

Collecting and Sharing Location-based Content on Mobile Phones in a Zoo Visitor Experience

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Abstract. The augmentation of visitor experiences with location-based technologies has been available for some time. Through in-depth studies of users during these experiences the field is building a rich picture of user behaviour in relation to certain location-based technologies. However, little work has explored the use of mobile camera phones and 2D barcodes on situated signs and their properties as a way of delivering such augmented visitor experiences. In this paper we present a study of people engaged in such a location-based experience at London zoo in which they use mobile camera phones to read 2D barcodes on signs at the animal enclosures in order to access related content. Through the fieldwork we highlight the social and collaborative aspects of the experience and how particular characteristics of the mobile phone and barcode technology shape these behaviours. The paper also highlights some of the non-instrumental aspects of the location-based experience, in particular in relation to the importance of *collecting* location-based content. We explore the social aspects of collecting as well as certain competitive elements it introduces into people's behaviour. This creates an interesting tension in that aspects of the application encourage cooperation and sharing among the visitors whereas others encourage competition. In the course of presenting the fieldwork, we explore this tension further.

Key words: 2D barcodes, collecting, location-based computing, mobile phones, situated displays, visitor experience, zoo

1. Introduction

For several years now, visitor attractions, heritage sites and tourists trails have received considerable attention from researchers in the Ubiquitous Computing field. A key focus of this interest has been the exploration of context and location-sensitive computing, whereby content on a device is triggered by presence in a particular place or proximity to a particular object. Notable exemplars of these technologies in the context of visitor experiences include Cheverst et al.'s (Cheverst et al., 2000a, 2000b) GUIDE, a mobile tourist guide, Abowd et al.'s Cyberguide (Abowd et al., 1997), and the deployment of Cooltown technology in the SF Exploratorium (Fleck et al.,

2002). Considerable pull for this kind of work has also come from museums, heritage sites and tourist boards themselves who wish to create more interactive and engaging exhibits and learning experiences for those visiting the attractions.

These and related systems highlight a number of intriguing possibilities for how people might engage with objects and places of interest, but their impact on visitor experiences is still not fully understood. While there has been considerable behavioural analysis and evaluation in this area, with dedicated journals of museum and tourist studies and evaluations of particular systems, much of this has been criticised by the likes of Heath et al. and Brown et al. for focusing too much on the individual rather than the social and for being high level in their analytic approach (Brown and Chalmers, 2003; Heath and vom Lehn, 2004). What is often lacking in much of the existing behavioural work is a detailed look at the activity that happens at these places, both alone and with others, and how these come to be shaped by the particular characteristics of the technologies and artefacts involved. It is this kind of detailed behavioural analysis that is informative to design. There are of course some notable exceptions to this critique. For example, the studies of Sotto Voce by Woodruff and colleagues have detailed the ways a PDA based guide in an historic house became integrated into social and conversational aspects of visitor experiences (Woodruff et al., 2001; Aoki et al., 2002; Grinter et al., 2002). Vom Lehn and his colleagues in their studies of museum experiences have also documented the minutiae of the visitor experience around museum and gallery exhibits and the particular role that technologies such as PDAs have in shaping interaction with the exhibits and with co-visitors (Heath and vom Lehn, 2004; Vom Lehn and Heath, 2005).

These kinds of studies have highlighted the importance of looking in detail at the behaviours of visitors involved in location-based experiences and how these are shaped by the affordances of the particular location-based technologies used. Yet these studies are but the start of our understanding in this area. Many different technologies are available for sensing proximity and location (e.g. GPS, RFID, Bluetooth beacons, 2D Barcodes)¹, and for consuming the content (e.g. PDAs, Tablet PCs, mobile phones, media players). While some of these technologies have common affordances, they also have some very distinctive properties in terms of their interactive possibilities with location, content and other people. Consequently, the kind of in-depth analysis adopted by these previous studies needs to be applied systematically across a broader range of location-based technologies and visitor experiences. With this in mind, the current paper presents some fieldwork that explores "Collect", a location-based visitor experience at London Zoo. In this particular experience, location-based content is collected and triggered using mobile camera phones to read 2D barcodes on signs located at particular animal enclosures around the zoo.

Surprisingly, in spite of their ubiquity, mobile phones have received relatively little analytic attention from the social sciences in terms of their use in location-based visitor experiences. Some commercial text-based applications have been deployed but have not been subject to close sociological and design enquiry. With mobile phones being carried by people all the time, it is likely to be one of the dominant devices for experiencing location-based experiences in forthcoming years. As such, an understanding of their properties for this type of experience is key. In particular, with visitor experiences being typically undertaken as part of a group, there is especial interest in understanding how the mobile phone – which is designed primarily for personal use – comes to be utilised within the social context of a visitor experience. A pertinent example here is the small screen size of the mobile phone. Some authors have argued PDA screens may be too small for an effective collaborative visitor experience (Brown and Chalmers, 2003). Phone screens, being smaller, should presumably fare worse according to these arguments. While there is some intuitive appeal to these arguments, they remain unsubstantiated empirically. Indeed other evidence suggests that local collaboration around PDA and smaller phone screens does take place under particular circumstances when the value is high enough (e.g. Cole and Stanton, 2003; O'Hara et al., 2004; Kindberg et al., 2005). Consequently it is an open question as to how the mobile phone comes to be used to support social and collaborative aspects of the visitor experience. This and other characteristics particular to the mobile phone are key concerns for the fieldwork presented in this paper.

Similarly, arguments can be made here regarding the use of 2D barcodes on situated signage. While these technologies are becoming well understood from the computer science and image processing perspectives, their social, behavioural and interactional properties are yet to be well elucidated. Despite widespread adoption in Japan for several years now, and some small scale and interesting trial deployments elsewhere, behavioural research of this technology has been limited to usability or scenario based evaluations (Toye et al., 2004). These studies play some role in our understanding of this technology but do not really address how the particular characteristics of the technology (relative to other location-based technologies) shape the ways social actions are managed in visitor experiences in real life public settings. Through the fieldwork presented in this paper, we aim to explore further affordances of 2D barcoded signs in relation to collaborative visitor experiences at the zoo.

Understanding the zoo experience from a social science perspective has received a certain amount of attention in the social science literature, most notably by authors such as Bitgood and colleagues (e.g. Bitgood et al., 1986, 1988; DeVault, 2000; Lindahl-Elliott, 2005). Bitgood's work has focused on understanding the functional relationship between characteristics of the

exhibits and visitor behaviour. The work highlights three key categories of variables which influence visitor behaviour at zoo exhibits in terms of time spent at each exhibit. These are: (1) animal characteristics such as size, novelty, activity and interactivity of the animal; (2) architectural characteristics such as visibility of the animal, physical features of the exhibit and proximity of animal to the visitor; (3) visitor characteristics such as age, gender and physical fatigue. While such work provides some insights into zoo exhibit design it provides rather a dry characterisation of the zoo visit and has a narrow focus on individual behaviour.

A much rich characterisation of the zoo visit can be gleaned from the work of DeVault who adopts an ethnomethodological approach in her studies of family visits to the zoo. Her work looks at how family is something that is actively constructed in settings beyond the home through activities such as the family outing to the zoo. In her work, family is a “*discursively organized practice; a mode of action rather than a state of being.*” (DeVault, 2000, p. 499). The research highlights the work done by parents in coordinating viewing behaviour of the family at exhibits and in teaching children the things which are deserving of attention as opposed to those things which are just there but not important. In this regard she discusses the role textual materials such as signs at the exhibits come to play in this goal. Another part of the research shows how many of the behaviours of the family are a performance in a public setting. It is not just that one is showing children things and highlight what to look at. It's also about demonstrating to others around that they are doing this properly. Much of the work done, then, is about making these behaviours visible to others. Finally, she describes the work done in coordinating the movement of the family around the different exhibits, characterising this as amoeba-like collective movement in which parents move directly and slowly from one place to the other while children buzz round them like little satellites – sometimes racing ahead and sometimes lagging behind. This idea becomes important in our later discussions of how groups were using the Collect technology.

Many zoos now are having to redefine the way they present themselves to their visitors in light of increased environmental awareness and an ever-changing media landscape affecting the ways animals get presented (e.g. the emergence of natural history documentaries on TV). Government legislation too is impacting the way zoos present themselves to visitors with a requirement for zoos to provide, through their exhibits, education and awareness about the conservation of biodiversity, about the species kept in the zoo and about their natural habitats (DEFRA, 2003: 30 cited in Lindahl-Elliott, 2005). Again, such changes to zoos have not been accompanied by much behavioural research into the impact of these redefined visitor experiences and behaviour (Dierking et al., 2002: 1). Exceptions here include some recent work by Lindahl-Elliott (2005) who has conducted extensive ethnographic

research at various zoos to look at the impact of exhibits and scientific communication practices on family visitor behaviour and their interaction with the exhibits and each other. He highlights the preference for “*iconic-environmental naturalism*”, where animal enclosures resemble natural habitats. In relation to this he discusses how television and the media have played a role in understanding this naturalism with natural history documentaries providing many families with a “base-line” naturalism against which to measure various aspects of the displays. Several children in his studies commented how some of the displays were “*missing the kinds of events they’d seen on television*”. Furthermore, the moving images of animals on television were argued to motivate children’s questions about the reality of zoo animals in situations when they failed to move whilst being observed. We discuss related issues later with respect to the use of location based content on the mobile devices in the trial.

With regards to the impact of mobile technologies on shaping zoo experiences, we know of only Bellotti et al.’s user research of a PDA-based hypermedia tour guide at Genoa Aquarium (Bellotti et al., 2002). Much of their insights focused on the individual aspects of the visitor experience with the PDA guide. In our look at the “Collect” experience we take a closer look at the social and collaborative aspects of these experiences.

A particular feature of note in the application discussed in this paper is the notion of collecting. In our application, the aim is not simply about the triggering of content at the relevant location. Rather content items are gathered at the relevant location to be consumed either there and then or to be kept. Some similar functionality was seen in the Rememberer system at San Francisco Exploratorium (Fleck et al., 2002) where web pages based on the exhibits visited were constructed in support of the post visit experience. But such work was not really explored in any great detail from the sociological perspective of collecting. As well as supporting these remembering aspects of the post visit experience, the Collect application is designed around the construction of a collection. While some location-based games have explored collecting objects as a game mechanic, collecting as an end in itself has not been significantly explored from a sociological and behavioural perspective in location-based computing. There are subtly different behaviours and social values at play here which we explore in our fieldwork. In particular, we discuss: the social meaning of content ownership; the narratives told around the content; the role of the collection in identity work and defining group membership; and some of the competitive behaviours that become manifest. We discuss interesting tensions between aspects of the application that encourage cooperation and sharing among the visitors and those aspects that encourage competition.

We turn first to a description of the technology deployed at London Zoo and then present the findings from the fieldwork. Following this we discuss

the implications of the findings for the design of location-based services and experiences.

2. The Collect system

2.1. THE ZOO

The system was deployed at London Zoo which is situated at the north end of Regents Park, London. The zoo was originally opened in 1828 as the World's first scientific zoo built to house a collection of animals for the purpose of scientific study. It has been open to the public since 1847 and today has a collection of over 650 animal species. The zoo is set over an area of 36 acres and receives over 800,000 visitors each year, with 90,000 of these being part of organised school visits. The zoo is currently undergoing a large redevelopment with a number of animal enclosures being redesigned to create a more "natural" habitat for the animals to live and to allow the public to experience them in more natural circumstances. There is also an ongoing redevelopment of the visitor experience in terms of purpose built trails, information displays and interactive exhibits. The aim is to facilitate learning about the animals and conservation programmes undertaken by the zoo.

2.2. THE SIGNS

Collect signs (plus one demonstration sign) were distributed at thirteen animal enclosures around the zoo, including lions, tigers, penguins, gorillas, monkeys, giraffes, camels, Komodo dragons, macaws, anteaters, meerkats, oryx and jelly fish. The signs were approximately 20×30 cm (see Figure 1 for an example).

Each sign had an enticing caption and a data matrix code (approx. 7×7 cm) which encoded the file locations for the relevant media files.

The signs were situated at the viewing points of the enclosures (see Figure 2). For larger enclosures with several view points, multiple signs were placed to accommodate people coming from alternative directions.

2.3. THE APPLICATION

The Collect application on the mobile phone was designed to let users retrieve content from barcodes on signs and to review that collected content as they toured the zoo. In Figure 3 we can see the interface for the application.

On launching the application, the user sees a screen (Figure 3, top row, 2nd screenshot) with the options of either launching the code reader to add to the collection or reviewing what has been collected so far. If they choose the "Capture Barcode" option, the code reader is launched (this is HP's Glass



Figure 1. A Collect sign.



Figure 2. The Collect sign at the viewing point of the Penguin enclosure.

application, based on Gavitec’s Lavasphere software) as shown in Figure 3, top row, 3rd screen shot. Holding the phone’s camera closely to a barcode with the application running ‘collects’ the content it references. As the code is read the screen says ‘Click to capture’ (see Figure 3, top row, 3rd screenshot).



Figure 3. Screen Shots from the Collect mobile application.

Clicking at this point extracts the ‘file’ URIs from the codes and adds the corresponding preloaded content files (audio video and text) to the user’s collection.

Users could also choose to review their collection from the application launch screen. On opening up the Collection, the user sees the list of animals collected (see Figure 3, bottom row, 2nd screenshot). Clicking on an animal shows the content files for that particular animal (see Figure 3 bottom row, 3rd screenshot).

2.4. THE COLLECT WEB PAGES

Upon registering to use Collect, a user has their own personalised Collect web page created. An individual’s web page is constructed from the content items they collect on the way round the zoo. The content on a particular web page replicates what is in the collection on a user’s phone. The design draws on the look and feel of the phone based application but scaled and optimised for viewing through a PC-based web browser. A person’s page was available immediately after their zoo visit and could be accessed for a couple of weeks subsequent to the visit.

3. The trial

3.1. PARTICIPANTS

The primary participants in the trial were 80 children aged between 9 and 12 years of age (mean of 10.7 years). Of these 80 children, 47 were female and

33 male. Thirty-three of the participants came to the zoo as part of an organised school trip, having been explicitly invited by the research team to take part in the trial. The remaining 47 participants were child members of the public who were visiting the zoo at the weekend or during half term. In addition to the children participating in the trial there were a total of 62 accompanying adults. Thirteen of these were part of the school trips, made up of teachers, learning support assistants and parents. The remaining 49 accompanying adults were part of the family visits. Fifty of the children owned their own mobile phone and used it regularly on a daily or weekly basis primarily for talking texting to friends, playing games and taking photos. Other functions such as listening to music, watching video and surfing the Internet were much less frequently used. Seventy-four of the children owned or had access to a computer on a regular daily or weekly basis. These were used primarily for playing games, emailing, surfing the internet and instant messaging. Other functions such as listening to music, watching videos and viewing photographs were also done but to a lesser degree.

3.2. METHOD

Participants were asked to register at the Collect tent where they were given one of the trial phones.² The registration was used to gather various data about each participant, such as age, mobile phone and technology experiences, who they were with and prior visits to the zoo. A member of the research team would talk the participant through the technology and give them a demonstration. Participants would try out and practice code reading on a demo sign. The research team member would answer any questions and resolve any difficulties the participants had at this point. It was then explained to the participants that all the Collect content gathered on their trip around the zoo would be subsequently available on their own personal Collect website. This website would be available for a limited period after the zoo visit. Participants were also given a Collect leaflet to carry round with them. This contained a map of the zoo indicating all the animal enclosures where they would find a Collect sign.

Observations were carried out by the research team as participants went about exploring the zoo. Some of these involved posting a researcher at particular points around the zoo, while other researchers would shadow particular groups around the zoo. In some cases, the shadowing was done discreetly at a distance from the group. At other times, with the permission of the participants, a much more engaged shadowing approach was used. This allowed motivations underlying observed episodes to be unpacked in more detail by the researcher through the use of *in situ* interviewing immediately following the episode. Video recordings were made where possible, providing

the basis for more in-depth analysis of certain interactional episodes. The observations were focused on the interaction and social behaviour that took place around the key information artefacts such as the mobile phones, the Collect signs, the Collect leaflet and other general signage/exhibits at the animal enclosures. They also looked more broadly at how the participants interacted with the animals and enclosures as well as the movement around the zoo between the different enclosures.

When participants completed their visit and returned their trial phones, a follow up interview was conducted with children and adults being interviewed separately. The interviews consisted of a core standard set of questions. A number of these questions had constrained responses such as rating particular aspects of the experience (for the purposes of quantitative analysis). Others required a more open ended response that allowed richer details of the experience to be explored. Once they had completed the interview, participants were given a Collect "Goody Bag" as thanks for their participation in the trial.

Following the visit to the zoo, all participants were sent an email prompting them to access their Collect website. They were informed that the web site would be available for seven days. An online questionnaire was delivered to the participants one week after their zoo visit which asked questions about the post visit aspects of the experience and their use of the web site. As well as the questionnaire, face-to-face interviews were conducted with a select number of participants from the two invited school groups. The purpose of these interviews was to gather a richer picture about participants' post-zoo aspects of the Collect experience such as the motivations and contextual circumstances surrounding their interactions with their Collect Web site.

4. Findings

In the following sections, we take a closer look at the details of the zoo visit and the role the Collect technology played in shaping that experience. In particular we focus on the ways that the social context and collective experience of the zoo visit impacted on and was impacted by the key affordances of the technology. We begin first with a look at the 2D barcode reading experience. Our concerns here are not straightforward ones of usability. Rather they relate to how characteristics of this particular location-based trigger technology impacted on the collective experience at the exhibit and how families and groups came to coordinate their behaviour around these Collect points. This involved both within group coordination and coordination with other members of the public at particular exhibits.

Following on from this, we look at engagement with the Collect content itself. The focus of the discussion here is the decoupling of content gathering

from content consumption. People would not always consume content at the time and location they gathered it. We discuss some of the reasons why they do this, such as coordinating views and coordinating movement with other people in the group. The paper further explores social and collaborative behaviours that take place around content consumption emphasising the importance of content mobility in accomplishing particular social actions and in enacting family, friends and other didactic relationships.

The paper then takes an interesting new look at the important social motivations underlying participants' collecting behaviour and how these were played out during the zoo visit and afterwards. The social motivations for collecting location-based information are contrasted with those for consuming location-based information. The post-zoo experience is then considered before moving on to a discussion of the findings and the implications for location-based technologies.

4.1. READING THE BARCODES

With barcode reading we observed elements of collaboration and competition in participant behaviour. Code reading required the mobile phones to be held close to the code and aligned with a certain amount of care. The first few attempts to read a code by any of the children were typically characterised by slow, careful and continuous adjustments to the phone's position until the code had been read. Unlike adults who showed considerable frustration at these initial difficulties children saw this as a skill to master. After only a few attempts they became much more adept at the code reading allowing a quicker and more fluid interaction with the Collect signs. Children would sometimes offer help to those who were demonstrably struggling, offering suggestions for how to align the phone correctly. Some of this was genuinely altruistic but other aspects were about demonstrating their proficiency with the technology.

Beyond the straightforward usability type issues, an important concern for us here was that reading the 2D barcodes on exhibit signs could only be carried out by one person at a time.³ This had implications for some of the collective experience of the zoo visit. With the larger school parties, in particular, this restriction created practical difficulties that needed to be managed. Our observations of the code reading in the early parts of the school visits revealed it to be a rather chaotic event, with tens of children gathering round single signs⁴ and all competing to hold their camera phones over the codes to read them. The pushing and shoving interfered with the achievement of successful phone alignment to codes themselves making it difficult to read the codes successfully. In response to this, the teachers and accompanying adults had to introduce a sense of order to the proceedings and organised the children into more orderly queues, allowing them to read the codes one at a time. This presented interesting challenges for larger groups of visitors both

in terms of time taken for the entire group to read the codes and in terms of the need for some top down management of the group processes. Indeed, there were occasions, such as at the tiger enclosure, where the teacher had to move the group of children on before all them had chance to read the code, much to their frustration. Part of the pressure to do this was about managing the overall time the children had in the zoo and making sure this was distributed sensibly across a good number of different animal exhibits. Another part concerned the practical management of different activities of children in the group. Some children who had read the codes first would finish consuming content before some of the other children had read the barcodes. Without anything else to do at the enclosure, the children who had finished became distracted, creating a control burden for those supervising. One strategy, which was actually predominant, was to break the group into smaller subgroups that had the freedom to walk round the zoo in any order they chose. This helped alleviate some of the congestion by distributing it across different animal enclosures at any one particular time. With smaller group sizes, the children were better able to coordinate the ordering of their activities among themselves without the intervention from the adults required in the larger group sizes. With the children visitors who were not part of an organised school visit, the issue of congestion was not really a concern. The group sizes which characterised these non-school visits were much smaller family units, which would typically share one phone and at most two, between them.

Reading the 2D barcodes (and thereby the location-based content) was also affected by other members of the public at particular exhibits. With the Collect signs typically placed at key viewing points for the various animal enclosures, other people looking at the animals would sometimes stand in front of them preventing participants from getting up close with their phone to be able to read the barcode.⁵ In most cases this problem was not manifest, with visitor numbers at most of the attractions being low enough for the signs to remain visible. The problem became manifest at the more popular attractions and key times. For example, scheduled feeding time of the animals, such as the penguins, was a particular attraction which would gather larger crowds that would remain there for significant periods of time obscuring the signs. At these times it became impossible to access the signs in order to trigger the content. Standing in front of signs is something that in time would be accommodated where possible. One of the issues here is one of understanding. For those not involved in the trial, they did not have sufficient understanding of the signs to realise the significance of standing in front of them.

4.2. ENGAGEMENT WITH CONTENT

In this section we discuss some of the ways the participants engaged with the content. Table I shows the mean number of Collect points for which the

Table I. The mean number of Collect points for which: codes were read; content was accessed, videos viewed, audio listened to; and text read

	Mean number of Collect points (max = 14)	Std error
Codes read	9.62	0.31
Content accessed	6.18	0.42
Video	5.18	0.38
Audio	2.38	0.26
Text	0.62	0.13

barcode was read, the number of Collect points from which at least some content was accessed, the number of Collect points for which video was viewed, the number of Collect points for which the audio was listened to and the number of Collect points for which the text item was read.

What we can see from Table I is that during the actual zoo visit itself people accessed, on average, just over 6 items of content. Interestingly, this number turns out to be significantly less than the mean number of codes on the Collect signs that participants read during their zoo visit ($F(1, 83) = 78.995, p < 0.001, MSe = 6.293$). What this suggests is that while location-based information was being adopted by the participants, only some of the value was to be found in the consumption of material during the zoo visit itself. There were other social motivations underlying the collecting and keeping of location-based content beyond its consumption in the moment. We discuss some of these later in the paper but first we take a closer look at people's engagement with content during the visit itself.

One thing to notice here is the difference in the number of content items consumed according to the type of media (video vs. audio vs. text). An ANOVA revealed a significant main effect of media type ($F(1, 83) = 170.38, p < 0.001, MSe = 5.125$). Follow up comparisons showed that the mean number of video items viewed on the phone was significantly higher than audio files listened to ($F(1, 83) = 82.733, p < 0.001, MSe = 3.973$). Likewise, the number of video items viewed was significantly higher than the number of text items viewed ($F(1, 83) = 170.38, p < 0.001, MSe = 5.125$). The number of audio items listened to was also significantly higher than the number of text items read ($F(1, 83) = 87.54, p < 0.001, MSe = 1.489$).

Video, then, was much the preferred media type, followed by audio, followed by text. Text-based items on the phone were considered to be "*a bit boring*" which accounts for their low consumption rate by many of the participants. Text was also something which was available more conveniently on other communication artefacts within the zoo such as the other signage at the enclosures or leaflets. With the video and audio content, this was something that they were unable to get at the majority of exhibits in the zoo. An important value of the video and audio content expressed by the

participants was how it allowed them to experience aspects of the animals' behaviour that they would otherwise be unable to during their zoo visit. During a typical brief encounter at the animal enclosures, many of the animals are sedentary so a visitor cannot experience the full range of behaviours that an animal may engage in in the wild over extended periods of time. The video and audio content provided the visitors with an opportunity to experience a broader set of behaviours, for example, by showing the animals moving, feeding, rearing their young, killing prey, or presenting what they sound like. This is illustrated in the following comment:

"It helped me to see all the animals in action so I could see what they would be like in the wild"

In addition, it was sometimes difficult to see certain animals which were hidden away within their enclosures.

"Sometimes it was disappointing if you couldn't get a clear view of an animal. With the video clips you could see the animals clearly and find out lots more information."

Such comments relate back to Lindahl-Elliot's (2005) observations about the role of TV in providing a base-line naturalism against which to compare the animals being observed. In light of this, an important question to ask concerns the importance of having the information delivered in the moment, outside the particular animal enclosures and the extent to which the experiences of seeing real animals was coupled together with the consumption of the context-related digital content. The first point of relevance here is that some of content was being consumed outside the animal enclosures themselves, in the way that one might associate with the traditional "walk-up, pop-up" notion of location-based content delivery. A second important behaviour in respect to the coupling of content to experiences of the real animals was the movement to get a better view of the animals while engaging with the content. A good example of this was seen at the tiger enclosure where the tigers were asleep in a small hut making them difficult to see. What we observed several times was that after reading the barcode, children would move from the Collect sign to a position right next to the hut where they could see the tigers. The consumption of the content would then be triggered; viewing video, for example, would then be interleaved with glances at the tigers sleeping. This interleaving was seen elsewhere in the other enclosures with information in the video being referred back to the real animals and vice versa through the shifts in attention between phone and animals.

Interestingly for some children, the consumption of location-based content from the phone occasionally became dominant in their experience. In these instances, attention was focused more on the phone content rather than on the animals themselves. The responses to this can be related back to

DeVault's (2000) observations about doing what is expected in the zoo – doing the “*right*” kind of viewing and demonstrating this to the other members of the public in proximity. In our observations we saw the work that parents would do to encourage their dependents to perform the right kind of viewing behaviour under such circumstances. They would gently intervene to encourage attention to be given over to the real animals themselves. In their eyes, giving more attention to the real animals rather than the location based content was the “*right*” way to be conducting the visit.

On other occasions the consumption of content was not so closely tied to the location from where it was obtained. We saw examples of varying degrees of coupling between the information and the time and place it was consumed. It was not uncommon, for example, for participants to move away from the viewing areas to some quieter places where they could consume the content without distraction from others. While still within the general vicinity of the animal enclosure and within a few minutes of reading the barcode, these behaviours provide additional evidence for the importance of mobility of the device and control over when the content is triggered. This was further supported by the use of “in between time” to view, listen to or read content – that is, participants looking at or listening to their phones as they were moving between the different animal enclosures. In this respect, there was slightly less coupling between content consumption, location and time.

In thinking about content consumption, an important consideration is how participants were managing the broader experience of visiting the zoo. The content consumption was something that was flexibly fitted in to other aspects of the experience. Binding content to a particular location did not always allow flexibility here. There were all sorts of other social issues and contingencies that needed to be managed. For example, most of the children went round in small subgroups and sometimes members of the subgroups would start to move on towards the next animal enclosure before other members had the chance to engage with particular bits of content. Under these circumstances, a coordination requirement was introduced similar to what was seen in DeVault's (2000) observations of group movement around zoos. The need and pressure to move with the group sometimes made it difficult to engage with content at the time and place where it was “attached”. As one participant noted, “*I didn't read it because we had to go*”. Under such circumstances, one strategy was to consume the gathered content while moving with the rest of the group. There were all sorts of other social contingencies to manage (e.g. when *banter* dies down or when *messing about* stops) so having control over when and where particular items of content were triggered and consumed allowed these contingencies to be managed. A purely location-based triggering of the content would have made some of this social management difficult.

4.3. SOCIAL ASPECTS OF CONTENT CONSUMPTION

We turn now to take a more specific look at the many ways that the phone and the location-based information were used to create a collaborative experience with other members of the visitor group (cf. Cole and Stanton, 2003). We do this by presenting some illustrative examples of these different collaborative experiences from the study. The first of these example concerns the *selective* sharing of content snippets for particular social effect, such as humour. In this example, one of the school girls was watching one of the videos of the animals. As she was watching, she saw something in the video which amused her. In response to this, she moved towards her friend who was standing close by and oriented the phone towards her so that she could view the screen (see Figure 4-1). The friend watched for a second then doubled up with laughter for a few seconds (see Figure 4-2). The friend then grabbed the phone to get a second look (see Figure 4-3). They viewed together for a second and the friend then imitated the animal they had been viewing on the screen (see Figure 4-4). They both laughed and walked off in different directions to join their respective friends (see Figure 4-5).

What we see in this episode is example of the brief encounters around particular snippets of video items where the participants did not watch the whole video clip together, but rather “picked out” key bits which made each other laugh. Both girls each had a phone with the same content on there so this was not a question of sharing out of necessity. Rather the first girl exploited the mobility of the display and timing of the display behaviour to explicitly highlight the source of her amusement in the content – it was a social gesture to share the content with the other girl. The second girl reciprocated this social gesture through her laughing and grabbing the phone for a second glance, indicating her amusement and interest in the content.

In a second example, we see how participants were able to create a shared experience by watching content together but on separate phones. The participants in question were a group of girls at the Komodo dragon enclosure. Having read the code, they moved to sit on a bench together so that they could comfortably watch the video content. They each used their own phones to view the content but they were watching it *approximately* in synch with each other. As they watched they facilitated the synchronisation of the experience by commenting about bits of the video content that the other girls had just seen or were about to just see.

“Oh my God they eat their own babies”,

“That’s gross man; they are ripping up the animals”

“Yuk”

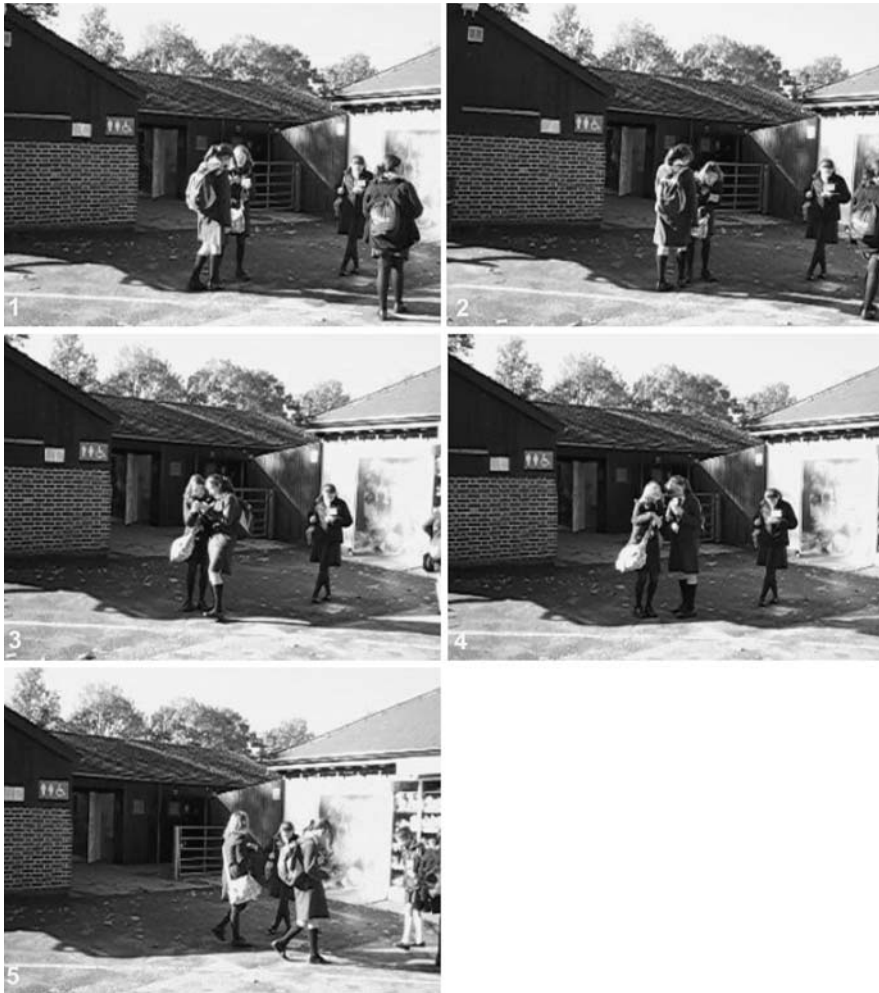


Figure 4. (1–5). Coming together to view video together on a single phone.

The viewing of the videos on the different phones was not precisely synchronised, but nevertheless provided sufficient shared grounding for the girls to have a conversation about the content as it was playing. The utterances helped align the group members to the important aspects of the content and helped them learn about what each other finds disgusting or funny or cute. The shared video viewing in this instance was more complete in that the whole video was watched.

Similar sharing behaviours occurred with the audio content. In one instance, one of the school girls was listening to an audio clip outside the animal enclosure. The phone was held to her own ear and as she listened she began to dance along with the content (Figure 5-2). She then turned and



Figure 5. (1–5). Sharing audio together.

walked up to her friend and held her phone up to her friend's ear so that the friend could hear what was playing on the phone (Figure 5-3). After only a few seconds she put the phone back to her own ear (Figure 5-4) and continued dancing while walking off (Figure 5-5).

A couple of things were going on here. First, the one girl was making her behaviour understandable to her friend who could not initially hear the audio stream the first girl was reacting to. Second, the first girl, through this gesture, indicated that the content was fun and that her friend should check it out on her own phone. Audio content was also shared more openly to a small group. In one example, a school boy turned the speaker volume up on his phone so that he and his friends could listen to the content on the same phone together as a group.

These social behaviours happened both at the enclosures themselves and beyond. Sharing of the collected content happened away from the enclosures too. Part of this was about the shared review of information as a kind of shared revisiting of the experience through the location relevant content that was collected. But some of this too arose out of the fact that groups would occasionally split up into smaller subgroups if their interests diverged at a particular point during the visit. A good example of this was seen with two fathers who were visiting the zoo together with their respective daughters; the older girl belonging to one father and the two younger girls belonging to the other. The group had one phone between them as they went round the zoo so that they could share the Collect experience. However, at one point, the group split up temporarily so that the younger girls and their father could go and see some more birds while the older daughter and her father went to look at some different animals on the way to the Komodo dragon enclosure. While the group was separated, the older girl (who had been put in charge of the phone) collected some content at the Komodo dragon Collect point. When the group came together again the elder girl offered to show the younger girls, much to their excitement, the content that she collected while they were away doing other things. Revisiting the content in this way as group provided a resource for sharing something about the other's experience that they otherwise would have missed.

Similarly a young boy was visiting the zoo with his mother and grandmother. At one point the grandmother decided to rest in the cafe area while the mother and son continued round the zoo to see some more animals. When they met up again later, the mother asked her son to show his Grandmother what he had seen. As they sat on the bench together, he showed her the items he had collected and some of the video content and talked through with her what he had seen (see Figure 6).



Figure 6. Boy showing his Grandma what he has seen and collected on the visit.

Both mother and Grandmother smiled as he recounted the experiences back. The mobile phone played an interesting role in this regard. Most obviously, it was a means of carrying the information round which could therefore be used opportunistically to show information as the social situation determined. It could be taken to the bench where the Grandmother, mother and son could sit together. On a smaller level of granularity of mobility, the boy was able to move the phone towards the Grandma, orienting the screen to her as a signal to her to join in and watch. Control over the initiation of the content by the boy was carefully choreographed with their coordinated readiness. As they watched, the grandmother reached to hold the phone together with the Grandson, helping to steady it for both of them and signaling her continued interest in the content. Once they had finished, she let go of the phone and he retained ownership over it.

Of course similar social value could have been achieved by local sharing of other content such as photos on the mobile phone (cf. Weilenmann and Larsson, 2001; Kindberg et al., 2005). The point here is not that this is something exclusive to location based content. Rather, the point is that location based content comes to acquire additional meaning and significance through these kind of narratives that get told as it is shared with others beyond the actual trigger location.

This example highlights a critical feature of these visitor experiences, namely the adult-child relationship that gets played out through them (cf. DeVault, 2000). In our observations of the visitors, the adults in their supervisory role made efforts to structure the experience for the children, asking questions about the animals, the content they had seen, pointing things out to look at, making suggestions for what to do next, and making sure they were within the bounds of safety. Through their use of the technology we saw a number of noteworthy features that pertained to the adult-child relationship in this experience. First, the adults let the children look after the phone as they went round the zoo. Through this, the child is put at the centre of the experience by the adult and also is helping to understand a valuable meta lesson in taking responsibility for something valuable. Another part of this was a concern on the part of the parents to give the children a certain amount of independence during their zoo visit. We can see this in the following remark:

“The kids hate being force fed with information – it makes them feel like they are at school. This [BBC Collect] gives them more independence. They can read the signs and go ‘look what I have found’. I think it is a great idea”

By making the children responsible for the phone and initiating the interactions with the codes and content, they were given a sense of control which the adults felt encouraged their engagement with the zoo experience. But

there was a delicate balance to be had here; complete independence was not desirable and the sharing of the device an important behaviour. As the parents monitored their children, so they would watch over the screen to see what the child was doing and make sure they were doing it correctly. This can be seen in an exchange between mother and son:

“Have you got it?” (Mum)

“Yeah.” (Son)

“What does it say then?” (Mum)

“Ah the babies – aren’t they sweet.” (Son)

What this quote also highlights is second key motivator for the parents, namely the importance of demonstrating their interest in their child’s behaviour and performance. Parents sitting down with their children to watch the collected video content was a way of them demonstrating their interest in the child and encouraging their engagement. This sharing behaviour was much more than the parents simply having some interest in the content themselves. If we return to the Grandmother/Mother/Son episode we can see this aspect of the behaviour played out. As he sat on the bench next to his Grandmother, she asked him:

“Have you got any more photos [she is referring to the Collect items]?”

He replies by listing what he has collected.

“Ooh that’s nice” the Grandmother replies.

He then asks:

“Do you want to see some lions?”

The mother then says:

“What did you learn about the Komodo dragons?” [the tone used here is a cue to tell his Grandmother what he has learnt about.]

He replies:

“That they are very rare and live in trees for 4 years”

A further important social aspect of the technology was how the parents used it to teach the children about sharing. For family groups which shared a phone for the experience, parents would explicitly intervene to make sure that all the children were part of the experience. The children were encouraged to share viewing with their brothers and/or sisters, but also to pass the phone round to share the code reading experience.

4.4. PLANNING WHERE TO GO NEXT

A key part of the visitor experience at the zoo was planning where to go next. This was very much a collaborative experience, being negotiated among the different members of the group. The paper handout with a map of the zoo given to the visitors who registered for the trial was a critical artifact in this activity (cf. Brown and Perry, 2002). While each child had their own map, they would often gather in their small subgroups around a single version of the map. In parallel to Brown's work with maps, the position of the map was adjusted to support this shared viewing of a particular group and pointed to in support of the discussion. There were also examples of participants walking while looking at the map, talking to the group as they were moving.

These general observations of paper map use in relation to the collaborative planning of visitor experiences are not new, being used here serving only to confirm the insights of Brown's work and more generally of those who have looked at the collaborative use of paper (e.g. Sellen and Harper, 2002). However, there were some significant aspects of these Collect zoo maps that are worthy of further discussion. In particular, the Collect maps had special icons indicating all of those animal enclosures where there could be found a barcoded sign for collecting location relevant information. These icons came to play an important role in people's decisions about where to go next. So planning decisions were not just about what animals to go and see next as they might have been with a standard zoo visit but were also determined by the presence of a Collect icon next to the enclosure representations on the map. In one example, a group of children were considering where to go partially on the basis of a clustering of these icons in a particular part of the map. By heading in the direction of this cluster they would be able to maximise the number of Collect points they could visit in the time they had left available.

Given the role of this paper artifact and the Collect icons represented, one might want to make the argument to include the barcodes themselves on the map as paper based hyperlinks to the context relevant information (cf. Brown et al., 2005). While this idea has some merit in term of enriching the pre-visit planning experiences, there are a number of reasons, both practical and design oriented why this was not pursued in the current application. The first relates to the size of the barcodes necessary. With the current crop of standard camera phones in Europe and the US, the optics on the cameras would require the barcodes to be a minimum of 3×3 cm for a robust code reading experience. To have included all these barcodes on the map would have created visual clutter and required a larger more cumbersome map.⁶ The second issue concerned the collecting experience itself and how designing for this is much more than designing simply for functional convenience. To have included the barcodes on the map would have destroyed an essential

part of the collection experience itself. We go on to discuss this further in the next section.

4.5. COLLECTING LOCATION-BASED CONTENT

As we discussed earlier, a notable finding was that there were a several times where codes would be read but that content would subsequently not be consumed. One reason for this can be found in the value to participants in the actual act of collecting itself and the social significance of this. That is, the value in the technology was not simply in providing content designed to augment the experience of the location where it was found. Before discussing the particular behaviours observed in the current study we first consider some insights from the social studies of collectors and collecting. These provide a theoretical foundation within which to understand the social value of the behaviours we observed in relation to collecting.

A collector is defined by McIntosh and Schmeichel (2004) as a person who “accumulates a series of similar objects where the instrumental function of the objects is of secondary (or no) concern.” Objects as part of a collection acquire value in symbolic terms and not simply utilitarian terms (Fournier and Richins, 1991). For children, in particular, collecting becomes a means by which they gain an understanding and mastery of the world by bringing things together from different places and times into meaningful coherent sets (Baudrillard, 1994; Bilsland, 2002). For collectors, objects themselves and the collection as a whole can also come to represent parts of the self (Baudrillard, 1994; McIntosh and Schmeichel, 2004; Pearce, 1992). This can be through the way they serve as explicit links to the past (e.g. souvenirs), as expressions of taste or merely through arbitrary associations with particular objects determined by the collector and the narratives they chose to attach to the objects. Collecting, then, is not just about the objects themselves but about the narrative of the collection: how the object comes to be talked about to others (Pearce, 1992; Bal, 1994; Bilsland, 2002; McIntosh and Schmeichel, 2004).

An important aspect of collecting can be found in the *membership* it bestows to a group of other collectors of the same objects (e.g. Christ, 1965; McIntosh and Schmeichel, 2004; Tajfel, 1982). Some of the value here lies in the friendship and camaraderie this brings. But there is also a definite sense in which collectors compare themselves and their collections to those of their peers. To have a bigger, better, more valuable or more complete collection than others can be an important source of self esteem. Conversely, it can have a negative impact if the collection is smaller, less valuable or incomplete.

Much of the value of collecting is not simply in the ownership but the whole process of finding and acquiring the objects themselves. In contrast to acquiring objects purely for their functional value, the act of searching for the

collectable objects is something that should be challenging to the collector. As Bilslund (2002) describes:

"It would be meaningless to acquire all the pieces of a collection at once. 'Earning' the collection involves waiting, creating the pauses that articulate its meaning. The difficulty in finding an object, the chase after it, makes its acquisition much more valuable of acquisition itself."

The search for the object, then, is regarded by collectors as one of the most enjoyable features of collecting (Belk et al., 1991; McIntosh and Schmeichel, 2004). The more difficult an object is to find the more value and kudos associated with it once it has been acquired.

With these behavioural insights in mind we return now to the particulars of the current study and how particular features of collecting sociology and psychology were manifest in the behaviours we observed. In particular we can see how some of these behaviours are bound up with particular characteristics of the technology.

A key thing we observed in relation to collecting were references to what were underlying competitive sentiments felt by the group of school children, e.g. *"You almost had a game and it made you race against your friends"*. Utterances such as *"How many have you done?"* were heard when different subgroups of children from the same class came together indicating their desire to compare the size of their collections. Other comparative verbalisations related to the specifics items in particular collection. One comment we heard was *"Have you got this one?"* as one of the school children showed the others the items in his collection. This kind of behaviour was particularly important because some items were regarded as being more valuable than others: either they were difficult to find or they related to favourite animals. For example, the sign for the jelly fish proved to be a particularly difficult one for the children to find bestowing it a certain value in an individual's collection.

As well as competition about numbers of items collected, there was evidence that *completing* the collection was an important motivation for some of these, a goal seen in other systematic collecting behaviours in the literature (for bounded collections). One child was proudly heard to say *"Yep, got everything"*. Others were heard to express disappointment when they weren't able to get a particular item or to complete their collection. This can be seen in an episode by the tigers where a group of school girls were being told by their accompanying teacher that they needed to move on in order to get back to school. The children expressed their disgruntlement at this because it meant they were unable to collect that particular item and complete their collection:

"But Miss, some of us haven't got the picture yet."

Another girl then said:

“I feel so left out.”

What is illustrated here is the social importance of these collections and what they mean in terms of *identity* among the group. Taken from a functional point of view, not having this particular item in the collection would seem to be a trivial thing. What we see, however, is the social importance that gets attached to the possession of these objects as part of a collection. The children bind these issues up with their sense of self, creating the feeling of disappointment when they are unable to achieve their ideal “collector self”. It is not just because they are unable to read or hear about tigers that they get disappointed.

The binding of the collection to a sense of self was also seen in a strong preference for the children to keep their collections separate from each other. This was apparent, in particular, in the school groups who all decided to each have their own phones rather than share a phone among a small subgroup. While the non school group children did share phones on occasion, in order to make a joint collection, the evidence suggested that they would have preferred not to have done; they “*had to*” because the parents would only allow one phone.

The important non-instrumental aspects of collecting behaviour were also apparent in some responses observed immediately after reading the barcodes on the signs. Some children for example were satisfied simply at collecting the item by reading the barcode. It was not important for them to view, read or listen to the information there and then. They were happy to collect and move on to the next: “*I’m not going to read it now. I’m going to see how many I collect first*”. That is not to say that they would never engage with this gathered information. Rather, the point is that, these functional aspects of the location-based information access were on occasions of secondary importance to the children relative to the value of collecting.

We can see this too in the experience of searching for these codes. For many of the children, there was excitement found in this search behaviour. Discovering a sign with a barcode was usually accompanied by animated utterances such as “*There’s one*” and “*You guys – a sign post*” and then running up to the sign to read the barcode. Again there were occasions when this sometimes took precedent over the excitement at seeing the animals themselves. This act of discovery is a social act with kudos earned by discovering the signs. What was key here is how the collected item came to embody the time and effort that went into the search. The collector, who has put time and effort into the acquisition of the items, is the only person who really understands the true significance of the item in relation to the whole collection (Bilsland, 2002). Additionally the collected item embodied the fact

that the collector had actually been to the place or seen the real life counterpart of the collected item. It became a digital *souvenir*.

The notion of digital souvenir was apparent too in the desire to collect more personal content in relation to the zoo visit. A prominent behaviour among the children was using the phones to take pictures and videos of each other at the different animal enclosures. At times, this became the dominant behaviour over the gathering and consuming of Collect items. While this is not in itself a surprising finding, what was interesting was that participants wanted these personalised media items to be clustered together as an integral part of their collections. Indeed some children went into their collections to see if the photos they had taken were in there. This functionality was not supported by the application and so there was disappointment to find that they were not in the collection. What we see here is a desire to personalise their collections and create an organised memento of their experience.

By revealing some of these non-instrumental aspects of the collection experience, we get an interesting new perspective on the value of binding information to location beyond the typical convenience model of providing information at the right place and right time. This additional non-instrumental value lies in the experience of finding something at a location which can contribute to the growth of a set of items that is meaningful to the user and their social network. It only becomes apparent in the context of collecting and revisiting the collected information. It is less apparent in location triggering models of location-based information where one cannot revisit information. This value also needs to be traded off against the advocated benefits of a less tight coupling between information and location⁷ (Brown et al., 2005).

In realising the non-instrumental values of the experience associated with collecting, the interaction design of the application played a crucial role. One option for implementing the technology was to go with our standard barcode reading software. This would have allowed the codes on the Collect point signs to have been successfully read and pointed to the same location-based content. It would even have kept a log of all the codes that had been read allowing participants to revisit information later (in much the same way as the History function in a web browser). From an instrumental point of view, this standard barcode reading software would have provided much the same functionality. However, it would have treated the collecting on objects as merely a bi-product of the code reading experiences rather than a vital part of the experience itself. With the final interaction design chosen by the design team, the application was designed more specifically to emphasise the visibility of the Collect items. In this way much more weight was given to the collection experience as apposed to the barcode reading experience. The barcode reader was subsumed within the experience, being something that was called from within the application rather than vice versa.

4.6. KEEPING AND REVIEWING CONTENT ON THE WEBSITE

A further explanation why codes were read without the consumption of content in the zoo can be found in the ability to view the information later on the Collect web site. The post-visit experience is an integral part of the whole visitor experience. Understanding the use of artefacts during the actual visit can only be partial without any reference to the post visit experience because their use shapes and are shaped by the opportunities for action in the post visitor experience. Consider for example, the act of taking a photograph during a visit. The importance of this action to a visitor cannot be understood without reference to the use of the photograph after the visit, during show and tell conversations or during bouts of reminiscing. In this section we explore the role of the Collect web site in the post zoo visit experience and how it provided further value to the collection of location-based content.

All the children visited the Collect web site when they returned home. One of the things this allowed them to do was to look at the information in more detail and at a relaxed pace in a comfortable environment without distraction. As we saw earlier, there was not always time during the zoo visit to explore the information they had collected (c.f. O'Hara and Perry, 2003). For example:

“[I] Wanted to digest information...Having the collection sent to my computer, so that I could look at it later when I had more time to spare, was really good because I couldn't spend too much time looking at each animal at the zoo as my brother and sisters and cousins were all with me.”

As we can see here, the social aspects of the visit to the zoo had actually constrained some of the opportunities for more intensive viewing of the content by this particular individual. Knowing that it would be possible to view some of the content later, they were able to defer some of consumption of content at the zoo as interactions with the rest of the family dictated.

Looking at the content again was also about “revisiting” the experience and reminiscing about what they had done.

“I was also really interested to see what we had done – to see for ourselves what we had done.”

Sometimes this was conducted as a personal activity, while at other times it also became an opportunity for sharing the experience. All the respondents in the on-line questionnaire reported having shown the web site to someone else; to brothers and sisters and parents. The content on the web site was used as a resource in the conversation to talk about the visit to those who had not been there and to explain what they had seen and done there.

“I was doing it on my own but then my brothers and sisters came in and they were looking at it and they really liked it because they were younger

than me and they were going 'oooooh animals'...I went and looked at the pictures and they asked questions about it"

Showing parents was particularly important with twice as many participants showing the site to parents as to friends or siblings. As well as an opportunity to display what they had done to their parents, it again provided an opportunity for parents to demonstrate their pride.

"My Mum thought it was really brilliant because she was really interested to see what we had done and I showed her in the Internet."

This value again does not lie simply in the individual pieces of content, but rather is bound up in the collection of objects as an entity. Part of the review process on the web was not just about seeing what they had done but also what they had collected:

"I wanted to see what I have collected."

Likewise with sharing the experience, it was as much about showing the collection as about showing what they had done. Important factors here were the notions of ownership and the persistence of the collection across time. Participants talked of how they could "*keep*" items "*for ages*". Some participants also revisited their site several times to look at items again.

"Yeah, I went on the computer most days and re-looked again at what we did – it is always interesting to look again – I dunno I just liked it."

In this respect they were making further emotional investment in their collection of location-based content. The web site was also seen to somehow legitimise the collection by virtue of it being published on the web. This is illustrated nicely by the following comment from one of the participants:

"I enjoyed using collect because it is not every day you see your work and name on the internet!"

'It is something I have done and it is on the internet.'

5. Discussion

Through the fieldwork presented in this paper, we have built up a rich characterisation of the visitor experience at the zoo and how this was mediated by the particular artefacts comprising the Collect system. We have highlighted, in particular, some of the properties and behavioural consequences of situated barcoded signage for delivering location-based experiences. Our concerns here have extended beyond simply the usability of such technology for delivering location-based experiences to individuals. Rather

they have been with how such technology works within the context of an outing to the zoo, something which is typically done as a group and something that is inherently social.

The focus on group behaviour has helped highlight different characteristics of the technology with both positive and negative implications that need to be considered in exhibit designs which employ location-based content. One example of this is the *single point access* model of the 2D barcode technology that differs from potential alternative location-based technologies such as, for example, GPS triggering or Bluetooth triggering (which are both multi-point access). This single point model can create bottlenecks to information access which, as we showed, can lead to coordination burdens for groups and for those in charge of groups. On the other hand, the visibility of the signs (contrast this with Bluetooth or GPS triggering which can operate without any necessary visible presence) had some important consequences. For example, it helped in the process of discovery of location-based information. As well as the practical benefits of simply finding the information, we saw too how this process of sign discovery generated a sense of excitement and anticipation among the children involved in the experience. Of course, other location based technologies could employ visible signifiers to similar effect. However, there is an additional affordance of the 2D barcode technology in relation to its visibility. That is, interaction with the barcode is a visible act. The act of pointing the phone towards the sign to initiate the location-based interaction renders the triggering of content a visibly understandable behaviour to others in the group (again in contrast to alternative location based triggers such as GPS or Bluetooth). This can help with some of the coordination work that DeVault (2000) describes allowing the group to more effectively to share new content, for example, to move to the person holding the phone.

A further feature of the technology worth discussing is how the Collect technology gave fine-grained control to users over when and where to consume content. There are a number of factors contributing to this control. First, while the initial triggering of content using the situated barcode was bound to location, playing of the content was not. Users could press play whenever was appropriate. Second, was the mobility of the phone allowing people to move the content to different places and into different social configurations. This control had a number of important effects. For example, it allowed people to get to more comfortable positions for consuming the content or to be better situated for viewing the animals in the exhibit. It facilitated the way people could bring the content in particular group configurations for sharing content, whether video, audio or text. All sorts of timing subtleties are important here such as coordinating with whether everyone is paying attention, or coordinating content with particular snippets of the accompanying conversations. Even when not sharing the content with others, control over the when and where of content consumption was

important in the way that movement around the zoo was coordinated with other members of the group. For example, if the group was moving on there were not always opportunities for individuals to consume content in situ.

Of particular interest about the location-based experience we explored in this paper was the emphasis on collecting and keeping content. In contrast to some other location technologies where the emphasis has been on providing the right information at the right time, location-based collecting has importantly different properties and social values. These can make the act of collecting an end itself over and above any informational value associated with the content. We saw how this behaviour was bound up with identity and representation of the self. We also saw how this non-instrumental aspect of the experience had a strong social basis. Part of the collection experience involved a comparison with other collectors, resulting in camaraderie and a sense of playful competition. In some ways location-based collecting simply shares the social and psychological motivations underlying any collecting behaviour whether, for example, stamps or football stickers. But there are ways in which it has some distinct properties too. It creates a sense of play around everyday activities in the same way that I-Spy books (spotter's guides where points are acquired when one sees particular objects while moving around the environment) do. Location-based collecting also allows particular narratives to be attached to the collected objects that are associated with the visit or outing. As we saw, it is these narratives that can be an important part of the value of these collected objects. Finally, tying objects to location imbues them with particular value because one has to go to the location to retrieve the object. The collected object becomes proof of the visit to the location; a kind of souvenir. It also embodies the effort associated with getting there and finding the object. This effort again is all part of the value that gets bound up in the object that can distinguish from other types of collected object.

Collecting was also about keeping content. Obviously, pragmatics of the trial meant that users had to return the loan phones which meant that they could not take the collection with them on their own phones. While taking the content on their own phones would have been better, the web site provided some of the value of having a continued sense of ownership with the collection maintained over time. This contributed to the value of the collection allowing content to be revisited repeatedly after the visit, nurturing the psychological relationship the collector could have with it. What might have been of further interest here would be the introduction of more sophisticated collection management facilities in the web site. For example, one thing that the sociology and psychology literatures identify as being important for the collecting experience is the act of categorisation. This was not a supported feature of our trial but could perhaps contribute to the creation of a richer collecting experience in future applications.

Keeping content in relation to the zoo visit was also important in how the visit contributed to the construction of ongoing family and group relationships. Much of the value of such outings extends beyond the here and now. Indeed one of the criticisms of some location-based tourist applications has been the failure to consider the period after the visit. In the application here, the collected content on the web site became the basis for ongoing conversations about the visit back at home with other members of the family who may or may not have been there. Extending DeVault's (2000) arguments about how family relationships are actively constructed through these zoo visits and other family outings, we want to argue that this active construction continues afterward through the shared reminiscing. The content collected at particular locations can become a valuable resource for this.

6. Conclusion

In conclusion, by highlighting some of the non-instrumental aspects of location-based collecting, we can see a number of interesting tensions arising for the design of such experiences. That is, such experiences are both competitive and collaborative; they have both utilitarian functionality and non-instrumental values. Designing to support these different facets of these experiences can often lead to direct conflict. For example, making location-based information easy to find and access supports the functional aspects of providing relevant information at the right place and time. However, it can diminish some of the acquired value of the object within the context of a collection where a more difficult-to-reach-and-find object is more valuable. The aim of highlighting these tensions is not so as to resolve them in this paper. Indeed there are no absolute resolutions here, merely design judgments on the basis of the relative experience desired. The aim of highlighting the tensions is to make designers of such experiences aware of the broader set of values and social behaviours that contribute to these experiences, so that they can make more informed judgments about particular design attributes.

7. Notes

1. There are a several 2D symbologies, the most common of which are data matrix codes (see Figure 1) and QR Codes, which feature square or dot-shaped modules arranged on a grid pattern. They are like linear (1-dimensional) barcodes in functionality, but have more data representation capability. 2D symbologies also come in other visual formats such as circular patterns. They are read by digital cameras with appropriate barcode reading software. By placing 2D barcodes on signs situated at particular locations, they create a form of location-based content trigger.

2. For security purposes the members of the public participating were asked to leave a deposit of something valuable such as a credit card, driving license, passport of the accompanying adult. These were given back on return of the trial phones.
3. This single point access characteristic of the technology can be contrasted with other location-based technologies in this space, such as GPS triggering or Bluetooth, which allow simultaneous access to content triggers by multiple parties (though Bluetooth also has its upper limits here).
4. Certain animal enclosures had multiple signs situated at different approach and viewing points around the enclosure which helped alleviate congestion a little.
5. Again this can be contrasted with GPS or Bluetooth where one is not necessarily bound so closely to a pinpoint location such as a situated sign. These characteristics have different behavioural consequences some positive and some negative. From a design perspective, the point here is to illustrate the different characteristics of the technologies and their particular behavioural consequences so that appropriate design judgments can be made for particular circumstances.
6. In Japan, it is standard to have camera phones with macro lenses which can read barcodes of equal data density at much smaller sizes. In Europe and US, macro lenses on camera phones were not standard at the time of the trial and only now beginning to emerge on the odd high end phone such as the Nokia N90. While we could have attached bespoke macro lenses on the phones, this almost defeats the point of using the phones in the first place. The specific value of using mobile camera phones is because there are so many out there. The intention was to exploit this and design application design idiomatically within the particular constraints of the standard phones rather than capabilities offered by a customised phone.
7. For example, Brown et al. have advocated the use of maps and guidebooks as a means of linking to location relevant information. This loosens the coupling of the information and the location allowing it to be used in planning and decision making before visiting an attraction as well as for reminiscing after leaving the attraction.

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