The Ethnobot: Gathering Ethnographies in the Age of IoT

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ABSTRACT
Computational systems and objects are becoming increasingly closely integrated with our daily activities. Ubiquitous and pervasive computing first identified the emerging challenges of studying technology used on-the-move and in widely varied contexts. With IoT, previously sporadic experiences are interconnected across time and space in numerous and complex ways. This increasing complexity has multiplied the challenges facing those who study human experience to inform design. This paper describes the results of a study that used a chatbot or 'Ethnobot' to gather ethnographic data, and considers the opportunities and challenges in collecting this data in the absence of a human ethnographer. This study involved 13 participants gathering information about their experiences at the Royal Highland Show. We demonstrate the effectiveness of the Ethnobot in this setting, discuss the benefits and drawbacks of chatbots as a tool for ethnographic data collection, and conclude with recommendations for the design of chatbots for this purpose.

Author Keywords
Chatbot; ethnography; Internet of Things; smart mobility

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Study methods have sought to keep up with the changing nature of experiences with technology. From wearables such as Fitbits [14] that monitor your activity through the day, to the Moona pillow [22] that keeps your head cool and monitors sleep patterns at night, IoT is technologically enhancing and connecting everyday objects and experiences [31]. Connected to the internet, and each other, these objects will transact with people and systems in a multitude of spaces, offering services, gathering and transmitting data and performing actions in the real world.



Figure 1: The Ethnobot: gathering data at the Royal Highland Show

As computers have moved out of the office and into a multitude of different environments, people have become accustomed to conducting a wide range of transactions, communications and other activities on the go and throughout their day, and will expect increasing flexibility and convenience from new IoT. To anticipate this new landscape and develop technologies that fit into it, HCI practitioners need to understand the existing terrain where one person's technologically mediated experiences are increasingly interwoven with the activities of many other individuals and devices [26].

Ethnographic practices have been widely adopted within the study of HCI, in order to understand interactions and relationships with technologies [21, 41, 40, 24] and have a long history of use in this field, beginning in the 1980's with the seminal work of Lucy Suchman [44]. Suchman

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describes how a person's action is most often based on unfolding activities and what their immediate situation presents, rather than any prior plans. In other words, their actions are based not on any original plan but on what just happened. Dourish [11] extends this idea in his theory of embodied action. Based on phenomenological theories, Dourish describes how physical and social phenomena unfold as we interact with our surroundings, artifacts and other people, and, rather than holding fixed notions of technology we make sense of them through our unfolding interactions and surroundings; the experience of being there is central to our understanding of our experience. This work points to the fundamental importance of investigating unfolding, in-the-moment activities, and emphasizes the crucial role of ethnographic studies in understanding the activities and experiences of people as part of developing technological mediation.

Ethnography in HCI most often follows the ethnomethodological tradition, which deals with the mundane act of observing human activity and situated practices and eliciting descriptions of events in the world [18]. The practice of eliciting these ethnographic stories regarding technology is in itself nothing special, but collecting it at critical moments has become an increasing practical challenge. Studies of IoT mediated experiences face the same set of challenges as ubiquitous and mobile computing when it comes to collecting ethnographic data, but they also face the additional challenges of the interconnections between a mass of devices and individuals, and a growing range of spaces where interactions with technology may be increasingly fleeting, sporadic, and interleaved with other non-associated activities [5].

It is into this problem space that we introduce the Ethnobot. The Ethnobot is a chatbot, developed as a research tool to collect data for the Smart Transactions in Public Spaces (STiPS) project. STiPS is exploring how IoT technologies may facilitate new value exchanges taking place in public spaces, and anticipates a future in which IoT and digital ledger technologies will underpin systems that enable stakeholders in public spaces: consumers, visitors, vendors, producers, suppliers, sponsors and event organisers, to exchange value in new ways and form direct and transparent relationships with each other [41]. To understand existing value transactions in public spaces this project must ideally examine the activities of a number of people on the go, transacting in space simultaneously. The Ethnobot was designed and deployed by ethnographers, and created to gather feedback on activities from study participants in situations where the presence of a human ethnographer is intrusive. This paper reports on the results of the first deployment of this prototype Ethnobot, and discusses how chatbots may best be implemented as part of ethnographic data gathering.

RELATED WORK

In recent years the practice of ethnography has evolved to keep up with the changing technological terrain. Studies of ubiquitous and mobile computing have begun to address the challenges arising from mobility, small personal displays, and interactions with invisible sensing systems that are distributed across different systems and devices [5]. Techniques have been developed which integrate multiple sources of computationally collected data with more traditional forms of gathered qualitative data, for example synching data streams and system logs with video recordings of activities [43].

Originating in the field of psychology, diary studies, where participants are required to journal their daily experiences, have been adopted in HCI to access experiences over long time periods and in the context of daily routines and spaces [36, 2, 37, 34]. Experience Sampling Method (ESM) is a type of diary study that aims to record in-the-moment activities by asking participants to make records at particular times of day, sampling activity specifically around these moments [7]. ESM has been enhanced by providing participants with pagers that prompt them to act at required times [8]. However, both in diary studies and ESM, participant compliance remains a problem, with participants not always responding when required, and engagement tailing off as the study progresses [38]. Froehlich et al [17] use sensor data to prompt sampling at convenient and meaningful moments, and Palen and Salzmann [38] ask participants to leave spoken messages for researchers rather than write down what is happening, and have found that in certain contexts this is easier or less intrusive than a written response.

Studies seeking to comprehend the complex landscape of IoT have tried to capture the activities and experiences of the systems and objects alongside those of the participants. In order to take into account the broader view of the whole system, non-anthropocentric methods of studying experience, such as post-userism [1], object orientated ontologies [10], objects and agents [3], and thing ethnography [19] have become widespread. These attempts to cope with the normally "hidden" connections that exist around, and sometimes independently of, often quite trivial human interactions, bring to the foreground the perspectives of devices in the system [28, 35, 46]. However, some have pointed out the potential risk that in moving away from human centric anthropological techniques we may lose sight of the human perspective [6].

Meanwhile, chatbot development is on the rise. From hardwired programs and simply coded patterns to systems built upon embedded learning algorithms, they are created for a multitude of different purposes and have proven success in eliciting feedback in a diverse range of other sectors. Work in chatbots dates back as far as 1966. Joseph Weizenbaum designed ELIZA using natural language programming to mimic a Rogerian therapist by rephrasing

patients' statements as questions, then posing them to patients [48]. Weizenbaum was astonished by the richness of the feedback from this simple implementation. The ELIZA chatbot became a reference for other program developments using similar conversational techniques [4, 23]. Many modern chatbots are still simple, task-based, spoken dialogue systems with a talk-reply-talk-reply structure [39, 28, 32]. Often they are designed to provide and gather information on specific topics, acting as virtual support agents in the place of frequently asked questions, survey takers, chat room hosts and learning assistants [27, 47]. The most significant explosion of bots has been in social media, with, for example, 24% of all activity on Twitter coming from bots [30, 45]. Bots deployed on social media platforms have low barriers to social interaction, easily rising to become top influencers on a social network, they are able to propagate news and political opinion and counter respond [9, 30]. Chatbots have also been developed for use in settings beyond information and entertainment. In 2014 many messaging systems introduced chatbot support within messaging apps, and provide a convenient way for services and developers to engage with users [25]. In HCI chatbots have been deployed as facilitators in voting systems [15], and in the health care sector, they have been used to elicit patient information, where it has been shown that in some cases patients will disclose more information to bots than human health care providers [20]. In the healthcare context chatbots have proved particularly successful in providing a consistent point of data capture [33, 20, 13].

With the use of beepers and voicemail in ESM, and the creation and syncing of thick data sets for understanding object perspective and IoT assemblies, as technology and experiences studied by HCI have developed, so have the tools by which to understand them. The use of a chatbot in this context is simply another step along this path. Aligning with previous work on chatbots in other sectors, the Ethnobot was intended to address the importance of capturing in-the-moment activities using a chat metaphor to create an ongoing, but lightweight and engaging mode of interaction.

IMPLEMENTATION

The development of the Ethnobot has its roots in ethnographic studies conducted at the start of the STiPS project. These studies revealed the complexity of interactions of participants attending large public events, and led to an increased awareness of value exchange within these spaces. However, whilst collecting experiences from stallholders proved straightforward, observing and interacting with visitors was more problematic, particularly when they were in groups that temporarily separated and regrouped. These studies also revealed the prevalent use of messaging apps and social media on mobile phones to connect with others either within or outside of the event, indicating that interacting with a chatbot may less intrusive than researcher presence. The design of the Ethnobot was based on insights gained from these early studies, and we based questions and responses on the most likely types of participant activity, whilst providing flexibility for participants to respond how they wanted.

THE ETHNOBOT

The Ethnobot is an app that runs on smart phones and is a simple chatbot implementation which uses a branching path structure to direct its conversation with participants. It asks participants a series of questions in chat format as they move around an event. Introductory questions are provided with short preset responses for participants to select from, which enable them to provide a quick response, whilst also encouraging them to consider what they have gained as part of their experiences. The preset response also leads to a preset next turn for the Ethnobot, which is most often an open-ended question prompting participants to elaborate and describe their transactions, activities and thoughts. The Ethnobot also encourages participants to use the smart phone camera to take photos of anything relating to a purchase or exchange of value, and integrates the photos into the dialogue, adding to the richness of the information collected. Finally, the Ethnobot sometimes directs participants to particular activities, for example by suggesting an area of the show for them to visit and explore, allowing feedback to be gathered from all participants on specific areas of the show. When a participant has arrived at the suggested location, the Ethnobot supplies preset responses for them to indicate whether they have bought, learned, tried, enjoyed or disliked something (see Figure 1), and then provides a free text response or photos for them to elaborate on these experiences.

STUDY METHOD

The objectives of this study were twofold, firstly to understand the implications of using a chatbot to gather ethnographic data from participants who are outdoors and on the move, and secondly to gather data for the STiPS project. This paper primarily reports on the first of these two objectives, touching briefly on the second, where is it useful in understanding the success of the deployment. To achieve these objectives the study aimed to learn about:

1) The responsiveness of the participants to the Ethnobot questions and directions, and how often they took the opportunity to expand voluntarily on their responses
2) The participants' perceptions and experiences of the Ethnobot, how they felt about the experience, and how comfortable they were using a chatbot in this context
3) The success of capturing the information required, by examining what was and what was not recorded.

The Ethnobot was trialed at the Royal Highland Show (RHS) in Scotland. The RHS is a large agricultural show which runs for three days at the end of June each year, and hosts over 1000 exhibitors, showcasing the best of both large and small businesses. It was chosen as an ideal venue for studying a series of value transactions because of the

density of experiences and goods on offer. Researchers were present on all days of the show, spending the first day testing and refining the Ethnobot and the second and third days trialing it with participants. thirteen participants were recruited, three from within the university and ten others. Participants represented a wide spread of ages, with four aged 18-25, four 25-35, one 35-45, one 45-55, one 55-65 and one 65+. Participants presented a diverse range of backgrounds including engineering, law, marketing and translation. Six of these participants took part on day two of the RHS and seven took part on day three. The trial was organised into two sessions on each day, early afternoon and late afternoon, with participants for each session arriving together. The STiPS project paid for entrance to the show as an incentive.

After greeting the participants at a meeting point, the researchers explained the trial process. Each participant was then provided with a smartphone with the Ethnobot app running on it, and the researchers demonstrated the use of the app. Participants were instructed to interact with the Ethnobot, and were told that we were interested in collecting information about their experiences. The Ethnobot also reiterated this in its first two turns as it started the conversation. Participants were asked to return to the meeting point after they had finished exploring the show to return the phones and take part in an interview to discuss their experiences.

The participants arrived for each session in groups of two or three, and although they did not always know each other, and were not required to explore the show together, some participants stayed together during their visits. This resulted in one group of three who stayed together, three groups of two, and four participants exploring the show alone. Although we had not anticipated this, we decided to allow it, as exploring an event like this tends naturally to be a social activity.

The interview questions

The interview was conducted outside and standing. Participants were often tired and so these interviews were kept short, lasting on average 8 minutes. The interview followed a pre-set list of questions, and follow up questions were asked in order to gain more insight if required. The interview was split into two parts. The first part aimed to learn about the participants' experiences and feelings towards the Ethnobot and consisted of four basic questions which aimed to uncover:

1) Overall impressions of the Ethnobot
2) Difficulties in using the Ethnobot
3) Reactions to the pre-set answers
4) Reactions to Ethnobot directions

Questions in the second part of the interview asked the participants about their experiences of the show more generally, in particular to find out what they felt had been valuable to them. Participants were asked how they had found the process of navigating the show, and if there was anything they had bought or experienced which they did not record with the Ethnobot, why this was the case. The purpose was to find out how well the Ethnobot had succeeded in capturing experiences, and how post-event descriptions to a human ethnographer compared to the data gathered by the Ethnobot.

RESULTS

This section describes results from both the records of the conversations of each participant with the Ethnobot (chat logs) and the interviews with the participants. The chat logs were first analysed quantitatively by counting the instances of participants' use of various features. This provided initial insights into aspects of the chat logs that indicated successful or problematic aspects of the experience. This was followed by a qualitative analysis by two researchers, who read through and extracted instances of certain types of response informed by the quantitative analysis; these were cross-checked for consistency.

Post-trial interviews with the participants were audio-recorded and transcribed. Responses were coded under six headings which reflected the subjects of the interview questions. This coding was carried out by two researchers who then cross-checked consistency.

The results described in the following sections begin with an overview of Ethnobot use and participant reactions, then describe the use of the key features of the Ethnobot and participant responses to them. We conclude with the a discussion of the quality of the data which the Ethnobot has provided to the STiPS project and a comparison with feedback gathered in the post-trial interview.

Overview of Ethnobot use

Participants spent an average of 120 minutes with the Ethnobot, with the longest test period lasting 222 minutes and the shortest 84 minutes. During this time, each participant recorded an average of 71 responses to an average of 56 Ethnobot requests for information or action, where participants could make multiple responses to one request. This includes pre-set responses which could be yes/no and other simple phrases. In only two cases did a participant not respond directly to an Ethnobot question or request with either a pre-set or free-text response. In these cases, the participants used the free text option to report an accidental click on a pre-set answer.

The inclusion of photos was not always available with a response, however when it was possible, it was not compulsory. A total of 151 photos, or an average of 12 per participant, were included.

General impressions of the Ethnobot

Four of the thirteen participants responded positively to the use of the Ethnobot during the trial, and stated that they felt it was easy to use, offered good guidance, and was a fun way to record their experiences. **P3** described her experienced with it as *"pleasant. It was nice to chat too [ ]*

technologically I find it astonishing, because I'm a bit naïve about these things. Um, actually very useful interactively, it was, it was good". **P9** also noted how she particularly enjoyed it as a convenient recording device saying, *"it was very easy to use, and, uh, I liked the fact that it was, I don't know, it was open all the time and I could just add to it [ ] it was quite good because you can communicate what your emotions are at a particular time or what you're doing"*. Seven of the participants expressed mixed feelings. They found the Ethnobot easy to use for the most part, and enjoyable to interact with, but expressed irritation or frustration with certain aspects. For example, **P4** described it as, *"an irritating but somewhat amusing guide"*, and **P8** described it as, *"easy to use but it felt quite limited in the way it communicated with you"*. This irritation was most often due to the Ethnobot directing them to places, the limitations of the pre-set answers, or because of the repetitive nature of its questioning. Two of the participants did not enjoy the experience of the Ethnobot for these reasons, and additionally described it as boring and tedious.

Most participants commented on the restricted nature of the questions the Ethnobot posed. Some also stated that they felt limited in what they could express as a result of the questions asked, and commented in the interviews that they would like more flexibility. They sometimes expressed disappointment and frustration. **P4** said *"I had no way to really express myself other than things that were directly related to the events or the distractions that were taking place"*. However, this was not always considered a problem, **P6** said *"it only asked very specific questions, but they did seem to cover a good range of emotions"*. Some participants also expressed a desire for the Ethnobot to be able to understand and respond to what they were saying more often, for example, **P7** said *"I wanted a, a nice bratwurst or a big hot dog or something like that and I couldn't find one, so I commented on that with the Chatbot expecting – maybe wishful thinking – that it would give me a suggestion"*

Many of the participants described how they anthropomorphised the Ethnobot. **P1** said *"I know it's a chatbot, but I kind of think, really it's a person"*. When participants described frustration arising from its inflexibility, they sometimes expressed the desire for it to be more like a person. For example, **P1** went on to say *"I would appreciate it if, if it could talk as a person"* **P6** said *"It, it didn't give you back enough, like, emotionally. Not that you'd expect that from a device, but since you're having a conversation, you'd want maybe something more"*. Some participants tried to write responses directly to the Ethnobot to see if it would react. For example, **P2** described how he tried to have fun with it: *"I think it's fun, I think it's, it's kind of friendly, because, I don't know, I say, I'm using language like 'my friend', and I use, you know, this emoticon"*. Participants were sometimes frustrated by the Ethnobot's inability to understand what they were saying. However, for the most part they either found this acceptable or adapted to it. For example, **P2** said *"Chatbot asked me something, and I said 'yeah', so he didn't understand anything, and I was like, okay, he didn't say anything. 'Yes', I said, 'yes', and he replied, so it's kind of, I need to adapt to his vocabulary."*

Reactions to Ethnobot functionality

Building on responses

The Ethnobot always checked to see if the participant would like to add more information to their previous response by asking, "Is there anything else you wish to add?". Out of 236 times in total the Ethnobot asked this, on 145 occasions the participants used the pre-set response yes and voluntarily added extra information, either as a comment or an image. Participants could continue to add as many extra comments as they wished, however in the majority of cases participants added only one extra response. In some cases participants added several before finishing and clicking no. In these cases, they usually embellished and added extra information to the original subject, or moved on to related subjects (see Figure 2).

Some participants particularly enjoyed making additions to their comments in this open-ended way. **P9** used this method of interacting with the Ethnobot for the majority of the trial period. She described her experience saying *"I really enjoyed going around and taking pictures and 'have you got something to add?', 'yeah I have', I always said yes to everything with 'have you got something to add?', 'cause I always had something to add"*

Out of a total of 922 participant responses, 151 are photos. Photos were included more frequently in responses when they were explicitly prompted than when they were not.

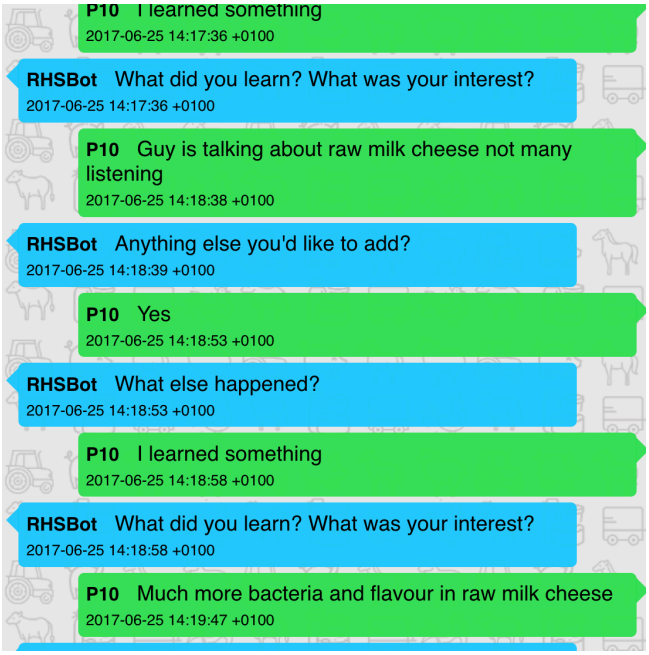

Figure 2: Chat log excerpt: the Ethnobot's prompting encourages participants to build on their responses

A total of 133 photos, or an average of 10 per participant, were provided after the request, "Take a photo and/or tell me about it". In contrast a total of 18, or an average of one or two per participant, were added to requests which did not explicitly ask for photos, for example, "What did you try? How was it?", see Figure 3.

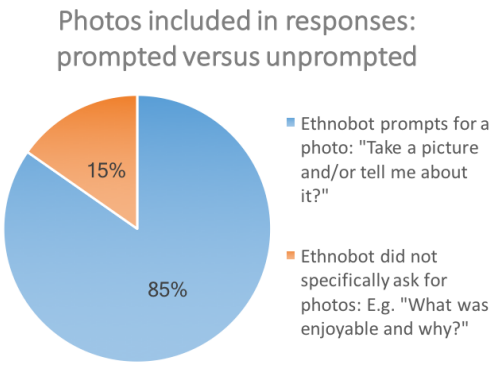

Figure 3: Chart showing percentages of photo taking after requests

It is clear that prompting for more information was an important aspect of the Ethnobot as it invited the participant to expand on their entries. **P9** commented *"because it would say 'have you got something to add?' or 'do you want to send a picture?', 'do you want to say anything?', and then that would prompt you to, to take another action"*

Use of the experience buttons

Of the 435 pre-set responses selected by participants during the trial, 70 were the experience buttons. Figure 4 shows the percentage breakdown of each type used.

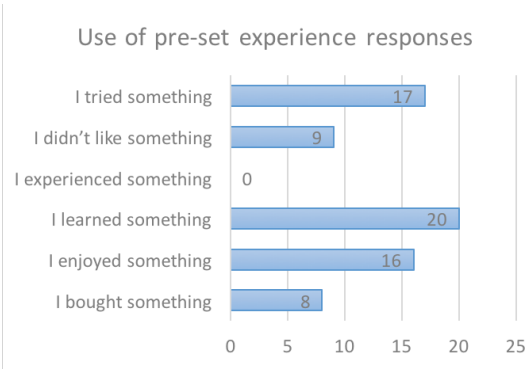

Figure 4: Chart showing percentages of the difference pre-set experience responses

I learned something was most popular and was used a total of 20 times. I experienced something was not used at all**.** Three of the participants did not use the experience buttons, because they only appeared in the chat dialogue when a participant arrived at a place the Ethnobot had directed them to, and clicked I'm here and these participants did not do this. Of the ten participants who did try them eight described them as too restrictive saying that they wanted to input their own answer, with only two saying that they thought they were useful and relevant to what was happening. Several participants described how none of the buttons described their activity or response to what was going on. For example, **P11** said *"I think if there had been a more open response to that as well, because at some point I was just observing things, it wasn't whether I liked or disliked something, I just wanted to make an observation"*. However, the issue is not necessarily with having the buttons, just the answers they represented, that did not seem appropriate. **P12** said, *"maybe there should have been more options, in terms of your reaction to the different parts of the show"***.**

Of a total of 19 purchases reported in the chat logs, 8 were reported using I bought something. However, 9 purchases were reported outside of the specific areas participants were guided to, and therefore the pre-set experiences responses were not available. Only 2 purchases were reported within the pre-set areas without using I bought something. Instead these participants used I tried something. In these cases, the emphasis for the participants seemed to be on the novelty of the experience rather than the purchase. The addition of the pre-set experience responses enabled the Ethnobot to tailor its subsequent questions to the specific experience the participant had reported, and although the majority of participants found these pre-set options restrictive, we can see from the chat logs that they did prompt participants to describe what they found interesting about a product or experience, as shown in Figure 2.

Directing participants

The Ethnobot was programmed to direct each participant to the same three places within the show. Once a participant arrived they could respond with I'm here or, if they had found something else of interest first, they could click I got distracted. If a participant was distracted the Ethnobot invited them to describe their current location and explain their interests and activities there. When they had finished, the Ethnobot would again ask them to visit one of the programmed places.

The experience of being directed to a particular area by the Ethnobot was problematic for the participants for a number of reasons. Three participants responded with a comment to the Ethnobot, for example **P1** said *"No I don't want to go there, after all I don't know what it is about"*. When asked in the interview how they felt about being directed to a particular location, four participants said they were happy with it, and felt it acted like guidance and took them to new places. These participants also seemed happy to use I got distracted, and as a result did not feel constrained by the directions. **P7** said *"I didn't feel obliged to go where I was told, you know, it, it, it was only ever an option"*. However, eight participants identified problems. Firstly, the Ethnobot did not take into account the current location of the participant when issuing the request, and so the place it

asked them to visit would not always be conveniently located. Secondly, participants were not always interested in visiting these areas, and they felt the Ethnobot should ask them if they would like to visit, and take into account their current activities and interests, instead of telling them to go there. **P13** described this experience: *"I felt that the directions were a bit random. I thought it would be more useful if it asked me up front what I was interested in and then sent me to those areas [ ] sometimes it wasn't relevant to my preferences, because it hadn't checked those out first"*. Thirdly, they felt the Ethnobot should give them a reason for going, to motivate them, for example **P2** said, *"I wouldn't mind to go, but I think it's important to know why – why do you want me to go there? What is there, what is happening there?"*. Finally, the Ethnobot offered no directions, which was problematic as some participants found the show difficult to navigate. Being lost was an issue which exacerbated the problems of being directed to a location. Four participants reported to the Ethnobot that they were lost, and three of them reported in the interview that they had difficulty navigating the show in general.

However, participants reported arriving at the specified areas a total of 27 times using I'm here, which triggered the Ethnobot's questions for the area. Since the Ethnobot asked each participant to go to three different places during the trial, on average participants successfully arrived in specified places two out of three times.

Moreover, for a number of participants the use of I got distracted ameliorated irritation arising from being directed to a particular place, and I got distracted was used a total of 55 times, or an average of just over 4 times per person. Some participants discovered this function as a way of liberating themselves from the directions of the Ethnobot and this resulted in them feeling more comfortable with the experience. **P11**, who used I got distracted a total of seven times, described the experience of being directed: *"I was actually quite happy with that. At times I did go off track, but there was obviously options for that, I got distracted, um, and so I got distracted, went around a bit, didn't feel like I was being constrained, but at the same time I felt that I was being guided"*.

Participants in groups and pairs used this response an average of nearly five times, and individuals used it an average of around three times. This was because groups would follow the directions of the Ethnobot on one participant's phone which meant that the other participant's Ethnobot directions were ignored. For some participants, this was a frustration and they tried to visit places multiple times in order to follow the Ethnobot directions for all members of the group. However, some participants coped well with this and were happy to use I got distracted to record activities and experiences that were happening while they were in an area that another participant in their group had been directed to.

Data captured and data missed

From an initial qualitative analysis of the chat logs and the interview responses we can see that the Ethnobot gathers information that is focused on the specifics of what it happening in the moment, with participants often using the present tense and describing things as they are happening. This information is organised into a narrative form with comments stamped with both the time and the location of the participant.

The majority of the free text responses are succinct, often consisting of a few words or a short sentence, though there are numerous examples where a participant will write a more extended response.

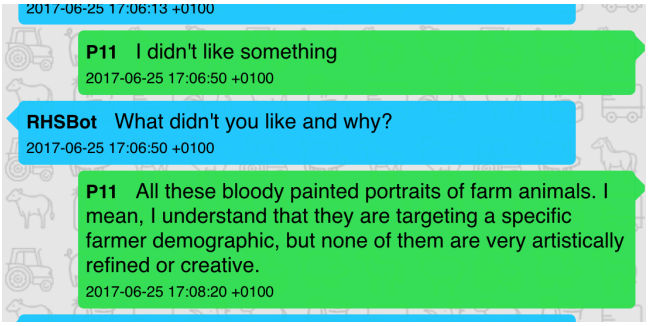

Figure 5: Chat log excerpt, showing an example of a longer comment

Comments provide feedback on a diverse range of topics from triggered memories to political opinions. All participants included information on what they bought and what they tried. Most often comments included factual information, for example, names of stalls and products. This is important as participants sometimes capture information in the chat log that they later forget. For example, **P6** recorded the name of a business from whom she had bought delicious curly fries, but had forgotten the name of this business in the interview later. Participants also included brief descriptions of their activities or surroundings, what was happening, and whether an area was busy or not. The inclusion of photos adds significantly to the value of these.

Photos enabled the participants to show us exactly what it was they were talking about, without having to provide much description. Participants never included a photo by itself; they were always accompanied by a comment, often but not always a caption for the photo. These are helpful in understanding what is important or relevant within the photo.

Factual descriptions are often combined with or followed up by opinions, in particular whenever something is liked or disliked, if the participant wants or needs something, products they would like to buy but resist, items they covet but could never own, and new experiences that prompt questions and thoughts. Examples of these can be seen in Figures 2 and 6.

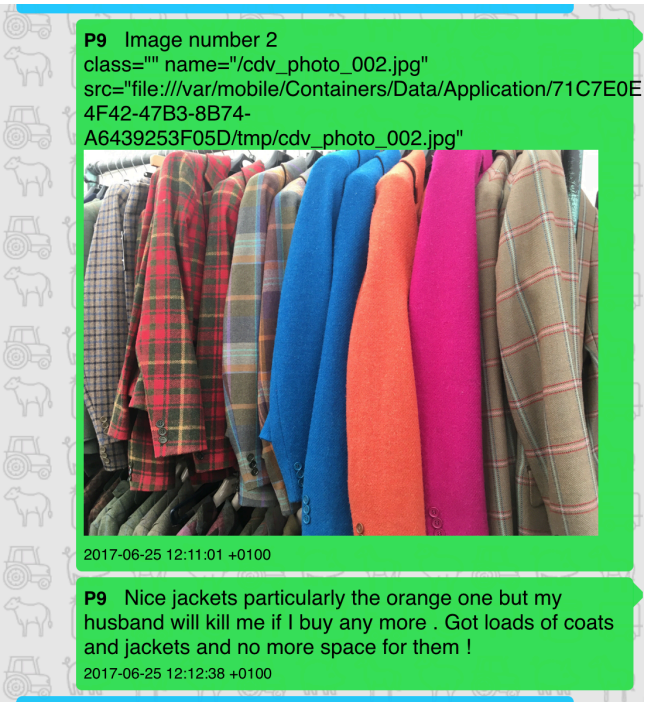

Figure 6: Chat log excerpt, showing how captions tell us what is important in a photo

When participants were asked if they had recorded all of their experiences in the conversation with the Ethnobot, eight out of thirteen said they had. In some cases, participants described how omissions were made because of the inflexibility of the Ethnobot's questioning as described earlier. However, sometimes the exclusion of certain information was deliberate, for example in response to whether he omitted anything from the conversation **P2** said *"yeah, I met a girl… [ ] I had a conversation with her earlier"*. Some participants described how although they included notable moments, they were not able to record everything. **P8** described her record as *"what I was offering it was whether things had stuck out for me in some way, rather than just kind of, I don't know, the mundane experience of walking around the Highland Show"* **P3** described this as *"it's kind of, I put in all the marker moments. But it's kind of, this kind of thing is a constant experience, so, you know, every face I noticed, or every animal I noticed, or every book"*.

The chat logs also show us the unfolding of the participants' perceptions and thoughts as they move through the space. This narrative is useful in understanding the organisation of a participant's experience, and can demonstrate how one activity may produce or have a knock-on effect on another. For example, impatience at a particular stall may arise as result of needing to eat but there not being any desirable food in the area. Furthermore, a comparison of the chat logs of participants experiencing the show together reveal interesting comparisons between their simultaneous experiences, for example while **P12** and **P13** are enjoying shopping **P11** is tolerating it but wanting to have a beer.

Comparing data capture of Ethnobot and researcher

When we compare the interviews with the chat logs, we can see that there are some types of information provided by participants in the interview that rarely feature in the chat log. These tend to be overview feelings about the events, for example **P9** reports in the interview *"I've seen a big improvement in the craft stalls from years ago"*.

What is even more notable is that participants provide more detailed information relating to their backgrounds or deeper emotions in the interview. For example, **P1** described her experience of the Royal Highland Show: *"I would say 'homesick' [ ] Because this is, um, very much similar to an exhibition that we have in my hometown"*. Similarly, **P2** described his experience: *"I saw these machines, these big tractors and trucks, and, uh, I see them at home but this is like, so big here, and also I saw this, uh, environment with farmers and, you know, because it's my first time in, uh, this kind of event in another country, so I'm from, uh, from Mexico, where this kind of farmer event is not like this"* **P3** described the smells of the show and **P8** also described the smells and how these evoked a sense of nostalgia and a feeling of getting back in touch with the farming community.

Sometimes responses to the researcher appear more open about not liking, or not being happy with something. We speculate that this is because there is more space for them to express these sentiments and they feel they are being heard. **P3** and **P8** described how they struggled with the large numbers of people at the show, **P3** said how she was *"a bit overcome at the beginning with the crowds and the parking and the, the Lowland – the food tent was absolutely heaving with people"*. Despite a rich record of the activities, including numerous photos and comments on items of interest in the chat log, **P6** provided a different view of her experience in the interview saying, *"I didn't have any money, so I can't really think about buying anything, and I wasn't really that interested in the things that were sold, and I also don't really care about farming stuff"*.

The Ethnobot did ask participants if there was anything else they wished to add at the end of the chat session. However only a couple of participants wrote more than a sentence here, even though all of them were willing to describe more of their experiences to the researcher during the interview that followed.

DISCUSSION

Reflections on the Ethnobot

The results of this study show that the Ethnobot has been successful in capturing a detailed corpus of data valuable to the STiPS project in building understanding of experiences in this context. As others have found [25], a basic chatbot implementation can capture rich and informative data. We

have shown that the simple act of prompting for specific actions, such as photo-taking, will gather a richer data set, with 85% of all the photos in this trial provided when participants were specifically asked for them.

Whilst seeming to go against the usually open-ended nature of ethnographic enquiry because of the tendency to direct participant response, pre-set responses were important to explore because of the practical benefit they offer in speeding up interaction for busy participants, who in this trial were negotiating a hectic event. They were also used as a way to nudge participants to report on particular activities, but the aim was to produce greater depth and breadth of response, with pre-set responses providing a starting point, and open-ended questions asked afterwards. Previous work in other sectors has demonstrated how pre-set answers can improve the user experience [25]. However, in this study the majority of participants described the pre-set responses as restrictive. In the case of interactions such as buying, trying or learning something these responses appeared to work better, but many of the activities that participants discussed with the Ethnobot in this study were more open ended in nature, and the I experienced something button did not help with this (see Figure 4).

Some participants also experienced frustration with the Ethnobot's directions, but despite the irritation, this none-the-less provided feedback from all participants on specific areas of the show, enabling useful comparisons. Moreover, the I got distracted response provided a way for participants to explore other areas, and the following free-text responses enabled them to report on activities at these places, which alleviated the irritation.

There is an inevitable tension between directing participants to places and allowing them to wander at will, between asking for specific information and inviting them to report on whatever is important to them. The direction caused some participants to have a negative experience, and this is likely to become increasingly problematic in trials with more participants, where incentives to participate may be smaller and this may affect engagement. However, this trial has also revealed numerous possibilities for improvement to features, which could help to rectify this.

The results show that participants anthropomorphise the Ethnobot. This appears to have benefits, inspiring playful responses, and the sense of talking to someone encouraged participants to reveal personal insights and memories, as previous work has also found [20, 48]. However, as others have previous discussed [33, 49] this anthropomorphisation also raises expectations of a chatbot to respond like a real person, and when it does not this leads to disappointment and frustration. If a chatbot has directed a participant to visit a place, and the participant gets lost, it seems natural that the chatbot should offer assistance, which the Ethnobot could not. In this trial, the Ethnobot did not provide a motivation for participants to visit the place it was directing them to. Furthermore, although the Ethnobot did record the participants' location data during the trial it did not take their current location into account when directing them to a place. Rectifying these shortcomings so the Ethnobot motivates participants to go to a place, and directs them to locations when they are near, is an obvious next step. The Ethnobot could offer assistance and guidance when participants report they are lost, and offer greater flexibility by recognising when participants are reporting arrival at a place it has directed them to, but have done so out of sequence.

We are interested in the potential for chatbots to capture data from groups of participants simultaneously. In this trial one researcher was able to set in motion three or four participants simultaneously. The Ethnobot gathered 26 hours of data from participants in just two days. We were also able to trace activities of individual group members and compare them with others in the same group. This would have been difficult to for a human ethnographer alone to achieve.

We have also seen how the data captured by the Ethnobot is different in nature to that captured by the post-trial interview. The Ethnobot is constantly present with the participants, and they report in-the-moment facts and activities including detailed thoughts and opinions. Despite the fact that post-trial interviews took place outside and standing up, when participants were tired, they appeared to talk more openly about feelings to the researcher. This may be in part because participants are more reflective once they are not immersed in immediate activities. It is also possible that participants were tired of typing, and as previous work suggests [38], talking is sometimes easier. However, the Ethnobot does not have the ability to ask tailored follow up questions as the human ethnographer does, and although the researcher did not probe extensively, subtle shifts in wording of questions, and simple prompting at the right time, is likely to have encouraged participants to reveal more. It is clear that at this stage anthropomorphisation only goes so far, and this points towards the benefits of combining the use of chatbots with researcher interviews.

A tool for IoT ethnographers

When a chatbot is used as a tool for ethnographic practices an ethnographer will be best placed to design the questions and structure, and will be required to analyse and interpret the data. It is evident that the data captured by the Ethnobot cannot replicate the quality of data captured by traditional ethnographic methods. Both interviews and observations performed by an ethnographer, witnessing activities and behaviours that a participant might not themselves be aware from an analytic stance, will always remain an essential research activity in HCI, and their value has been shown in many studies and projects [5, 21, 24, 40, 42]. However, we imagine that the Ethnobot might be deployed alongside other ethnographic methods, and contribute to a "thick" data set, in the same way that ethnographic notes, diaries

and collected artefacts may form part of traditional ethnographic studies, and digital data sets from, for example sensors, may form part of ethnographic enquires in IoT. The Ethnobot could also link into other data collected by devices or apps where appropriate, a feature that others have implemented with chatbots on phones [13]. In this way, the Ethnobot could be integrated with other large-scale IoT data gathering methods providing subjective meaning to large and otherwise objective data sets.

Use of the Ethnobot is similar to Experience Sampling Method, in that participants record their own data when prompted. However, the chat logs have an immediacy arising from lightweight, rapid interactions between the Ethnobot and participants, where the Ethnobot's continual nudging encourages participants to provide a little more and report what just happened. As the theories of Suchman and Dourish explicate [11, 44], capturing the in-the-moment activity and thinking is vital to understanding experiences, as things change so rapidly depending on unfolding circumstances. The Ethnobot is effective in capturing ephemeral facts and thoughts, that were lost by the post-trial interview. Previous work has demonstrated the inaccuracies in reporting post-event [16], and this is clearly the case in the comparison between the chat logs and the post-trial interviews, as is demonstrated in the example of **P6** and the curly fries.

LIMITATIONS OF THE WORK & FUTURE DIRECTIONS

An aim of this study was to begin to develop a tool that can capture data from large numbers of participants moving through public spaces simultaneously. This trial involved a limited number of participants. However, results indicate that it should be possible to scale up participant numbers, potentially enabling data capture from crowds.

In this study, participants were recruited in advance and incentivised with free tickets to the show. Recruiting from the public on an ad hoc basis would be a naturalistic approach. In this case the Ethnobot would need to provide a more fluid and engaging experience, and it is anticipated that iterations should provide this by building on the insights from this study.

The previous ethnographic work in STiPS suggests that the chat logs may be of value to participants. However, this has not yet been explored. It is possible that providing participants with their chat logs as a record of their experience, or enabling them to share the logs with external friends and family, may increase participant engagement.

The Ethnobot was designed for individual use. In practice, some participants wanted to experience the show in groups, and this has provided valuable insights. It would be beneficial to explore group syncing to address problems with directions for groups, so the Ethnobot could recognise when participants are together and provide directions to all group members at the same time, taking into account their activities as a whole.

Finally, because the Ethnobot requires participants to visually focus on their phone and type messages it may be inappropriate for some activities. For example, where participants are riding a bike or driving a car, it would be dangerous. To address this, we plan to experiment with an audio version providing a hands-free, speech interface.

CONCLUSIONS AND RECOMMENDATIONS FOR CHATBOT DESIGN

The IoT has increased the number of activities that are digitally mediated. In this new and complex landscape where many lateral connections between users and devices occur, understanding the simultaneous activities of large numbers of people has become increasingly important. This is essential to both understanding the existing terrain into which new technologies will be deployed, and for testing out complex prototype IoT systems.

This study has demonstrated that a simply implemented chatbot can provide useful data to begin to map out detailed events and actions in a new context. Despite the small number of participants in this study, the simultaneous gathering of data from three or four participants by one ethnographer points to the possibility of scaling up participant numbers, ultimately enabling data capture from crowds.

Creating a chatbot that is more sophisticated and responsive is not just a case of implementing natural language programming, but will also require careful design. Ethnographers will be best placed to consider the design of questions and general functionality of the chatbot, with a view to the capturing the specific data they wish to gather and how other study methods may complement this. When considering the deployment of chatbot for ethnographic data collection we recommend attention to the following:

1) A chatbot should be sophisticated enough to have sensitivity to the participants' current situation and activities, so that it can act as a guide or an assistant in the areas that it is exploring
2) Prompting subjects will achieve the best results
3) Flexibility is necessary so that the subjects always have the option to input free-text and report on activities of their choosing

Whilst chatbots will not be a replacement for human ethnographers, it is clear that the role of the Ethnobot as a remote and ever-present ethnographic tool has a wide-reaching value for HCI research.

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