



Identifying cues for monitoring stewardship in Swedish pasture landscapes



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ABSTRACT

Perceived stewardship is an important factor driving people's landscape preferences, and there is a need for landscape planning and monitoring tools to address this characteristic in landscape management. The European Landscape Convention emphasizes landscapes as perceived by people, so the political pressure to develop indicators suitable for monitoring landscape qualities related to perception has increased. This paper presents the results from a study that uses eye-tracking to explore what it is in the agricultural landscape that people look at when asked to evaluate stewardship. In the study, photographs of Swedish agricultural landscapes were shown to 19 respondents while their eye movements were recorded, and after each picture they were asked to evaluate the landscape in terms of stewardship using a 7-point Likert scale.

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The result shows that features such as fences, patches of grass, edge zones, and wooded vegetation in pasture attracts attention to a high degree, emphasizing their role in the assessment of stewardship. The features identified as important for assessing stewardship have been discussed in relation to their identification in aerial photographs, using image analysis techniques as an example of how one can scale up the results for the monitoring of perceived stewardship in the landscape. This article demonstrates that novel techniques from the cognitive sciences could help the development of landscape indicators with which to analyse aspects important for human well-being and landscape multifunctionality.

1. Introduction

In Scandinavia, as elsewhere, there has been a change in agricultural policy and production since the 1950s, with a shift away from purely focusing on food production towards a multifunctional agriculture where the production of natural and historical qualities of landscape are seen as an important source of income for the farmers (Antonsson and Larsson, 2011). The importance of the landscape as

an asset for tourism and recreation has been widely recognized in recent research (for example, Garrod et al., 2006; Daugstad, 2008; Dramstad and Sang, 2010) with both agricultural policymakers and representatives of the tourism industry starting to recognize their common interest in rural areas (for example, Daugstad, 2008). For the agricultural sector in Scandinavia, rural tourism could provide a necessary diversification, with the potential to generate a substantial income for farmers, and thereby help sustain agricultural practices in the landscape (Daugstad et al., 2006). While the study presented here will focus on Scandinavia, there are parallel developments found in other parts of Europe (Garrod et al., 2006; Cawley and Gillmor, 2008).

There has also been an increased awareness of the landscape's potential role in supporting public health, with several studies supporting a link between natural landscapes and health. Thus visually attractive and preferred environments have been found to promote both mental and physical health, because it is in enjoyable circumstances that humans have the best chance of facing uncertainty and confusion as well as stimulating physical activity (Kaplan and Kaplan, 1989). Several empirical studies have shown that there is a relationship between preferences and perceived restorativeness (for example, Purcell et al., 2001; Staats et al., 2003; Tennart Ivarsson and Hagerhall, 2008), supporting the hypothesis that preferences involve implicit expectations for restoration. However, as

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found in the review by [Velarde et al. \(2007\)](#) of landscape types in environmental psychology, the categories of nature compared in studies of restorative effect have been poorly defined and rarely address particular elements of nature to any considerable extent. On the other hand, extensive research on landscape preferences has explored aesthetic appreciation in relation to specific landscape elements and landscape types (for example, [Arriaza et al., 2004](#); [Ode et al., 2009](#); [Coeterier, 1996](#); [Dramstad et al., 2006](#); [Van den Berg and Vlek, 1998](#); [Carvalho-Ribeiro et al., 2013](#); [Sevenant and Antrop, 2009](#)). [Tveit et al. \(2006\)](#) presented a framework suggesting that nine concepts were contributing to for the formation of landscape preference. These included naturalness, stewardship, complexity, coherence, ephemera, disturbance, visual scale, historicity, and 'imageability'.

For agricultural landscapes, several studies have identified the presence of stewardship as an important contributory factor in the formation of landscape preferences (for example, [Coeterier, 1996](#); [Nassauer, 1997](#); [Ode Sang and Tveit, 2013](#); [Sevenant and Antrop, 2009, 2010](#); [Sharp et al., 2012](#); [Weinstoerffer and Girardin, 2000](#)). [Tveit et al. \(2006\)](#) define stewardship 'as the presence of order and care, contributing to a perceived accordance to an "ideal" situation. Stewardship reflects human care for the landscape through active and careful management.' [Nassauer \(1997\)](#), meanwhile, has presented an aesthetic theory of care which stresses the importance of having 'cues of care' in order to frame novel and often messy ecosystems; cues which, while they are now recognized to vary by landscape as well as by culture, are understood to denote care of the landscape ([Ode et al., 2008](#); [Nassauer, 2011](#)). In the review paper by [Ode et al. \(2008\)](#) two groups of indicators were identified. The first group focus on the level of management for vegetation and describes the level of cultivatedness. Indicators suggested are level of abandonment/stage of succession; presence of weed; management type/frequency and detail. The second group of stewardship indicators focuses on the status and conditions of man-made structures in the landscape. Indicators for this group are: status and maintenance of structures such as fences and farm buildings. In common for all of the indicators identified by [Ode et al. \(2008\)](#) are their reliance on identification of a status of optimal care and management from which deviation could occur. The challenge for identifying the most relevant indicators lies in identifying relevant cues in the landscape that changes with level of care and management and that are also used for assessing the level of stewardship.

A study by [Rogge et al. \(2007\)](#) suggests that not only are visual cues important for assessing the level of stewardship in the landscape, but that the contribution of stewardship in deciding preference varies from group to group (in that example, landscape professionals, country-dwellers, and farmers). In their study of the perception of stewardship in Norwegian agricultural landscapes, [Ode Sang and Tveit \(2013\)](#) have shown that there is a difference in the perception of stewardship's presence in the landscape depending on whether one asks landscape professionals or the general public. The content of the images where significant differences were noted suggests that lay people seem to associate crop production more strongly with stewardship than do landscape professionals. Landscape professionals instead associated a more complex landscape composition with stewardship than the general public did. As a quantitative measure of stewardship, [Ode Sang and Tveit \(2013\)](#) apply a stewardship indicator based on the succession and level of management of vegetation, where a low level of succession suggested a high level of management and hence a higher degree of stewardship. The study showed that the levels of succession and of management were stronger indicators of perceived stewardship on the part of landscape professionals, as opposed to the general public.

When exploring the cues that are crucial to landscape perception and assessment, a standard approach has been to use different types of preference surveys, often with photographs as visual stimuli (for example, [Carvalho-Ribeiro et al., 2013](#); [Nassauer, 1997](#)). Preference studies usually call for visual stimuli to be controlled, including or excluding the elements and features addressed in the study, and then exploring the correlations and statistical relationships between the evaluation and the content of the image (for example, [Ode et al., 2009](#); [Hands and Brown, 2002](#)).

However, this approach has its limitations, for it does not provide any direct information about which elements respondents actually look at and emphasize when assessing images. By interviewing respondents, we might discover the strategies the respondents are aware of and are willing or able to communicate, but there might still be strategies that are more unconscious or not clearly formulated. Eye-tracking as a research method has been developed within cognitive science as a means of understanding cognitive processes ([Nyström, 2008](#)). Within several different disciplines it has recently been promoted as a technique that could provide objective measurements of the importance of visual features in evaluating different types of visual stimuli ([Holmqvist et al., 2011](#)). This would certainly permit the evaluation of the elements in an image that actually have informed the decision process. This is done by recording the respondents' eye movements when viewing a visual stimulus while being required to evaluate the contents of the image. An analysis of the respondents' viewing patterns will make it possible to gauge the relative importance of different elements present in the visual scenes they are evaluating ([Yarbus, 1967](#)). While eye-tracking as a method for linking evaluations with viewing patterns has been widely applied in fields as disparate as linguistics and medicine ([Holmqvist et al., 2011](#)), it has been little used in landscape research ([Dupont et al., 2014](#); [Nordh et al., 2012](#); [Ode Sang et al., 2014](#)).

In this paper, we consider which elements in the agricultural landscape are important for perceived stewardship, and use eye-tracking methods to address the question of whether the elements proposed as indicators by [Ode et al. \(2008\)](#) are valid. We hypothesize that while most people will respond to similar cues, the importance of each cue will vary according to the individual's knowledge and familiarity with landscape issues. The implication of the results for identifying indicators of stewardship in landscape monitoring will be discussed with regards to how the cues of stewardship identified could be extrapolated and used as indicators in landscape monitoring.

2. Method

2.1. Materials and stimuli

The stimuli used in the experiment were photographs of Swedish pasture. Forty sites in three different parts of Skåne, Sweden's southernmost county, were visited. All of the sites were classified as pasture according to the Swedish GSD-Marktäckedata (land cover data). The areas were used were the Söderåsen National Park and the municipalities of Kristianstad and Svedala. Each site was photographed, with the photographs framed so as to be dominated by the pasture. For each photograph the geographical coordinates were recorded. From the 40 areas visited and photographed, 13 photographs were selected for the experiment, the selection criteria being that they should show a range of different types of pasture, while including the elements of the stewardship indicators proposed by [Ode et al. \(2008\)](#).

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