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Ashlea Rendell

*University of Newcastle*, [ashlea.rendell@uon.edu.au](mailto:ashlea.rendell@uon.edu.au)

Marc T. P. Adam

*University of Newcastle*, [marc.adam@newcastle.edu.au](mailto:marc.adam@newcastle.edu.au)

Ami Eidels

*University of Newcastle*, [ami.eidels@newcastle.edu.au](mailto:ami.eidels@newcastle.edu.au)

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# Setting the e-Commerce Scene: A Qualitative Investigation of the Use of Nature Imagery in User Interface Design

*Research in Progress*

## **Ashlea Rendell**

School of Electrical Engineering and Computing  
The University of Newcastle  
Australia  
Email: [Ashlea.Rendell@uon.edu.au](mailto:Ashlea.Rendell@uon.edu.au)

## **Dr Marc T. P. Adam**

School of Electrical Engineering and Computing  
The University of Newcastle  
Australia  
Email: [Marc.Adam@newcastle.edu.au](mailto:Marc.Adam@newcastle.edu.au)

## **Dr Ami Eidels**

School of Psychology  
The University of Newcastle  
Australia  
Email: [Ami.Eidels@newcastle.edu.au](mailto:Ami.Eidels@newcastle.edu.au)

## **Abstract**

User experience designers often employ natural landscapes as background imagery in e-commerce user interfaces (UI). However, at this stage, there is only limited work on how nature imagery in UI design affects user perception and behaviour. In this paper, we present a qualitative study involving semi-structured interviews into the use of nature imagery in UI design. Our study builds on theories in environmental psychology and seeks to develop a theoretical framework for the role of nature imagery in user perception and behaviour. Further, building on the expertise of user experience practitioners and end users, we seek to develop theoretically-grounded design guidelines for the capture, selection, and integration of nature imagery in e-commerce UI designs.

**Keywords:** e-commerce, exploratory study, interviews, nature imagery, user interface design

## 1 INTRODUCTION

User experience designers often employ natural landscapes as background imagery in e-commerce user interfaces (UIs). For instance, a survey of 500 international university websites, a service with no inherent connection with nature (as opposed to, for example, a landscaping business), found that approximately 40% depicted garden imagery on their homepage (Vilnai-Yavetz and Tifferet 2013). However, despite its abundant use in UI design in practice, a recent literature review by Rendell et al. (2019) found that (1) overall there is limited research investigating the influence of nature imagery on user perception and behaviour, and (2) there has been no exploratory qualitative investigation that considers the expertise of user experience (UX) practitioners and end users themselves. This gap is concerning because it limits the knowledge base of how nature imagery can be created, selected, and integrated into UI designs for optimal user experience in different application areas. In this paper we present an in-progress qualitative investigation of the knowledge held by expert stakeholders and end-users in relation to the use of nature imagery in e-commerce UI designs.

Overall, there is ample evidence of the positive impact of nature exposure on human physiology, perception, and behaviour. For instance, potted plants in retail environments positively affect customer satisfaction and service quality perceptions (Tifferet and Vilnai-Yavetz 2017). Similarly, using nature imagery in print advertising can improve consumer attitudes towards brands (Hartmann et al. 2016; Schmuck et al. 2018). In a recent meta-analysis, Twohig-Bennett and Jones (2018) reported positive effects of nature exposure on 11 health outcomes, including improved heart rate variability, salivary cortisol levels, and cardiovascular mortality rates. Perhaps of most interest to human-computer interaction (HCI) researchers are nature's beneficial impacts on attention restoration and information processing (see Berto (2014) for a review). Recently, Gerber et al. (2017) showed that natural elements can mitigate physiological stress (e.g., blood pressure, heart rate) as well as information-processing fluency (as evidenced by eye fixations), even in virtual reality (VR) environments. Further, recent work has demonstrated that specific animal imagery can elicit phobic affective responses associated with increased information recall (Riaz et al. 2018). Despite this evidence, most existing research primarily focuses on nature exposure beyond digital interfaces. As such, this research does not take into account considerations unique to the digital or e-commerce environment (e.g., the alignment of nature imagery with personalisation principles in e-commerce UI design), nor does it provide design knowledge for how to successfully integrate nature imagery into e-commerce UI designs.

The present paper sets out to address this gap by conducting a qualitative investigation of nature imagery use in e-commerce UI designs. Our study is rooted in environmental psychology and theories emerging from the Biophilia Hypothesis (Wilson 1984). In particular, we consider the impact of nature imagery on human affect and cognition through the lenses of Stress Reduction Theory (Ulrich 1993) and Attention Restoration Theory (Kaplan and Kaplan 1989), as well as UI aesthetic preferences via the Landscape Preference Matrix (Kaplan 1987). In this vein, we build on existing propositions from the literature and investigate these qualitatively with design practitioners and end-users. The overall goal of the study is to develop a set of practical guidelines that can support researchers and practitioners in successfully employing nature imagery in UI designs, linking these guidelines to established theories in environmental psychology.

## 2 THEORETICAL BACKGROUND ON NATURE IMAGERY AND BIOPHILIA

The Biophilia Hypothesis by Wilson (1984) posits that humans have an innate biological connection with nature, and seek affinity with living things for health and vitality. Wilson argued that replacing forests and woodlands with urban jungles and concrete cities poses a threat to human survival due to the disconnection with our natural living ecosystem. Three related theories are critical to investigating why, and how nature imagery influences users in HCI. Herein we discuss these theories.

### 2.1 Stress Reduction Theory

*Stress Reduction Theory* (SRT) is an evolutionary psychology approach that focuses on the *affective* influences of nature (Ulrich 1993). According to Ulrich (1993), humans who were better able to recognise and process specific natural cues of a healthy environment were more likely to survive during the Pleistocene Epoch. The recognition of these cues triggered an automatic reduction in sympathetic nervous system activity, which is subjectively experienced as a decrease in arousal, and corresponding increase in positive affect. Due to the survival-enhancing nature of being able to automatically recognise positive environmental cues, Ulrich suggested that humans developed domain-specific brain modules responsible for processing specific natural elements without conscious thought. The elements identified

by Ulrich which trigger this process are (1) clear calm water (as it provides a hydration source), (2) healthy verdant vegetation (as it provides sustenance, both directly and indirectly), as well as (3) landscape openness, herein referred to as vantage (it affords visibility of approaching threats; Ulrich 1993). Research in lab and field environments has provided strong support for SRT (see a recent meta-analysis by McMahan and Estes 2015). In the lab, Ulrich (1981) found improvements in self-reported positive affect, as well as water specifically, and nature generally, being more beneficial in increasing feelings of wakeful relaxation, as measured by alpha amplitudes, in comparison to urban environments. Similarly, Friedman and colleagues (2008) found that individuals who looked at a live-feed of a local park displayed on a screen in their office reported feeling refreshed and refocused. Improvements in heart rate variability have also been seen in participants viewing *videos* of natural environments in comparison to urban environments (Laumann et al. 2003). Such varied evidence of affective improvements triggered by nature exposure suggest possible benefits to user engagement via the inclusion of nature imagery within e-commerce UI designs.

## 2.2 Attention Restoration Theory

In contrast to SRT, *Attention Restoration Theory* (ART) is a *cognition* focused interpretation of Biophilia (Kaplan and Kaplan 1989). It builds on the notion that the finite capacity of human information processing can cause fatigued executive functioning when exposed to complex environments (Kaplan and Kaplan 1989). Symptoms of this fatigue can be seen in a range of behaviours (e.g., impatience, reduced performance; Berto 2014). However, according to ART, as a result of the innate “soft fascination” humans have for nature, our attention systems are effortlessly engaged when we are exposed to it, thus allowing the recovery of depleted attention resources (Kaplan and Kaplan 1989). It is this recovery of cognitive functioning that ART focuses on in explaining the signs and effects of Biophilic responding. There is strong support of ART in the literature, such as improved proof-reading after nature exposure (Hartig et al. 1991; Laumann et al. 2003), increased search-task accuracy in nature-inspired virtual environments (Juliani et al. 2016), and improved information processing as evidenced by eye tracking (compared to urban imagery; Dupont et al. 2014; Wang and Sparks 2016). Further, the inclusion of nature imagery in tourism advertising has also been demonstrated to increase viewer recall (Sparks and Wang 2014). Similar to SRT, evidence such as this suggests positive effects of the inclusion of nature imagery in e-commerce UI design.

## 2.3 The Landscape Preference Matrix

The *Landscape Preference Matrix* is an alternative theory to explain the *aesthetic preference* for natural environments. Unlike SRT and ART, it does not depend on the natural elements themselves (such as water or vegetation). Kaplan (1987) hypothesised that rather than specific types of natural elements, it is the macro-level environmental characteristics (e.g., form and structure) that are important for aesthetic preference. Within the matrix, Kaplan identifies visual coherence, legibility, complexity and mystery as critical indicators of an environments’ visual aesthetic potential (Kaplan 1987). In addition to evidence from other domains, the Landscape Preference Matrix has been perhaps the most common of the Biophilia theories translated to the IS context. The factors have been assessed in relation to numerous contexts and outcomes, including webstore trust, satisfaction, and purchase intention (Lee and Kozar 2009; Yeh and Li 2014), the usage intention of blogs (Liao et al. 2011), and the aesthetic preference of website design more generally (Rosen and Purinton 2004). While each of these studies found evidence that websites scoring high in the Landscape Preference Matrix factors are likely to trigger more positive behavioural outcomes than those which do not, the analyses did not consider nature content specifically, nor was there consideration of stakeholder expertise.

## 3 THEORETICAL MODEL AND RESEARCH QUESTION DEVELOPMENT

As detailed above, there is ample evidence indicating potential benefits of including nature imagery in UI designs. While a recent theoretical framework captures the potential pathways between the use of nature imagery in UI design (e.g., the presence of water and vegetation), user perceptions (e.g., perceived nature presence, perceived visual aesthetics), and UI outcome variables that are of central interest to user experience designers (e.g., brand attitudes, purchase intentions, see Figure 1; Rendell et al. 2019), the framework was derived from a review of existing research and hence is limited to the results, and contexts, of those studies. As the review found, no study so far has jointly considered the pathways of perceived nature presence and perceived visual aesthetics on UI outcome variables, and more generally there is limited IS literature on this topic. As a result, there is no acknowledgement or investigation of UI specific constraints and knowledge that is held by experts in this context. For example, should nature imagery be the environment a product is displayed within, or should the nature image be displayed on

the product being sold (e.g., on the screen of a television on a product page)? Further to this, should practitioners be making an effort to personalise the nature imagery used, to reflect the users' own native environment, or does a generic stock nature image satisfy requirements? Hence, the goal of this research is (1) to validate and extend the pathways in the framework and (2) to develop a set of practical guidelines that can support researchers and practitioners in successfully employing nature imagery in UI design.

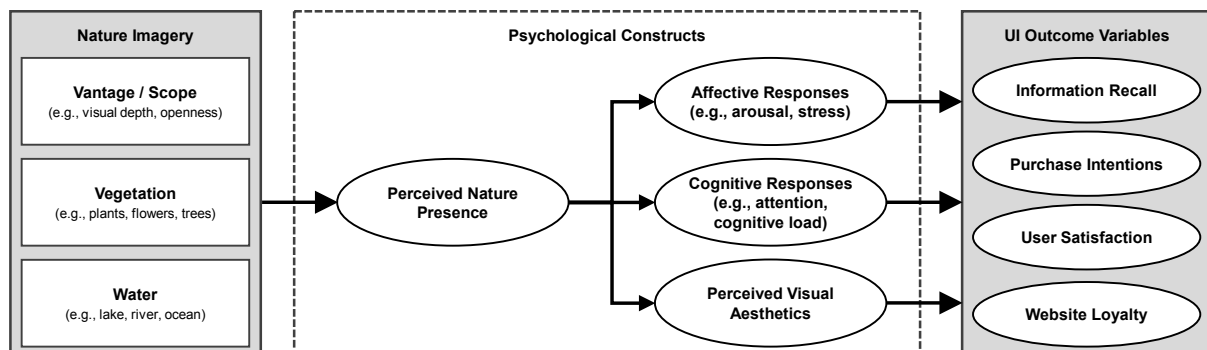


Figure 1. Theoretical framework on the influence of nature imagery on UI outcome variables, adapted from Rendell et al. (2019)

### 3.1 Validation and Extension of the Framework

While Figure 1 (Rendell et al. 2019) provides an important conceptualization of what is already known about the influence of nature imagery on user perception and behaviour, the review also revealed that there is a range of factors that have not been considered in the literature so far. First, in the UI context there has been no research so far on whether the *native landscape* of an individual may affect their responses to particular nature imagery. For instance, a user coming from a background rich in mountain and lake scenery may respond differently to imagery of grasslands than a user growing up in a coastal environment. Second, nature imagery is linked to *weather conditions* and time of day. Prospect-Refuge Theory (Appleton 1975) suggests that a nature scene photographed on a sunny afternoon may trigger different approach-avoidance responses than the same scene photographed on a rainy morning. Third, as with every background image, UX designers have a range of options for how to embed the imagery into the site (e.g., as the scene in which a car is driving through, or on the screen of a computer being sold) and how to link it to the products and services on the site. All of these aspects could potentially play an important role in the impact of nature imagery in different contexts and hence require further investigation. Against this backdrop, our first research question states:

**RQ1:** How can the influence of nature imagery in e-commerce UI design be conceptualised into a theoretical framework?

### 3.2 The Development of Design Guidelines

Nature imagery is widely used by user experience designers in practice (Vilnai-Yavetz and Tifferet 2013). Though there are established guidelines to identify the psychological restoration potential of nature imagery (Thake et al. 2017), and there has been research on the application of the Landscape Preference Matrix to UI design, to the best of our knowledge there are currently no guidelines available to assist designers in capturing, selecting, and integrating nature imagery into e-commerce UI designs. This is concerning because (1) the wide proliferation of nature imagery in practice builds on a limited knowledge base, hence, (2) it is difficult for system designers to decide and justify how to integrate nature imagery into their UIs, and (3) it is thus also difficult to discern what effect this may have on users. Hence, our second research question centres on the development of practical, yet theoretically-grounded design guidelines for employing nature imagery in UI design.

**RQ2:** How can system designers create, select, and integrate nature imagery in e-commerce UI design?

## 4 RESEARCH METHOD

In light of the scarcity of stakeholder expertise consideration in the extant literature we are conducting a qualitative study engaging with a range of stakeholders, including professional UI designers, imagery and nature experts, and private users to address these research questions. In doing so we aim to validate and extend the theoretical propositions identified in the extant literature (RQ1) and derive a set of

practical guidelines for the capture, selection, and integration of nature imagery in e-commerce interfaces (RQ2).

#### **4.1 Participants**

Based on our review of the literature, we identified three groups of stakeholders, namely (1) *nature and design experts* (e.g. academics, book authors, consultants), (2) *professional staff in organisations* (e.g. user experience designers, marketing designers, developers), and (3) *private users* (e.g. home users, students). This enables us to capture a range of different expertise and experiences and to triangulate response themes (Myers and Newman 2007). As varying 'levels' will be recruited for groups one and two (e.g. design management as well as 'on-the-ground' designers), we reduce the risk of collecting a biased sample of experiences and opinions. As data collection and analysis in qualitative research runs concurrently (Braun and Clarke 2006), the final number of included interviews will be confirmed once thematic saturation can be confirmed.

#### **4.2 Interview Structure**

Based on the theoretical background summarised in Section 2 and Section 3, we follow a theoretically driven deductive analysis, while also allowing for inductive themes to be identified within the specific context of user perceptions and behaviours toward e-commerce user interfaces. This is seen in the semi-structured nature of the interviews being conducted. The structured portion of each interview focuses first on the validation and possible extension of the theoretical framework shown in Figure 1. The second part of the interviews then focuses on best practices for the capture, selection, and integration of nature imagery in UI interface design. For designers and practitioners, this includes questions on participants' current and ideal image selection process, the purpose of using nature imagery in their UI designs, and the potential influences of nature imagery on user perceptions and behaviours. The interviews will conclude with participants offering their suggestions on guidelines for image selection processes and practises. With regard to the private user group, interviews will begin with general questions regarding the participants' experience with e-commerce user interfaces, and their beliefs regarding the influence of nature imagery within e-commerce user interfaces. This will be followed by questions regarding the users' own preferences and responses toward e-commerce interfaces, including their opinions and responses toward organisations utilising nature imagery in their UI designs.

#### **4.3 Procedure**

Potential participants will be given an information statement and consent form prior to participation in the study, with informed written consent being given prior to the commencement of each interview. Participants will be able to withdraw their data from the study at any time, even if prior consent has been given. During the interview participants are allowed to ask for their recording to be stopped and edited or erased. Participants will also have the opportunity to review the transcript of their interview and edit their contribution if they wish. Interviews shall last no longer than one hour, with the possibility of revisiting to discuss issues or matters that require clarification during analysis. This study was approved by the ethics committee at the University of Newcastle, Australia.

#### **4.4 Modes of Analysis**

For this study we are using thematic analysis to consider the interview material of participants. Thematic analysis, as described by Braun and Clarke (2006), provides theoretical flexibility and allows us to make a direct interpretation of participant motivations, meanings, and experiences. The interview recordings will be orthographically transcribed, creating a verbatim account of each interview. Following the thematic analysis phases suggested by Braun and Clarke (2006), once each interview is conducted and transcribed (Phase 1) we will analyse the transcripts by generating initial codes (Phase 2), search for themes (Phase 3), review themes (Phase 4), define and name themes (Phase 5), and conclude with the production of a final manuscript (Phase 6). As per our research questions, the themes relate to the pathways in the theoretical framework (RQ1) and the development of practical guidelines (RQ2). We acknowledge phases 2 through 5 are iterative, and as such the identified themes and sub-themes may develop or become more refined as more interviews are conducted. It is possible that identified themes may include specific natural elements, compositions or styles, weather or contexts of imagery that should be included when selecting nature images for UI designs, or specific responses users experience when interacting with nature-filled UI designs. The final thematic map resulting from analysis will be used as the foundation for a set of design guidelines for the identification and selection of nature imagery to be used in e-commerce UI designs.

## 5 EXPECTED CONTRIBUTIONS AND CONCLUSION

Modern consumers are inundated with product and organisational choice via the Internet, making e-commerce UI designs an increasingly critical factor in organisational success. Evidence from a range of settings on the beneficial influence of nature and nature imagery on human perception and behaviour suggests the use of nature imagery in e-commerce UI designs could trigger positive user responses such as reduced arousal/stress responses and improved information processing (e.g., Friedman et al. 2008; Yeh and Li 2014). Indeed, recent work has demonstrated that the inclusion of animal imagery can enhance user recall of online information (Riaz et al. 2018). However, there is a present juxtaposition between the abundant use of nature imagery in e-commerce designs and a lack of understanding for the context-specific constraints around the integration of such imagery. Design guidelines have been the output of research in a range of human-computer interaction contexts (e.g. mHealth applications (Noorbergen et al. 2019); gamified information systems (Liu et al. 2017); biosensor-enabled decision support systems (Astor et al. 2013)), and provide a useful starting point for systems designers by facilitating empirically-driven design decisions. Further, to the best of our knowledge this is the first IS research attempting to uncover the expertise of stakeholders working within this space to contribute to the integration of domain knowledge from both academic literature and real-world experiences.

The present study aims to provide the first qualitative exploration of the use of nature imagery in e-commerce designs. The inclusion of multiple stakeholder perspectives will enhance theoretical understanding of the role of nature imagery in e-commerce UI designs, and allow the refinement of the existing theoretical model on the influences of nature imagery on user perception and behaviour (Rendell et al. 2019). Knowledge obtained from stakeholder interviews will guide the development of design guidelines for use in the process of selecting nature imagery for e-commerce UI designs. These guidelines will offer a reference point for practitioners to select nature imagery that is most suitable to their context of use and offers a mechanism for triggering positive user responses targeted when attempting to increase engagement.

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