ParkPal: Design and Wizard of Oz trial of a voice-based nature guide

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Urban societies risk disconnection from nature and have few opportunities to develop awareness and appreciation of local flora, fauna and ecosystems. To investigate the challenges of designing technologies for personally meaningful engagement with nature, we designed ParkPal, a voice-based chatbot for people visiting a city park during a workday break, and conducted a Wizard of Oz trial at the park. Findings offer new insights into the role that interactive agents might play in enhancing time in nature, and point to the challenges that users encounter in personalising conversations with a chatbot guide. To address these challenges, we identify three avenues for future design and research, including attention to interpersonal aspects of chatbot design, designing for repeat visits, and alternative approaches for users to tailor the conversations. We offer design guidance relevant to creating effective interactive agents in a range of visitor settings.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**.

Additional Key Words and Phrases: Nature engagement, Visitor Guide, Informal Learning, Conversation design, Voice chatbot

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1 Introduction

In an era marked by ecological crisis there is growing concern about people's disconnection from nature [9, 45, 48, 74]. Contact with nature enhances human wellbeing [11, 52], and can promote appreciation and concern for the natural world [57, 79]. However, rapid urbanisation and loss of biodiversity [12, 37, 82] mean that many people lack regular exposure to healthy natural ecosystems [18, 81]. Furthermore, only a few have opportunities for interactions with knowledgeable family elders, educators, or community mentors, to cultivate substantial nature knowledge and familiarity [16, 28, 56, 59]. Interactions with such local nature experts can inspire curiosity and appreciation [28], engage existing interests and orientations [77], create personal connections with nature [28], and enable people to become familiar with specific ecosystems [21].

In this research, we investigated how a voice-based chatbot might simulate the experience of learning in-situ about nature from an expert. We focus on voice-based interaction, because we hypothesise that in natural settings there is greater acceptance of listening to music and audio content than visual modes of technology use: there are strong indications that people want to put their phones out of sight while in natural settings to avoid being engrossed in their online lives [23, 36]. In addition, screen-based technology presents usability challenges in bright sunlight and rain [31].

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Conversational tools based on Large Language Models (LLMs) allow users easy, personalised access to information [63] and can now be accessed anywhere on mobile devices. Custom AI applications can be easily created (using e.g. OpenAI's GPTs and Assistants API), can be trained on a supplementary knowledge base and can incorporate user-side information such as location data [5]. Multimodal models which can work simultaneously with text, images, video, and audio are predicted to further expand the capabilities and use-cases for conversational AI [33].

We explore the challenges of designing voice interactions that are engaging, informative, usable and acceptable for people relaxing at a city park. Our focus is on understanding how chatbot interactions can proactively guide people's attention, offer significant information about the site, and nurture personally meaningful connections. Designing technology for nature engagement in daily life presents three interrelated design challenges. Firstly, technologies need to be compatible with, and appropriate to, the activities that people seek to take outdoors [40]. Secondly, they need to avoid intruding on people's sensory experiences of nature [36]. Thirdly, they need to allow user agency and personalisation, to be relevant and pitched appropriately to the target audience, so as to foster a sense of relevance and connection [77, 86].

We designed a voice-based nature guide, ParkPal, for people spending time at an urban park (the System Garden, at The University of Melbourne) during a workday break. We conducted initial investigations into user preferences and information they sought about nature, through contextual inquiry at the park. From this, we developed a Wizard of Oz (WoZ) prototype, comprising chatbot scripts, protocols and supporting materials. We then ran a trial with 8 participants, gathering data through observations and semi-structured interviews.

Through this work we provide new insights to guide development and continued research into conversational technology for use in natural settings. Specifically, this work contributes:

- insights on the potential value and limitations of voice-based chatbots for nature engagement;
- guidance for design of conversational agents for nature engagement;
- reflections on challenges and future research directions for nature guide chatbots.

This work is of relevance to designers and researchers looking at conversational design and visitor technologies in a variety of settings, including museums, galleries and heritage sites.

2 Related Work

2.1 Nature engagement in urban settings

Engagement with nature includes diverse nature-focused activities, and can bring multiple individual and societal benefits. Modern cities offer few opportunities for citizens to develop an appreciation of nature [18, 81] due to biodiversity loss [12, 37]. Local green spaces such as parks and gardens are valued as opportunities for relaxation, active leisure, socialising and entertainment [49, 61]. Time in nature is linked to better physical and mental health, including reduction of stress and improved mood [11, 52, 57]. It can also cultivate an appreciation of nature and foster a sense of environmental responsibility and pro-environmental behaviours [52, 57, 76]. There is growing awareness of the broad social and political import of green spaces, including the significance of Indigenous peoples' cultural and spiritual connections to country [17, 22].

Green spaces in cities are important sites for environmental education and conservation. The emerging field of urban ecology recognises that green spaces in towns and cities are crucial for biodiversity [6] and public participation in conservation and nature-based learning [1, 26, 62], which can enhance connection to nature [79]. In a city such as

Melbourne, physical and mental health, social participation and nature-based learning are fostered in urban green spaces such as community gardens [46] and urban parks [25].

Place-based learning about nature [1, 34] is especially effective when facilitated by a knowledgeable guide or educator. For example, tour guides at national parks in Australia play a pivotal role in connecting visitors with nature [7]. Broadly, the role of a tour guide includes facilitating physical access, interpreting and engendering understanding, enabling encounters and eliciting empathy [86]. In environmental tourism, the guide can also be expected to enhance visitors' appreciation, awareness and understanding of the site; and to promote thoughtful use of the site by minimising visitors' impact on fragile or overused areas [87]. Recent years have seen an increased emphasis on tour guides' co-creation of experiences with visitors, to foster personalised, interactive experiences which resonate with the individual [86].

2.2 Technology for nature engagement

Several threads of HCI research have explored the potential for digital technology to motivate, support, record and share users' engagement with nature. A recent review found that HCI researchers began to address nature engagement in the 1990s, with the topic becoming more prominent since 2016, and around 12 HCI publications annually since then [85]. This review points to varied roles for technology in promoting urban nature engagement, including installations at parks and green spaces [42, 67], interventions to aid families' learning about local nature [44, 75], camera-based systems to reveal backyard wildlife and natural phenomena [27, 72, 84] and digitally-augmented environmental education programs [24, 68].

While this work indicates a range of ways in which technologies might enhance and promote nature engagement, important concerns exist about potential negative impacts. One set of concerns relates to the richly meaningful and evocative sensory experiences of nature contact, and the risk that these might be supplanted by digital substitutes, or sanitised and simplified by technological framings such as gamification [41, 80]. A second area of concern is that by making encounters more convenient and comfortable, technologies will undermine those valued attributes of nature experiences which involve uncertainty, endeavour, resourcefulness and patience [53, 54]. A third issue is that many see nature experiences as an occasion to disconnect from mediatised distractions and mundane communication demands [19, 78], and so are reluctant to use personal devices such as smartphones in nature. A series of "NatureCHI" workshops revealed the diverse challenges of designing technologies to be unobtrusive in the context of varied forms of outdoor recreation and direct nature contact [36].

It follows from the above that design of appropriate technologies for this context requires attending to a wide variety of sociocultural expectations about nature encounters. Furthermore, interventions need to be highly specific to the person, integrating with their primary intention for spending time outdoors, their interests and activities, their orientation to nature, and their individual sense of what is appropriate and desirable in terms of technology use in nature.

2.3 Conversation design for visitor experiences

Chatbots powered by LLMs, such as ChatGPT, offer new capabilities for personalised learning and information access. There is burgeoning interest in chatbots and conversation design for education [15, 38, 64] and informal learning [2, 4], including at visitor destinations such as museums, galleries and heritage sites [69, 83, 88]. This work extends a long history of research into the role of robots and other interactive technologies to deliver personalised guided tours in visitor settings [8, 51, 66].

The capacity of AI-powered chatbots for generating personalised learning experiences [43] is of particular interest in the context of people's varied motivations for spending time in nature. Tools that allow for question-and-answer exchanges have the potential to promote deep learning and aid with managing cognitive load [47]. NLP and machine learning technologies can also allow people to flexibly interrogate large datasets and online information sources [3, 32], access information about their immediate surroundings from digital media [73], and to surface content which corresponds to their prior knowledge, interests and preferences [60]. The present research investigates how this technology might be leveraged for nature engagement, and the design challenges and opportunities that emerge, through design and evaluation of a WoZ prototype chatbot.

Fig. 1. The System Garden at University of Melbourne

3 ParkPal System Design

3.1 Context: The System Garden

This study was conducted at The System Garden (hereafter, "the Garden") a small botanic garden housed within the University of Melbourne (see Figure 1). Historically, the Garden served important scientific and educational functions, and was much larger than its current size of approximately one acre. The Garden is an important green space in a larger urban precinct, surrounded by buildings and located close to a major city thoroughfare. The garden contains many botanical specimens (the "collection"), organised taxonomically in demarcated precincts and beds, and a small heritage building. It has been found to attract a variety of birds, mammals and reptiles, including species rarely seen

in urban settings. The Garden is intended to provide a space for teaching, including for visits from school groups, and also a social space for relaxing, informal gatherings, and small-scale community events. Due to development of surrounding buildings, the Garden is subject to ongoing change. It has been targeted for strategic redevelopment to improve the biodiversity values and the presentation of botanic collections. One aim of this strategy is to provide engaging interpretation, which is set to include digital information to supplement visitor signage and botanic labelling.

3.2 Initial investigation: Visitor expectations of a nature guide

All members of the research team visited the Garden to familiarise ourselves with the space and observe how it is used by visitors during the workday. We gathered documentation about the site and its collections. We reflected on what we found interesting about the site, what sparked our own curiosity, and noted significant features. We met with a staff member of the horticulturalist team, who was knowledgeable about the gardens, the collections and how they are managed. She was able to provide further information and answer our questions. This experience helped the researchers to consider the characteristics of an expert guide with site-specific knowledge that might be desirable for visitors and instantiatable in a chatbot nature guide.

We sought to understand people's preferences for spending time at the Garden setting and their expectations of a nature guide. We conducted contextual interviews with people who spend their workday at the University. We invited participants to explore the Garden, tell us about features they noticed, reflect on their experience, and ask any questions that came to mind. We asked them what they might ask of a knowledgeable guide, reasons they might visit a site such as this and how they would spend time there, things that would appeal to them and things they would find frustrating or annoying in this setting. Subsequently, we described the concept of a voice-based chatbot as a nature guide, asked them for their opinions on such a tool and how they might use it. Through this, we investigated how we might balance provision of information with the intent to avoid disrupting nature engagement. Interviews were conducted with four participants, graduate students in their 20s and 30s, who had varying degrees of familiarity with the Garden.

We analysed our data through affinity mapping, identifying three themes: guiding, unobtrusiveness and control of the technology. All respondents were all excited about the idea of a voice-based chatbot to enhance their experience in nature. In particular, they expressed a strong desire that the chatbot would direct them in the garden so that they would avoid missing something interesting. The participants' views aligned with the research team's experience of meeting a staff horticulturalist during a visit to the Garden.

Participants agreed with the idea that the technology should suggest activities designed to help them to relax and enjoy the sensory experience of the Garden, and to help them learn more about plants. However, they also expressed concerns about technology being disruptive to their own experience, causing noise and disrupting other people. Participants said they would like to have control over the technology, that it should be responsive to their interests, and should be more interactive than a recorded audio tour.

3.3 Design of ParkPal

We conducted a careful reading of literature on conversation design and interactive agents, as well as nature engagement interventions. From this, we identified several interrelated aspects of design that need to be considered when creating interactive agents for this setting. In designing ParkPal, a mobile app that combines a voice-based LLM-powered chatbot with location awareness, our design decisions were informed by prior work in this domain, the contextual inquiry, and pilot tests.

3.3.1 Design decision: audience and scenario of use. We designed ParkPal to be used by people visiting an urban park, during a workday break. It therefore follows that our users would be likely most interested in relaxation, either sitting or wandering at will in a green space. We envisaged that users would not inherently be seeking an educational or informative experience; while we hoped that ParkPal would pique their interest in the park's natural features, we envisaged that this would be secondary to their aim of relaxing in nature. Our intervention was specifically designed for adults, in contrast to the large proportion of HCI research on nature engagement which targets children and young people [85].

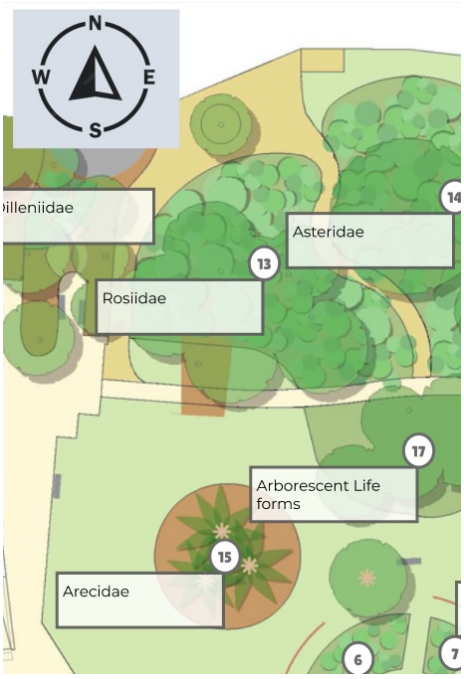

Fig. 2. A section of the plan of the System Garden. The plan was the only visual content provided to participants.

3.3.2 Design decision: modes of interaction. To reduce its impact upon a user's experience of nature, and reduce disruption of others nearby, we proposed ParkPal as a mobile application which people would interact with through voice only, wearing earphones and placing their phone in a pocket or bag. To emphasise this design decision, and focus on the experience of voice-based interaction, we created only a single screen for the app consisting of the site map (see Figure 2) with no additional written text or interactive on-screen features.

3.3.3 Design decision: user context awareness. While many audio guides offer a prescribed route (or "tour"), or assume that visitors will visit predetermined locations in a site, in this design we sought to allow visitors to wander at will, or choose a specific location to visit at their discretion. This decision was in keeping with our intention that ParkPal should enhance a casual visit to a park for relaxation during a workday break. We propose that this can be achieved with existing technologies by obtaining user location through GPS and comparing this against database items to identify significant features and plants in proximity to the user. Furthermore, we determined that ParkPal would be able to

predict direction of travel if a user moved along a path, and would also be able to estimate users' walking speed and adapt the timing of content delivery, accordingly. We intended that it should be quick and easy for users to start using ParkPal, and so we did not include any additional mechanisms to collect data about the user, beyond their GPS location and information they provided in conversation.

3.3.4 Design decision: underpinning technologies. As LLM tools can be augmented by training on an additional knowledge base, we envisaged that ParkPal would have GPT language capabilities supplemented by knowledge of the Garden, plant and animal species found there, and the institution's database which contains georeferenced items representing plant collections, buildings and other features. To determine user location, we selected GPS which is is typically accurate to within 5m outdoors, though this can be worsened by trees and buildings, so we designed for user positioning accuracy in the range of 5-10 meters. These technology selections informed some of our decisions related to user context awareness and information to be provided.

3.3.5 Design decision: information to be provided. The information offered by ParkPal was drawn from online sources and the institution's botanic database. Given the large volume of potential content, information was selected based on our own exploration of the gardens to identify salient and interesting features, as well as on the contextual interviews. ParkPal content includes information about the Garden's history, the site and its evolution, the precincts and the collections they each contain, and specific plants of significance, and wildlife species which have been observed there. Aligning with place-based environmental education practices, we wrote scripts which would provide some information and also encourage users to observe, explore, and pay close attention to natural features of the park. In addition, ParkPal would recommend interesting areas to explore or quiet spots for relaxation, inform users about significant collections and other features in their vicinity, and suggest activities to enhance sensory experience of the site, such as listening to natural sounds, and touching leaves of plants. (See Appendix for examples of content).

3.3.6 Design decision: levels of proactivity. A focus of this project was to investigate how proactive a chatbot nature guide should be, and associated effects on user experience and preferences. Our initial investigation indicated that a proactive chatbot would be able to guide users and point out interesting features, but that a passive design would better respond to respondents' desire to be in control, and would be less likely to disrupt a nature experience. To investigate this issue more fully, we designed two modes for ParkPal, "Proactive Mode" and "Passive Mode", and designed the study so that participants would experience both modes.

- In Proactive Mode, ParkPal offers information without being prompted. In selecting content to be delivered, ParkPal makes use of the user's location and movement around the park, and information about their interests if these could be inferred from their previous utterances and responses to previous content.
- In Passive Mode, ParkPal offers information only when prompted. ParkPal reminds users that they can ask a question, and then remains silent, waiting for user queries or input.

3.3.7 Design decision: chatbot personality. We explored options for a personality for a nature guide chatbot. Our decisions were informed by our positive interaction with the horticulturalist staff member, and our own experiences of guided tours in nature. We outlined characteristics relating to domain expertise, extending beyond the specific site, to be able to also answer broader, general questions, for example about relevant historical events, flora and fauna and ecosystems. We noted that the horticulturalist was friendly, volunteered information in addition to the topics we asked about, but provided information in short, conversational segments rather than as a short lecture. We noted also that the

horticulturalist's authority was enhanced by perceptions of her expertise and her official status as a staff member of the institution.

We adjusted scripts so that they were not more than one minute long, but still provided some rich detail that visitors would be unlikely to know. Scripts were written to focus on information delivery, with little extraneous chat. We identified potential benefits of creating a distinctive personality and backstory for the chatbot, inspired by the horticulturalist that we had met. However, in the context of this research, in which we focus on voice interaction and levels of proactivity, we decided against giving the chatbot a strong identity, to avoid participants' responses being coloured by their feelings towards the persona. We therefore developed a friendly but professional tone for ParkPal, aiming for a neutral demeanour, and selected a name which evokes a mobile app rather than a human tour guide.

4 Method: Wizard of Oz Trial

4.1 Employing WoZ in nature

Wizard of Oz (WoZ) prototypes have been implemented for many years in HCI research. This approach to a system mock-up, in which a human actor simulates technology, allows researchers to explore how people might react to and interact with an envisaged technology that might not become a reality until future technological advancements occur [20]. This offers opportunities for early explorations of future use and potential impacts of a hypothetical technology before it is developed, but also presents some limitations. For example, some have pointed out that these scenarios often represent human-human interactions rather than genuine human-computer interactions [65]. To address these concerns, we implemented several measures to ensure so that we could investigate users' experiences using the envisaged AI-driven chatbot, ParkPal, rather than their interactions with the researcher simulating ParkPal. Firstly, we developed protocols and scripts which set out how the chatbot would communicate with our participants, perform validation and user feedback, and perform error handling and fallback if unable to find relevant information in response to a user request (see Appendix A for example scripts).

In accordance with WoZ reporting guidelines proposed by [70], we provide in this paper a clear statement regarding the technology capabilities (Section 3.3), participants' information (Section 4.3) and the environment in which the test was taken (Section 3.1).

ParkPal was simulated by an actor, one of the researchers, who developed familiarity with the scripts, information and protocols through practice and piloting. Scripts and associated information were collated in a flip book, providing the actor easy access to specific scripts when required.

As ParkPal is conceived as a voice-based chatbot, we simulated it through a voice call between the actor and the participants, using the mobile app Zoom and its recording functionality. At the beginning of the session, participants connected to a Zoom session using the app their mobile device. We recommended they use earphones and inline mic to improve audibility in the outdoor setting, which is an appropriate setup for users of a voice-based chatbot, as an inline mic is generally recommended to ensure good speech recognition in outdoor settings.

4.2 Data collection and analysis

Participants met the researcher at the Garden at a scheduled time. In advance, they were provided with the study description, signed the consent form, and were directed to install the Zoom app on their phone. Participants were informed about the intent of the ParkPal nature guide, and that the study prototype would be delivered through a

simulation. They were asked to pretend that they were interacting via voice with an AI-powered chatbot, similar to Alexa or Siri. The researcher aided the participant to connect to the Zoom session and started the recording.

The actor moved out of sight and then, in the role of ParkPal, provided a welcome message, and instructed the user to say "Hey, ParkPal" to initiate a question or request, and to say "Stop" at any time to pause information delivery. Each trial lasted 15 minutes and started in either Proactive Mode or Passive Mode, selected at random. After 8 minutes the actor switched to the other mode, so that all participants experienced both modes. This transition was not announced. During the trial, the actor observed the user's behaviour and recorded memos afterwards, relistening to the session recording to jog their memory.

After the trial, we conducted semi-structured interviews lasting approximately 30 minutes with participants, at the Garden. We asked participants about ways in which ParkPal enhanced or interrupted their experience of the Garden, and probed for specific examples of ways in which it encouraged them to engage more closely with their surroundings. We enquired about their experience and preferences of interacting with ParkPal in both Proactive and Passive Modes, the advantages and drawbacks of each mode. We asked for their input on the chatbot personality and their preferences in that regard. Finally, we asked whether users would be likely to use a chatbot of this sort in non-urban nature settings such as national parks and forests.

We conducted reflective thematic analysis to gain deeper insights from the interviews and researcher observations of the trial [10]. All data was reviewed and analysed, at first independently by two researchers. Codes and themes were developed iteratively and discussed by all authors. While one researcher (the actor) played the role of ParkPal, the other two contributed to design decisions and took part in ParkPal pilots, analyzed data, and reflected on this experience and their own perspective on nature engagement. Researchers brought this subjectivity to the analytic process [10]. Our research questions evolved through this process, as is common in reflective thematic analysis. While our early focus was on proactivity of a chatbot for use in nature, we broadened this to explore other design factors and technological issues that shaped users' experience of using ParkPal, and the chatbot's impacts on people's experience of the urban nature setting.

4.3 Participants and Recruitment

We recruited eight people who spend their workday close to the Garden for our ParkPal user study. Participants were recruited through the university's newsletters and noticeboard and through researchers' personal networks. Participants included workers and graduate students, hailed from a range of cultural backgrounds, and ranged in age from 20s to 50s (see Table 1). In terms of prior use of voice assistants such as Siri and Alexa, two said they often used these in daily life, one said they had used them occasionally, and the majority said that they did not use them at all. The majority of participants reported occasional intentional visits to national parks, and two participants reported that they rarely spend time in nature, preferring urban settings for recreation. Two of the participants had visited the Garden previously, but said they had not spent much time there.

5 Findings

Here we present the results of observations of participants' use of ParkPal and thematic analysis of interview data.

Table 1. Participant details

P#	Gender	Age range	Occupation	Cultural background
1	Female	20-29	Grad student	Kenyan
2	Female	20-29	Grad student	Chinese
3	Male	50-59	Academic	Aus
4	Male	20-29	Academic	NZ, Chinese
5	Female	20-29	Grad student	Chinese
6	Female	30-39	Academic	German
7	Female	20-29	Grad student	Aus, Indian
8	Male	30-39	Professional	Chinese, Aus

5.1 Utility and impacts of a chatbot nature guide

During the WoZ trial of ParkPal, all participants made active use of the nature guide while walking through the gardens, requesting information about specific plants and about the history of the garden and its layout. On average, participants visited approximately half of the Garden area. All demonstrated an interest in actively exploring.

In interviews, the majority of participants commented favourably that ParkPal prompted them to visit areas of the park and see things they wouldn't otherwise have seen, as exemplified by the following comment: "I don't think I would have even found the rainforest area over there, which I really like that the AI pointed out [...] it was very useful" (P7). ParkPal led the participants to stop and notice interesting things they would otherwise have "just walked past" (P4), "go back and look at another feature that I missed" (P7), and to "stop and look around, trying to find [a specific tree]" (P1). The information provided by ParkPal was welcomed by most of the participants, being described, for example, as "very valuable" (P6) and in line with "the questions that I usually want to find out about anyway" (P4). It was noted that signage and species labels were only sparsely provided in the gardens and so ParkPal helped them to "know more of the features there, more about the plants because there's not much information" (P7).

Two participants expressed concerns about using technology of any sort in nature. One expressed a disinclination to use audio guides and apps when visiting sites such as museums, and expressed concerns about data privacy (P6). Although they found the experience "surprisingly pleasant", "interesting and really engaging" they thought that a printed booklet could be preferable as it would be "less disruptive" and avoid the use of phones altogether. Another felt that any use of a smartphone was problematic as "once you're actually on your phone, you've got all the functions available to you. And the temptation is then to open something else" (P3).

Nuanced concerns about the impact of a chatbot nature guide were also expressed. For a couple of respondents, even those who appreciated the information provided, using the guide seemed to clash to some extent with their desire for a relaxing, sensory experience of nature. For example, one respondent said "it's nice to just appreciate the view, I don't go specifically go out looking to learn about plants" (P1). Similarly, P3 commented that "whilst it's useful to learn some information about what that plant that that tree is out there [...] what's essential primarily is the experience of just being immersed in nature", ultimately stating "I'm feeling quite ambivalent about it now" (P3). We probed other participants on this issue, and found that this was not the case across the board. For example, one said "I don't feel like I missed any immersive experience within the park. I think the ParkPal actually helps me to feel more" (P7).

For the two participants who noted impacts on sensory immersion, it also seemed that ParkPal had a framing effect on their time in nature. Specifically, being prompted to ask for information about the gardens meant that participants had to put cognitive effort into finding questions to ask. For example, during the trial P1 found themselves thinking

"maybe I should wonder more about this stuff", commenting also "but sometimes you don't want to think". For P3, being provided information about the gardens before the visit, before experiencing them sensorially, would be problematic. They compared the aesthetic experience of the park to visiting an art gallery, stating "What I don't want to do is read the plaque about the painting beforehand, certainly beforehand, and sometimes not even till afterwards, or the second time I go and see the exhibition. Because I mean that shuts down, that prescribes how you experience the art and how you experience the vision, right?" (P3).

We were curious as to whether people thought they would use a guide such as ParkPal in non-urban settings such as national parks. One participant commented that they would appreciate the guide if they were doing an extended hike: "I'd certainly get bored. So it would be good to have an enhancement that lessens the boredom of being there." (P3). However, it seemed that in the context of this trial and interview, most participants struggled to imagine the distinctions between the urban nature setting and a visit to a forest or national park. This question would therefore require further investigation.

5.2 Experiences of voice-based interaction in nature

Participants responded enthusiastically to the potential for a chatbot nature guide with geolocation capabilities. Audio-based conversation was seen to be a good way to learn about nature in situ, found to be "like a podcast" (P2) and easier than reading signage (P2, P4), a way to learn which didn't disrupt the flow of exploring (P8), and which avoids having to look back and forth between objects of interest and written information (P4). This form of information delivery was felt to be far preferable in this context to seeking information on the phone screen "which is so distracting and not really enjoyable for me" (P2).

We were curious as to whether participants would find that receiving auditory information interrupted their experiences of the sounds of nature. We found that listening to digital content in urban nature settings is common practice for some people, with half of our participants reporting that they regularly listen to music or podcasts while walking in parks. However, three of our participants were concerned that they might miss out on the "natural sounds from the park, like the birds or maybe the trees, the wind" (P2). One participant had especially strong reservations about blocking out nature sounds, and stated that they "seldom use headphones" (P3). Although this participant rarely spent time in nature, they stated "I would never walk through a forest or bush listening to music. Why? Because I want to hear the sounds. I want all the total sensual experience" (P3). We suggested to participants that they might prefer to wear just one earbud so that they could simultaneously hear the sounds of nature. While some participants followed this approach, at least one participant found this unsatisfactory, stating "I wasn't really experiencing either thing properly, so I just kept it in" (P4).

A greater area of concern for our participants was that speaking aloud to a chatbot might disturb others or be socially inappropriate. They stated for example that they worried about disturbing other people in the gardens (P4, P6), that they would be self-conscious about using it if there were other people around (P7, P6) and that it would be "weird" to use it if they were in a group with others (P5). One participant likened the garden setting to a church, "you're meant to be quiet" (P3) and was worried that they had disturbed people or committed a faux pas when they saw a security guard approaching. Participants suggested that this could be avoided by more proactive information delivery (P4) or by providing buttons to choose between information offerings (P6).

Participants responded positively to the idea of conversational information delivery. As we will discuss (see Section 5.4), this is partly because it allowed for tailoring the information to their own interests. However, participants also mentioned that ParkPal would allow them to experience a park "with someone" (P2), that the experience would be "like

talking to a tour guide" (P8), and could feasibly be an incentive for some to get into nature because they "won't be lonely" (P3). When we probed participants as to how they would interact with a chatbot to minimise unwanted content and get information of interest, people reported they would want to avoid being rude, saying for example "you want to treat it like a person" (P4). Prompted to describe the desired chatbot personality for a nature guide, some participants had clear preferences, for example that it should be "outdoorsy" (P7), or to-the-point rather than chatty (P4). Others suggested that it should be configurable in terms of its style of conversation (P5) voice pitch (P7) or by assigning a celebrity's voice (P3).

5.3 Proactivity of chatbot: benefits and pitfalls

An important focus of this study was the level of proactivity that participants would prefer of a nature guide chatbot. Exploring this question with participants, we found it was connected with a range of other design issues including verbosity, user control, personalisation and contextual awareness.

Proactivity was found to be beneficial primarily because the chatbot volunteered information about items of interest that users might not have noticed. The unsolicited suggestions were helpful for "suggesting what to do next", encouraging them to explore other areas (P4), and pointing out things of significance that they might not be aware of (P3). This approach was particularly important on first usage as it allowed users to understand the capabilities of the chatbot (P6).

When in Proactive Mode, the chatbot was configured to provide more information without needing to be prompted than when in Passive Mode. Several participants expressed a preference for proactivity, and for verbosity, to not have to prompt for information. For example, P7 would have liked to learn about more of the gardens saying they would have "preferred a bit more information just because there were a lot of different trees and different features around". Similarly, P2 was hoping to hear more information, in greater depth, and P1 felt "a little lost" when the delivery stopped.

On the other hand, we also saw proactivity was problematic in some instances partly because it was more verbose. For example, P5 preferred that the guide provide only the response to their question, without extraneous information. The verbose chatbot was an interruption to the nature experience for P1 who wanted "to just appreciate the view… I don't go out looking to learn about plants", and for P6, who preferred the Passive Mode "because I had time to look around and experience the surroundings without interruption". P8 and P3 felt that the Passive Mode gave them more control; as P3 explained this allowed them "to continue the conversation, as it were, if I wanted to" (P3).

Getting the level of verbosity right to please all users might be difficult, as a couple of our participants noted. P1 drew parallels to the information on visitor signage, noting that "sometimes it's just too much", and questioned how the chatbot would determine how much information the user wants, stating "personally I wanted more, other people might want less" (P1). Reflecting on the quantity of information they would find ideal, P7 stated that they would have liked to get more suggestions of things to look at, "but not too much, not bombarding, but in a way that's well paced" (P7). One solution suggested was to give users control over the level of proactivity (P4), or offer the choice between a guided tour versus a passive chatbot (P1).

On the other hand, two participants described that it was difficult for them to know what to ask about when the chatbot was in Passive Mode. One said, "I didn't really know what to ask about at that point [and] I haven't thought about what I wanted to see" (P1), and the other that "I needed to think of something to say first (P4). This points to the limitations of giving users control to initiate information-seeking conversations in a place and on topics that they are unfamiliar with.

5.4 Importance of personalisation and user control

An important insight regarding nature guide proactivity was that unsolicited information is generally appreciated by users if it matches their interests. For example, P3 expressed an interest in fruiting plants and an espalier, and was later pleased to be offered information about a wasabi plant. It is notable that P3 was generally resistant to the proactive approach. They noted that "if someone had not expressed any interest whatsoever in the fruiting plants or for that matter any of those plants, then it would be disruptive and sort of illogical to start talking about it "(P3). Similarly, P4 felt that the guide should be passive and allow the user control except "when it detects I have a clear goal in mind" (P4). They imagined that this might be best achieved by monitoring the user's walking trajectory; if this indicates a specific destination or interest, then it would be appropriate to offer information, however, the user might prefer to not be interrupted if "I'm just walking" (P4). This suggests an ideal envisaged state in which the guide should fully understand users' interests and intentions.

As part of the introductory user instructions, participants were informed that they could pause the chatbot at any time by telling it "stop". We were curious as to why participants did not make use of this feature, despite some preference for less verbosity. Respondents indicated that they liked to have the option to stop the information delivery if they found it inconvenient (P7), but would generally would prefer to simply "tune out" rather than stop it (P6). Some expressed a reluctance to be "rude" even to a chatbot (P4), while others thought that it might say something of interest (P6, P4). Further investigation on this point would be necessary, given that participants were aware that in our simulation the role of the chatbot was being performed by a human, and so might have been more likely to avoid a discourteous request to stop.

5.5 Importance of contextual awareness

To deliver relevant information to users, our actor relied heavily on contextual and behavioural cues to make inferences about potential topics of interest and the user's intentions. Information was tailored to individuals' interests and prior questions. When participants walked away from an area, that was interpreted as their having lost interest and so previous topics were dropped in favour of information about the areas and items they were moving towards. When people paused to look at a plant, the actor avoided giving instructions or general information. This ability to "read the room" relied on familiarity with the site, its precincts and significant features, as well as the participant's location, speed of movement, and orientation. It was noticeable for participants when there was a mismatch between content and context. For example, on occasion people were asked to listen to the sounds of nature (as part of a default script) but this turned out to be a poor experience when there was nothing interesting to be heard.

Several participants found it difficult to ask questions about aspects of the garden that they were unfamiliar with. For example, asking for information about a specific plant could be difficult "when you've never actually described the plant before" (P1), when there was no identifying label on site, or if the name was in Latin or "really complicated" (P8). More broadly, participants struggled to ask for information about a site with which they had very little familiarity and which they were visiting with no specific goal in mind (P4).

To address these challenges, participants suggested that the chatbot would be improved through more precise geolocation information, supplemented by awareness of their interests. It was suggested that this would improve on suggestions for specific precincts or trails (P1), and help ensure they don't miss significant items close at hand (P7). Combined with prior knowledge of the user this would allow the chatbot to direct them to features of specific personal interest to them (P3). P4 hoped that more precise location information would enable the chatbot to predict where they

would go next, and "offer me explanations before I even asked for them". An alternative to precise geolocation could be QR codes, suggested by P8, enabling them to easily request information about things they see without the challenge of providing a clear, specific description.

Related challenges encountered by the actor and participants relate to using deictic words (such as "over there", "this plant"), to indicate specific features, and directional language to provide guidance. Participants wanted to ask the chatbot to provide information about "this plant", indicated by pointing or "that tree over there" (indicated by direction of gaze and head movement) and found it challenging to instead have to provide a verbal description of the flora (P1). The actor attempted to time directions and guidance to match the user's location, while deliberately ignoring gestures, but information sometimes came too late (much as would happen if relying on GPS for user location), which caused some confusion and required corrections (P5). Similarly, given that GPS alone would not provide reliable information about which way a visitor is facing, the chatbot gave directions using compass directions rather than left / right, which P2 and P5 noted to be confusing.

6 Discussion

We here discuss the findings of our user study, propose avenues for design to address the challenges we uncovered, and outline future research towards designing a usable and appropriate nature guide chatbot.

6.1 The promise and limits of a nature guide chatbot

In this study we investigated how a voice-based chatbot might emulate a (human) nature guide, in a way that could encourage attending to, understanding and appreciating natural surroundings.

We find evidence that technology can inspire people to explore and discover new things in their surroundings, as part of an undirected visit, by pointing out significant features and hidden areas, and offering information. Participants valued being directed towards areas that they didn't previously know about and having plants indicated to them that they might otherwise have passed by. This affirms the role that technology can play in helping people notice and become familiar with nature [85]. It also demonstrates that a conversational agent can augment user-led exploration (see e.g. [44]) while stopping short of a structured educational experience (e.g. [68]). For many participants, this enhanced their time in the park and was of value, during this one-off visit, for people interested to learn about these topics.

We note however, that social and interpersonal dimensions of learning about nature from a human expert were largely absent from our design, and require further attention. We saw only weak indications of social engagement engendered by the chatbot, and our participants had little of substance to contribute regarding the design of an effective and engaging personality for ParkPal. By contrast, human nature guides can be highly inspiring for their audiences, as they provide an opportunity to learn from someone highly knowledgeable about the site and who cares for the environment. There is a need for further research, integrating insights from visitor studies [86], and design of chatbots' social characteristics [13] with a focus on credibility [30]. A key question to be investigated is whether a chatbot can emulate the interpersonal effects of learning from an expert, and engage users through a sense that they are involved in a community of people who care about, and attend to nature.

6.2 Beyond proactivity: offering personally meaningful nature content

Our findings offer new depth of insight into the challenges of designing proactivity, personalisation and user agency into a chatbot nature guide. We envisaged that a chatbot would provide a highly individualised nature engagement, however it is apparent from our study that new approaches are needed to offer users control and help develop personal

connections with nature. Unsolicited information delivery, offered at the beginning of the trial session and during Proactive Mode, was found to be of great benefit in revealing to users interesting things that they might otherwise have missed, and pointing them towards area of the gardens that they did not know to investigate. However, users also seek control over UX and agency in their nature encounter, and this needs greater attention as relevant mechanisms offered in ParkPal were underutilised. People struggled to ask meaningful questions when ParkPal was in Passive Mode, and while they may have specific interests which have relevance to nature, they need additional support to make these connections. To enable people to access nature content in situ that speaks to their own interests, we identify two ways in which a chatbot can better simulate a skilled nature guide.

Firstly, drawing on techniques for building rapport, pertinent to tour guiding [35] and chatbot design [50] , a chatbot can ask the user about what they hope to get out of their time in at the site, about their background and their day so far. This can provide indications of the user's orientation to nature and their preferences regarding chattiness. It may also elicit information about their broader interests that might be used as hooks for nature engagement, or to select topics likely to be of interest.

Secondly, a chatbot can propose topics and see whether any arouse the user's curiosity. As part of an introductory overview of the site, ParkPal could describe several of the park's significant collections and features and some of the ways that people use the space (e.g. relaxation, mindfulness, nature appreciation). The chatbot could then ask the user if they would like more information about any of the topics mentioned. The information offerings can be created to appeal to the types of visitors that frequent the park. For this, we can draw inspiration from environmental education in organisations such as zoos, which focus on topics of relevance to their target audience in their presentations [29, 55]. For example, a common topic in zoos' public-facing communication is the challenge of rearing young animals, as this appeals to a primary target audience: families with young children. Additional research would be needed to validate appropriate topics for an urban park visited by workers and students. We can envisage that these might include recent wildlife observations, practical uses of plants in the collection, alternative strategies for using nature experiences to enhance wellbeing, and Indigenous perspectives on the importance of caring for country.

6.3 Signalling objects of interest in nature

For a park visitor with little nature knowledge, indicating specific features by voice presents several challenges. Generally, visitors lack the specific vocabulary to accurately describe what they see, and scientific terminology used by the chatbot might be misunderstood. Framing questions precisely is difficult without knowing relevant details, and limited observational skills hinder the visitor's ability to notice significant features. In conversation with a human guide, signalling would rely on deictic expressions like "this tree", "that bird" or "over there". Designing for deictic interactions with robots is an area of continued interest [58] but there has been relatively little attention to options for overcoming this limitation when communicating with a chatbot. This challenge is shared with other settings including museums and cultural heritage sites but takes on a particularly problematic form in a nature setting, where animals can arrive and depart unexpectedly and quickly, and where the appearance of plants and other features changes seasonally.

Evidently, use of photographs and multimodal chatbots will offer new approaches to address this challenge [33]. In particular, integrating computer vision will allow users to identify and ask about unknown species [39]. Similarly, including images in information delivered by the chatbot will help users to distinguish specific plants, animals and landmarks in their environment. We note that this avenue raises concerns about screen-based interaction, given people's preferences to put phones away when in nature. It also would entail further design research to ascertain to what

extent it is sufficient to provide users stock images (drawn from e.g. Wikimedia Commons), and in what cases recent, site-specific images are required, to communicate information about the item in its context.

6.4 Appropriate technology for urban parks

There are clearly multiple design challenges involved in designing technology-based interventions to integrate with park visits in a way that strengthens attention to nature rather than distracting from it. We found further evidence that some people seek uninterrupted sensory immersion in nature and prefer an experience free of technology if their aim is to relax and clear their minds. However, our study also affirmed that others already incorporate technology into their relaxation in parks, for example by listening to music or podcasts. In addition, people worry that using technology in public might disturb others, or seem inappropriate. But it seems that this is becoming more accepted due to changing social norms. We note also that our participants were first-time visitors to a park, and that aims, preferences and habits change with repeat visitation in nature settings and in other visitor contexts, such museums and galleries [14, 71].

To accommodate these concerns and differing preferences, we identify two alternative strategies which warrant further investigation. The first could include offering the option of incorporating interaction through on-screen buttons and written responses for situations where voice-based interaction is uncomfortable. Again, this raises additional design challenges to accommodate some users' preferences to avoid screen-based interaction. A second approach involves providing content that can be consumed before or after the visit, to appeal to users who do not want to use technology in situ. For example, updates on nature at the park - such as information about seasonal changes and new plantings - could be delivered for a user to consume during their commute to work, or at their office desk.

6.5 Future Work

In summary, our findings and proposed avenues for design and raise three important additional topics that will require attention in progressing towards designing a suitable chatbot nature guide.

Firstly, we find that social and relational aspects of chatbot design will play a substantial role in helping visitors to engage with local nature and understand its significance. Chatbot personality and interpersonal interactions will be intrinsic to helping connect users to nature-related topics that have personal relevance, and to feel connected to a community of people who appreciate the park. We note that participants had varied ideas as to the ideal personality for a nature guide chatbot, and several wanted to be able to configure it. It is necessary to explore how a chatbot persona – including, for example, name, face, backstory and tone of voice – can be crafted and presented in such a way as to engender a sense of connection with a respected expert or institution.

Secondly, this user study affirms the importance of careful design of agency, and signals that it is not sufficient to encourage users to ask their own questions. Additional research is needed to design and evaluate approaches such as incorporating multimodal interaction, emulating a tour guide's rapport-building conversation and eliciting responses to a range of possible topics.

Thirdly, our user study involved a one-off interaction by users who had little prior exposure to our chosen nature site, but we recognise the importance of designing for repeated contact and continued connections with nature. Significant opportunities warrant further investigation, including providing information about Indigenous connections to country, cultural significance and traditional uses of the site, and Indigenous knowledge about the flora and fauna and ecosystems within the collection. It might also include seasonal events such as plants' changing colours, growth and blooming, birds' hatchings and migrations, and lifecycles of frogs and insects. In addition, visitors' attention might be drawn to

changes brought about by new plantings and environmental shifts associated with global warming, including arrival of species not previously observed at this site.

Our findings provide a foundation for studies with larger and more diverse cohorts, and investigation of users' preferences and behaviour in remote nature sites as well as urban green spaces.

7 Conclusion

Our study addresses urban societies' disconnection from nature and explored how a voice-based chatbot could be designed to simulate the experience of conversing with a local nature expert. We designed and trialled ParkPal, a chatbot nature guide intended for use by individuals visiting a city park during workday breaks. Our design research outlines important decisions that must be made when creating effective interactive agents for nature use, providing guidance to others researching technology for nature engagement and visitor experiences.

The trial data offer nuanced understandings as to the potential of interactive agents for enhancing nature experiences, especially the value of helping people notice aspects of nature they might otherwise overlook. We find also that a chatbot can pique users' curiosity by connecting to their existing interests, but that additional research and design is needed to address the challenges that users face in personalising content to their interests, making enquiries about unfamiliar plants, and exercising choice and control over the flow of conversation. We suggest ways to address this, including building rapport through warm-up conversations, proposing audience-relevant topics for users to choose between, and investigating use of multimodal chatbots. Consequently, we have identified three key directions for future design and research: exploring the social and interpersonal aspects of chatbot design, developing alternative approaches for users to guide the conversation, and designing for repeat visits.

Our study provides a foundation for future explorations into how digital technology can enhance incidental nature contact, and enable people to develop awareness and appreciation of local nature. More broadly, our findings have application to other visitor settings, providing guidance for design of interactions which can foster personally meaningful, tailored experiences.

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A Chatbot Protocols and Scripts

We provide here examples of the scripts and protocols developed for the ParkPal prototype.

A.1 Welcome and user instructions

> Hi there, thank you for visiting the system garden.
> I am ParkPal! I'm powered by AI and I'm here to help you learn more about the garden and enjoy your time here.
> Please ask me any questions anytime!
> You're more than welcome to explore the beautiful park by just following your instincts, but I am happy to give you some suggestions!
> Let me know what you want to see here and what you'd like to learn more about, and I will navigate you through the park! When you want to ask me something, just say "Hey, ParkPal" and I will answer your questions.
> If you'd heard enough from me at any time, just say "stop".

A.2 Proactive Mode

Default routine; adapt based on user requests and behaviour.

- Deliver "Garden history" script"

- Deliver script: a collection item close to the user.
- Deliver an activity
- Deliver script: cultural
- Deliver script: a collection item close to the user.
- Deliver an activity

A.3 Passive Mode transition

Please take your time to explore this beautiful park. If you want, you can refer to the map on your phone.
When you want to ask me something, just say "Hey ParkPal". I'll be happy to answer your questions.
Enjoy your walk.

A.4 Example Informational Scripts

A.4.1 Script: Garden History.

Fun facts about the System Garden.
The System Garden at The University of Melbourne was established in 1856 by the university's first Professor of Natural History, Frederick McCoy. He named the System Garden because the garden design was arranged systematically, grouping plants according to their family and planted in rows. Plants in the same family will have some things in common, for example, their shapes of leaves and flowers. Can you see similarities in plants in each area? Have a look!

A.4.2 Example collection item script: Osage Orange.

The large tree that dominates this area of the garden is an Osage Orange, and was planted over 150 years ago. It's a very special old tree, it's listed on the state register of significant trees. This species is native to the USA. Osage orange wood is very durable and is still used for making fence posts in the US.

A.4.3 Example cultural script: Indigenous weather.

Did you know Indigenous people have different seasons from the four seasons we refer to in the Western world? For example people of the Kulin nation would refer to September and October as *poorneet* - the tadpole season. If you're very lucky, you might come across a frog today at the garden!

A.4.4 Example activity script: Look.

The plants of this area belong to the group known as [Cycads]. Most of them have [a woody trunk and stiff, spiky leaves]. But there's lots of variety between them. Can you see differences and similarities among them? Have a close look! What do you notice?

A.4.5 Example recommendations scripts.

I can give you suggestions if you want! Tell me there's a particular type of plant you're interested in, and I will guide you to where they are.

- "Flowers" : Number 10 and 14 are currently blooming.
- "Mosses and ferns" You can check out some amazing mosses and ferns in the Australian Rainforest -

- “Trees” > offer Palms or Osage orange or Banana trees -
- “Nothing really” > Look activity

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