



# Natureculture Probes: Opening up dialogues in heritage(s) landscapes

## Abstract

This pictorial introduces Natureculture Probes, an innovative tool designed to enhance visitor engagement at heritage sites through participatory methods. Rooted in feminist post-human approaches and post-humanist HCI, these probes aim to bridge nature and culture, offering diverse perspectives on heritage. Developed through an iterative research-through-design approach, the tools include postcards and sensory maps, enabling visitors to document their reflections and sensory experiences. Field tests at two UNESCO heritage sites highlight the probes' potential to capture diverse, contextual data and foster deeper connections with nature and cultural heritage. However, tensions emerged between heritage preservation, public engagement, and technology's role in nature. The study underscores the importance of inclusive, co-designed tools to balance economic, cultural, and environmental entanglements. The findings advocate for adaptive, seasonally varied deployments to better address the diverse needs of heritage visitors and stakeholders, ultimately contributing to more empathetic and sustainable heritage site management and visitor experience design.

## Author Keywords

Design probes; Natureculture; More-than-human; Heritages; Outdoors, Feminist posthumanism; Human-nature interactions.

## CSS Concepts

- Human-centered computing~Systems and tools for interaction design~HCI design methods.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

TEI '25, March 4–7, 2025, Bordeaux / Talence, France  
© 2025 Copyright is held by the owner/author(s).  
ACM ISBN 979-8-4007-1197-8/25/03.  
<https://doi.org/10.1145/3689050.3704430>

**Anna My Bertmark<sup>1\*</sup>,**  
**Mathilde Gouin<sup>1\*</sup>,**  
**Nuno Jardim Nunes<sup>1</sup>,**  
**David E. Millard<sup>2</sup>,**  
**Pedro Galvão-Ferreira<sup>1</sup>,**  
**Vera Fearn<sup>1</sup>,**  
**Marta Ferreira<sup>1</sup>,**  
**Valentina Nisi<sup>1</sup>**

<sup>1</sup>ITI / LARSyS, Instituto Superior Técnico,  
University of Lisbon, Lisbon, Portugal

<sup>2</sup>University of Southampton, Southampton,  
United Kingdom

\*both authors contributed equally  
to this pictorial

This research is part of the EU-funded project LoGaCulture, which aims to explore how transmedia interventions can enhance accessibility and innovation in the European heritage sector. We focused on the **Avebury landscape** and **Madeira's Laurisilva and Levada walks** (see p.2) due to their historical significance and traces of human engineering endeavours linked to nature. These sites are among four research locations selected by the LoGaCulture consortia.



## Introduction

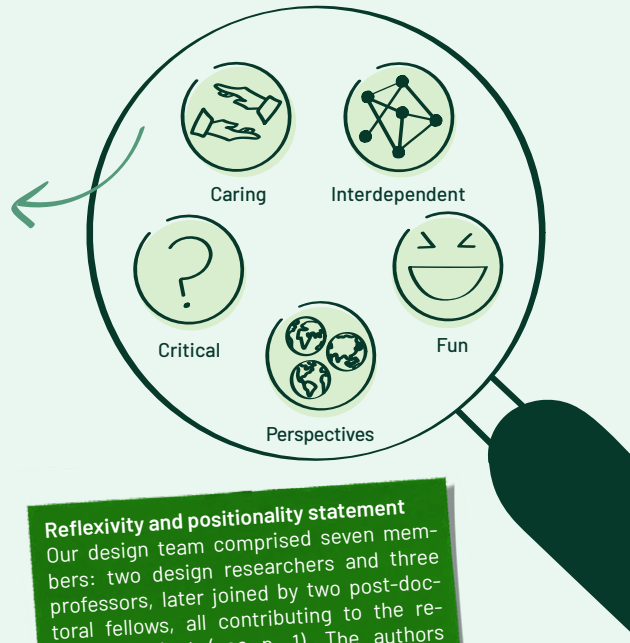
Recent research in Human-Computer Interaction (HCI) calls for new participatory methods and tools to design technology for nature-related experiences [70][1][64][48][38]. Post-humanist HCI methods have explored ways to conceptualise nature-human entanglements[19][31][62][66]. When designing tools for visitor engagement at heritage sites, factors such as cultural, ethical, social, technological, and environmental challenges need to be considered[42][21][43][10]. Research has shown that tangible methods are effective for accessibly collecting tacit and ethnographic data for shaping design processes that aim to enhance human-natureculture reconnection [47][69][32]. We created Natureculture Probes, a bespoke tool for informing the design of heritage-related digital interventions. These aim to critically foreground who, when, and what is and is not present in heritage-making. We developed the tools through an iterative research-through-design (RtD) approach, which included field visits and dialogues with the respective stewarding organisations. This allowed for an emergent and interpretative process for generating design knowledge for nature-related locative experiences at heritage sites.

We build on feminist post-human approaches [24][4][6], **focusing on the relational attributes of natureculture** [21][25] and enabling design researchers to embrace new critical explorations of speculative, situated, embodied and affective aspects of natureculture heritage(s) within their work. Natureculture presents the notion of nature and culture interwoven as one and nature being “constituted through social constructions of language”[21]. Situated knowledge argues that all knowledge is contextual and based on physical, cultural and social conditions [24]. This standpoint allows for critiquing the singular notion of heritage and opens up research on methods for digital visitor engagement. These methods align with critical socio-environmental considerations, as highlighted by the United Nations Educational, Scientific and Cultural Organization’s (UNESCO) designations of these sites [11][12]. UNESCO aims to identify, protect, and preserve cultural and natural heritage worldwide deemed outstanding for humanity.

With this work, we contribute to the design of tools to explore nature-immersed heritage sites and extend on innovative design methods. Inspired by Dunne and Gaver’s cultural probes [22] and many applications in design research [23][5][9][14], we designed tools to inspire and guide the creation of design spaces

that enhance visitor experiences and access to rich natural and cultural heritage sites. These tools also aim to preserve the well-being of the surroundings and local communities. This theoretical foregrounding enables us to capture multiple aspects of our becoming-with the environment [25]. **Natureculture Probes consist of a set of postcards and sensory maps**, which visitors can fill out during or right after their site visits. The postcards aim to capture elements of temporality and different impressions that affect the act of visiting. The sensory maps gather sensory information and allow for new embodied discoveries. This pictorial presents our method and unpacks tensions highlighted through the design process and the piloting of the tools.

### The relational attributes of natureculture at heritage sites



#### Reflexivity and positionality statement

Our design team comprised seven members: two design researchers and three professors, later joined by two post-doctoral fellows, all contributing to the research project (see p. 1). The authors write and reflect on this project as white, able-bodied academics and designers and acknowledge their embeddedness within urban Euro-centric modern standpoints, from which this work emerges. The sites for this research have been, and continue to be, shaped by European humans as the dominant species.

The **Avebury henge and stone circle** dates back 4,600 years and surrounds the village of Avebury in Wiltshire, UK, approximately 25 miles north of Stonehenge [73]. Awarded UNESCO status in 1986 [11], the site contains the world’s largest standing circle of sarsen stones, and the surrounding area displays Bronze Age burial sites. Here, natureculture points to specific spiritual value embedded in the site.



The **Laurisilva rainforest in Madeira**, dating back 20 million years (Tertiary Age), was once widespread in Southern Europe and Northern Africa [74]. However, due to the Mediterranean climate and geological changes, it retreated to Macaronesian islands. Designated as a UNESCO World Heritage site in 1999, this unique ecosystem can be explored through human-made irrigation channels called *levadas*. On Madeira, human habitation depends on the levadas and its linked natureculture.

## Natureculture Probes related work and inspiration

The Natureculture Probes build and extend on the work of wild probes [2] that test work-in-progress studies in public and walking methods [35] that facilitate “wayfaring” as **temporal, sensory and embodied participatory design methods** in nature settings.



We also seek to **complement these methods** by including **speculative fabulation** [27][24] and collect inevitably human-centred, **subjective impressions** and reflections on unarticulated **multi-species standpoints** for informing heritage-site-based and multi-stakeholder game design.

HCI's recognition of diverse perspectives and relational ontologies to generate situated knowledge has gained traction with increasingly diffuse object-subject divisions in human-technology relationships [19]. We extend on these views by exploring how a multifaceted view of heritage(s) and epistemologies of care may be co-authored for our specific purpose and context. NatureCulture [24] is an underexplored notion in nature-immersed heritage landscapes. In this specific context, we leverage the familiarity of maps and postcards, which are common artefacts at heritage sites, to allow for deeper exploration and engage participants. As a methodological answer, probes have evolved as a meaningful research tool for eliciting subjective, contextual, and often obscured aspects of everyday human experiences for inspiring design processes [5]. Çerçi et al. discuss how probes are used and interpreted by HCI research, arguing for situated adoptions [14], while Wang, Desjardins et al. and Paraschivoiu et al. illustrate their compelling and versatile nature for self-reflection and place-based co-speculation [69][15][49].

Building on sensory ethnography [51][33], ‘smellscape mapping’ [50], ‘soundscape’ [52], and sensewalking [29], **sensory maps** aim to be an immersive method, capturing the here-and-now of the experience through punctual sense recordings. Participants can engage individually or as a group, draw or write their answers, and decide how much time they invest in the activity. The sensory mapping activity aims to bring new perspectives to the self-exploration of heritage sites by re-discovering the area through all senses. By inviting participants to stop and sense during their visit, and document and share a wide range of sensory information, the maps allow for collecting data in situ and integrate new ways of noticing [37][67] and remembering.

**Postcard probes** have previously been used in HCI research as a tool to facilitate reflection on temporal past and future perspectives [49][63], as well as for informing and shaping museum visitor experiences [46]. However, for cultural heritage situated in natural landscapes and multi-species contexts for HCI, probes are underexplored in design research. This work expands upon designerly co-design methods with existing and planned data collection by open-air site heritage institutions [2]. The postcards feature probing ques-

tions that participants are invited to answer. To devise the questions, a literary review was made on the theories of natureculture [21], diverse ontologies [34][18][45][57], regenerative sustainability [8][39], sustainable tourism [10][40], and multi-species temporality [48], reflecting on how to better relate to the place and counteract conventional authorised knowledge [21].

Inspired by these processes, the authors selected ten salient concepts to form the base of the probing postcards (see key on p. 5). Among these concepts are ‘diverse cosmologies’, which speak to the spiritual purposes of the site over time and serve visitors still seeking a ‘spiritual space’ today [68]. ‘Unique vocation of place’ derives from regenerative thinking, promoting place-sourced development and “considers nested human and natural systems, and incorporates a layered understanding of reality and time.” [8]. ‘Diverse temporalities’ encompass non-human relationships with time as well as crip temporalities [57]; its connection to accessibility and anti-ableism. The perspective of becoming a ‘Friends of [the] place’ may foster a sense of respect, care, and shared concern with residents to understand ‘How to visit’ to safeguard it ‘for those who follow’ [42]. The postcard motifs’ aesthetic is intentionally distorted and humorous, including surreal collages featuring elements from the heritage site, aligning with the original postcard probe aesthetics [22]. The presence of modern technological devices also explores heritage(s) as a continued process of entanglement with material ecologies [20].

**Speculative fabulations** unsettle fixed and expected ways of understanding and experiencing the world. It is a “mode of attention, a theory of history, and a practice of worlding” [27], contributing to critical discussions and world-building by exploring historical narratives and incorporating voices that have often been overlooked [28]. Here, we apply speculative fabulations as a design approach for the postcard probes to illustrate the messy reality of heritage(s). We acknowledge that, as makers, participants, and visitors of technoculture, we bear a “generational duty to its failures as well as its accomplishments” [26]. We also employed autoethnography as a method for eliciting initial impressions and to “empathise with the users” [55] and noticing for “cultivating alternative perspectives in technological intervention” [37].



# Designing the probes

## Step-by-step design process

### 1 Getting to know the place

The design process started with a visit to the Avebury Cultural Heritage (CH) site on Summer Solstice. The longest day of the year, essential to the Pagan calendar, draws large crowds to the site. Positioned as naïve artists and rural flâneuses [17] [56], the two designer researchers collected autoethnographic impressions of site-specific negotiations of invisible rules and social relationships.

#### First person impressions:

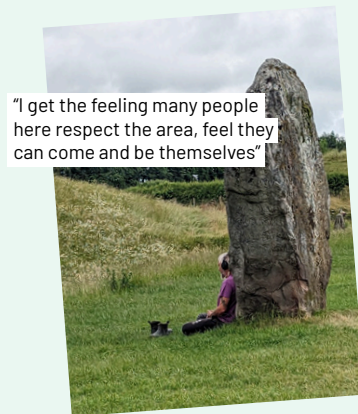
*The village is nested within the circle of remarkable megaliths, and we repeatedly noticed the words 'ancient', 'respect', and 'sacred' in the signage. Able visitors can physically engage with the stones, in contrast with the inaccessibility to wheelchair users. Walking around allowed for multi-species encounters with sheep, insects, and rooks.*

### 2 Harvesting information

The initial reflections prompted more profound research into Avebury's history, further exploration of visitor experiences, and future visions for the site.



Independent self-published information booklets about the site illustrate a naturecultures perspective on authoring and diversity in how the story of heritage(s) is told [75][59].



### 3 Design Exploration

Initial probe ideas included "Neolithic Tiktok" and "TimeTravelcards", asking participants to imagine travelling through time and "sensory report", including photos of what may be different then. The Postcard probe questions and themes emerged from the literary research. The Sensory Map explored different maps of Avebury, with sensory prompts and a "warm-up exercise" for tuning into the senses (see, feel, move, hear, touch, smell, taste) to question conventional representations of heritage.



How do we explore the entangled interdependencies of natureculture figurations?



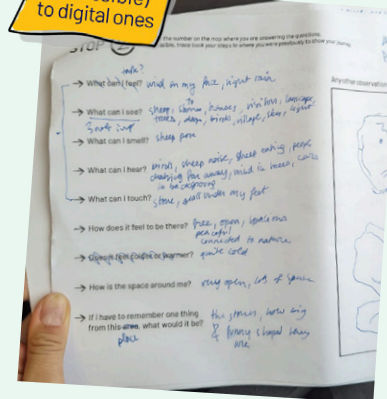
### 4 Prototyping and testing

The researchers returned to Avebury, meeting with the National Trust (NT) to discuss the initial probe versions. We heard about Avebury's history and efforts to address value tensions among local stakeholders [10] [13] [71], which impacted the design. They also requested that familiar landmarks be added to each postcard to reflect its contemporary spiritual significance, but to avoid AI-generated imagery of Neolithic people. Overall feedback was positive, but we decided to keep to two probes: maps and postcards, integrating the "time travel" ideas into the Postcard themes. During the visit, we piloted the maps in situ to ensure feasibility and decided to add the prompt 'Describe where you are' to invite more precise location details.

Feedback from the NT meeting

Prefer physical probes (more accessible) to digital ones

Show questions on both sides of cards



### 5 Final probes design

Most postcard questions remained unchanged from the first version. Still, we paid attention to aesthetics for subverting the conventional, familiar, and singular notion of heritage and to invite participants to share subjective reflections on the questions. Logistics and resources were guiding factors in designing the participant information forms, the text on the back of the postcards, and how the probes were deployed on-site.



Photos taken during the visits became material for the postcard motifs.





## Visitor postcards

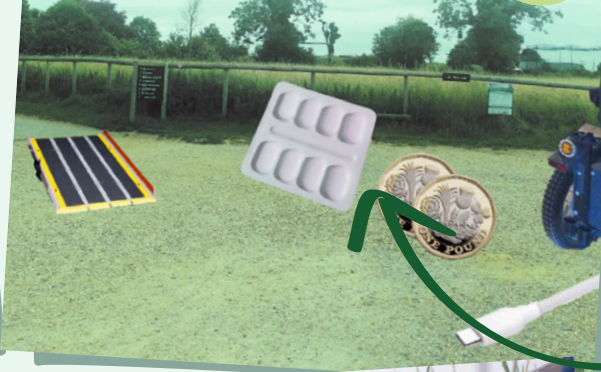
### Initial postcard design for Avebury

This card invites situated reflections on **temporalities** and **relational connections** to past and present humans and more-than-humans.  
Text: Probing connection with the past inhabitants of the place.  
Visual: Linking **human cultural and historical** (antique pieces) **activity** (consuming food) **to the landscape**. Juxtaposing scales to suggest multiple perspectives.

IF YOU COULD SEND A MESSAGE TO A VISITOR IN THE PAST, WHAT WOULD YOU ASK OR TELL THEM ABOUT?



WHAT CHALLENGES DID YOU HAVE TO OVERCOME IN ORDER TO GET HERE?



This card calls attention to the **accessibility** and **limiting aspects** of some open-air heritage sites.  
Text: Sharing challenges affecting the visit's factors for future design considerations.  
Visual: Juxtaposing images and icons representing **transport and accessibility** (a ramp and a mobility scooter), **costs and use of currency** (coins), **mobile coverage and charging issues** (mobile phone charging cable), and **physical discomfort** (painkillers).

This card points to the **positive aspects of visiting** and how tacit and shared rules for visiting may influence future visitors' experiences.

Text: Probe for the **cherished, familiar**, functional elements at the site.  
Visual: **Shared responsibilities** of co-stewarding the site while moving around the landscape, such as **highlighting the iron lock** that asks visitors to close the gates behind them to prevent animals from trespassing.

WHAT DO YOU PARTICULARLY ENJOY ABOUT AVEBURY AND WHAT MAKES IT SPECIAL TO YOU?



TO SOME VISITORS AND RESIDENTS YOU ARE A GIANT. WHAT DO YOU THINK THE SMALLER ONES MAKE OF US?

This card directly probes participants' perception of **relational multi-species standpoints** and speculative fabulation.  
Visual: The **co-production of places** through our interdependency with invertebrates.  
Text and Visual: The perspective from the world beneath our feet of 'messy' layers of rock, soil, and grass.

The text probe repeats at the back of each card with space for optional sharing of the participant's email address to receive further information. The **aesthetics mirror holiday postcards**, informing where to 'post' the card after filling it in. A 'fake' address to the researchers provides an **informal relationality**. A QR code links to a secure digital online form as an alternative participation method.

HOW CAN THIS PLACE BETTER SERVE YOU AND WHAT WOULD YOU LIKE TO SEE IMPROVED?

Please write your email address below to receive updates about the research project. We may contact you in the future to hear more about your visit.



NOT FOR SALE - FREE TO TAKE

LoGaCulture Project  
 University of Southampton  
 Southampton SO9 1B6

DO NOT POST  
 PLEASE USE A DROPBOX

BY RETURNING THESE CARDS TO US VIA THE DESIGNATED DROPBOX, YOU CONSENT TO TAKING PART IN THE LOGACULTURE RESEARCH PROJECT. PLEASE SEE THE PARTICIPANT CONSENT INFORMATION CARD AND PROJECT INFORMATION SHEET FOR MORE INFO OR ASK A MEMBER OF STAFF | [HTTPS://LOGACULTURE.EU/](https://logaculture.eu/)

HOW CAN THIS PLACE BETTER SERVE YOU AND WHAT WOULD YOU LIKE TO SEE IMPROVED?

This card invites visitors to **reflect on the present and future** of the site.  
Text: **Sharing ideas** about enhancing the visitor's experience.  
Visual: A **more critical angle** through the image of a white cloud provides a **blank space to be filled in**, not to direct the participants' response.

### Themes key:

- Past(s) [34][45]
- Future(s) [34][45]
- 'How to visit' & 'for those who follow' [42]
- Diverse temporalities [48][54][57]
- Invisible implication of visiting [18][42][10][21]
- Present(s) [34][45]
- Friends of place [8][39]
- Unique vocation of place [8][39]
- Diverse cosmologies [68]
- Non-anthropocentric personhoods & perspectives [18][42][10][21]



# Visitor postcards

## Initial postcard design for Avebury

This card asks participants to share ideas about **how heritage(s) changes through time** and what to consider when stewarding the site for future generations.

**Text:** Examining what aspects of heritage(s) should be **protected or let go of**.

**Visual:** Emphasising how **heritage** is continually **marked** and **eroded**.



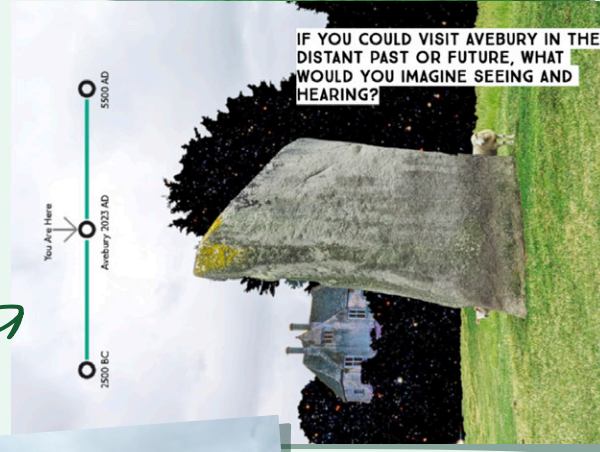
This card queries the visitor's values related to the site and its **spiritual role** through time. **Text:** Asking about their **subjective ideas** of sacredness while engaging with natureculture.

**Visual:** Elements from the site associated with "**sacredness**", such as a sheep, a megalith, vital technologies, **circles** linked to **pagan symbolism**, earth, and dividing cells.

This card invites a **reimagination** of how to **negotiate our relationship with deep time**.

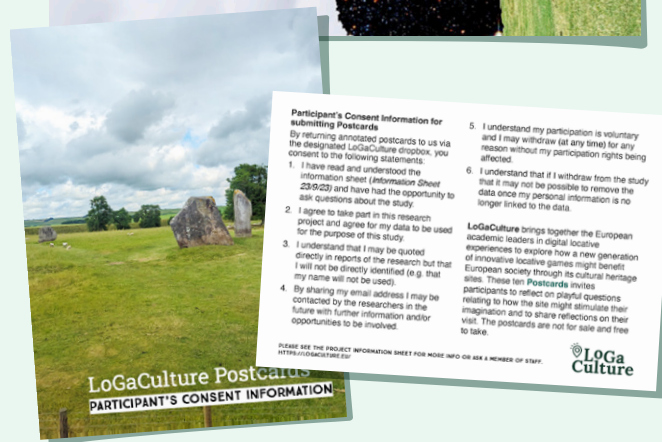
**Text:** Inviting to imagine the place through the **senses** and **time travel**.

**Visual:** A **playful timeline** in the style of the London tube map to help situate the self through time and a **surreal starry sky** that points to the **mystery of time**.



This card investigates **situated multi-species temporalities**, such as how the site is experienced over millennia vs. in one day. **Text:** An authored notion of heritage, inviting **relational** and **imaginative impressions**. **Visual:** Googly eyes on the megalith **subvert the conventional anthropocentric perspective**.

Due to **ethics requirements**, an 11<sup>th</sup> postcard with a more conventional motif contains the participant's consent and project information, designed to be kept by the participant as a "**souvenir**".



This card asks the participant to reflect on their **place in time** and their contribution to the **stewarding of natureculture**. **Text:** **Situating the visitor** in the place of heritage artefacts to emphasise natureculture entanglement.

**Visual:** Showing a visitor from the earth's perspective with a mobile device to query whether technologies are barriers or enablers of deeper engagement.

## Themes key:

- Past(s) [34][45]
- Future(s) [34][45]
- 'How to visit' & 'for those who follow' [42]
- Diverse temporalities [48][54][57]
- Invisible implication of visiting [18][42][10][21]
- Present(s) [34][45]
- Friends of place [8][39]
- Unique vocation of place [8][39]
- Diverse cosmologies [68]
- Non-anthropocentric personhoods & perspectives [18][42][10][21]



# Sensory maps

User journey and initial design for Avebury

## 1 Before the walk

Participants are invited to read the activity's instructions and take some time to **warm up their senses** with a mindfulness exercise inviting them to connect with their environment (p1).

**Sensory mapping toolkit**

What is this about?  
This sensory mapping aims to bring new perspectives to your exploration of the Avebury site, by re-discovering the area through all senses.

It can be done in parallel to your visit and you can decide how much time to spend on it - from a few minutes for each stop, or much longer if you feel like it. At the end of your visit, return this toolkit where it was handed to you, and pick up your reward.

What's in this toolkit?  
→ Instructions  
→ A map of the area  
→ 5 tables to record your senses in a specific location  
→ Extra sheet to draw or write down any other observations  
→ A consent form

How does it work?  
→ During your visit, stop at five different places whenever you want. For example, this can be where you enter the site, somewhere you notice something exciting, or somewhere you feel connected to.  
→ Each time you stop, write the stop number (1,2,3,4 or 5) on the map and when possible, connect the number to the previous one on the map to illustrate your journey.  
→ Answer the sensory questions on the matching sheet number.  
→ Once you've done your five stops, write or draw any final thoughts on the 'Anything else' sheet.  
→ Find out more about this study and sign the consent form on the last sheet before handing the kit back.

Before we start the journey, take some time to warm up!

**WARM UP YOUR SENSES**  
Relax, breathe and focus on...

- 6 things you can see
- 5 things you can feel
- 4 things you can move
- 3 things you can hear
- 2 things you can smell
- 1 thing you can taste

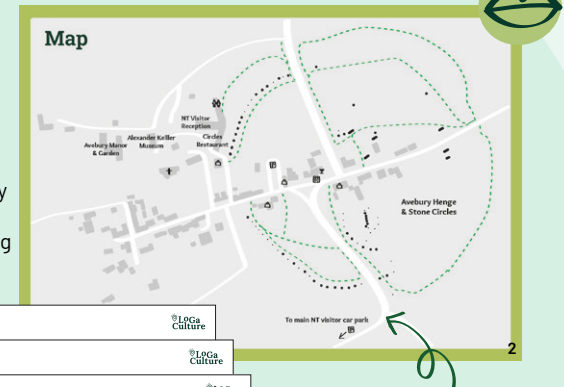
Approved by the National Trust.

Participant email address (optional)

Participants must also familiarise themselves with the project information (p9) and complete the consent form (p10).

## 2 During the walk

Participants start exploring the site and are invited to stop five times in whichever location they choose during their visit. For each stop, they must indicate their location on the map (p2) and fill in the corresponding Stop page (p3 to p7).



The map allows the collection of **data in situ** and the development of **new ways of noticing** [37] [67] and remembering, **immersed in places**.

Each sense is prompted by a specific question to **encourage both visual and less ocularcentrist 'non-visual sensory modes'** [52] of experiencing the place.

**Stop 1**  
Write 1 on map to show where you are.

Describe where you are:

What can you see? List your five favorite things:

What can you smell?

What can you hear?

What can you touch or feel?

How does it feel to be there?

How is the space around you?

If you have to remember one thing from this place, what would it be and why?

Any other observations about this place? Write or draw below

The sensory prompt questions were developed to cover the five primary external senses and a sixth internal sense: **proprioception**, the sensation of body position and movement [65] relevant to the visitor's exploration of the site.

## 3 After the walk

Participants have some time and space to reflect on their experience and the senses engaged (p8).

**Anything else?**  
Write or draw any extra thoughts and reflections.

This can be observations about a specific area or the sensory mapping process. For example, you can tell us how much time you spent in each stop, if you noticed anything different, what was your reason for noticing and why?



# Adapting the probes: Madeira

## Step-by-step adaptation design process

1

### Building on local knowledge

Inspired by the Avebury set, the probes' design for the Madeira levadas followed a different process. A participatory design session was organised with local experts by experience at the National History Museum of Funchal (NHMF). Six participants, two design students, two professors, and three staff members from the museum held a three-hour workshop to discuss the adaptation approach.

Participants were invited to give feedback on the Avebury probes and share ideas using the 'I like, I wish, I wonder' method [76], allowing for a more subjective structure for generating critique.

I LIKE ♥  
bright colours of postcards

I WONDER?   
if we need more than one map

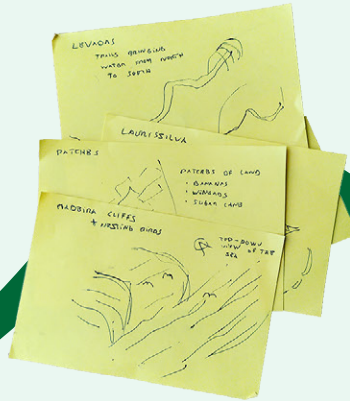
I WISH ★

2

### Workshop findings

The discussion focused on local heritage concepts such as the levada trails, their locations, and diverse visitor groups, including locals, foreigners, tourists, elders, and young teens.

*The sensory map could be expanded to more than one levada trail to widen its reach. Suggested deployment locations included local tourist offices and levada starting points.*



The existing themes aligned well with the institutional stakeholder priorities, so the probing questions were kept, while the visuals and place names were changed. Probes were adapted in English and Portuguese to accommodate tourists and locals.

O QUE VOCÊ MAIS GOSTA NA LEVADA E O QUE O TORNA ESPECIAL PARA VOCÊ?



3

### First Levada walk

Researchers and designers had different levels of familiarity with the natureculture of Madeira. To gather material and firsthand experiences of the levadas, especially for the two researchers being first-time visitors, an afternoon walk was organised to the accessible Levada dos Balcões.



Photographs, sketches, observations, and local guides' knowledge were collected to inform new probe designs and illustrate the place's complexity.



4

### Testing the tools

A second levada walk was arranged for the two design researchers to experience a guided tour with a larger group of tourists. We tested the probes and learned that stopping along the busy trail made it challenging to fill in the probes. This insight was shared with the NHMF, which informed the subsequent pilots.

Researches used this opportunity to collect more material and insights on the Levada experience.



5

### Designing the probes

Site-specific details were included in the sensory maps, such as one-way systems, which were unclear on the online and onsite maps, but important when immersed in the levada trails. Updated participant information forms aligned with locally available resources.

Amendments to the back of the postcards include an instruction to "Hand me to a staff member" and a different "address" for the recipient researchers.

HAND ME TO A STAFF MEMBER

The collected material from the walks and the NHMF (taxidermied marine animals) informed the probe aesthetics and logistical particularities.





## Adapt & translate

### Adapted probes design for Madeira

The Madeira postcards are adapted from the Avebury questions and the imagery reflects researchers' interpretations of Madeira's unique natureculture CH landscape.

**Text:** Inviting situated and temporal reflections.

**Visual:** Juxtaposing anthropocentric elements (the hand on the guard rail) with imaginary, present and past details in the landscape, such as the moon-like radar station, deep valley villages, and a taxidermied manta ray.

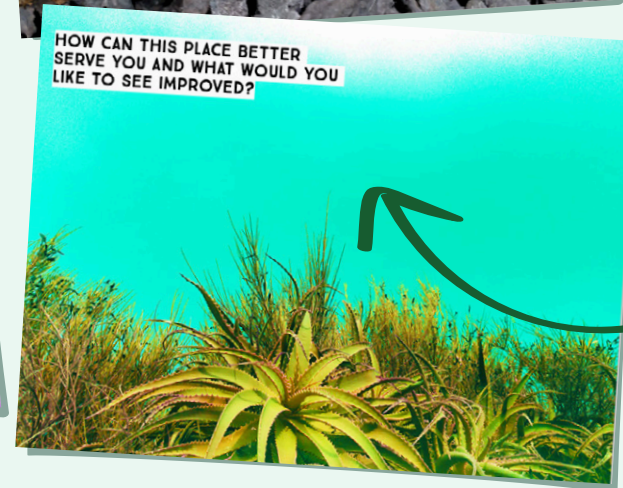
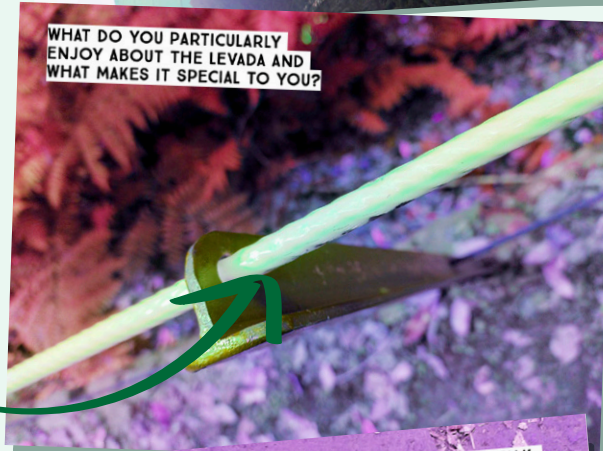
This card seeks to capture the positive aspects of visiting in a non-suggestive way.

**Text and Visual:** Seeking to highlight the caring and parental aspects that benefit visitors and the limits required for this purpose.

**Visual:** A practical and familiar object from the levada trail, such as the metal wire fence that provides safety from the sheer drop of the mountain.

**Text:** Imagining what it would tell us facilitates reflecting on the more-than-human aspects of the levada heritage.

**Text and Visual:** Replacing Avebury's 'stones' with Madeira's 'levada' stones. Characterising factors of the levada, such as the sound of the flowing water, lend themselves to the anthropomorphising of the levada as if it had a voice.



This card has **deep significance** in this setting, as visiting the rural levadas requires considerable mobility and resources. **Text:** Probing **location-specific challenges** that affect visitors' CH engagement.

**Visual:** A passport (soaring tourism), a tampon (lack of facilities), road signage, barrier tape, a laurisilva tree trunk (hazards), and a traditional model boat (presence of water).

Similar to the Avebury card, this imagery highlights **visitors' relationships with local wildlife**.

**Text:** Eliciting imagined perspectives to **dislocate familiar hierarchies** between species. **Visual:** The hidden, **non-authorized**, and **regenerating entanglement** of flora and fauna.

This card echoes the corresponding Avebury card featuring **thriving local vegetation** and a saturated blue sky as a **blank space** for the participant to fill.

### Themes key:

Past(s) [34][45]	Future(s) [34][45]	'How to visit' & 'for those who follow'[42]	Diverse temporalities [48][54][57]	Invisible implication of visiting[18][42][10][21]
Present(s) [34][45]	Friends of place[8][39]	Unique vocation of place[8][39]	Diverse cosmologies [68]	Non-anthropocentric personhoods & perspectives[18][42][10][21]



## Adapt & translate

Adapted probes design for Madeira

This card invites perspectives on **relationality across generations**, adapted through using **familiar signs of degradation** of technoculture, such as paint flaking off a metal railing and lichen that share patterns with the landscape, pointing to **under-noticed** details all around.

This localised version of the question seeks to **situate the participant** through **time and place**.

**Text:** Linking the **hearing** and **visual senses** with locally occurring elements.

**Visual:** Adapting the **timeline visual** from the Avebury card, a levada path leading to a **mysterious destination** and a **traditional levada conch**.

This card probes whether the **location** affects the generation of **different responses** to this question by pointing to situated visual marks such as a taxidermied pufferfish from the NHMF, carvings of initials in the levada paving stones, symbolic love-locks on a fence, **footsteps on the path**, and a visitor using a mobile device.



This card also seeks to explore how this question is received along the levadas, as there are **fewer explicit mentions of the "sacred"** or spiritual manifestation in this place, unlike Avebury. It juxtaposes other aspects that may have **objective value** and **local cultural significance**, such as foods, animals, water and technology, all fundamental to living systems and directly linked to our comforts and needs.

As recommended during the workshop with local experts, **three map booklets** were developed covering the Levada das 25 Fontes, the Levada do Calderão Verde, and the Levada dos Balcões.

The sensory maps were adapted into **A5 booklet format**, making it easier for participants to carry and navigate while walking.

## Mapa sensorial

### Do que se trata?

A atividade de mapa sensorial pretende trazer novas perspectivas à sua exploração da zona, redescobrimo a zona através de todos os sentidos.

Por cada parada, você pode decidir se continua a caminhada e você pode decidir se para em cada parada, ou se continua a caminhada.

### Levada das 25 Fontes

Relaxe, respire e concentre-se

6 coisas que você pode ver



### Themes key:

Past(s) [34][45]	Future(s) [34][45]	'How to visit' & 'for those who follow' [42]	Diverse temporalities [48][54][57]	Invisible implication of visiting [18][42][10][21]
Present(s) [34][45]	Friends of place [8][39]	Unique vocation of place [8][39]	Diverse cosmologies [68]	Non-anthropocentric personhoods & perspectives [18][42][10][21]



## Piloting the probes - Avebury

At Avebury, the probes were piloted by being picked up and returned in a special box on a table near the ticket office at the main visitor centre barn (see map p. 7). The initial idea was to return the probes in a drop box at the car park so participants could fill them in during the visit and return them at the end. The plan changed due to difficulties in placing the collection box outdoors. This potentially impacted the data, as participants often completed and returned the cards on the spot. The sensory maps requiring higher time investment saw more engagement from visitors walking around before returning to the barn. A pilot group of twelve students was organised to test the sensory maps, and ten maps were completed. Deploying probes during autumn and winter posed challenges, so the probes were left on site to leverage seasonal changes. At the time of collection, 63 postcards had been filled in after roughly three months.

### Practical changes during deployment included:

- The public interpreted postcard semiotics for "take away" postcards, so clarifying information was added to the presentation stand, explaining that the postcards were not for actual posting.
- The QR code for digital participation was linked to the University of Southampton's database for safe storage.
- The logo and wording on the sensory maps were adjusted to align with the NT style preferences.

Demographic data was not collected, but the authors expect it to align with the existing data collected by the NT, suggesting the average age was 55, 92% from the UK, and 50% repeat visitors.

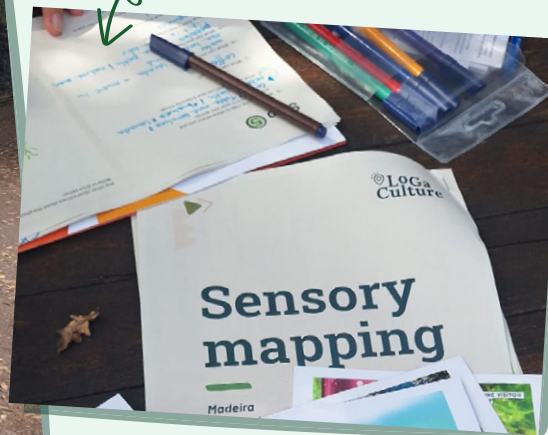


## Piloting the probes - Madeira

As the levadas are further away from the NHMF than the stone circle is from the NT centre at Avebury, deploying the Madeira probes was more challenging. The researchers and cultural partners remain in discussion about the most practical solution. However, two separate group walks of twelve participants each were organised to visit the 1.5 km Levada dos Balcões trail to test the tools. Participants were shuttled to the starting point and briefed about the project and the probes, before setting off in small groups or individually. The trail started in a small hamlet, led through the Laurisilva forest, and ended at the Vereda dos Balcões viewpoint, allowing encounters with indigenous flora and fauna. Two researchers accompanied the groups to answer questions but mainly remained in the background to let the probes speak for themselves. After the walk, the participants handed the completed probes to the researchers and filled in a questionnaire as part of the LoGaCulture project, enquiring about the levada visit in general, feedback on using the probes, and demographic data. A total of 230 postcards and 23 maps were collected, although not all were filled in.

Participants were 57% locals and 43% tourists or short-term residents; 52% female and 48% male. The majority (52%) were between 18-24, 24% between 25-44, and 24% above 54 years old.

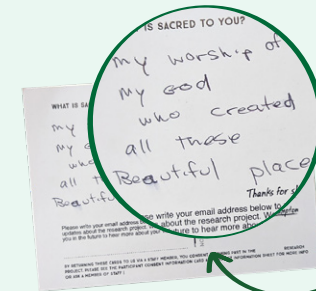
The sensory maps were printed locally in an A4 format rather than a suggested A5 booklet, due to limited facilities.



## Pilot Takeaways

### 1 Clarify postcard semiotics

Despite added information, the postcards left in the visitor centre at Avebury were often mistaken for 'free take-away postcards' rather than a survey tool. This emphasises the importance of accessibility and clarity in communicating the study's purpose and instructions to the public.

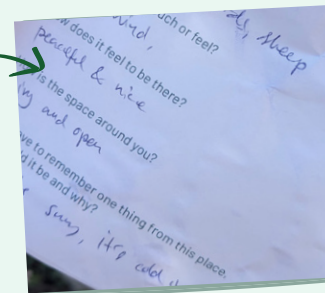


### 2 Refine probes for more precise data

The probes effectively collected reflections on natureculture, but answers were quite general. The questions and visuals could be made more specific and propose to allocate a discrete amount of time to focus longer on the senses.

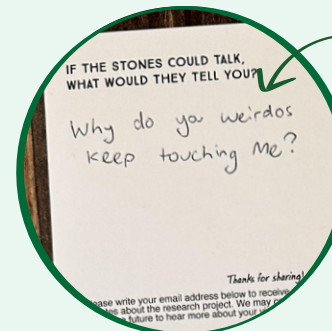
### 3 Enhance paper probes for wet weather

The variable weather conditions and physical manipulation of the probes influenced the reporting of engaging with natureculture. Adding questions that probe this aspect, location positioning through photos and sounds, and making it more resilient through digital enhancement can allow for more place-specific data collection.



### 4 Invite reflection on senses, not just recordings

Although the sensory maps encouraged introspection of natureculture, it was rarely made explicit. This calls for more detailed prompts to help these unravel.







## Probes for further heritage landscapes

In the scope of the LoGaCulture project, other researchers adopted and adapted the method for two further cultural-heritage landscapes (Hill of Tara and Battle of the Boyne).

### Probe changes:

i) While the thematic and textual prompts of the postcards were left almost unchanged (just some light wording tweaks in line with local cultural values), the visuals were adapted according to how the researchers captured and interpreted the sites. ii) The QR code for submitting the cards digitally was removed since never used. iii) Given the impact of weather conditions at open-air heritage sites, a postcard was added to understand how this affected the visit. ii) To prepare visitors to tune into the felt sense, the sensory maps asked them to stop, allocate time to focus, and describe how this impacted their thoughts.

## Discussion and next steps

The design and piloting of the probes highlighted some tensions and ways forward in addressing the design of natureculture exploratory tools.

### 1) Heritage Preservation vs. Public Engagement

While well-received by the visitors, the probes were of concern to the cultural partners at both sites (NT and MHNH) regarding their content and the scope of the study: i) Cultural partners at both sites were concerned with providing authorised heritage and scientifically correct information to the visitors, resulting in casting themselves as the gatekeepers of knowledge. The probes can offer an inclusive alternative to the creation of knowledge around heritage topics. ii) Local communities' lives are exacerbated by over-tourism and the invasive quality of visitors at both sites. The local cultural partners voiced concern about this fact, illuminating a space where probes could be piv-

oted to address these issues and support the locals in reflecting on positive solutions. The tension between the economically profitable exploitation of the sites and how it could affect the authenticity of everyday local activities deserves further and more inclusive discussion. The tools could explore multiple perspectives to enrich the data collection from all publics. The probes could be co-designed with locals and target different beneficiaries and audiences. For example, the postcard questions could be co-authored with locals to better understand and address their concerns, including the tensions between the economic benefits of tourism and the disruption of residents' quality of life. Future challenges related to applying co-design principles include negotiating established hierarchies within and between these complex polyphonic ecosystems, including humans and more-than-humans, as well as natural and cultural differences, as the process requires trust and transparency. The probes must be deployed over time and with a wider variety of audiences to build this more complex and complete picture.

### 2) Tensions between Nature and Technology

The tension between the role of technology for and in nature has been extensively debated in HCI [41][3]. While much technology has been studied and designed to facilitate the appreciation of nature and open-air cultural heritage sites [36], such as locative story guides [16], nature field guides and nature walk companions [40][60], digital games and VR experiences [44], technology used in nature is criticised for capturing the participant's attention and cognitive ability, rather than favouring immersion [58]. Nevertheless, technology in the open can also support citizen science initiatives, such as the collection of data, memories, and reflections [53][30]. Finally, several studies propose that VR experiences of nature can be as beneficial in regulating stress and anxiety as nature itself [7][61]. Inviting analogue and tactile experiences offers a different way of interacting with the world compared to the digital everyday, despite both methods having their limitations and affordances, as seen in the pilots. The probes can be designed to illuminate various technological potentials in nature before, during, and after the visits. Moreover, digital technologies can help deploy the probes, addressing the challenges of using paper materials outdoors.

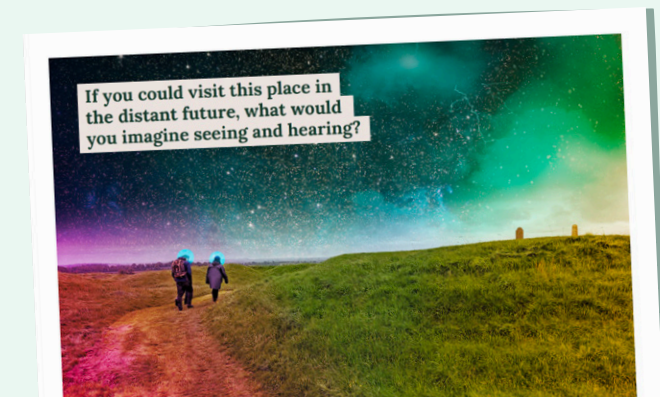
### 3) Relational attributes of natureculture

Applying feminist post-human concepts of care, interdependence, fun, criticality and diversity in perspective to the design

of sensory and tactile methods, allows for probing impressions of heritage sites through different lenses. Visually suggesting different situated points of view, along with question prompts through tactile interaction, focuses the inquiry on the senses. This approach encourages participants to reflect on their thoughts, feelings, and relationship with the natureculture that they are temporarily embedded within. Additionally, it enables design researchers to embrace new critical explorations of speculative, situated, embodied and affective aspects of natureculture heritage(s) within their work. The probes can be adapted to these different ways of experiencing CH landscapes, proposing opportunities to probe mindful and solitary reflection. They can also leverage social aspects of the experience to facilitate exchange, sharing, and social commentary.

## Conclusion

This research demonstrates the potential of Natureculture Probes to foster deeper visitor engagement and enrich the design of heritage-related digital interventions. It contributes valuable insights into developing participatory tools for heritage sites and advocates for an empathetic, socio-environmental approach to digital heritage design. Combining sensory maps and postcards gathers diverse, contextual data on visitors' experiences. Engaging local communities and addressing their concerns about over-tourism and site authenticity is crucial for future iterations. Balancing the relational aspects of unique naturecultures with digital and analogue elements, as well as solitary vs. social experiences, can further enhance the tools' adaptability. Despite limitations like seasonal deployment and audience diversity, the Natureculture Probes offer a promising way to explore natureculture intersections at heritage sites. Future work should focus on broadening demographic reach, refining the co-design approach, and exploring digital enhancements of the probes. By addressing these areas, the probes can better support sustainable heritage management and foster meaningful and inclusive visitor experiences.



## Acknowledgement

Thank you to Maritza Silva, the pilot participants, the staff at the National Trust in Avebury and the Natural History Museum of Funchal, for their conversation and contributions. This study was supported by the LoGaCulture project and funded by the European Union's Horizon Europe Framework Programme under grant agreement 101094036. The probes were subject to ethics approval number ERGO/FEPS/86789 under Southampton University.

## References

- [1] Ferran Altarriba Bertran, Oğuz "Oz" Buruk, and Juho Hamari. 2022. From-The-Wild: Towards Co-Designing For and From Nature. In Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22), April 28, 2022. Association for Computing Machinery, New York, NY, USA, 1–7. <https://doi.org/10.1145/3491101.3519811>
- [2] Ferran Altarriba Bertran, Jordi Márquez Puig, Maria Llop Cirera, Eva Forest Illas, Joan Planas Bertran, Ernest Forts Plana, Oğuz "Oz" Buruk, Çağlar Genç, Mattia Thibault, and Juho Hamari. 2023. Designing and Using the Wild Probes Toolkit (v1) to Co-Design From-the-Wild. In Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23), July 10, 2023. Association for Computing Machinery, New York, NY, USA, 765–778. <https://doi.org/10.1145/3563657.3596102>
- [3] Koen Arts, René van der Wal, and William M. Adams. 2015. Digital technology and the conservation of nature. *Ambio* 44 Suppl 4, Suppl 4 (November 2015), 661–673. <https://doi.org/10.1007/s13280-015-0705-1>
- [4] Karen Barad. 2010. Quantum entanglements and hauntological relations of inheritance: Dis/continuities, spacetime enfoldings, and justice-to-come. *Derrida Today* (Nov 2010), vol. 3, no. 2 : pp. 240–268. (January 2010). Retrieved June 18, 2024 from [https://www.academia.edu/1857585/Quantum\\_entanglements\\_and\\_hauntological\\_relations\\_of\\_inheritance\\_Dis\\_continuities\\_spacetime\\_enfoldings\\_and\\_justice\\_to\\_come](https://www.academia.edu/1857585/Quantum_entanglements_and_hauntological_relations_of_inheritance_Dis_continuities_spacetime_enfoldings_and_justice_to_come)
- [5] Kirsten Boehner, Janet Vertesi, Phoebe Sengers, and Paul Dourish. 2007. How HCI interprets the probes. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07), April 29, 2007. Association for Computing Machinery, New York, NY, USA, 1077–1086. <https://doi.org/10.1145/1240624.1240789>
- [6] Rosi Braidotti. 2022. Posthuman feminism. Polity, Cambridge, UK.
- [7] Matthew H. E. M. Browning, Seunguk Shin, Gabrielle Drong, Olivia McAnirlin, Ryan J. Gagnon, Shyam Ranganathan, Kailan Sindelar, David Hoptman, Gregory N. Bratman, Shuai Yuan, Vishnunarayan Girishan Prabhu, and Wendy Heller. 2023. Daily exposure to virtual nature reduces symptoms of anxiety in college students. *Sci Rep* 13, 1 (January 2023), 1239. <https://doi.org/10.1038/s41598-023-28070-9>
- [8] Kimberly Camrass. 2023. Regenerative futures: eight principles for thinking and practice. *Journal of Futures Studies* 28, 1 (2023), 89–99.
- [9] Ozge Merzali Celikoglu, Sebnem Timur Ogut, and Klaus Krippendorff. 2017. How Do User Stories Inspire Design? A Study of Cultural Probes. *Design Issues* 33, 2 (2017), 84–98.
- [10] UNESCO World Heritage Centre. Sustainable Tourism Toolkit. UNESCO World Heritage Centre. Retrieved June 18, 2024 from <https://whc.unesco.org/en/sustainabletourismtoolkit/>
- [11] UNESCO World Heritage Centre. Stonehenge, Avebury and Associated Sites. UNESCO World Heritage Centre. Retrieved June 18, 2024 from <https://whc.unesco.org/en/list/373/>
- [12] UNESCO World Heritage Centre. Levadas of Madeira Island. UNESCO World Heritage Centre. Retrieved June 18, 2024 from <https://whc.unesco.org/en/tentativelists/6230/>
- [13] UNESCO World Heritage Centre. Avebury Residents' Pack: bringing together diverse stakeholders in Avebury (United Kingdom). UNESCO World Heritage Centre. Retrieved June 18, 2024 from <https://whc.unesco.org/en/canopy/avebury/>
- [14] Sena Çerçi, Marta E. Cecchinato, and John Vines. 2021. How Design Researchers Interpret Probes: Understanding the Critical Intentions of a Designerly Approach to Research. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21), May 07, 2021. Association for Computing Machinery, New York, NY, USA, 1–15. <https://doi.org/10.1145/3411764.3445328>
- [15] Audrey Desjardins, Cayla Key, Heidi R. Biggs, and Kelsey Aschenbeck. 2019. Bespoke Booklets: A Method for Situated Co-Speculation. In Proceedings of the 2019 on Designing Interactive Systems Conference, June 18, 2019. ACM, San Diego CA USA, 697–709. <https://doi.org/10.1145/3322276.3322311>
- [16] Mara Dionisio and Valentina Nisi. 2021. Leveraging Transmedia storytelling to engage tourists in the understanding of the destination's local heritage. *Multimed Tools Appl* 80, 26 (November 2021), 34813–34841. <https://doi.org/10.1007/s11042-021-10949-2>
- [17] Lauren Elkin. 2017. *Flaneuse: women walk the city in Paris, New York, Tokyo, Venice and London*. Vintage, London.
- [18] Arturo Escobar. 2018. *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds*. Duke University Press, Durham, NC.
- [19] Marta Galvão Ferreira and Sherry Hsi. 2024. Dear Nature: Using data drawings to promote sensemaking in human-nature relations. *Designing Interactive Systems Conference* (July 2024), 1426–1438. <https://doi.org/10.1145/3643834.3660732>
- [20] Christopher Frauenberger. 2019. Entanglement



- HCI The Next Wave? *ACM Trans. Comput.-Hum. Interact.* 27, 1(November 2019), 2:1-2:27. <https://doi.org/10.1145/3364998>
- [21] Christina Fredengren. 2021. Nature:Cultures – Heritage, Sustainability and Feminist Posthumanism. *csa* 23, 1(June 2021), 109–130. <https://doi.org/10.37718/CSA.2015.09>
- [22] William Gaver, Anthony Dunne, and Elena Pacenti. 1999. Design: Cultural Probes. *Interactions* 6, (January 1999), 21–29. <https://doi.org/10.1145/291224.291235>
- [23] William W. Gaver, Andrew Boucher, Sarah Pennington, and Brendan Walker. 2004. Cultural probes and the value of uncertainty. *interactions* 11, 5(September 2004), 53–56. <https://doi.org/10.1145/1015530.1015555>
- [24] Donna Haraway. 1988. Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies* 14, 3(1988), 575–599. <https://doi.org/10.2307/3178066>
- [25] Donna Haraway. 2003. The Companion Species Manifesto : Dogs, People, and Significant Otherness / D. Haraway. (January 2003). 244.
- [26] Donna Haraway. 2011. Speculative Fabulations for Technoculture's Generations: Taking Care of Unexpected Country. In *Australian Humanities Review*, May 2011. . <https://doi.org/10.22459/AHR.50.2011.06>
- [27] Donna J. Haraway. 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Duke University Press. <https://doi.org/10.2307/j.ctv11cw25q>
- [28] Saidiya Hartman. 2008. Venus in Two Acts. *Small Axe: A Caribbean Journal of Criticism* 12, 2(June 2008), 1–14. <https://doi.org/10.1215/-12-2-1>
- [29] John Henshaw. 2012. *A Tour of the Senses*. Johns Hopkins University Press. <https://doi.org/10.56021/9781421404363>
- [30] Yen-Chia Hsu and Illah Nourbakhsh. 2020. When human-computer interaction meets community citizen science. *Commun. ACM* 63, 2(January 2020), 31–34. <https://doi.org/10.1145/3376892>
- [31] Yuta Ikeya, Miguel Bruns, and Bahareh Barati. 2024. Designing for Interdependence of Bees, Garden, Designer, and the Changing Season. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference (DIS '24)*, July 01, 2024. Association for Computing Machinery, New York, NY, USA, 1385–1399. <https://doi.org/10.1145/3643834.3660743>
- [32] Sylvia Janicki, Alexandra Teixeira Riggs, Noura Howell, Anne Sullivan, and Nassim Parvin. 2024. Sensing Bodies: Engaging Postcolonial Histories through More-than-Human Interactions. In *Proceedings of the Eighteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '24)*, February 11, 2024. Association for Computing Machinery, New York, NY, USA, 1–15. <https://doi.org/10.1145/3623509.3633389>
- [33] Scarlet Jaxen. 2023. A Different Kind of Ethnography: Imaginative Practices and Creative Methodologies. *Cult. and Ped. Inq.* 14, No.2(July 2023), 179–182. <https://doi.org/10.18733/cpi29699>
- [34] Asnath Paula Kambunga, Rachel Charlotte Smith, Heike Winschiers-Theophilus, and Ton Otto. 2023. Decolonial design practices: Creating safe spaces for plural voices on contested pasts, presents, and futures. *Design Studies* 86, (May 2023), 101170. <https://doi.org/10.1016/j.destud.2023.101170>
- [35] Anne Marie Kanstrup, Pernille Bertelsen, and Jacob Østergaard Madsen. 2014. Design with the feet: walking methods and participatory design. In *Proceedings of the 13th Participatory Design Conference on Research Papers - PDC '14*, 2014. ACM Press, Windhoek, Namibia, 51–60. <https://doi.org/10.1145/2661435.2661441>
- [36] Gunnar Liestøl. 2014. Along the Appian Way. *Storytelling and Memory across Time and Space in Mobile Augmented Reality*. In *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection*, 2014. Springer International Publishing, Cham, 248–257. [https://doi.org/10.1007/978-3-319-13695-0\\_24](https://doi.org/10.1007/978-3-319-13695-0_24)
- [37] Szu-Yu Liu, Jen Liu, Kristin Dew, Patrycja Zdziarska, Maya Livio, and Shaowen Bardzell. 2019. Exploring Noticing as Method in Design Research. <https://doi.org/10.1145/3301019.3319995>
- [38] Qiuyu Lu, Andreea Danielescu, Vikram Iyer, Pedro Lopes, and Lining Yao. 2024. Ecological HCI: Reflection and Future. In *Extended Abstracts of the 2024 CHI Conference on Human Factors in Computing Systems (CHI EA '24)*, May 11, 2024. Association for Computing Machinery, New York, NY, USA, 1–4. <https://doi.org/10.1145/3613905.3643985>
- [39] Pamela Mang and Bill Reed. 2020. Regenerative Development and Design. . 115–141. [https://doi.org/10.1007/978-1-0716-0684-1\\_303](https://doi.org/10.1007/978-1-0716-0684-1_303)
- [40] Sónia Matos, Alexandra R. Silva, Duarte Sousa, Ana Picanço, Isabel R. Amorim, Simone Ashby, Rosalina Gabriel, and Ana Moura Arroz. 2022. Cultural probes for environmental education: Designing learning materials to engage children and teenagers with local biodiversity. *PLoS ONE* 17, 2(February 2022), e0262853. <https://doi.org/10.1371/journal.pone.0262853>
- [41] Lucy R. McClain and Heather Toomey Zimmerman. 2016. Technology-mediated engagement with nature: sensory and social engagement with the outdoors supported through an e-Trailguide. *International Journal of Science Education, Part B* 6, 4(October 2016), 385–399. <https://doi.org/10.1080/21548455.2016.1148827>
- [42] Ismael Lopez Medel. 2020. The Palau Legacy Pledge: A Case Study of Advertising, Tourism, and the Protection of the Environment. *Westminster Papers in Communication and Culture* 15, 2(July 2020), 178–290. <https://doi.org/10.16997/wpcc.380>

- [43] Valentina Nisi, Paulo Bala, Hollie Bostock, Vanessa Cesário, and Nuno Jardim Nunes. 2023. "Before gentrification, we claim for habitation": Eliciting Values and Assets through Cultural Heritage Storytelling. In Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23), July 10, 2023. Association for Computing Machinery, New York, NY, USA, 2423–2436. <https://doi.org/10.1145/3563657.3596124>
- [44] Valentina Nisi, Catia Prandi, and Nuno Jardim Nunes. 2020. Towards Eco-Centric Interaction: Urban Playful Interventions in the Anthropocene. In Making Smart Cities More Playable: Exploring Playable Cities, Anton Nijholt (ed.). Springer, Singapore, 235–257. [https://doi.org/10.1007/978-981-13-9765-3\\_11](https://doi.org/10.1007/978-981-13-9765-3_11)
- [45] Lesley-Ann Noel. 2023. Design for social change: take action, work toward equity, and challenge the status quo. Ten Speed Press, Emeryville, California.
- [46] Elena Not, Massimo Zancanaro, Mark T. Marshall, Daniela Petrelli, and Anna Pisetti. 2017. Writing Postcards from the Museum: Composing Personalised Tangible Souvenirs. In Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter (CHIItaly '17), September 18, 2017. Association for Computing Machinery, New York, NY, USA, 1–9. <https://doi.org/10.1145/3125571.3125583>
- [47] Claudia Núñez-Pacheco. 2022. Dialoguing with Tangible Traces: A Method to Elicit Autoethnographic Narratives. In Proceedings of the Sixteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '22), February 13, 2022. Association for Computing Machinery, New York, NY, USA, 1–14. <https://doi.org/10.1145/3490149.3502255>
- [48] Gizem Oktay, Yuta Ikeya, Minha Lee, Bahareh Barati, Youngsil Lee, Yuning Chen, Larissa Pschetz, and Carolina Ramirez-Figueroa. 2023. Designing with the more-than-human: Temporalities of thinking with care. In Companion Publication of the 2023 ACM Designing Interactive Systems Conference (DIS '23 Companion), July 10, 2023. Association for Computing Machinery, New York, NY, USA, 104–106. <https://doi.org/10.1145/3563703.3591462>
- [49] Irina Paraschivoiu, Marta Dziabiola, and Alexander Meschtscherjakov. 2023. Postcards from the Future: Speculating the Future of Built Environments with Citizens. In The 11th International Conference on Communities and Technologies (C&T), May 29, 2023. ACM, Lahti Finland, 215–226. <https://doi.org/10.1145/3593743.3593784>
- [50] Chris Perkins and Kate McLean. 2020. Smell walking and mapping. (April 2020). <https://doi.org/10.7765/9781526152732.00017>
- [51] Sarah Pink. 2015. Doing sensory ethnography (Second edition ed.). Sage Publications, London ; Thousand Oaks, California.
- [52] J. Douglas Porteous. 1990. Landscapes of the Mind: Worlds of Sense and Metaphor. University of Toronto Press. Retrieved June 18, 2024 from <https://www.jstor.org/stable/10.3138/j.ctvfrxgfs>
- [53] Jennifer Preece. 2016. Citizen Science: New Research Challenges for Human-Computer Interaction. International Journal of Human-Computer Interaction 32, 8 (August 2016), 585–612. <https://doi.org/10.1080/10447318.2016.1194153>
- [54] Jörgen Rahm-Skågeby and Lina Rahm. 2022. HCI and deep time: toward deep time design thinking. Human-Computer Interaction 37, 1 (January 2022), 15–28. <https://doi.org/10.1080/07370024.2021.1902328>
- [55] Amon Rapp. 2018. Autoethnography in Human-Computer Interaction: Theory and Practice. 25–42. [https://doi.org/10.1007/978-3-319-73374-6\\_3](https://doi.org/10.1007/978-3-319-73374-6_3)
- [56] Jessica Rizk and Anton Birioukov. 2017. Following the Flâneur: The Methodological Possibilities and Applications of Flânerie in New Urban Spaces. TQR (December 2017). <https://doi.org/10.46743/2160-3715/2017.2913>
- [57] Ellen Samuels and Elizabeth Freeman (Eds.). 2021. Crip temporalities. Duke University Press, Durham, NC.
- [58] Chris Sandbrook, William Adams, and Bruno Monteferri. 2014. Digital Games and Biodiversity Conservation. Conservation Letters 8, (May 2014). <https://doi.org/10.1111/conl.12113>
- [59] Esther Smith. 2013. Avebury Stone Circle - World Heritage Site. Forward Publications. Retrieved June 18, 2024 from <https://www.forwardpublications.com/avebury-stone-circle>
- [60] Daniel Sousa, Alexandra Silva, Isabel Amorim, Simone Ashby, Ana Arroiz, Flora Piasentin, Rosalina Gabriel, and Sónia Matos. 2021. The Field Guide App Connecting Island Communities to Local Conservation Through Mobile Interaction. <https://doi.org/10.18420/ct2021-064>
- [61] Giuseppina Spano, Annalisa Theodorou, Gerhard Reese, Giuseppe Carrus, Giovanni Sanesi, and Angelo Panno. 2023. Virtual nature, psychological and psychophysiological outcomes: A systematic review. Journal of Environmental Psychology 89, (August 2023), 102044. <https://doi.org/10.1016/j.jenvp.2023.102044>
- [62] Velvet Spors, Oğuz "Oz" Buruk, and Juho Hamari. 2024. Ecological In/Congruence: Becoming Sensitised to Nature in Video Games through Humanistic First-Person Research. In Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24), May 11, 2024. Association for Computing Machinery, New York, NY, USA, 1–16. <https://doi.org/10.1145/3613904.3642659>
- [63] Zhida Sun, Sitong Wang, Wenjie Yang, Onur Yürüten, Chuhan Shi, and Xiaojuan Ma. 2020. "A Postcard from Your Food Journey in the Past": Promoting Self-Reflection on Social Food Posting. In Proceedings of the 2020 ACM Designing Interactive Systems Conference



- (DIS '20), July 03, 2020. Association for Computing Machinery, New York, NY, USA, 1819–1832. <https://doi.org/10.1145/3357236.3395475>
- [64] Oscar Tomico, Ferran Altarriba, Svenja Keune, Oğuz Buruk, Danielle Wilde, and Ron Wakkary. 2023. [WORKSHOP] Designerly ways of engaging with nature. In Proceedings of the 26th International Academic Mindtrek Conference (Mindtrek '23), November 02, 2023. Association for Computing Machinery, New York, NY, USA, 309–312. <https://doi.org/10.1145/3616961.3616993>
- [65] John C. Tuthill and Eiman Azim. 2018. Proprioception. *Current Biology* 28, 5 (March 2018), R194–R203. <https://doi.org/10.1016/j.cub.2018.01.064>
- [66] Kellie Vella, Yvonne Rogers, Ayesha Tulloch, and Margot Brereton. 2024. Nature Networks: Designing for nature data collection and sharing from local to global. In Proceedings of the 2024 ACM Designing Interactive Systems Conference (DIS '24), July 01, 2024. Association for Computing Machinery, New York, NY, USA, 1439–1452. <https://doi.org/10.1145/3643834.3661520>
- [67] Jo Lee Vergunst and Tim Ingold (Eds.). 2016. *Ways of Walking: Ethnography and Practice on Foot*. Routledge, London. <https://doi.org/10.4324/9781315234250>
- [68] Robert J. Wallis and Jenny Blain. 2003. Sites, Sacredness, and Stories: Interactions of Archaeology and Contemporary Paganism. *Folklore* 114, 3 (2003), 307–321.
- [69] Xiaoge Wang. 2022. Nature Jar: Design for Facilitating Nature Connectedness and Restoration in Home Scenario. In Proceedings of the Sixteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '22), February 13, 2022. Association for Computing Machinery, New York, NY, USA, 1–7. <https://doi.org/10.1145/3490149.3502426>
- [70] Sarah Webber, Ryan M. Kelly, Greg Wadley, and Wally Smith. 2023. Engaging with Nature through Technology: A Scoping Review of HCI Research. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems, April 19, 2023. ACM, Hamburg Germany, 1–18. <https://doi.org/10.1145/3544548.3581534>
- [71] 2010. Conservation Bulletin 63 | Historic England. Retrieved June 18, 2024 from <https://historicengland.org.uk/images-books/publications/conservation-bulletin-63/>
- [72] 2024. Home. LoGaCulture. Retrieved June 17, 2024 from <https://logaculture.eu/>
- [73] Avebury's stone circles & henge | Wiltshire | National Trust. Retrieved June 18, 2024 from <https://www.nationaltrust.org.uk/visit/wiltshire/avebury/exploring-the-stone-circles-at-avebury>
- [74] Laurissilva Forest – Visit Madeira | Madeira Islands Tourism Board official website. Retrieved June 18, 2024 from <https://www.visitmadeira.com/en/what-to-do/nature-seekers/laurissilva-forest/>
- [75] *Weird Walk by Weird Walk*: 9781786786821 | PenguinRandomHouse.com: Books. PenguinRandomhouse.com. Retrieved June 18, 2024 from <https://www.penguinrandomhouse.com/books/725702/weird-walk-by-weird-walk/>
- [76] *Playbook for People Power: Practical frameworks, activities and approaches to unlock the potential of people and communities to transform systems*. 38. Retrieved from [https://media.nesta.org.uk/documents/Playbook\\_for\\_People\\_Power.pdf](https://media.nesta.org.uk/documents/Playbook_for_People_Power.pdf)