From image descriptions to perceived sounds and sources in landscape: Analyzing aural experience through text

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ABSTRACT

The importance of perception through all the senses has been recognized in previous studies on landscape preference, but data on aural perception, as opposed to the visual, remains rare. We seek to bridge this gap by analyzing texts that describe more than 3.5 million georeferenced images, created by more than 12000 volunteers in the Geograph project. Our analysis commences by extracting and automatically disambiguating descriptions that potentially contain verbs and nouns of sound (e.g. rustle, bellow, echo, noise) and adjectives of sound intensity (e.g. deafening, quiet, vociferous). Using random forests we classify more than 8000 descriptions based on the type of sound emitter into geophony (e.g. rustling wind, bubbling waterfall), biophony (e.g. gulls calling, bellowing stag), anthrophony (e.g. roaring jets, rumbling traffic) and perceived absence of sound (e.g. not a sound can be heard) with a precision of 0.81. Further, we additionally classify these descriptions as negative, neutral and positive using an Opinion Lexicon and GloVe word embeddings. Our results show that sentiment classification gives an additional level of understanding of descriptions classified into different types of sound emitters. We see that geophony, biophony and anthrophony cannot be uniquely classified as positive or negative. Our results demonstrate how text can provide a valuable, complementary to field-based studies, source of spatially-referenced information about aural landscape perception.

1. Introduction and background

What is the contribution of sounds to the way people perceive landscapes? And how can we gather information about such perceptions over large spatial scales? User Generated Content (UGC) has proven to be a suitable source for research questions dealing with such phenomena as people’s perception of sense of place (Jenkins, Croitoru, Crooks, & Stefanidis, 2016), conceptualizations of natural features (Derungs & Purves, 2016), olfactory perception (Quercia & Schifanella, 2015), visual perception of landscapes (van Zanten et al. 2016) and assessment of the collective value of protected areas (Levin, Mark, & Brown, 2017). In this study we investigate another subjective phenomenon, namely aural perception of landscapes in UGC, with the underlying future aim of integrating sound information in landscape preference models.

Aural perception is an important constituent in landscape preference assessment (Brown & Brabyn, 2012; Sherrouse, Clement, & Semmens, 2011; Tudor, 2014) and is typically integrated using field surveys (Pilcher, Newman, & Manning, 2009) or laboratory sessions (Benfield, Bell, Troup, & Soderstrom, 2010; Manyoky, Wissen Hayek, Heutschi, Pieren, & Grêt-Regamey, 2014). However, these methods do not allow large regions to be characterized and are time consuming. We assume that aural perception of landscape is present in some written descriptions associated with photographs uploaded by individuals in UGC since photographs have been argued to be a good source of information related to shared experiences of places (Fishé & Unwin, 2005), and sound is one important element of such experiences. The following example vividly illustrates such use of language at an individual level: “If you press your nose to the computer screen, you might just catch the scent of the wild garlic, and if you listen carefully you should hear the song of willow warbler and blackcap.” However, if we wish to analyze such descriptions, then important questions remain with respect to how they can be extracted, how common they are, and what properties they have.

1.1. Sound experiences

Although our sensory experience of nature is by definition multisensory, the visual is often privileged in both research and policy. Thus, despite the introduction of ‘soundscape’, ‘acoustic ecology’ and
‘soundscape ecology’ (Southworth, 1969; Schafer, 1993; Pijanowski, Farina, Gage, Dumyahn, and Krause, 2011), aural perception is often of secondary importance in modelling landscape preferences. To relate sound to landscape preference it is important to consider the influence of perceived sound emitters as natural or unnatural (Fisher, 1999), rather than simply decibel values, since we do not hear abstract sounds, but “we hear the way things sound” (p. 40 Morton, 2009). Krause (2008), in collaboration with Gage, developed a useful taxonomy for sound emitters in landscape, identifying geophony (non-biological natural sounds), biophony (sounds produced by animals) and anthropophony (human-generated sounds).

Fisher (1999) claims that as soon as we perceive a sound as natural it has a positive aesthetic quality. Thus, similar sounds when perceived as being emitted by a jet engine or a waterfall would be considered unpleasant or “majestically powerful,” respectively (p. 28–29 Fisher, 1999). Carles, Barrio, and De Lucio (1999) in their study of sound influence on landscape value note that similar to findings in visual perception, water sounds are typically positively connoted. Furthermore, discordant scenes, for example with positive visual (e.g. a water body) and negative aural cues (e.g. the sound of a busy road) were considered to be especially disturbing. In a series of soundwalks carried out on by Pérez-Martínez, Torija, and Ruiz (2018), visitors characterized the sounds of certain emitters as being unpleasant, with, for instance, bird calls dominating, and thus detracting from landscape aesthetics. The negative effects of anthropophony are reported by Pilcher et al. (2009) to be especially important in wild areas, natural parks and other protected areas, where the intrusion of anthropogenic sounds is more disturbing. All of these studies provide us with useful clues as to how aural perception influences landscape perception, but none of them are easily applied across large regions.

1.2. User generated content and extraction of subjective phenomena from language

Our starting point is the hypothesis, based on an initial exploration of content, that UGC can be used to estimate aural perception of landscapes in the British Isles. This hypothesis is supported by previous work which has shown that, for example, tags associated with Flickr images or Tweets content have strong associations with place (Jenkins et al. 2016; Rattenbury, Good, & Naaman, 2007) or that olfactory perception of urban landscapes can be explored through UGC (Quercia & Schifanella, 2015). The same team of researchers also generated maps of urban noises using tags (Aiello, Schifanella, Quercia, & Aletta, 2016) by relating particular terms (e.g. church, car, dog) to particular sounds. However, their study implicitly links sounds to terms without clear evidence of the actual perception of sounds at a location. Similarly, analysis of spectrograms recorded by acoustic sensors (e.g. Pijanowski, Villanueva-Rivera, et al. 2011) does not allow a direct link between the presence of sounds and their perception by humans.

In this paper we build on previous work in two key ways. Firstly, the methods currently used in estimation of aural perception are time consuming and are not suitable for large regions. Using UGC provides an opportunity to explore the link between aural perception and landscapes across the British Isles. Secondly, in the case of recorded sounds presented in laboratory sessions the nature of a sound is abstracted from its context in the landscape. Therefore, we here set out to explore the efficacy of a range of methods for extracting and classifying textual descriptions related to aural perception of sounds, and apply sentiment analysis methods to explore the extent to which landscape descriptions related to different sound emitters can be characterized as positive, neutral or negative. We then explore, quantitatively and qualitatively how aural perception is characterized in our corpus, zooming in to explore local patterns in the description of sound experiences and zooming out to characterize the prominence and distribution of different sound experiences.
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