Using Mobile Phones to Reveal the Complexities of the School Journey
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ABSTRACT
In this paper, we present findings of a research project in which mobile phones were used as part of a multi-methods approach to analyze the effects of air pollution on children’s journeys to and from school. In particular, we will present the results from the space-time blogs generated by 30 Year 8 pupils (aged 12-13) on their school journeys during four periods of study across the seasons of a year. The blogs were generated by the teenagers using a specially created application running on a mobile phone linked to a Bluetooth GPS unit and consist of spatially and temporally-referenced texts and images together with a record of their route using GPS coordinates stored at one second intervals. Whilst the blogs generated considerable amounts of quantitative information, particularly when coupled with the pollution profiles of the routes the teenagers travelled, it is the range of qualitative information revealed in the interviews with the teenagers after each study period, using the routes and blogs as a trigger, that demonstrates the benefits of the multi-methods approach. In particular, we highlight some of the depth of contextual information revealed not only in regard to the use of the phone application and GPS unit but also the complex social factors which contribute to formation of the school journey.

ACM Classification
C.3 Special-purpose and Application-based Systems.

General Terms
Human Factors.

Keywords
Mobile, blogging, photo, GPS, travel, school, pollution, health.

1. INTRODUCTION
Whilst we are ever more aware of the environmental effects of vehicle emissions, there is also increasing evidence of the adverse effects of air pollution on our health. Road traffic is principally associated with pollutants such as nitrogen dioxide, ozone and fine particulate matter which are now commonly linked with symptoms of respiratory illnesses including reduced lung function, increased risk of wheeze and rates of hospitalization for asthma [5]. Certain groups are more susceptible to these effects than others. In particular, the young, the elderly, those with respiratory ailments and those completing vigorous exercise within polluted areas. Children are considered to be at particularly high risk as: they breathe more per unit body weight than adults, have immature host defense mechanisms, may spend long periods of time outdoors, and have a higher prevalence than adults of asthma and respiratory infections [8]. One activity that the vast majority of children undertakes often, and generally places them at a high risk of pollution exposure, is the journey to and from school.

Whilst there have been a number of epidemiological studies, with regard to studying the levels of pollution exposure in this area, they have generally employed simplified representations of the complex spatial-temporal variations in human behavior and pollution concentrations [9]. One of the major aims of this project was to provide greater depth of information (or micro geography) about the school journey than these previous studies had been able to provide and thereby address one of the Economic and Social Research Council’s (ESRC), who funded the project, grand challenges for social sciences research, namely, the understanding of individual behaviour.

Although we are familiar with the concept of journeys, they can be difficult to describe or represent since they incorporate both spatial and temporal information coupled with human interactions with, or perceptions of, elements of the environment through which we travel. Indeed, one of the contributions of this paper is to highlight the complexity of factors influencing what may be considered a simple and rather mundane journey such as the trip to school.

To enable us to study the complexity of journeys, tools must be devised which include quantitative elements of Capture, Extraction, Synchronization and Representation (CESR) [3] reconciled with a qualitative understanding of users themselves. To create such a tool for this project, it was decided to couple a mobile phone, which is capable of recording user interactions with the environment through text and images, together with Global Positioning System (GPS) information. In addition to providing the technical capabilities required for the data collection, it has the added advantage of utilizing relatively cheap consumer electronics. There is a further advantage in that mobile phones are already familiar to the majority of school children and are, in many cases, integrated into their daily lives.

2. PROJECT METHODOLOGY
As was stated previously, the overall project used a mixed methods approach using data capture, simulation, and user interviews to draw upon on the expertise from the particular disciplines of the researchers involved whilst ensuring the project

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addressed the requirement to capture the complex nature of the journeys.

In order to meet previously defined CESR criteria a customized application was created called GeoBlog which provided a simple means for users to create geo-tagged photo and text blogs whilst providing background route tracking. Obviously, any project involving children has to consider security implications and whilst it would have been possible to send the data collected over the network, it was decided to store all the information on the phone memory in standard formats which would then be extracted and combined at the end of each study period. In terms of synchronization, the GPS unit provides a universal timestamp which may be used to synchronize multiple sources of mobile information even if there are insufficient satellites to provide a positional fix. Finally, in terms of representation, the GPS routes images etc. are combined to illustrate spatial and temporal behavior augmented with user interactions using a Geographic Information System (GIS).

Thirty teenagers were recruited and each provided with a mobile phone pre-installed with GeoBlog and a separate Bluetooth-enabled GPS unit. Four one-week periods of data capture were organized throughout the year 2007. The teenagers were asked to use the mobile phones to take pictures and create text messages of anything that ‘interested’ them on their journeys to and from school. Follow-up interviews were conducted with the teenagers after each period of data capture in order to gain a deeper insight into factors affecting their choice of routes and associated photographs and texts.

Whilst Kanjo et al. utilized portable carbon dioxide sensors [7] coupled with mobile phones to study pollution, these sensors were relatively large and expensive pieces of equipment used for specific classroom projects and not likely to be easily integrated into a pupil’s daily travel. Neither are they able to provide the type of pollution emission data required. Therefore, in this project, a GIS dispersion model was utilized as it could be developed offline based on the known traffic conditions in the city where the school is located and then combined with the teenagers’ routes to produce individual exposure profiles. The dispersion model, ADMS-Roads, was used to generate concentrations of traffic-related pollution using a combination of manual and automated traffic count with modelled estimates [9].

3. GEObLOG CLIENT APPLICATION

3.1 Overview

A great deal of care and consideration was put into the design of the mobile application GeoBlog, as it would have to be both easy to use and robust to the actions of the teenagers. Normally such applications go through a series of iterative usability testing and modification before completion but due to the time constraints of the project and the fact that we would only have half an hour with the teenagers to explain how it worked prior to them taking the phones home to use, we drew heavily on the experience of a previous phone space-time blogging project called LocoBlog [1].

In the following sections we will present the overall design and rationale for GeoBlog in order to provide an understanding of the generic considerations required for mobile application design and evaluation of the user experience in this particular project.

3.2 Hardware

The criterion for the project hardware was that it had to be cheap (under 200 € per user), robust, easily replicated, and able to be incorporated relatively unobtrusively into the daily activities of the teenagers. With over 3 billion subscribers worldwide, mobile phones are undoubtedly the most pervasive consumer electronic device and are already integrated into the daily activities of both adults and children. Further, they are relatively cheap and easily available and were therefore an ideal platform for this project. Although phones with integrated GPS are now available, at the time of development there were no such devices on the market and a separate Bluetooth GPS module was chosen. Indeed a separate module has additional benefits in that they are relatively cheap and easy to obtain, have improved battery life over integrated devices and, as with the SiRFstarIII units used in this project, some external Bluetooth receivers have technological benefits over integrated GPS due to advanced chipset design (such as faster time to first fix and the ability to maintain signal lock in urban areas). Further, the separate GPS was also small enough to allow it to be attached relatively unobtrusively to the clothing of the teenagers, or carried around the neck. Having the GPS unit worn externally allowed for a better GPS fix (due to greater line-of-sight with GPS satellites) and helped avoid personal security issues that carrying a high end GPS-enabled smart phone in open view might attract. The particular phone and GPS module used are as shown in Figure 1. This particular combination was selected not only because the phone had Bluetooth functionality and a large memory card for storing users’ data but also because it was capable of running the software described in the following section. Additionally the particular physical design of the phone meant that it was also robust, being a sports model, and was such that it was unlikely to yield unwanted attention and the GPS unit could be charged from the same charger as the phone. Further, the phone ran the Symbian S60 3rd Edition OS, a multi-tasking operating system which allowed GeoBlog to run in the background thereby allowing other phone-related tasks to be run concurrently e.g. phone calls, SMS messaging etc.

Figure 1. GeoBlog: hardware (the Nokia 5500 Sport)
3.3 Software

The GeoBlog client application was written for Java 2 Micro Edition (J2ME) enabled handsets. Although, Java is often termed 'a write once run anywhere' language, this is not true on mobile phones [2] and a large number of variants are available. More specifically, the application client requires a phone running J2ME Mobile Information Device Profile (MIDP) version 2.0 with JSR-82, the Bluetooth API. Although this may sound particularly constrictive to those unfamiliar with mobile phone application development, it is a commonly available configuration seen on many phone models regardless of manufacturer.

The application was installed on the phones and they were configured such that it could be run via the left soft key shortcut on the phone’s home screen as shown in Figure 1 to make it easy for the teenagers to find. Due to the physical constraints of the mobile phone interface, successful applications must be simple to navigate with minimal key presses [2] and with this in mind GeoBlog has one main application screen shown in Figure 3 that is controlled by selecting one of the four icons navigable via the phone’s directional key pad. The ‘Hide’ function allowed the teenagers to put the application to run in the background so they could make calls and send text messages and although this could have been achieved via normal phone key actions, it was felt it would aid usability to a less experienced phone user if it were incorporated within the application itself. Whilst the ‘GPS’ function could be selected to gain specific details of the GPS data e.g. latitude, longitude, number of satellites in fix etc. its main function was to indicate the current status for the GPS unit. The icon changed automatically to one of the three states shown in Figure 2 which were indicated as a traffic light with symbols (for colour blind users) to help the teenagers ensure they had a GPS fix prior to setting forth on their journey. It is worth noting that once a GPS fix has been established the current GPS position is recorded automatically, at one second intervals, to a file on the phone’s memory card and every journey (each time the application is started) is recorded in a separate file.

<table>
<thead>
<tr>
<th>GPS not Connected</th>
<th>Connected but no GPS fix</th>
<th>Connected and with GPS fix</th>
</tr>
</thead>
</table>

Figure 2. GeoBlog: GPS status icon.

As the ‘Blog’ and ‘Survey’ screens contain the main user interaction they will be discussed separately in the following sections.

3.4 Blogging

The ‘Blog’ function is basically a four stage process and it was decided for simplicity to maintain the same sequence of actions for each blog entry even though not all actions may be required e.g. the user may not always wish to submit text alongside their photo. The navigation has been kept simple and can be controlled through the two soft keys of the keypad. The soft key labelling is consistent with Nokia mobile application design practice of left key for positive actions and right key for negative actions.

The first stage of blogging process is to take a photo as shown in Figure 3 which represents the viewfinder. A photo is taken when the user selects the ‘Next’ soft key, or the center button (usually mapped to ‘OK’ actions) on the directional keypad.

Once the photo has been taken and processed, the user is presented with the second stage screen – a framed preview of the captured photo. If the user is unhappy with the photo, they can go back to the viewfinder to retake the photo. Once the user selects ‘Next’, to advance to the third stage screen, the photo, alongside the current GPS coordinates (if available) and timestamp are stored to file.

The third stage is a simple self perceived health survey which allows the user to provide a general indication of how the feel at the time they are blogging by selecting the bad, ok or good smiley emoticon. Changing between emoticons is achieved through use of the left/right directional keys.

The final stage allows for textual input as shown in Figure 4. Users are provided with the phone’s standard text editor with which to make their blog entry. Note that we limited the character count to 500, not the 160 character limit of a standard SMS. At the end of the process, the blog text and health status are saved to the phone memory using the same GPS timestamp as the photo.
3.5 Health Survey

The ‘Survey’ function was designed to provide a twice daily self perceived health report which we hoped could provide us with an insight into the general effects of pollution on the teenagers’ health. The survey was restricted to two screens, each with four selectable options, as shown in Figure 5. We limited the number of criteria to prevent the survey from becoming onerous a requirement on the user, particularly as the participants were likely to have very limited free time in the mornings.

Figure 5. GeoBlog: health survey.

The teenagers were asked to complete the survey before they left home in the morning and after they arrived home at the end of the school day. After completing the survey the results were sent via text message to the phone of the researcher liaising day to day with the teenagers during the survey weeks. The rationale for sending the results in this way was not to gain access to the information immediately but rather to allow us to ascertain whether the teenagers were engaging in the project. This was particularly important in the first study period when the teenagers had no experience of the application or of using a GPS device.

4. Study Periods

Thirty teenagers (aged 12-13) were recruited from a voluntary aided comprehensive school catering for 11-18 year olds to which we had an existing link to their Geography department. In 2006, the Ofsted report for the school said that it “attracts many students from some of the most socially and economically deprived parts” of the city. The whole of the year group was invited to apply to participate in the project. In order to participate, parents/guardians of volunteers were required to fill in an authorization form. The 30 teenagers chosen were selected for the project using a range of variables (including gender, location of home address, mode of transport and history of illness) in order to gain a representative sample of 30 young people across the academic range within the school. However, although mode of transport was a factor in selection, most of the teenagers had very mixed modes of getting both to and from school.

During the study periods each participant was provided with a mobile phone pre-installed with GeoBlog and a Bluetooth-enabled GPS unit. Four one-week periods of data capture were organized across the four seasons in 2007 and after each capture week the teenagers were interviewed using their route maps and blogs to stimulate discussion. As part of the project each participant chose a pseudonym which we will use within this paper to maintain the anonymity of the teenagers involved.

4.1 Data Collection Kit

The basic GeoBlog kit was provided to the teenagers on the Thursday before every trial week. This consisted of a mobile phone, charger, GPS receiver and a set of operating instructions together with a recommended daily routine\(^1\). The phone and GPS were numbered and the same kit was assigned to each teenager for all the study periods so that there was no possibility of personal data (that may have been inadvertently left on the phones) being made known to others and in order to maintain the Bluetooth pairing between phone and GPS. The kits were collected on the Monday after each study week so that the data could be collected and the route maps produced for the subsequent participant interviews.

4.2 Data Collected

As one of the major innovations of the project was the mixed methods of data collection, in this section we will examine the performance of the mobile data collection, presenting a sample of how it can be combined and represented.

4.2.1 GPS Data

In theory, the study periods could have produced a maximum of 1,200 recorded routes. However, due to technical issues, user

\(^1\)\url{http://www.geoblogger.co.uk/guide/}.  


illness and unforeseen changes (such as moving house or school) the actual number of recorded routes was 1,080. In terms of quality for estimating personal exposure 113 (10%) of the routes could be considered as good in that they required minimal processing before use as shown in Figure 6. Of those remaining 541 (40%) routes require some processing, predominantly due to a combination of spatial scattering and/or dilution of precision (DOP) due to changes in system or environmental conditions. The remaining 50% of results are insufficiently complete for exposure assessment although could be used to provide some route information. Whilst a 50% data return may seem low, given the well known problems affecting GPS in urban environments and the fact the data was gathered by young and inexperienced users, we believe that overall the project was successful.

Changes in the system or environmental impacts come from a variety of sources, such as a change in satellite position (as they are in non-geostationary orbit), weather, etc. and tend to manifest themselves as changes in positional accuracy or loss of fix. An example of this type of error is illustrated in Figure 8 which shows the same route for one participant on two different days. Whilst the first route is very precise, the other is patchy and broken. This could have resulted from changes in GPS shadowing from buildings, trees etc., due to the satellites orbital position, the effect of bad weather on signal propagation, or simply because the user had put the GPS receiver in their pocket or bag instead of wearing it around their neck.

In terms of the two effects mentioned, spatial scattering was most evident at the start of the journey when the GPS receiver was acquiring an initial fix and at stopping points within the journey. This is likely to be due to the users being stationary in one place but continually changing their orientation with regard to the satellites thus causing confusion in the GPS caching algorithm, producing spatial inaccuracies as illustrated in Figure 7.

4.3 Blogs

In terms of blog entries, 963 were obtained (a few others were accidentally deleted by the teenagers). Of these entries collected, 87% were combined photos and text and these were used to create the route maps such as that shown in Figure 6. In terms of language used, the majority were written using a combination of English, text speak and Ebonics as illustrated by the example from Brook in Figure 9 with the occasional word from the regional dialect such as ginnel².

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Figure 6. Example GeoBlog for Sarah.

![Figure 6. Example GeoBlog for Sarah.](image)

Figure 7. Spatial scattering.

![Figure 7. Spatial scattering.](image)

Figure 8. System and/or environmental DOP.

![Figure 8. System and/or environmental DOP.](image)

Figure 9. Blog entry from Brook.

![Figure 9. Blog entry from Brook.](image)

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² A north of England dialect word for a narrow passageway or alley.
4.4 Health Surveys
Over the four study periods, 817 health surveys were submitted, 60% of which were completed in the morning. Thus far, only a preliminary analysis has been performed and perhaps unsurprisingly most health issues were reported during the winter study period. Interestingly, the next highest period was during summer, with high instances of a snuffy nose which could be related to hay fever. However, given the simplistic nature of the survey, it is difficult to make any meaningful conclusions although the general method could provide a useful feedback mechanism in other studies.

4.5 Pollution Mapping
The dispersion model, ADMS-Roads, was used to generate 15-minute concentrations of traffic-related pollution across the city, as illustrated in Figure 10, which also shows route data for three teenagers. The model created covered the area of the city where the school and homes of the teenagers were situated and used a combination of manual and automated traffic counts and composition data for the major roads and modeled estimates of count and composition for minor roads within the city. From these models and the route data shown it is possible to derive a pollution exposure profile for each of the teenagers on the days in question [9].

5. USER EXPERIENCE
In the previous section we highlighted just a small part of the quantitative data obtained as part of the project and an insight into some of the possible methods of representation. In this section we focus on the qualitative data of the users’ experience of GeoBlog and how the quantitative data from the routes and blogs was used to trigger the discussions with the teenagers.

5.1 Software and Hardware Issues
As part of the interview process the use of the GeoBlog application was discussed, particularly after the first trial period. In some cases the teenagers immediately grasped the project and the technicalities as highlighted by a section from the first interview with Sasha.

Sasha: Yeah it did work really good the GeoBlog. I didn’t have any problems with it. You know when you connect with the GPS I didn’t have any problems. It just did it like that.
M: So you just came out of your house and…
Sasha: …And the tick came on.

However for others there was a gradual learning process and confidence building as in the case of Katie, who attended all of the sessions and took a set of instructions, but was initially reluctant to take photos or write blog text.

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Blog Images</th>
<th>Blog Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2</td>
<td>2</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 1. Blogging activity during project of Katie.
Overall the application itself met the design requirement for the data collection in that it was somewhat transparent to the users. When asked to discuss it, those that had experienced problems using GeoBlog invariably talked about GPS issues. Although obtaining a GPS fix was the most frequent problem encountered throughout the project, the improvement in data quality across the study periods indicated a growing awareness amongst the teenagers of how to use GPS. A specific example of this is demonstrated in the following extracts from the interviews with Faith during the first and second study periods and the blog entry shown in Figure 12.

**M:** You had difficulty getting a fix on the way to school?
**Faith:** The GPS just kept messing up, like I’d get a signal one minute and then it would go away and I’d be like stood there and then the bus would come so I’d have to like run down to the bus stop, so it wouldn’t work...

**M:** Was it easier using the GPS this time?
**Faith:** Yeah cos I was putting it against the window in the morning and so it was getting the connection straight away.

Another hardware issue was related to the teenagers forgetting to charge their phone and/or GPS which resulted in either a failure to gather data or fragmented journeys such as the one preceded by the blog from Charlie in Figure 13. Although forgetfulness relating to keeping the batteries charged was the main problem, on occasion we were reminded that for some it was an economic issue, as is the case with one girl who was unable to charge her phone as the family didn’t have any credit on their pre-paid electricity meter.

The only other hardware related issue concerned the Bluetooth pairing between the phone and the GPS unit. The application allowed the phone to be paired with a specific GPS receiver during start-up by holding down a specific key (*) for a few seconds. This was an undocumented feature, hidden from the teenagers as it was only required to initially configure the system before the kits were issued. However, it became evident during the study that many of the teenagers were also using the Bluetooth on the phones to transfers music, videos, images, etc between each other and in some cases, perhaps to remove the evidence, had un-paired the phone from the GPS using the phone settings. This meant that the application would fail to work when next activated and on a couple of occasions we had to go into school during the study period to repair the Bluetooth pairing. On one occasion we noticed one of the teenagers, Rose, observing the process. Later, in a conversation between Jodie and the project RA, it was demonstrated that Rose had understood the implications:

**Jodie:** Rose sorted it out and put in “0000” and then it worked.

The code “0000” was required to pair the particular Bluetooth GPS used with the phone.
5.2 Social Influences on Data Collection

Thus far we have concentrated on issues directly related to the hardware and software used for data collection during the project. In this section we highlight some of the social influences that impact on the school journey and consequently the data capture. Whilst some of these factors will no doubt appear in future analysis by the social geographers associated with the project, when discussing the school journey, our focus here is to consider how these factors have impacted on the data gathering process itself and how they could be used to improve the analysis of the original route data.

5.2.1 Time

One of the interesting elements of the journeys is how the teenagers managed their timing in relation to different modes of transport. To illustrate this time management, consider Figure 14 which shows representative space-time paths for three journeys by three different pupils on the same morning by foot, bicycle and car. Space-time paths illustrate how a person navigates their way through the spatial-temporal environment. The physical area is reduced to a two-dimensional plane, with these dimensions representing a person’s top-down position (e.g. longitude and latitude). Time is represented by the vertical axis. These three dimensions combine to form a world representing a specific portion of space-time [6].

What is apparent from this figure is that the teenagers set off for school in the following order according to their transportation method: walking, cycling, and finally by car. Whilst the walker and the cyclist arrived early, the car passenger arrived very close to the start of school. This is because the parents, who are obviously in control of the timing of car journeys, are affected by their own travel influences. This confirms existing research relating to the amount and timing of traffic on the school run [6]. It was much more apparent in all other modes of transport that it was mainly the teenagers who managed the school journey schedule and they often chose to travel at a certain time for specific reasons as highlighted by the following extract from Peter.

<table>
<thead>
<tr>
<th>M: So why do you cycle?</th>
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<tbody>
<tr>
<td>Peter: I don't know. I just don't like walking.</td>
</tr>
<tr>
<td>M: Is it because it's quicker when you're cycling?</td>
</tr>
<tr>
<td>Peter: Yeah and I can get up at five past eight.</td>
</tr>
<tr>
<td>M: Well that makes sense. So you get up at five past eight and then you can whizz to school quickly?</td>
</tr>
<tr>
<td>Peter: Yeah.</td>
</tr>
<tr>
<td>M: Do you cycle with anyone or alone?</td>
</tr>
<tr>
<td>Peter: Sometimes I cycle with a lad that lives two doors down but he gets up proper early so I haven't cycled with him in ages.</td>
</tr>
</tbody>
</table>

In terms of the study, these time factors impacted specifically in relation to the participant’s gaining a GPS fix at the beginning of their journeys. Subsequently, this often resulted in modifications of behaviour. For example, consider this extract from an interview with India whose friend called for her each morning.

India: If it's raining I let her in but if it's nice, like today, she waits outside for like two minutes while I get my shoes on...She said to me that it was wicked that I had a phone off school. She was trying to encourage me to do it every day and like to try to get it working but also she was like saying 'hurry up, we're gonna be late for school'.

M: Right, so the fact that she comes for you and then you've got to put your shoes on and then you've got to run out...was that difficult then for you to get that first signal?

India: Mmm unless I set off, like I was stood outside of my door about ten past eight cos she calls for me about twenty past eight.

M: So that's what you do have to do then on that week of the project?

India: Yeah.
In the case of Adam, who travelled with his mum every day in the car, getting the GPS fix resulted in her modifying their daily routine.

M: So you just stood about for a bit until you got the tick and then you got in the car?
Adam: Yeah.
M: Your mum wasn’t saying ’come on Adam we’re going to be late’?
Adam: No, we set off a bit earlier.
M: Your mum set off a bit earlier especially?
Adam: Yeah.

5.2.2 Friends and Family
Another social influence that was clear, particularly through the blogs entries, is that the journeys themselves were often social occasions with the chance to talk to friends, as highlighted from the following comments from Joel.

| M: So how do you get to school then? |
| Joel: Walk; I walk with my friends. |
| M: Right, every day? |
| Joel: Every day yes, I never get a lift, I always walk, the same route with the same people, always. |

In terms of the data collection, the teenagers were often influenced by what they thought their friends might think about their participation in the project. For example, Floyd took photographs on the way to school when he was with his best friend but on the way home he said:

“I didn’t want to take it in the afternoon because I felt embarrassed with all the other people there”.

However, by the fourth study period this had changed as illustrated by Figure 15 and he had started taking photos of them on the way home.

M: You took this one at 15.13 ‘the [river]’ and then you’ve taken one more of the water and you’ve said ‘the [river] looking really blue’.

Another factor evident for a number of teenagers was the complexity involved for those living in non-nuclear families. This sometimes meant that teenagers stayed at different homes on different days of the week or met up with parents they no longer lived with on certain days after school. The main impact of this on the data was that whilst certain children might have been chosen for a particular attribute, such as their home location, this could not always be relied upon to be static.

5.2.3 Safety
Throughout the interviews, safety issues were apparent not only in how the teenagers travelled to school but also in where and when they travelled. In some cases, particularly amongst the girls who walked, parents often defined places or occasions when certain routes should be avoided.

During the project we encountered a specific example of how safety concerns were not unfounded by the teenagers. One of the teenagers, Jessica, was rather nervous at the start of the process primarily due to shyness using the equipment in public rather than as a safety concern and only managed two blogs in the first study. However, during the second study she took six photographs and was making very meaningful observations about her journey as the following interview section and corresponding blog reveal.

Figure 14. Blog entry from Floyd.
Jessica: Yeah 'cos usually it's not that blue 'cos it's usually all mucky and grey and everything so I thought I'd take it 'cos it looked really blue.

M: So do you feel like the [river] is important on your journey?

Jessica: Yeah 'cos it's the main thing that stands out and as I'm walking to school it's the main thing that's there all the time and sometimes it overflows... so you can tell if the sea level is rising and when it's not or if the tides in or when it's out by the [river].

Figure 16. Blog Entry from Jessica.

However, in an incident that took place between the second and third study period, Jessica was attacked in the park and from then on she kept both her GPS and phone hidden, managing no blogs in the third period and only one in the fourth.

A factor which was often seen to negate the fears of parents, as illustrated by the following extracts from Claire and Bernard, was ownership of a mobile phone by the teenagers. This does raise an interesting question for debate as to whether some schools should allow phone use by pupils if they can allay some of the fears of parents about letting them travel to school alone.

M: So your mum and dad aren't so bothered about you going through this bit of the park on your own?

Claire: No they don't care because they know like what's there and if I get into trouble I can like defend myself and they like let me walk anywhere as long as it's bright and I have to have a phone on me.

M: ...So if you missed the bus on the way home would your mum be worried?

Bernard: Not really cos I get credit ...and I text my mates and stuff but I always leave 50p on so I can text my mum.

6. CONCLUSIONS

The project presented in this paper provides a very practical illustration of the enormous possibilities for using mobile phones to enable members of the general public to collect large amounts of spatial and temporally referenced data as part of their daily activities. We believe that the project clearly demonstrates that mobile phones are particularly well suited to this type of study as they are already part of the daily lives of a large proportion of the population and when coupled with a carefully designed application can produce significant results by following the criteria of CESR.

Whilst raising environmental awareness amongst the teenagers was not one of the principal aims of the project, we hoped that their participation would have a positive effect and that they would feel justifiably proud of their efforts. During the last interview we asked all the teenagers about their experiences. We were delighted by the majority of their responses. The following comment from Louise expresses the feelings of many, if perhaps more eloquently than others and highlights that mobile may well help engage teenagers more readily in such projects given that this was outside their normal activities.

M: So do you think that because we've asked you to take photographs of what you've seen and then I started asking questions like what do you like on your journey, what don't you like on your journey ...and things like that do you think that's affected the way you feel about the places that you pass through on your way to school?

Louise: Yeah, it's made me notice them more.

M: What sorts of things do you think you've noticed?

Louise: I don't know really erm the whole journey I suppose through the different seasons.

M: Right 'cos this one is definitely autumn...you've taken a photo in the park of the conker tree so it's obvious from your photos...so do you think you been more aware of the changing...

Louise: ...around me, yeah

M: With the trees and...

Louise: ...like before I used to think 'oh god the winter' and I used to just go to school every day, come home every day; it was like a timetable. I've started taking more notice of my surroundings, sort of looking. Even though I do the same route every day, there's something different every day.

The contribution of this paper is to provide a practical demonstration of the benefits of cross disciplinary research and the power of adopting a complimentary multi-methods approach. In particular, this paper has illustrated how the quantitative route data and blogs produced by the teenagers helped inform the subsequent interview process and the resultant qualitative information revealed both the teenagers experiences in using mobile phones and application together with the complex influences on the journey to school.
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8. REFERENCES


