calming or giving rise to feelings of elation, for example.

One way culture may affect how people experience landscape is through the specific categories encoded in language. Seminal work by Mark and Turk (2003) on ethnophysiography and ethnolinguistics shows substantive differences across communities in landscape terms. For example, Burenhult and Levinson suggest a number of open questions, including: 'How is landscape divided into categories, and how are these categories named? Are there cross-linguistic differences in how landscape is divided into categories? Which are the main determinants of landscape categorisation?' (Burenhult & Levinson, 2008, p. 140). Similarly, Mark and Turk (2003) call for more ethnographic research and documentation of the ways landscape forms are characterised in different languages.

Curiously, despite the importance of documenting and understanding landscape in a multi-lingual context within Europe, there have been few studies of landscape language, beyond

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etymological investigations of the term 'landscape' itself. For example, it has been noted that cognate terms in German (*Landschaft*) and Dutch (*landschap*) refer to land reclamation and creation, related to Dutch efforts to drain polders and literally create land—quite different to the roots of the seemingly equivalent French term *paysage* (Antrop & Van Eetvelde, 2017). A recent study by van Putten et al. (2020), went further and asked more than 440 participants from seven European languages (Dutch, English, French, German, Italian, Spanish and Swedish) to list as many examples of 'landscape' as they could. They found that, in comparison to categories related to body parts and animals, the concept of landscape was weakly structured and cross-linguistically variable. This raises further questions about where exactly the differences in the conceptualisations of landscape lie.

Cognitive scientists often use the lexicon as a way of exploring concepts, comparing for example how words used in different societies carve the world up into objects, events, properties, and relevant here, topographic eminences (Burenhult & Levinson, 2008; Majid, Burenhult, Stensmyr, De Valk, & Hansson, 2018; Majid & Van Staden, 2015; Malt & Majid, 2013; Smith & Mark, 2001). In this study, we used this approach and studied three related European languages—English, French, and German—and investigated how speakers of these languages conceptualise different elements of the landscape. We chose these languages since, policy—as implemented, for example, by the European Union—uses all of these languages and appears to assume simple linguistic equivalence between them. The speaker communities live in broadly similar cultural and environmental conditions, that is Central and Western Europe, so perhaps this assumption is warranted. However, there are reasons to think that regional cultural values may be expressed in language (cf. Pascual et al., 2022), and there may nevertheless be differences between closely related languages, as has been found in other domains (e.g. Kopecka & Narasimhan, 2012; Majid, Gullberg, Staden, & Bowerman, 2007; Newman, 1998).

To study speakers' conceptualisation, we tapped into people's embodied knowledge of landscape by asking participants to rate their sensory, motor, and emotional associations to different landscape categories. According to embodied theories of cognition, the meaning of terms is grounded in basic properties of sensory, motor, and affective systems (Lakoff & Johnson, 1980; Varela, Thompson, Rosch, & Kabat-Zinn, 2017) which makes them especially relevant for the classification of landscape (Brabyn & Mark, 2011). We combined existing validated rating scales to tap into sensory, motor (e.g. Lynott, Connell, Brysbaert, Brand, & Carney, 2020), and emotional (e.g. Warriner, Kuperman, & Brysbaert, 2013) dimension of meaning. This allows us to explore the role of these different dimensions in the cross-linguistic conceptualisation of landscape.

Specifically, we compared a large set of landscape concepts, such as MOUNTAIN[i]—or rather the language equivalent terms, in this case *mountain*, *montagne* and *Berg*—in English, French and German respectively. We asked whether culturally specific experiences may be reflected in different sensory, motor, and emotion meaning components in different speaker communities. For example, is it the case that translation equivalent terms to MOUNTAIN in German and French-speaking countries, with their glaciated Alpine mountains differ from those in the English-speaking UK? We can address this question for each of the landscape concepts studied. More generally, we ask if speakers of different languages differ in their sensory, motor, or emotional associations with landscape concepts. As suggested by the ethnophysiographic hypothesis (Mark & Turk, 2003), we expect to find differences between classes of landscape objects between languages. Theories about place suggest that differences, perhaps particularly in emotional associations between languages, might have important implications for concepts such as sense of place (Brown & Raymond, 2007).

Materials and methods

The study was approved by the Faculty of Arts and Social Sciences' Ethics Committee of the University of Zurich.

Materials

To collect sensory, motor, and emotion ratings for landscape terms from English, German and French speakers, we collated linguistic stimuli for commonly used landscape terms in these languages. We based our collection of linguistic stimuli on the lists of landscape terms elicited by van Putten et al. (2020). Forty-six English speakers from the UK, 52 German speakers from Switzerland, and 80 French speakers from France completed a free-listing task for the domains ANIMALS, BODY PARTS and LANDSCAPE. In an online survey, participants were asked to write down as many terms as they could think of in three minutes for each concept. We used the terms that most participants mentioned for LANDSCAPE.

Initially, we retained terms that were mentioned by more than six participants from each language group. We chose this threshold to ensure that we investigate only shared landscape concepts since the distributions of landscape terms had long tails of concepts mentioned by only a few participants. Because the French list had the most terms using this criteria, we began with a seed list of 58 French terms as the basis for the compilation of translations in the other languages. We identified German and English terms based on the free-listing task and dictionary translations. After matching the German and English terms to the French seed list, we next identified the most frequently mentioned terms in German and English not already included in the initial compilation. This way any term mentioned by more than 6 people in any language made it to the final mega-list of terms. When identifying translation equivalents, if there was no equivalent term in the free-listing data that was mentioned by more than six participants, we identified a less frequent term with the closest meaning. For example, French *sable* was mentioned by 14 participants and English *sand* by 13 participants, whereas German *Sand*, the term with the closest meaning selected for inclusion in the study, was only mentioned by one participant. In seven cases, there was no equivalent term at all in the free-listing data, so an equivalent identified by dictionary definition was included instead.

This final mega-list contained 78 French landscape terms with putative translation equivalents in English and German. The German list contained only 75 terms because two concepts (HORIZON and SKYLINE) were both matched to the German *Horizont*. The English list contained 76 terms. The French list made a distinction between *rivière* and *fleuve* which we matched to a single term in English (*river*) and German (*Fluss*), as the two French terms *bâtiment* and *immeuble* which we matched to *building/Gebäude*.

To collect ratings in each language, we implemented a questionnaire using Limesurvey (Limesurvey GmbH, 2022) and ran the study using the academically focussed crowdsourcing service Prolific (www.prolific.co). The full questionnaire was translated from English to German and French by a professional translation agency, followed by a quality check for translation accuracy of instructions and experimental materials by a second translator using back-translation. To reduce the time taken by individual participants to complete the questionnaire, we divided the full list of terms into four separate lists by picking every fourth term, starting with the first term for list one, the second for list two, and so forth.

Participants

In Prolific we pre-screened native speakers of English, French, and German with residency in the UK for English, France for French, and Germany or Switzerland for German. We recruited participants between May and July 2022 and paid each £9 or equivalent for completing the survey. Each group of 24 participants rated items from one of the four lists of terms in their native language. One extra participant was automatically recruited by Prolific and thus in total, 289 participants completed the survey. Ten participants indicated they did not know one of the control items (described below), and so were removed from the analyses. Table 1 summarises the demographic characteristics of the final 279 participants.

Table 1. Participant demographics.

Language	*n*	Woman	Man	Queer /non-binary	*M* age	Range age
German	95	36	58	1	33	18–72
English	88	50	38	0	41	18–74
French	96	32	63	1	33	19–59

Procedure

Participants took part in the survey in their native language. Each participant rated one list with at most 20 items, with each term presented individually in upper case (e.g. MEADOW) alongside the relevant rating scales.[ii] There were three blocks querying in turn either sensory perception, motor activity, or emotion. The order of blocks was counterbalanced across participants, and the order of terms within each block was randomised to avoid set effects.

Sensory and motor ratings were adapted from Lynott et al. (2020) and emotion ratings from Warriner et al. (2013). In the sensory rating block, participants were asked to rate to what extent they experienced each term from 0 (not at all) to 5 (greatly) by feeling through touch, tasting, smelling, sensations inside the body (interoception), hearing, and seeing. In the block for motor ratings, participants were asked to rate on the same Likert scale how much they experienced the term by performing an action with the: head excluding mouth, foot/leg, hand/arm, mouth/throat and torso. For emotion ratings, participants were asked to indicate on a scale from 0 to 5 how they felt when they read the terms. The scales were unhappy to happy for valence, calm to excited for arousal, and in control to controlled for dominance.

Before rating the terms in each block, participants received instructions and were asked to rate a calibration word in order to ensure they comprehended the task. For this purpose, we used calibration words from Lynott et al. (2020). Before beginning the sensory ratings for landscape terms, participants first saw *echo* (in all languages); similarly, before motor ratings, they saw *tourism* (*Tourismus* in German and *tourisme* in French); and before emotion ratings, *statue* (in all languages).

Participants had to indicate if they 'don't know the meaning of this word', or proceed in the self-paced survey to rate the term on each dimension. As a quality check, we included five control items in the sensory rating block where the sensory values are known with some certainty according to previous studies (Lynott et al., 2020). We used these validated control items and translated them to German and French: *laughing/lachend/riant*, *honey/Honig/miel*, *republic/Republik/republique*, *hungry/hungrig/affamé* and *noisy/laut/bruyant*. Aberrant responses to these items enabled us to identify participants who were not complying with the task instructions.

To summarise, all participants rated all three blocks for one list of terms, as well as three calibrator and five control items. After data exclusion, each list was rated by at least 20 and at most 25 participants from each language group. To complete the survey, English speakers took on average 25 minutes (range 10–82), French speakers took 22 minutes (range 12–83), and German speakers took 24 minutes (range 12–68).

Results

Initial data checking: data exclusion and validation

Most terms were known to all participants. Only those listed in Table 2 were marked by more than two participants as unknown. Because the English term *steppe* received fewer than 10 valid ratings, it was removed from subsequent analysis.

We next established interrater reliability: low interrater reliability would suggest that individual differences dominate ratings, thus casting doubt on their use in our cross-linguistic investigation. To do this, we calculated mean Cronbach's alpha per list for each rating dimension. A value close to 1 is interpreted as high reliability, while for comparing groups values of 0.7 to 0.8 are

Table 2. Terms for which participants indicated they did not know the meaning.

Language	Term	*n* (do not know)
English	*moor*	3
	pasture	3
	prairie	3
	glade	4
	steppe	15
French	*skyline*	10
	steppe	4

Table 3. Mean Cronbach's alpha for sensory, motor, and emotion rating scales.

	Rating scale	Cronbach's alpha
Sensory	Visual	0.93
	Auditory	0.87
	Haptic	0.88
	Interoception	0.94
	Gustatory	0.83
	Olfaction	0.9
Motor	Head	0.95
	Mouth	0.92
	Torso	0.92
	Hand/ arm	0.9
	Foot/ leg	0.9
Emotion	Valence	0.85
	Arousal	0.87
	Dominance	0.87

regarded as satisfactory (Bland & Altman, 1997). All values of Cronbach's alpha were greater than 0.8 with a range of 0.83–0.95 (Table 3), indicating these data are robust enough for further cross-linguistic comparison.

Cross-linguistic comparison of sensory, motor and emotion ratings

To investigate the influence of participants' language on the conceptualisation of landscape terms as measured by ratings, we used linear mixed effects models in R (R Core Team, 2018) with the lme4 package (Bates, Mächler, Bolker, & Walker, 2015). We modelled each of the rating dimensions separately as a dependent variable predicted by the fixed effects of language, item (i.e. landscape term), and their interactions. We added participants as random intercepts to the models to account for individual variability in the use of the rating scales; we did not use random slopes because they yielded singular fitting models. We used the likelihood ratio with chi-square to test the main effects and their interactions by comparing all models to simpler models without the effect of language or the interaction term between language and item. These main effects have to be interpreted in the context of any significant interactions. To investigate these in more detail, we conducted independent two-sided t-tests on each rated term for the relevant interaction terms using the rstatix package (Kassambara, 2023), with *p*-values adjusted for multiple comparison using the Holm method. We present the results of each rating block in turn, beginning with sensory, then motor, and finally emotion associations.

Sensory ratings

For sensory ratings, all speakers overall agreed that vision was strongly related to all landscape terms and taste was weakly related, while the other senses were given intermediate-level ratings

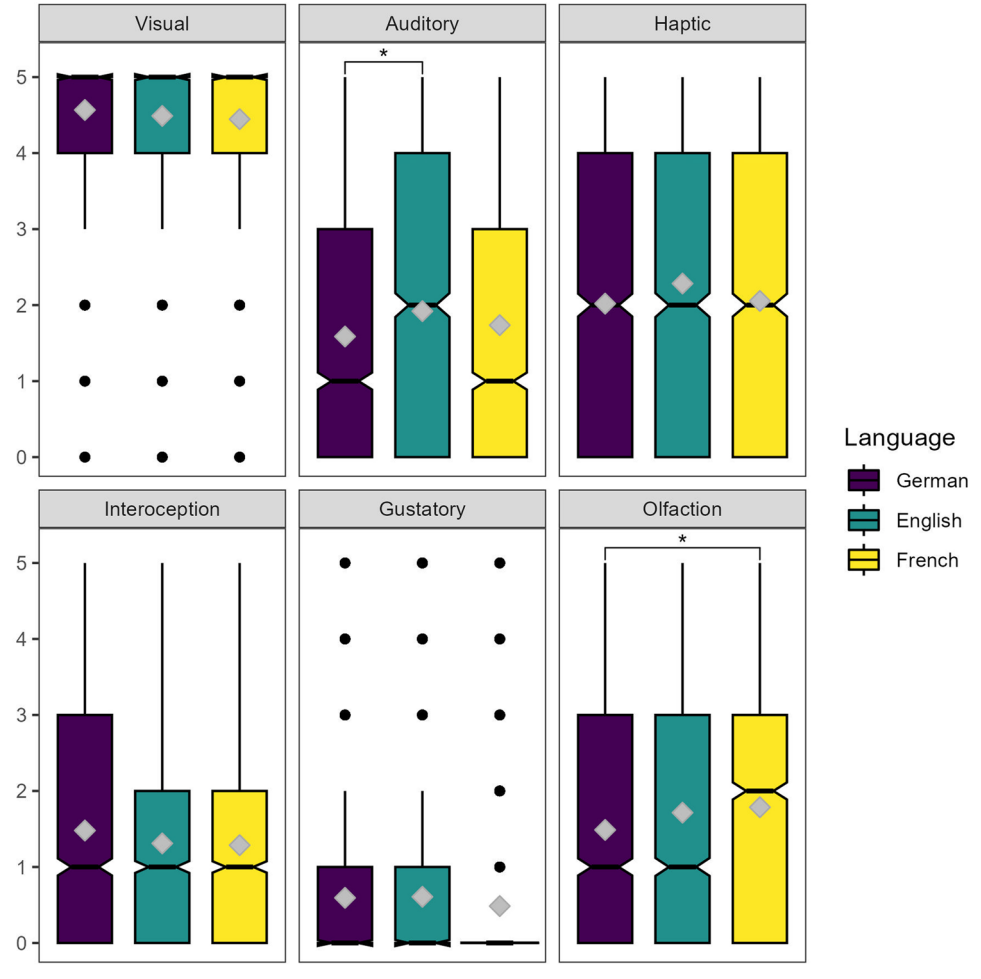

Figure 1. Ratings by language for each sensory dimension, with notches indicating median and diamonds mean values. Brackets with stars indicate significant differences between groups.

(Figure 1). Statistical analysis showed there were no significant differences between languages for sight, taste, touch, or interoception, but there were differences in ratings for the distal senses of sound and smell (see Table 4). Follow-up analyses revealed that German speakers had the lowest associations of sound to landscape concepts, and gave significantly lower ratings than English speakers in particular [$\chi^2(1) = 6.76$, $p < .01$]. Meanwhile, French speakers had the strongest association of smell to landscape concepts, significantly higher than German speakers [$\chi^2(1) = 8.11$, $p < .01$].

For all sensory dimensions, there were no significant interactions between language and landscape terms, except for vision [$\chi^2(1) = 14.83$, $p < .001$] (see Figure 2). Compared to all other terms, English speakers gave significantly lower visual ratings to *glade* than French and German speakers did for *clairière* or *Lichtung*, the translation equivalents. This may be due to the fact that these terms in French and German are transparently related to the visual qualities *clair* 'bright' and *Licht* 'light' leading these speakers to rate the landscape terms higher for visual association than English speakers. HORIZON was rated higher for vision by French speakers than German speakers. On the other hand, French speakers gave significantly lower ratings on vision for seven landscape terms than German or English speakers: BUSH[74], FENCE[70], LAKE[6], PEOPLE[75], PLANTS[66], ROCKS[50], and RAIN[38] (superscripts refer to items in Figure 2).

Table 4. Main effects of language according to likelihood ratio tests for each rating task.

	Rating scale	χ^2	p
Sensory	Visual	1.48	0.48
	Auditory	7.27	0.03*
	Haptic	5.42	0.07
	Interoception	2.19	0.33
	Gustatory	2.58	0.28
	Olfaction	6.80	0.03*
Motor	Head	18.76	<0.01*
	Mouth	8.48	0.01*
	Torso	6.86	0.03*
	Hand/ arm	12.11	<0.01*
	Foot/ leg	9.69	<0.01*
Emotion	Valence	8.57	0.01*
	Arousal	14.60	<0.01*
	Dominance	0.06	0.97

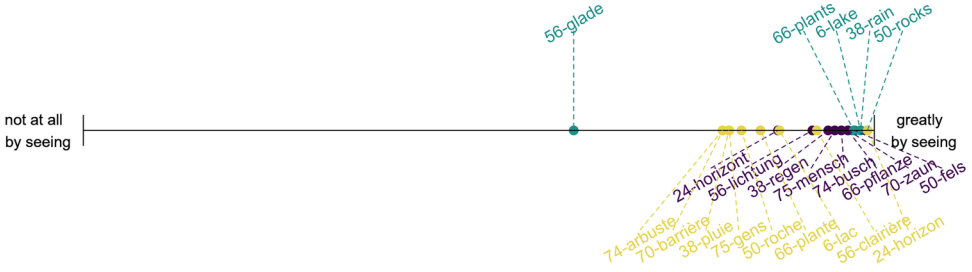

Figure 2. Mean ratings by speakers of English (top), German (middle) and French (bottom) for how strongly landscape terms were related to vision, on a scale from left 0 (experienced not at all by seeing) to right 5 (experienced greatly by seeing). Terms that differed significantly across languages are plotted; translation equivalents can be identified by number (e.g. 56 is *glade* in English, *clairière* in French and *Lichtung* in German).

Motor ratings

For motor ratings, there were significant main effects of language on all aspects of how the body relates to the landscape (Figure 3).

Examining these differences in detail, we found that for the head, English [$\chi^2(1) = 11.0$, $p < .01$] and German [$\chi^2(1) = 16.19$, $p < .01$] speakers gave higher ratings than French speakers. There was also a significant interaction between language and landscape terms for the head [$\chi^2(1) = 6.17$, $p = .046$] (see Figure 4). French speakers associated the head less strongly than Germans and English speakers specifically with certain anthropogenic landscape elements (e.g. FARM[60], BRIDGE[45], BUILDING[59], PAINTINGS[34], PEOPLE[75], URBAN[54]), and some landscape concepts that are tangible or experienceable through other parts of the body. These included aspects of the land (e.g. EARTH[42], FIELD[13], ROCKS[50], STONE[71], PRAIRIE[30], GLADE[56]), vegetation (e.g. BUSH[74], GRASS[19], LEAVES[53], PLANTS[66], WOOD[33]), and water-related substances (e.g. GLACIER[41], SNOW[21], LAKE[6]).

For the mouth, there was also a significant main effect (Table 4). English speakers gave higher ratings than both German [$\chi^2(1) = 6.62$, $p < .01$] and French speakers [$\chi^2(1) = 4.91$, $p < .02$]. English speakers also rated the torso higher than French speakers [$\chi^2(1) = 5.79$, $p < .02$]. Lastly, for both hand/arm and foot/leg, German speakers gave lower ratings than English [hand/arm, $\chi^2(1) = 10.99$, $p < .01$; foot/leg, $\chi^2(1) = 5.33$, $p < .02$] and French speakers [hand/arm, $\chi^2(1) = 5.15$, $p < .02$; foot/leg, $\chi^2(1) = 8.48$, $p < .01$]. There were no other significant interactions.

Overall, then, it seems as if French participants associated landscape terms less strongly with the head, mouth, or torso and conversely more strongly with the hand/arm and foot/leg than the other groups, suggesting landscape terms may be interacted with differently by the French in particular.

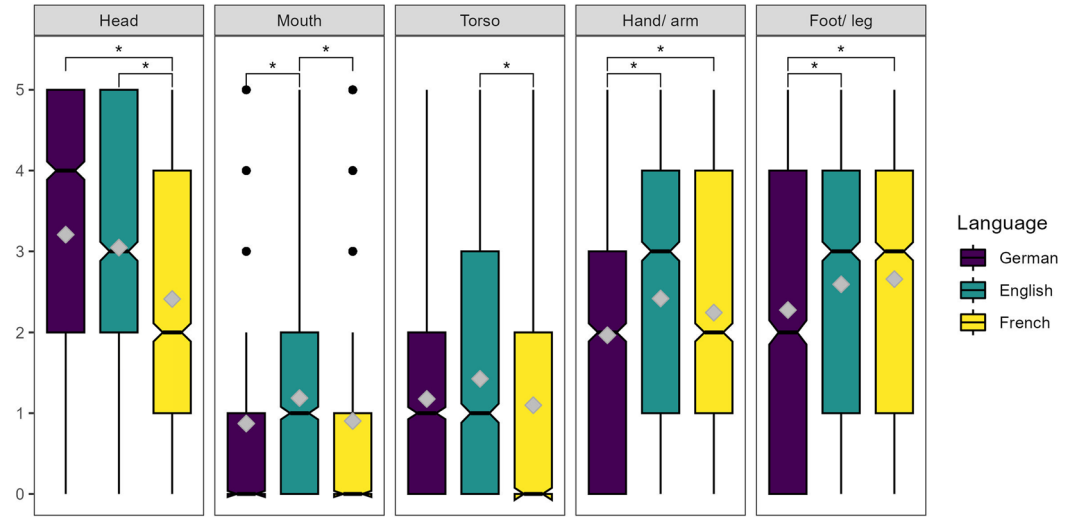

Figure 3. Ratings by language for each motor dimension, with notches indicating median and diamonds mean values. Brackets indicate significant differences between groups.

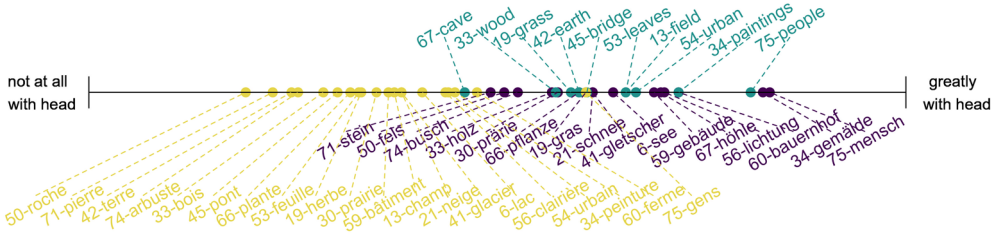

Figure 4. Mean ratings by speakers of English (top), German (middle) and French (bottom) for how strongly landscape terms were related to the head, on a scale from left 0 (not related at all to head) to right 5 (highly related). Terms that differed significantly across languages are plotted; translation equivalents can be identified by number.

Emotion ratings

Finally, turning to emotion ratings, there were main effects of language for valence and arousal, but not for dominance (see Figure 5 and Table 4).

Across the board, English speakers gave significantly higher ratings for valence than German speakers [$\chi^2(1) = 9.66$, $p < .01$], but there were no other differences between groups. There was a significant interaction between language and landscape terms [$\chi^2(1) = 9.86$, $p < .01$]. There were 15 terms that were rated significantly differently between at least one language pair (see Figure 6). German speakers rated CANYON[69] significantly more negatively than English speakers. On the other hand, French speakers rated certain types of landscapes (e.g. PLAIN[18], HILL[9], PRAIRIE[30], CANYON[69]) significantly more positively than German and English speakers. There were also significant differences for anthropogenic concepts (e.g. FIELD[13], BUILDING[59], PATH[25] and FENCE[70]) with generally higher ratings from English speakers, except for PATH[25] where French speakers rated it higher. Terms referring to vegetation (e.g. VEGETATION[57], LEAVES[53], GREENERY[48]) were mostly rated higher by French and English speakers than Germans. English speakers also rated SAND[29] and COUNTRYSIDE[16] more positively than both German and French speakers, but they rated RAIN[38] less positively than German speakers.

There was a main effect of arousal (Table 4), such that English speakers gave higher ratings of arousal than both German [$\chi^2(1)=11.99$, $p<.01$] and French speakers [$\chi^2(1)=9.92$, $p<.01$], suggesting they found landscape terms overall less calm and more exciting. There was also

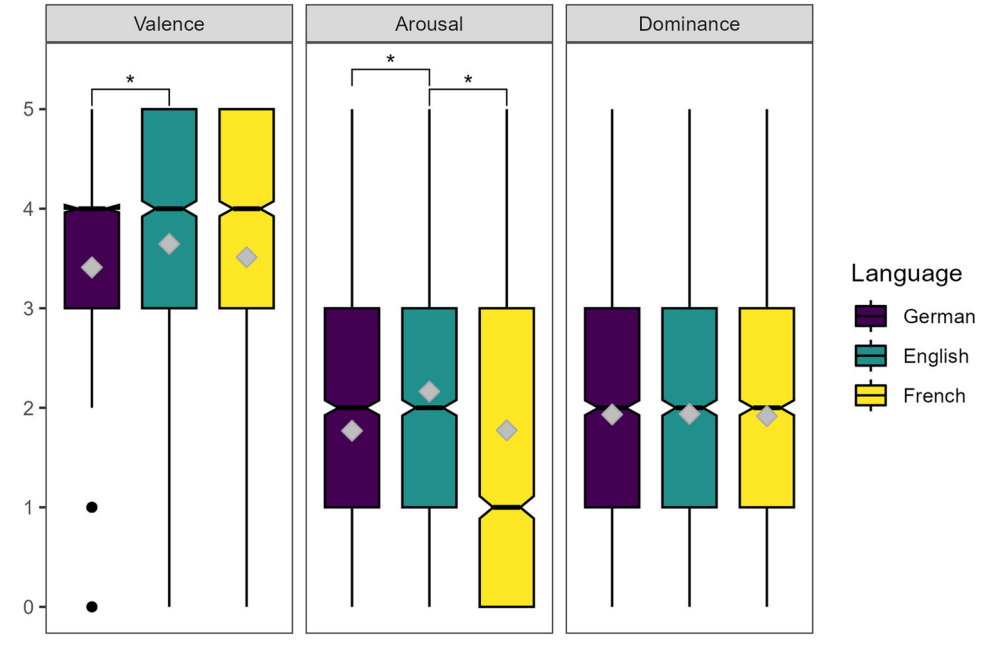

Figure 5. Ratings by language for each emotion dimension, with notches indicating median and diamonds mean values. Brackets indicate significant differences between groups.

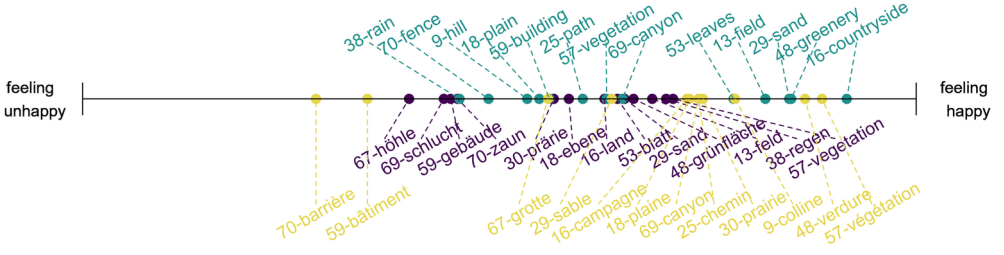

Figure 6. Mean ratings by speakers of English (top), German (middle) and French (bottom) for how landscape terms were related to feeling unhappy or feeling happy, on a scale from left 0 (unhappy) to right 5 (happy). Terms that differed significantly across languages are plotted; translation equivalents can be identified by number.

an interaction between language and landscape terms for arousal [$\chi^2(1) = 8.762$, $p = .013$]. There were 18 concepts that were rated differently between at least one language pair (see Figure 7). English speakers gave significantly higher ratings for some aspects of the land (e.g. PRAIRIE[30], ROCKS[50]) as well as concepts related to cultivation, gardening, and vegetation (e.g. EARTH[42], FIELD[13], FLOWER[20], PLANTS[66], VEGETATION[57]), and for concepts evoked by a holiday frame (e.g. BEACH[10], SAND[29], SNOW[21], SUN[14], SUNSET[37]). Interestingly, ratings from German speakers suggest they feel more excited by potentially dangerous environments that can be part of an adventure (e.g. CAVE[67], CLIFF[26], CANYON[69], RAINFOREST[76]).

To summarise, there were substantive differences between groups in which specific landscape terms were associated with pleasant/unpleasant feelings or calming/arousing feelings.

Comparing conceptual spaces on sensory, motor and emotion dimensions cross-linguistically

An alternative way to explore the conceptualisation of landscape is to use Wingfield and Connell's (2022) distance measure to compare mean ratings for all terms in each language. Unlike the previous

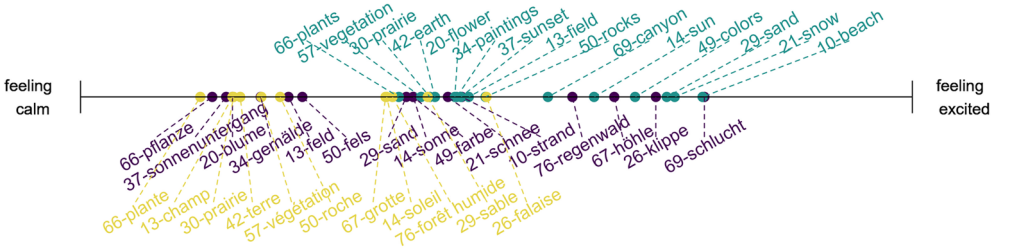

Figure 7. Mean ratings by speakers of English (top), German (middle) and French (bottom) for how landscape terms were related to feeling calm or excited, on a scale from left 0 (calm) to right 5 (excited). Terms that differed significantly across languages are plotted; translation equivalents can be identified by number.

analyses, this disregards individual-level differences and so provides a way to uncover differences across language groups. To do this, we calculated matrices of cosine distance values between the vectors of all terms in each language for each sensory, motor, and emotion dimension. The resulting nine matrices allow a ranking of the most similar (with the lowest values) and most distinct (with highest values) concepts across languages (complete data is published as Supplementary Material).

To visualise distance values, we followed Wingfield and Connell (2022) by applying Sammon multidimensional scaling (MDS) to the matrices using R's MASS package (Venables & Ripley, 2002). We also symbolised point hues according to their ratings on selected dimensions—mean haptic ratings for the sensory plots (Figure 8), mean head ratings for the motor plots (Figure 9), and mean arousal ratings for the emotion plots (Figure 10). We chose these dimensions after exploration of the data because they illustrate well potential grounds for differences in the plots. For completeness, we include plots using all rating dimensions to symbolise point hue in the Supplementary Material.

The three plots in Figure 8 illustrate that distance values on the sensory dimensions show similar structures. A few blue terms with lower ratings on haptic associations are concentrated at one extreme of the horizontal axis, while most terms spread horizontally and vertically in a central region of the plot. The smaller group contains related concepts, including CLOUD, HORIZON, SKY, SUNSET and COLORS[iii] in all three languages which can primarily be perceived and experienced only by seeing but not through touch.

For the motor dimensions visualised in Figure 9, there are similar patterns with one smaller and one larger cluster of terms in each language plot. As reflected in the earlier analyses, the French plot looks most different with some terms more distinctly represented than in English or German. Differences in hue also suggest that French, German and English speakers differed in how they rated individual terms in relation to head.

Finally, for emotion the English and French plots show a few terms scattered towards the right corner and most spread left of the middle (see Figure 10). In contrast, German terms are concentrated in a smaller right and a larger left cluster. The hue based on mean arousal ratings also illustrates differences in the use of this scale between speaker communities. For all languages, the terms on the right side of the plots belong to the concepts CITY, ROAD, VOLCANO, DESERT and CAVE, but for English only CITY and VOLCANO are distinct from most concepts.

Discussion

The results of this study suggest that speakers of English, German, and French experience landscape concepts in broadly similar ways, consistent with the universalist perspective adopted by the European Landscape Convention. For example, across all groups we found unanimous agreement that vision is strongly associated with landscape, whereas taste is only very weakly related. Nevertheless, despite these general similarities, we do find evidence consistent with

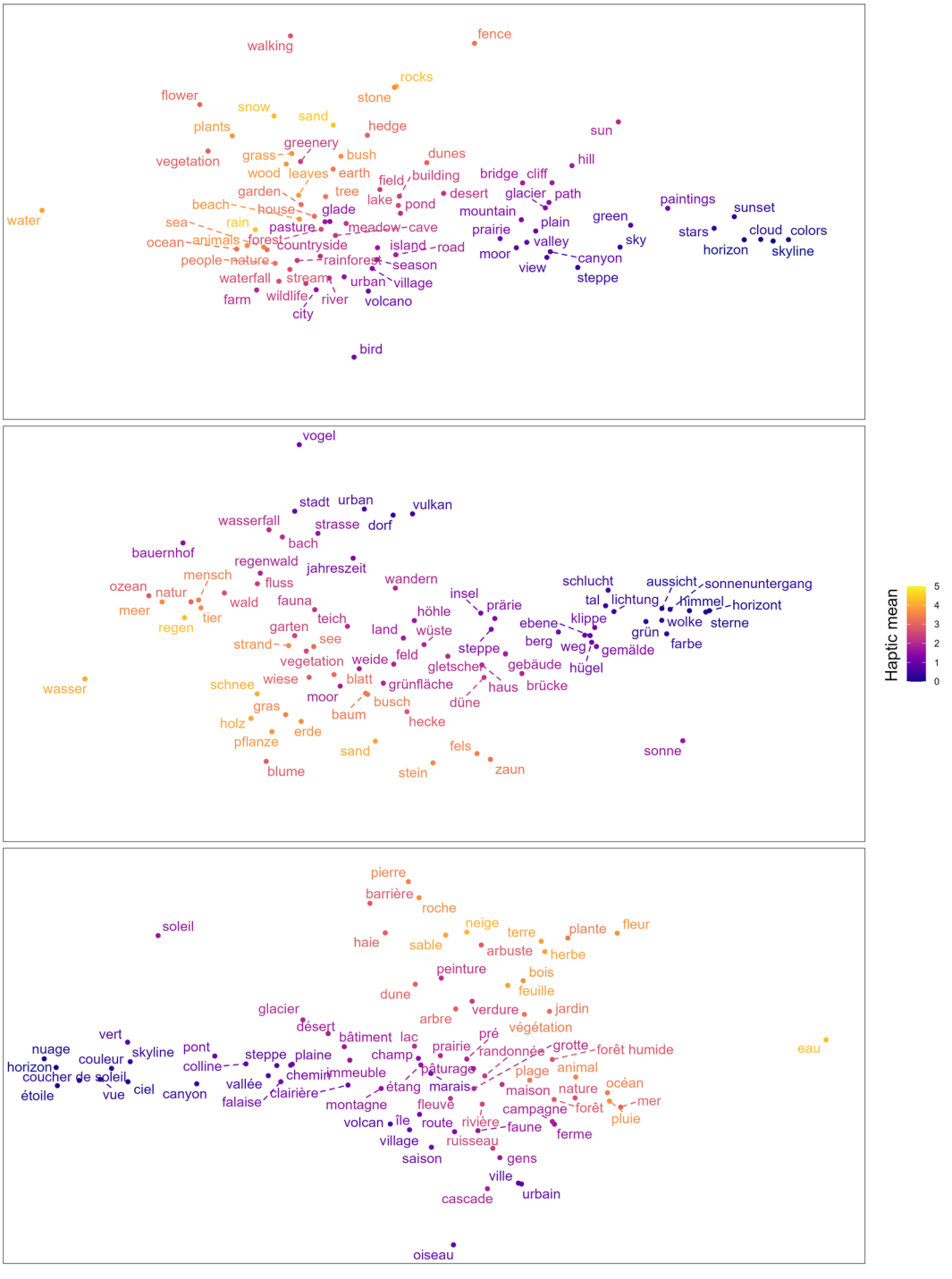

Figure 8. Scatterplots of MDS based on sensory distance values for all English (top), German (middle) and French (bottom) terms. The terms' hue represents mean ratings on the haptic dimension.

the ethnophysiographic hypothesis (Mark & Turk, 2003): there are subtle differences between classes of landscape objects between languages on the dimensions of vision, head, valence and arousal.

Figure 9. Scatterplots of MDS based on motor distance values for English (top), German (middle) and French (bottom) terms. The terms' hue represents mean ratings on the head dimension.

Figure 10. Scatterplots of MDS based on emotion distance values for all English (top), German (middle) and French (bottom) terms. The terms' hue represents arousal mean ratings.

Embodied and emotional associations to landscape

We found vision dominates the way in which participants experience the landscape, echoing what has been found for other sorts of concepts. For example, ratings of almost 40000 English terms across diverse categories showed visual ratings were most prominent for speakers of English (Lynott et al., 2020). Similar visual dominance has been reported in other languages using the same measures (e.g. Chen, Zhao, Long, Lu, & Huang, 2019; Miklashevsky, 2018; Speed & Majid, 2017; Vergallito, Petilli, & Marelli, 2020), suggesting visual dominance is not something specific to landscape or the languages studied here. Nevertheless, we see some subtle differences between languages in how strongly specific terms are associated with vision. French and German speakers gave higher visual ratings to GLADE than English speakers, likely due to the fact that in French and German the translation equivalent terms are transparently related to visual qualities, but the comparable English term is not. Compared to the other groups, French speakers however gave significantly lower ratings on vision for other landscape concepts, specifically BUSH, FENCE, LAKE, PEOPLE, PLANTS, ROCKS, and RAIN. The language groups also differed in how strongly they associated sound or smell with landscape terms. These small differences suggest that even basic perceptual engagement with the landscape may be culturally shaped to some limited extent. These differences in the way landscape concepts appear to be related to perception have implications for emerging work on, for example, sound- and smell-scapes in landscapes and its transferability between cultural settings (Cerwén, 2016; Quercia, Schifanella, Aiello, & McLean, 2021).

A similar pattern was seen in the results for motor ratings across groups. Participants differed with respect to how tangible or experienceable landscape concepts were taken to be. This is in line with Montello's (1993, p. 315) theoretical distinction between psychological spaces: on the one hand, there are 'figural, vista, environmental' spaces which are tangible or experienceable, and on the other hand 'geographical' spaces which are not experienceable and have to be learned with the help of symbolic representations. This distinction appears to be reflected in Figures 8 and 9 where the plots for sensory and motor distance in all three languages show intangible concepts such as STARS, CLOUD, SKY and HORIZON on one side and tangible and experienceable concepts such as WATER, STONE, PLANT and FLOWER on the other. Moreover, French speakers appear to have stronger associations of landscape concepts to their motor effectors—hand/arm and foot/leg—than the other groups, suggesting perhaps a more active conceptual representation.

Finally, turning to emotion ratings, Figure 10 plots participants' emotion ratings and suggests the different groups distinguished tranquil (calm and happy), engaging (happy and exciting), and potentially dangerous (unhappy and controlled by) landscape concepts. Tranquil concepts (such as GARDEN, MEADOW and STREAM) are plotted in the middle and bottom left region, engaging concepts (such as BEACH, SNOW and ANIMALS) are scattered towards the upper middle region, and potentially dangerous concepts (such as VOLCANO, CITY and DESERT) are scattered in the lower and middle right region in all the plots.

Most landscape terms were rated positively for valence, confirming the so-called 'positivity bias' observed by Warriner et al. (2013, p. 1194) for 14000 distinct concepts. They describe a 'tendency for more words to make people feel happy' which was reported in 'findings of positivity biases in English and other languages' (Warriner et al., 2013, p. 1194). Comparatively speaking, German speakers on the whole gave lower valence ratings than English speakers for landscape terms. English speakers overall gave higher ratings for arousal than French and German speakers. The nature of this arousal, or excitement, seems to vary culturally—English speakers are excited about locations they associate with pleasure and holidays, such as BEACH, SAND and SNOW. By contrast, French and German speakers seem to report arousal more with respect to busy or dangerous settings such as CITIES and VOLCANOS where they experience stress.

There were exceptions to general rating tendencies which suggest further modulation by culture. For example, low valence ratings for RAIN from English speakers indicate they associate rain more with feeling unhappy than other language groups. Such differences reveal one important limitation of our approach—we can hypothesise this difference may relate to the cultural narrative about the 'rainy UK' (but see Limitations section below).

Implications for landscape research

Our results suggest that sensory, motor, and emotion ratings are an effective way to explore conceptual similarities and differences for landscape. Broadly speaking, our results indicate landscape is conceptualised in similar ways in English, French and German. But there is cultural shaping too, as evident in the different sensorimotor associations in smell, sound, to a certain extent vision, and different parts of the body. Moreover, some of these differences are specific to certain types of landscape terms, suggesting subtle intuitions about how the senses and body relate to landscape. Different emotional reactions to landscape suggest that work in landscape preference should be cautious in extrapolating findings across cultures and languages. Especially, differences in valence and arousal ratings for specific landscape terms indicated that speaker communities associate them with different values.

Given the relative ease of conducting large-scale scale online-surveys and the availability of recruitment platforms such as Prolific, sensory, motor and emotion ratings are a relatively low-cost method for the generation of crowd-sourced data which can be fruitfully applied within many research paradigms (cf. Wingfield & Connell, 2022). Applications within corpus linguistics are particularly promising (Winter, 2022). In this context, the emotion norms collected with this study could be used, for example, to improve models for sentiment analysis directly related to landscape, an increasingly popular approach which often relies on lexicons generated in other domains (Chesnokova & Purves, 2018; Kong et al., 2022; Liao et al., 2023). More generally, experimental approaches to computationally exploring the relationship between language, narrative and landscape has great potential, which has to date been the subject of only very limited work (Purves, Koblet, & Adams, 2022).

Limitations

Our results suggest systematic differences between the language groups included in this study. However, speaker communities of the same language are diverse in many respects (Geeraerts, 2008). The rating used in this analysis may therefore obscure in-group differences. Variance in ratings within one speech community might be caused by sociodemographic characteristics of participants, such as age, place of residence or particular experiences with landscape elements. To investigate the influence of these and similar variables on rating behaviour, a larger number of participants from stratified samples are needed.

Furthermore, our analyses cannot explain why participants rated terms in a particular way. The next steps could be to study landscape terms and their linguistic context. For example, corpus analyses could reveal common lexical associations with other terms which may help to understand rating patterns in more detail. Alternatively, a qualitative approach, asking participants directly about their experiences, could be employed.

Finally, we deliberately asked participants to rate terms from one semantic domain, namely, that of landscape. However, this approach may cause participants to adopt set effects. A previous study found ratings for healthy and unhealthy food concepts differed across all sensory modalities when presented alone, but when mixed with other sorts of concepts, ratings only differed for taste, smell, and interoception (Speed, Papies, & Majid, 2023). The authors suggest that presenting only food concepts may have highlighted eating-related behaviours. It would

be interesting to explore the potential role of context effects for landscape concepts in future research.

Conclusion

Using sensory, motor and emotion ratings to explore the cross-linguistic conceptualisation of landscape by native speakers of English, French and German we find, first, that within language ratings of landscape terms are robust—participants speaking the same language broadly agree on the extent to which they experience concepts like MOUNTAIN through the perceptual senses and body parts, and in the emotions they evoke. Second, sensory and motor ratings of the landscape are also shared to a large extent across these three European languages, although modulated to a small extent by cultural experience. Finally, ratings of vision, head, valence and arousal for landscape concepts show significant differences between speaker communities at the term level. Particularly, cross-culturally different emotional associations reflected in ratings of valence and arousal have important implications for studies of landscape value.

Notes

i. In the following, concepts are written in English and referred to using small caps, while the linguistic terms used in English, French and German to refer to these concepts are given in *italics*.
ii. The German term *Horizont* appeared twice since it mapped to two different concepts HORIZON and SKYLINE. For the analyses, all ratings for each instance of *Horizont* were collapsed.
iii. COLORS were often associated with landscape, even though the term describes a landscape property rather than a landscape element.

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