

# Interweaving Mobile Games With Everyday Life

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## ABSTRACT

We introduce a location-based game called Feeding Yoshi that provides an example of seamful design, in which key characteristics of its underlying technologies—the coverage and security characteristics of WiFi—are exposed as a core element of gameplay. Feeding Yoshi is also a long-term, wide-area game, being played over a week between three different cities during an initial user study. The study, drawing on participant diaries and interviews, supported by observation and analysis of system logs, reveals players' reactions to the game. We see the different ways in which they embedded play into the patterns of their daily lives, augmenting existing practices and creating new ones, and observe the impact of varying location on both the ease and feel of play. We identify potential design extensions to Feeding Yoshi and conclude that seamful design provides a route to creating engaging experiences that are well adapted to their underlying technologies.

## Author Keywords

Mobile multiplayer games, ubiquitous computing, seamful design

## ACM Classification Keywords

C.2.4. Distributed systems – distributed applications. K.8.0. Personal Computing – games.

## INTRODUCTION

Mobile devices with increased power, faster communications and higher resolution displays are increasingly saturating our everyday life. Commercial location-based services that run on these devices, such as restaurant finders are becoming more established. At the same time, research into new location-based services continues to move forward, in areas such as wayfinding [15] cultural tourism [5,6] and games [11,14]. Studies of the experience of ubiquitous computing services 'in the wild' have also begun to appear in the HCI literature, revealing

the ways in which users interact with ubicomp technologies, and identifying new design challenges and opportunities, e.g. [3, 8]. Set within the Seamful Games project of the Equator interdisciplinary research collaboration ([www.equator.ac.uk](http://www.equator.ac.uk)), this paper presents a study of a location-based game that extends this body of work in two key directions. First, it follows through an example of 'seamful design', a new design approach in which the inherent limitations of technologies are deliberately exploited in a user experience, rather than being hidden away. Second, it focuses on an experience that takes place over an extended time period of a week and over a large geographic area spanning three cities, providing insights into how an experience can be designed to interweave with patterns of everyday life.

## Seamful design

A key issue to emerge from early ubicomp studies has been the impact of variation or uncertainty with regard to location and network connectivity [3,5,11]. Consequently, a number of strategies have been proposed for dealing with this issue, such as *removing* the variation by technological means, *hiding* it in the system design, *managing* or influencing users' activity so that the variation is not made apparent to them, *revealing* variation so that they can make decisions as to how to handle it and, finally, *exploiting* it as a design resource [2]. Exploiting it, and to some extent revealing it, means taking a pragmatic stance to the characteristics of the digital media we work with. This forms part of the seamful approach to design discussed by Weiser [17]. This notion of seamful design has recently been applied to create new kinds of location-based games, in which players deliberately seek out and exploit the limitations of network coverage or positioning, for example U. Glasgow's game *Treasure*, in which players had to move out of and then into wireless network connectivity in order to first collect and then deposit gold 'coins' [1].

## Interweaving experiences with everyday life

Previous studies have mostly focused on experiences that are relatively small-scale, both in terms of geographic area (typically a few city blocks) and duration (typically up to an hour or so). While understandable from the practical

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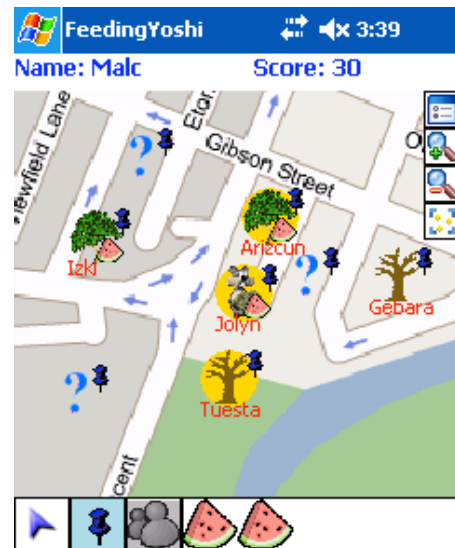
perspective of being able to field experimental technologies and study mobile participants, a consequence is that relatively little has been reported about how location-based experiences actually vary with location or how a ubiquitous computing experience actually fits with other activities. This stands rather at odds with one ideal of ubiquitous computing, namely that it should be woven into the fabric of everyday life, to paraphrase Weiser's *Scientific American* article [16].

One notable exception is *Mogi*, a location-based game for mobile phones and the web, which was launched in Japan in April 2003. It still has over 10000 players, although only 1000 are highly active [13]. Part of its success has been the way that it is a *nagara* or '-ing' game, i.e. a game one plays while doing something else. The phone display uses maps that are heavily trimmed to show only the information most significant to the current context in game terms. The designers were content to rely on players' understanding of how to relate this information to the city around them. *Mogi* does not rely on precise location or orientation, because many players use phones with positioning based only on GSM cells. It uses a 400m threshold of distance when estimating whether a player is at a given location. While most game events are based on spatial location alone, the game also uses a geographical information system to make a proportion of game events relate to existing local activities, e.g. taking 'digital sushi' to a school at the students' lunchtime. It is reported that different aspects of game play happen at different times and in different places: most 'hunting' out on the street happens during the day, with peaks around lunchtime and commute times, whereas most of the socialising within the game happens in the evening, at home. Joffe reports a surprising finding, backed up by other studies by Japanese telecommunications firms: the majority of play of mobile games happens at home. The flexibility of when and where to play, allowing people to fit it into home life, commuting and work, is a vital factor in the game's success and longevity.

With these motivations in mind, we developed and studied a new location-based game called Feeding Yoshi, in which seamless design has been applied to create an experience in which players explore the characteristics of network coverage (especially, whether networks are secure or open) across several different cities as they go about their daily activities. In this paper we report on a study of a week-long game of Feeding Yoshi that took place across three large urban areas and that provides insights into how seamless experiences can be interwoven with the patterns of everyday life.

### THE DESIGN OF FEEDING YOSHI

Feeding Yoshi is a mobile multiplayer game that is played over a relatively long period—the game we report on here lasted a week. Rather than being built on the assumption of users' continuous engagement over such a long time, we assume that players use the system intermittently, as they go through their normal daily routines of work and leisure.



**Figure 1.** In the map screen, Yoshis and plantations are shown as icons, and navigation controls are on the right. Near the bottom is a row containing (from left to right) a button for selecting icons, pinning an icon onto the map, initiating a swap with another player (greyed out), and the basket of up to five fruit: in this case two melons.

The game requires players to explore public and private 802.11 wireless networks that are already deployed across urban environments. In this way, we treat the player's environment as part of the game 'system'. Feeding Yoshi is played in teams and although teams in theory could be of any size, we found that having four players on each team was sufficient for interesting play yet small enough for manageable trial orchestration. However, the play mixes individual play with team play and does not *require* the team members to be close to each other.

### The game

The aim of Feeding Yoshi is for each team of players to collect as many points as possible, by feeding Yoshis the fruits they desire. Yoshis are creatures that players find scattered around the city and which are constantly hungry for five fruits, of seven varieties. In order to collect fruit, players must first collect seeds from the Yoshis themselves—each Yoshi always has a seed for the fruit it most often enjoys. These seeds can then be sown at plantations that can be found scattered around the city, just as Yoshis are. Once a seed is sown, the plantation will begin to generate fruit, which can then be picked and used to feed Yoshis. Feeding a Yoshi one of his desired fruit scores 10 points, but feeding several fruit simultaneously gives more points, e.g. feeding all five desired fruits at once scores 150 points. Feeding a Yoshi a fruit it does not want results in the player losing 10 points.

As a player moves through the city, nearby plantations and Yoshis appear as names in a pull down menu and as icons on a map (Figure 1). An audio alert is also made when a plantation or Yoshi is detected so that the player does not have to continually visually attend to the PDA screen.



**Figure 2.** The Yoshi screen shows the Yoshi himself, as well as the five fruits he currently desires (top right) and a seed of his favourite fruit (top left). After selecting one or more of the fruit in the basket (bottom right), the *Feed* button is used to feed the Yoshi and gain points. The left arrow returns to the map.

On first being detected, a Yoshi or plantation appears in the centre of the currently displayed area of the map, although a player can ‘pin’ a Yoshi or plantation icon in a better place. On the right hand side of the map are buttons for switching to a list view rather than the map, panning, zooming and selecting a Yoshi to be highlighted on the map as a ‘favourite’. Along the bottom of this screen, and also shown in the other two screens in the game, is the player’s ‘basket’ that provides space for a limited number of fruits and seeds to be carried. Clicking on a Yoshi brings up a screen showing the Yoshi, a seed for his favourite fruit, and the five fruit he currently wishes to eat (Figure 2). Similarly, clicking on a plantation leads to another screen with either a tree empty of fruit, i.e. an unseeded plantation, or a tree with fruit ready to be picked, i.e. a seeded plantation. Seeding is done by selecting a seed in the basket then clicking a *Seed* button.

When two players approach one another, they see each other’s icons on their maps. Selecting a nearby player’s icon triggers an opportunity to swap fruit and seeds. This is useful if the Yoshis in the areas that a player knows want fruit that do not grow there. By swapping with team-mates with access to other areas, they may gain more points. Swapping is also intended to encourage simultaneous play and to make it more fun to play together. Lastly, the game provides a webpage with a scoreboard showing each player’s score so far, as well as the total score for each team. Players use this webpage to update their scores as described below.

#### *Technology*

The game runs on 802.11-equipped PDAs. For our trials we used a mixture of HP iPAQ 2750s and 4150s, which

have built-in 802.11 and which, due to their small form factor, were relatively easy for users to carry with them throughout the week. Each PDA was additionally fitted with an SD card to allow us to store the substantial amount of log data we gathered as our users played the game.

The Yoshis and plantations that are detected while playing the game are actually wireless access points. As a player moves around in the city, their PDA continually scans for the presence of wireless networks. Secured wireless networks become Yoshis and open networks become plantations. While it would be an easy and in some ways a graceful solution to communicate with the Feeding Yoshi gameserver via the open access points that are discovered (e.g., to automatically upload scores), it is a matter of debate as to whether using open networks in this way is legal in some countries, including the US and UK (even though opening networks up to neighbours and passers-by may be a common and deliberate practice [12]). In order not to encourage our players to potentially break the law, Feeding Yoshi does not transmit any data over the open networks that it discovers. It only detects their existence and identity. Instead, players have to manually upload their scores at the game website using a ‘score voucher code’ that is generated by the PDA. This uses the PDA’s MAC address as a unique key for this player to encrypt their current score and the current time in order to prevent cheating. When a code is entered on the website, decryption is attempted using the MAC address of every PDA in the game. The player’s identity is made apparent, as only one MAC address is likely to provide a logical score. This workaround allowed us to keep the scores relatively up-to-date, which in turn helped to keep the game competitive between the different teams. Indeed, players reported that they often felt a strong urge to play immediately after checking the leaderboard and seeing their score was close to another team or player’s score.

Swapping fruit between players is achieved through 802.11 peer-to-peer ad hoc networking between the PDAs. Each game client continually broadcasts its own existence on a specific ad-hoc network SSID while also scanning for broadcasts from others’ PDAs on the same network, all in a way that emulates ZeroConf/Bonjour service discovery ([www.zeroconf.org](http://www.zeroconf.org)). When another PDA is detected and one of the players wishes to initiate trading, that player’s PDA stops scanning and sends a message requesting the other PDA to cease scanning too; important as the constant scanning is a relatively heavyweight task for the 802.11 equipment on standard PDAs. The exchange itself is done through traditional TCP socket connections. A simplified version of the game is available for download at [www.yoshigame.com](http://www.yoshigame.com).

#### **Feeding Yoshi as an exploration of seamful design**

As part of his vision for ubiquitous computing, Mark Weiser suggested that we should take a pragmatic or even positive view of the characteristics of digital tools and media, in terms of how they function in themselves, and

how we use them with other tools and media: what he called *seamful* design [17]. Quoting from [1], “a seam is a break, gap or ‘loss in translation’ in a number of tools or media, designed for use together as a uniformly and unproblematically experienced whole. Seams often appear when we use different digital systems together, or use a digital system along with the other older media that make up our everyday environment.” We therefore see seamful design as about exploiting characteristic limits and variations that are apparent in use and interaction, and which contribute to users’ practical understanding and use of a system as they experience it in their everyday life.

The design of Feeding Yoshi is intended to take advantage of seams that arise from the use of wireless networks, seams that many might see as a disadvantage or limitation. While it may be considered that, ideally, fast and free network access should be available wherever we go, this is currently not practically achievable, however, and may not even be an ideal for everyone, e.g. for the telecommunications companies. The current variability in 802.11 WiFi is well-known, with its limited range leading to hotspots of network availability often being set among large ‘cold’ expanses. To complicate matters further, hotspots sometimes overlap. This means that users may encounter several networks in one location, and that the use of one network may be interrupted by or suffer interference from other networks. Even when a cleanly usable 802.11 network is present, its use may be limited by financial charges, legal constraints and access controls. System design based on the assumption that 802.11 is uniformly and unproblematically available may lead to problems for users, as they may have to handle breakdowns and exceptions to this assumption, without a great deal of help from the system.

Access control is of particular interest to us here. Whereas previous seamful games have focused on exploiting the limited coverage of WiFi [1], Feeding Yoshi also exploits whether that WiFi is open or secure. This is interesting in terms of highlighting important debates around this technology. First is the suspicion that many WiFi deployers may be unaware of security issues, especially domestic users who (quite reasonably) may not be sufficiently expert to deal with the complexities of configuring the technology. Second, is the broader debate around the nature of open access, reflected in the current legal uncertainty described previously. Consequently, deliberately probing and exploiting the distinction between open and secure WiFi is an appealing basis for designing a seamful game.

Feeding Yoshi’s design therefore takes advantage of characteristic variations in 802.11, as deployed in urban environments, which are apparent in use. Our design exploits spatial variation, in terms of location, and also variation in access control, characteristics that we anticipate might reflect the social geography of the city, for example differences between business and suburban districts.

## STUDYING YOSHI

Due to the situated nature of the game and our interest in observing how players responded to the contingencies of the technology and of the everyday world in which they were playing, we adopted an approach of ethnographic study. We collected data through interviews with each player, video clips of gameplay, a game diary that each player kept him/herself, and from system logs.

An initial pilot study was conducted with a game played over five days, between three teams of four people and with each team based in a different town or city. Our observations of these pilot games strongly suggested that the nature of the local environment (city, suburban or rural) had a great impact on the game play itself, since wireless access points varied not only between urban and suburban areas but also within different suburban areas. The study was used to fine-tune the technical issues of the game, and to make sure that it would be possible to play the game at these different locations. Finally, the game duration was extended to one week, so as to give players the opportunity of playing both at the weekend and during the working week, and in the different contexts associated with those times.

### The Main Trial: Teams and Locations

In the main trial, four teams played in three different urban areas in the UK: Glasgow, Derby and Nottingham. There were two teams based in Glasgow, *Glasgow1* and *Glasgow2*. We use the names *Derby* and *Nottingham* to refer to the two latter teams. It was important for us to have differentiated milieu in order to investigate the impact of location on the experience. Glasgow is a densely populated large city, whereas Nottingham is a medium-sized city in which most of the game area was a mix between city and suburban, and Derby is a small city mostly of suburban character. In addition some participants travelled to other areas during the game, especially over the weekend. This meant that either they played in a completely different location or that they did not play these two days.

We chose teams of players who knew each other before the trial and who might feasibly be expected to meet throughout the period of play, providing opportunities for collaborative play. Within each team, all were well acquainted with each other and some were close friends, which ensured a natural team spirit from the beginning. The teams all played against each other during the same week-long period from Tuesday to Monday competing against each other. The Derby team were all colleagues who worked in the same organization and who saw each other most weekdays. There was one female and three males, and their ages ranged from 23–29. *Glasgow1* were friends as well as co-workers, including one couple; three were working in the same building. (3 females, 1 male, ages 22–30) *Glasgow2* were friends and acquaintances, and included one couple. (1 female, 3 males, ages 22–25.) Nottingham were friends working in the same company, although they did not necessarily see each other during the day, except for

two who were flat-mates. (1 female, three males, ages 26-27.) We chose participants who were not in the computer science or HCI fields, but instead came from a variety of other professions. Three of the participants from Glasgow1 were graduate students of biology; the rest of the participants held jobs such as bartender, personal assistant, technical project worker and artist. They were all familiar with computers and often with PDAs as well. Half of the participants played computer games of some kind on a regular basis, which assured us that they had an interest in games and competition. One quarter played games once in a while. The players were all compensated for their participation, however, to make the game more competitive, the compensation for the winning team was doubled.

A daily diary was developed and tested during the pilot game, in order to get specific insights into play and the participants' other daily activities. Participants were also interviewed individually after the game. After transcribing the interviews and reading through the diaries, each team's game play strategies were summarised. We also collected system log information to assist in tracing the teams' patterns of play.

#### PLAYERS' EXPERIENCE OF FEEDING YOSHI

In very broad terms, the basic mechanism of Feeding Yoshi—that is, of exploring the physical world to find Yoshis and plantations, sowing seeds, harvesting fruit and feeding Yoshis—seems to have been appreciated as being fun and engaging. Most players said that they enjoyed going out specifically to play for an hour or two, and three participants (two from the Derby team and one from Glasgow1) went further by saying that the game had been highly addictive; as one of the them observed: “The game is highly addictive when a ‘good spot’ is found!” From the interviews we learned that their motivation was a balance of competition against others and excitement about the play activity in itself.

The Derby team put great effort into the first day's play, scoring over 10000 points. This was slightly discouraging for the Nottingham team, who expressed that they felt it was hard to catch up with them. In contrast, the two other teams were motivated to gain on Derby. In the end, Derby won, with 58060 points, followed by Glasgow1 with 45190, Glasgow2 with 11250 and Nottingham with 8190. A few players found that their initial enthusiasm for the game dropped as the week progressed, either due to its repetitive nature or due to the absence of convenient Yoshis or plantations. As one player from Nottingham observed, “During the middle of the week, the game lost interest. It gets a bit repetitive”. Most players however continued with excitement and almost half said they could easily have played another week. It therefore appears that while the underlying interaction was engaging, players' overall experiences were quite varied. To understand why, we focus on three key issues in detail: the fit of the game with patterns of everyday life, friendship and collaboration, and the impact of location.

#### Fitting with Patterns of Everyday Life

A key factor in successfully playing Feeding Yoshi was the amount of time that players were prepared to invest in the game. Given that Yoshis and plantations were inexhaustible resources, the game rewarded players who were prepared to search hardest for them and then spend the most time sowing, harvesting and feeding. This time spent playing the game was structured in various ways, however, and we observed two general modes of play and several specific impacts on the patterns of everyday life.

##### *Modes of play*

The first mode was to change one's patterns of everyday life by deliberately setting aside time for special, often relatively prolonged, game sessions, for example during the evening or weekends. Figure 3 shows the longest single individual turn reported by each team on each day, where a turn is defined as any time the PDA was picked up and used by an individual player. It appears that Derby gained an advantage by intensively playing the game in this mode in the early days. Glasgow1 were not able to play in this way when at work, but did play in their lunch break and at the weekend two members went out for two hours specifically to play, in order to catch up on Derby. Unfortunately they were still 8000 points short and had little time to play on the last day, Monday. Glasgow2 and Nottingham appear to have generally played short sessions, with the exception of a major excursion by Glasgow2 on the Thursday.

The second mode of play involved augmenting daily routines by interweaving the game with normal activities, most notably work and journeys, and consequently playing larger numbers of shorter turns. Figure 4 illustrates how the week-long game developed in terms of the total number of turns played by each team on each day. From the interviews, it was clear that the number of turns was a good indication to how well the game was blended into a players' everyday activity. Players who reported taking many turns interleaved them with other activities, to avoid severely disrupting the routine of their day.

The two most successful teams employed both modes of play. Derby was able to use them both during the first few days of the game, playing many turns and also some long turns, giving them an unassailable lead. Glasgow1 also employed both modes, but at different times. On workdays they largely augmented their existing activities, whereas at the weekend they changed their normal activities through a specially organised session. In contrast, the least successful pattern of play was that of Nottingham, who played for only a few short periods. In their interviews they indicated that not only were they discouraged by Derby's score of over 10000 points on day one, but that their everyday activities did not take them anywhere where there was a good distribution of Yoshis and plantations. Three of them went specifically out to play most days, but not for more than an hour.

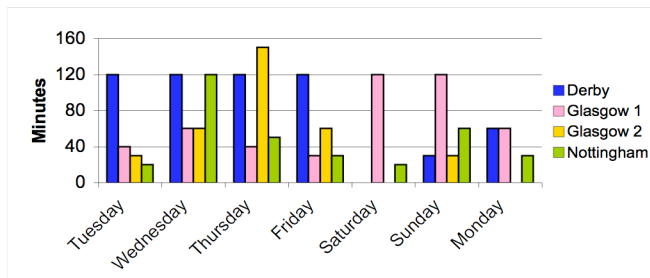


Figure 3. The maximum time a player of each team spent playing in one turn, per day.

#### Impacts on the patterns of everyday life

Beyond these broad categories or modes of play, our players reported that the game had some specific impacts on the patterns of their lives. The impact on work was a factor for many. Some gained an advantage by being able to play at work where WiFi was available, including three players in the winning team (Derby). A few reported that they most enjoyed playing the game when they should have been working, although several noted that less work was done and one player from Derby commented: “I think we might have got into trouble at work”. Other players only played outside of work hours, e.g. the bartender and the multimedia developer who formed half of Glasgow2. Some had time off work during the game, and others had less paid work available—the two artists in Nottingham reported having a ‘dry spell’ in work the week of the game—but this did not necessarily result in more hours of play.

Another notable feature was playing during journeys, especially to and from ‘town’ as part of the daily commute, to go shopping or to meet friends. Journeys may have been good times to play, as players naturally move through different locations and so may encounter many Yoshis and plantations. Everyone in Glasgow1 augmented their journeys with play during weekdays, as did two players in Glasgow2 and two players in the Nottingham team. Their strategy was to remember the different Yoshis and plantations encountered during, for example, the bus ride to work, and pick fruit and feed Yoshis along the way. One player from Glasgow1, for example, said that she specifically brought in an orange seed from her home neighbourhood because she remembered that they were difficult to find in her work neighbourhood. After she had seeded an orange plantation, she could feed almost any Yoshi in her work area when she went out to lunch.

Several players also noted that playing the game in this way made them late for work, late getting home, or late for pre-arranged meetings. One Glasgow1 player, for example, was late for an appointment with a friend who was a team-mate, because she got caught up in the game on the way—but the friend had been playing while waiting, so they laughed at the situation and went on to play together for half an hour.

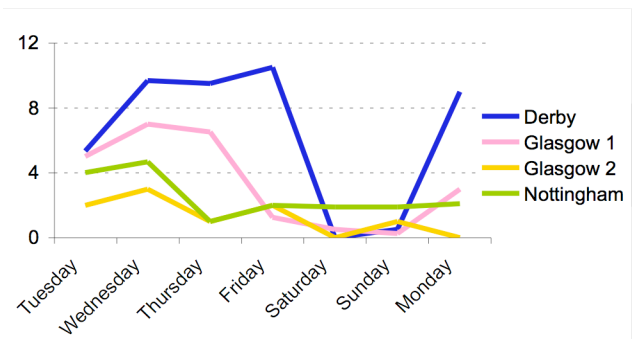


Figure 4. Daily average numbers of game plays, per player.

Many of the participants started planning their time with Yoshi in mind. Besides going out to play specifically, five of the participants (one from Nottingham, two from Glasgow2 and two from Glasgow1) would take a different route to their destination, either for work or leisure, in order to play Yoshi. One participant from Nottingham explains:

I’d take slightly different street routes than I’d normally take; initially to see what was there. Once I realised there was good stuff there then I would adjust my route.

The game is most easily played walking around, but it was also played in cars, buses, trams and trains, and even when bicycling. It can be a welcome distraction from everyday commuting. None of our participants reporting playing while actually driving; we warned participants against this, and in the country where the trial took place it is well-known that it is illegal to talk on a mobile phone while driving. However, some did play as passengers in cars. Two players reported that when moving quickly in a car, bus or tram, one can detect many Yoshis and plantations, but it is difficult to connect to them. However, another player said that it could be done with enough skill and quick reactions. A novel way of playing Yoshi in the suburbs was invented by Derby, which they called ‘Drive-by Yoshi’. One of the team members would drive the car, while another would play the game. The player would ask the driver to slow down when they were near useful access points so as to pick fruit or feed Yoshis. According to the two players, this had been great fun, but only worked in small streets with little traffic. One person played while bicycling, stopping when he heard that a wireless access point was near.

#### Friendship and Collaboration

Another major factor in weaving the game into everyday life concerned friendships and opportunities for collaboration. Collaboration within teams naturally depended on how much time the participants spent in the company of team-mates. All in all, the more time team members spent together, the higher the score they got. However, this was not necessarily due to trading. We found that excitement and competitiveness came from being around and talking to team mates, and that much of the benefit in collaborating was in exchanging information about the availability of Yoshis and plantations as much as it was about exchanging seeds and fruit.

Participants from all teams except Nottingham went out together in pairs to play at least once during the game. Some gatherings were planned and others were ‘spur of the moment’ games. The nature of the competition in the game was friendly, as shown when, by chance, two members from opposing teams came across each other during play in Glasgow. They did not know each other, but had both gone to the city centre to play since there were some excellent playing spots around a shopping centre. The woman from Glasgow1 who met a man from Glasgow2 describes the situation:

I was playing away and then this box popped up saying ‘Norman would like to trade’ and I thought ‘I don’t have a Norman on my team!’. Then I saw this guy with a PDA and he was looking around, and then we caught up with each other and we thought ‘hmmm... not the same team’. But he walked over and he said that he was from [the other Glasgow team] and could he trade? And well, I was in my prime playing spot so I had all the fruit I needed, so I just thought, okay I would trade with him.

She was initially hesitant because he represented an opposing team and they did not really know each other. Since the game was a week long game, they both knew that trading with ‘the enemy’ did not necessarily mean a major loss of points. Also, it was interesting to find out how other participants played.

However, one aspect of collaborative play that could be problematic was getting team-mates together in the first place. Players had other constraints and demands on their time. The two teams that scored lowest (Glasgow2 and Nottingham) had players who did not see each other over the course of the game, even though all the team-mates knew each other. Glasgow2 met up only in pairs, and Nottingham met up as consistent pairs, although two players with different ‘partners’ did meet up once. The player from Glasgow1 who met ‘Norman’ from Glasgow2 had specifically gone into the city centre on the Saturday to play on the recommendation of her team-mate friend. Overall, the teams who spent more time together had an advantage over teams who played mostly individually, with social gathering and information exchange weighing more heavily than trading fruit. In short, an important aspect of successfully embedding the game into everyday life was the extent to which the team structure reflected likely encounters between team-mates.

Successfully interweaving the game with everyday life also involved managing interactions with non-players including family, partners, colleagues and strangers. This could be a positive factor: one player, when visiting family relatives in another city, shared the game with them. She taught her sister and mother how to play, and went out to play the game with them in their neighbourhood. It could also be negative: another player reported how playing the game as he walked with his girlfriend tended to annoy her. Since access points are sometimes difficult to connect to, he—like most players—had developed a pattern of walking a couple of metres, then standing still, and then walking again. We

shall also see examples below of potentially problematic interactions with strangers.

### The Impact of Location

In a game like Feeding Yoshi, play happens differently in different locations. Location was a major factor, both in terms of the distribution of open and secure WiFi access points across each city, and also in terms of which places felt good to play in and which felt bad.

Considering the distribution of WiFi, players built up an understanding of precisely where Yoshis ‘lived’, and where they could be detected. They also came to know areas that were good places to play, and were able to roughly predict whether a district might have many Yoshis or plantations. Not only did the game take place in three different urban areas, but it also varied according to the kinds of places that could be found within them. For example, playing in a business district tended to be different to playing in suburbia. At a basic level, the *easiest* places to play are localities where Yoshis and plantations are mixed with each other, so that one does not have to go far when moving between them. The quickest way to score was to find a physical location from which both Yoshis and plantations were visible without having to move at all. However, exploring new areas could be a great pleasure – as reported by our player who visited family in a far city.

The access points used in the games were rarely directly visible, and were often detectable from a range of many metres. Nevertheless players began to associate Yoshis and plantations with more fine-grained locations. They would remember which fruit was the Yoshi’s favorite and which fruit grew at a plantation. Features of the environment would be associated with the names and characteristics of Yoshis and plantations. One Derby player expressed it this way:

It got to the stage here where we’d played it that much that we knew exactly who lived where. Kelly lives by the door of the block. We’ve got Laurence down the bottom. There’s Lamar, who’s out here somewhere [pointing]. He’s always a nightmare to pick up. He’ll always want a load of fruit, so you go get a load of fruit thinking ‘big score’.... It’s all part of the game really. He was the one you could never find when you wanted him.

This player shows how he has developed a familiar way of talking about some of the Yoshis. He talked about Lamar rather like a pet, although an annoying one because he was difficult to detect properly. Yoshis ‘lived’ in different places, and the environment thereby became augmented with the Yoshis and plantations. Players would often come back to places they considered good to play in. Details of these places were often exchanged between team members.

Although an understanding of what Yoshis and plantations were in technical terms was not necessary for the players to enjoy the game, almost half of the players would choose a specific place to play based on their understanding and experience of wireless networks. They had been told that Yoshis represented secure access points whilst plantations were insecure access points but, rather than relying on such

details alone, they built up an understanding of the likely distribution and variety of the access points that the Yoshi game exposes in relation to the broader cultural geography of the urban environment.

Only five players, distributed through Derby, Glasgow<sup>1</sup> and Nottingham, remembered during the game that closed access points led to Yoshis and unsecured ones were plantations. Of these, three players from Derby searched out suburban areas to find more plantations. Because of the game structure it was best to play in an area with many plantations but surprisingly for us and for players, there were several in both business areas and city centres. Players often simply went to places where they assumed there would be many wireless access points with both success and surprise. Two Nottingham players kept going back to ‘the Chinese Restaurant’ where there apparently was a good distribution of Yoshis and plantations. One participant described his strategy when beginning the game:

The first few days I walked around areas of the city centre that I thought would be good areas to play in... passed by places where I knew there were connections, like at coffee shops and areas where there were more businesses.

One Nottingham player found out that certain coffee shops offered wireless access, and played around them and explored new areas to find them. There was some variation over time, however, with these areas tending to have less Yoshis at weekends than during the week as many businesses would shut their WiFi down out of hours. Thus, there was a temporal as well as a spatial variation in play. Similarly, players sought out suburban areas in order to locate plantations, as many domestic access points are not secured. Some believed that a wealthier block of apartments would sustain a good mix of Yoshis and plantations.

#### *Location and How it Felt to Play the Game*

Location had a major impact on play beyond the availability or otherwise of Wi-Fi. Location also affected how it *felt* to play the game. Some locations gave a negative feeling. Players reported problems with colliding with strangers when playing while walking along crowded streets: “I kept walking into folk!” It could also feel dangerous or appear odd to walk around with a PDA in some areas, and the distinctive back and forth movements required by the game would draw attention. One player was asked kindly by a stranger whether she was lost, but mostly players just reported strange looks as they shuttled back and forth in the same area to pick fruits and feed a Yoshi, especially when standing outside or moving past homes in suburban areas.

Players also reported feeling uncomfortable in industrial and business districts where there were surveillance cameras: “The industrial area over the road from my house. Lots of Yoshis and plantations but too many cameras and security guards.” A few players also felt afraid to play in some areas. One player, unfortunately, reported that he could not play when working, out of fear of getting mugged. He was a water engineer and often had to go to

areas of the city where he feared the PDA would have been stolen out of his hands if he had taken it out. We had initially made it clear to all the participants that they would not be held responsible for the PDA if something like that happened but, when explaining the danger of these areas to us, he asked rhetorically: “why do you think we have this little black button under the dashboard in our car?” Consequently he played very little and obtained the lowest score in his team (Glasgow<sup>2</sup>).

However, other locations felt good to play in. We have already seen that playing at work could feel good, in part due to its illicit nature, and some players enjoyed a sense of familiarity with Yoshis and plantations around their homes, e.g. one player mentioned how good it felt to feed her local Yoshi while in bed at the end of a day. Finally, as noted previously, buses, trains, cars and even bicycles could feel like good, even if somewhat challenging, places to play. In short, a good location for Feeding Yoshi was determined both by the distribution of WiFi but also its ‘feel’.

#### **DISCUSSION**

More than most previous games that have been reported on, players’ experiences of Feeding Yoshi were strongly linked to the large-scale spatial, social and cultural structures of urban environments. In [1], for example, it was reported that players built up experience and understanding of game infrastructure in game terms, in and through their interactions, i.e. in terms of basic game functions and how they fitted together in players’ interactions in different game contexts. Here we see a wider view of context being taken into account, because of the increased spatial and temporal scale of play as well as the game’s internal design. (See [7] for more theoretical discussion of a historical view of context.) The game infrastructure of wireless access points is shaped by existing socio-technical systems, and so different kinds of places were perceived as having different characteristics for play, both in terms of ease and feel of playing. For example, business areas have more closed access points than residential areas and are subject to more explicit security control, and industrial areas and rougher residential areas are less pleasant places to play.

Individuals’ play therefore varied not only with their spatial location, but with their positions within this wider context. The Derby players won the game not only because of their own commitment and collaboration, but because their workplace and their work routines allowed them to take advantage of a city with good areas for play. The Glasgow<sup>1</sup> team not only played in a different city but had different kinds of jobs and enjoyed less opportunities to play than the Derby team. Players accommodated many of the restrictions stemming from their locations and work practices, for example playing while travelling between home and work, but they often also augmented their routines with new practices, varying their commuting routes and making special trips, and developing and sharing strategies such as transporting seeds in order to create useful plantations in convenient locations.

### Feeding Yoshi as a Seamful Game

Players learned to interpret urban environments in ways that would help them play the game, on the basis of their ongoing understanding of the game's technical characteristics, players' practices and the game's wider context. Inherent in the design process was an interest in using the existing ubicomp infrastructure as a resource for design and use, in a seamful way. The existing environment was part of the design context, and of the wider context of use. As Weiser put it, "the unit of design should be social people, in their environment, plus your device". We suggest that Yoshi provides an example of how this can be approached, in that many of players' actions and strategies were specific to the characteristics of the wireless access points and PDAs' networking, used and interpreted on the basis of their experience and understanding of this wider context. Indirectly, players were learning about wireless networks' range, distribution and access control mechanisms, accommodating and appropriating from the perspective of the game rather than from formal education.

Players also became aware of some technical features that we were only vaguely aware of ourselves. In one case, a player became aware—and angry about—the fact that his PDA's 802.11 antenna had a significantly lower sensitivity than his team-mates', even though they were using the same model of PDA. Although we had experienced such variation ourselves in the past, we had not expected that this variation would be the cause of such annoyance to players. The manufacturer may see smoothing this variation out as in their control and in their interests. We do not have that control but, given our interest in seamful design, in the future we may consider new game designs that take advantage of this variation, introducing both advantages and disadvantages for devices that can 'see' further. For example, one disadvantage might be that they can also be seen from further away.

### Implications for Redesign and Evaluation

Our general sense of Feeding Yoshi is that the core game mechanics worked effectively and were engaging, but that the overall structure of the game suffered from some flaws. Specifically, it might be considered a weakness that the initial effort of Derby gave them an advantage for the remainder of the game, making some other teams feel that it would be too much effort to try to win. While we do not wish to conflate success in winning a game with enjoyment of a game, at least one of the teams lost some of the excitement that arises from more even scores. It might even be argued that the current game is perhaps too much about hard 'graft' than about skill or luck. However, there is already a strong element of luck to the game in terms of the characteristics of the environment in which the players find themselves. How then might we improve the level of skill involved in playing the game? In doing this, we have to ask ourselves whether we are changing the game or making a new one.

One option might be to make the game time-limited, in terms of the duration of play. Players would have to score as many points as possible based on a fixed allocation of play each day, requiring more skillful planning or interweaving of play with patterns of everyday life. A variant might be to let players search for Yoshis and plantations as much as they liked, but limit the opportunities to harvest and feed, hopefully increasing the need for strategy or collaboration. The game would then be more about skilful use of information about Yoshis, plantations, and the locations and baskets of other players. On the other hand, Derby played fairly, using an effective strategy. An inherent part of the game is the tension between play and work, and the risks one takes in order to gain an advantage. In this regard, Derby's strategy was like 'stealing the march' on the opposition, travelling through territory or at a time that others were not prepared to brave. Therefore, further game trials will be needed to see whether play like Derby's really is detrimental to the game, and whether we should intervene with design changes.

One tactic that many did feel to be unfair was the way that players could repeatedly move between Yoshis and plantations, scoring lots of points with 'too little' effort. Some players thought that the game would be better if it forced players to keep seeking out new territory, with new access points to seed and feed. To this end, we have considered making Yoshi's favourite fruit change and for plantations to become exhausted after a while. There was also concern about the potential unfairness of competition between quite different locations. Observed patterns of play confirmed that the greater density of access points in metropolitan areas affords an advantage to players compared to, for example, a small city in the country. One option might be to only run games only between areas of similar expected WiFi distributions, or in the same urban area, but even then there will be variations within areas.

A further issue is playing at speed. Several players reported wanting to play in vehicles and there are some good reasons for encouraging this. Time in vehicles is often downtime in which it may be good to play; vehicles cover wider areas than pedestrians and so expose players to a broader variety of locations (perhaps a vehicle-based game would be fairer in terms of experiencing the distribution of WiFi); players are relatively safe in vehicles and may not affect non-players so much; and finally, playing on a train, bus or tram is unlikely to make one late. However, playing at speed was difficult due to the transient nature of WiFi access. A few players felt that this might be a skill one could develop, but several others felt it to be much too difficult. Some tactics, such as 'Drive-By Yoshi', were developed to help in this regard. Factors such as 802.11 range and detection time may be difficult for us to control and change, but we might help players by supporting interaction with Yoshis and plantations that happens more quickly or automatically, with detection triggering quick exchanges—in a way rather like Hocman [10], which supports 802.11 exchanges between motorcyclists passing each other at speed.

## CONCLUSION

This paper has presented what we believe to be the first detailed study of a long-term location-based game, going beyond quantitative analysis to offer more qualitative data on the user experience. We explored how the players interweaved the game into their everyday life. We propose that players benefited from a design that afforded a good deal of flexibility with regard to play. They could augment existing activities, such as travelling to work, or they could develop new game-specific activities, such as Drive-By Yoshi. People could play reasonably well in a relatively small area, and people often preferred not to have to move around far and often, but there were advantages for players willing to cover a larger area, such as discovering new Yoshis and plantations. There was also scope for different degrees of recording and representation of where to play, ranging from just using whatever appeared as one went about one's daily life, to deliberately seeking out and noting areas that were good to play in.

The patterns of use and social interaction around the game were specific to the different players, locations and resources available for play. The quality of play, in terms of collaboration and scoring, depended strongly on the ability of team members to find ways to fit game play into their everyday lives. Play varied with, for example, people's work constraints, routes and modes of transport used in commuting, the character of home neighbourhoods, and choices and expectations as to who to spend leisure time with, and what to do where. We would suggest that, in such a long-term game, there is an in-built tension between game play and the rest of players' lives. To a large extent, this is what gives such games their character. We could change the game to avoid such tension, but this would make for a very different kind of game. The commitment, creativity and strategy of the winning team in our trial, for example, might be frustrated by such changes—although such a team might also adapt their play to a new game.

We suggest that Feeding Yoshi serves as further evidence of the viability of the seamless design approach. Details of ubicomp system infrastructure were selectively and deliberately exposed, in ways that were an essential and enjoyable part of the user experience. Indeed, the core game mechanic of seeking points of open and secure WiFi access was one feature that was strongly appreciated by most of our players.

Finally, we continue to refine Feeding Yoshi, in the light of our experience, but we are also developing new systems that go further in making good use of system features and characteristics that are often considered as features to hide or remove, but which become apparent in interaction nevertheless. Overall, we see this as contributing to our goal of design that supports people in fitting digital technology into their everyday lives, accommodating and appropriating it as they develop and sustain what becomes their technology in their practices and their community.

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