

Abstract

This paper explores how to research the opportunities for emotional engagement that mobile technologies provide for the design and enactment of learning environments. In the context of mobile technologies that foster location based linking, we make the case for the centrality of in-situ real-time observational research on how emotional engagement unfolds and for the inclusion of bodily aspects of interaction. We propose that multimodal methods offer tools for observing emotion as a central facet of person-environment interaction, and provide an example of these methods put into practice for a study of emotional engagement in mobile history learning. A multimodal analysis of video data from sixteen pairs of 9-10 year olds learning about the WWII history of their local Common is used to illustrate how students' emotional engagement was supported by their use of mobile devices through: multimodal layering and linking of stimuli; the creation of digital artefacts, and changes in pace. These findings are significant for understanding the role of digital augmentation in fostering emotional engagement in history learning; informing how digital augmentation can be designed to effectively foster emotional engagement for learning; and provide insight into the benefits of multimodality as an analytical approach for examining emotion through bodily interaction.

Keywords: multimodality, mobile technologies, emotional engagement, history learning

Introduction

This paper aims to show the potential of a multimodal approach in providing insight into the bodily opportunities for emotional engagement with the in-situ history experiences that are opened up by children's use of mobile technologies. By bringing emotional engagement into focus in this paper we are not suggesting that it is more important than engaging with learning processes socially, behaviorally or cognitively; or that it is independent of these. Rather we focus in on emotional engagement as one type of engagement. Indeed this paper points to how intertwined these different kinds of engagement are in learning (Fredricks, Blumenfeld, & Paris, 2004). Emotional engagement is used as a central concept in this study to focus attention on person-environment interactions and how emotional responses unfold through interactions with specific stimuli in the learning environment. That is we understand emotion as existing via person-environment interactions rather than residing in either an individual or the object/environment (Schutz et al., 2006). Through a grounded analysis of the data, and drawing on the literature on emotion and history learning this study focuses on a range of emotional expressions including empathy, care and protection, respect, pity, and excitement. This study suggests that these types of emotional engagement underpin practices that are significant for in-situ history learning using mobile technologies.

Mobile technologies offer the potential to change how learners engage with the environment (Price & Rogers, 2004; Sharples et al., 2007). Context-related digital augmentation can be coupled with the physical environment to provide new information not visible or readily available in the physical world. This foregrounds key information relevant to the learning task, links information to specific physical locations to foster

different experiences of that 'place', and guides or directs learners' attention in useful ways. Different experiences of place connect with history learning: historical events are associated with a particular place, and digital augmentation in-situ through mobile technologies enable the re-imagining of space in ways that can foster emotional engagement - an important component of history learning (Davis et al., 2001; Rosiek, 2003; Stuart, 2001). This study moves beyond previous research on digital augmentation which focuses on emotional engagement among users in terms of concentration and enjoyment (Jones et al., 2003; c.f. Huizenga et al., 2009) to examine how contextually relevant digital augmentation prompts and supports empathy and mediates emotional responses to places and their histories. It illustrates how students' emotional engagement, promoted by in-situ experiences are central to practices of significance for history. This includes practices of textual reflection and interpretation, making links between the present and the past, identification with people and their experiences in the past, memorialization, and the re-imagining of places through history.

Researching students' emotional engagement during digitally augmented explorations of place presents methodological challenges: it requires an analytical framework that looks at emotion as it unfolds in the moment of the person-environment interaction and this happens through various modes of interaction. This study demonstrates the potential of multimodal methods in this complex field, providing an analytical process that looks at emotional engagement as a social process that unfolds in-situ and over time and through a range of modes of communication, including the non-verbal. In this way we hope to contribute to methods that can examine emotional engagement as it is experienced and enacted through the body (Horton & Kraftl, 2006;

Davidson & Milligan, 2004) in ways that attend to the features of digitally augmented exploration of place in the context of history learning.

Multimodality is an inter-disciplinary approach that is concerned with understanding how people communicate and represent meaning and attends systematically to the social interpretation of a range of forms of making meaning (Jewitt, 2014; Kress, 2010). This paper argues that it can provide insights into how emotional engagement is realized through the body and how it plays out as part of the wider person-environment interaction and in-situ learning. It provides concepts, methods and a framework for the collection and analysis of visual, aural, embodied and spatial aspects of interaction and environments. These aspects of interaction, as well as speech and writing, are all seen as parts of a larger multimodal ensemble. While other modes of communication, such as gesture, have been recognized and studied extensively, multimodality investigates the interaction between communicational means and in doing so it challenges the prior predominance of spoken and written language in research (Scollon & Scollon, 2014).

Three interconnected theoretical assumptions underpin multimodality and inform this paper (Jewitt, 2014). The first assumption is that all modes are theoretically equal. A form of communication is considered a mode if it has a regular set of elements, the use of which is governed by clear organizing principles and norms, and is a recognized, regularized usable system of communication within a community (e.g. gaze). A mode is a social communicative system, shaped by and embedded in a clear community of use (Kress & van Leeuwen, 2001). For example, when a person speaks from a multimodal perspective how and where they look, their use of gesture may be equally important in

understanding their meaning, for instance when giving directions, or when the meaning of what a person says appears to be in direct contrast to the meaning of their facial expression, posture or gesture. Thus, the starting point for multimodality is that all modes that are a part of a representation and/or an interaction need to be included in the analysis, with a view to understanding the choices available to communicators, its potentials for meaning and the purposes for which they are chosen. The second assumption is that all modes have, like language, been shaped through their cultural, historical and social uses to realize the social functions required by specific communities. For example, gaze, gesture, and posture have all been shaped in different ways to realize the social function of close-ness or distance, and different cultural contexts have shaped these differently. Following on from this, each mode is understood as having different sets of semiotic resources with different meaning potentials and realise different kinds of communicative work. Multimodality takes all communicational acts to be constituted of and through the social, and draws attention to the ways in which communication is constrained and produced in relation to social context. This emphasis on the social points to how modes come into and are used in spaces, and this connects with the third assumption that people orchestrate meaning through their selection and configuration of modes into multimodal ensembles. The interaction between modes is significant for multimodality as the meanings realised in one mode is always interwoven with the meanings made with the other modes co-operating in the communicative ensemble. The interaction between modes is itself understood as a part of the production of meaning.

The study presented in this paper asks: how is students' emotional engagement elicited through attention to the different modal affordances, and multimodal ensembles

afforded by the digitally augmented explorations of place? How can emotional engagement be made visible through analysis of modes of bodily activity? How can emotional engagement be researched by attending to interaction with the multimodal environment? The analysis explores the intersection between the multimodal interaction, types of emotion and features of mobile technologies to address these questions.

These three questions are important to investigate as there is increasing interest in the beneficial role of emotion in learning, alongside which mobile technologies and digital stimuli bring with them new opportunities, making it an imperative to better understand how emotional engagement unfolds through person-environment real-time interaction. It is important to understand how students' interaction with the location-sensitive qualities of mobile technologies can support emotional involvement and attachment with places, enhance their range of emotional responses, facilitate memory, and support authentic (rather than sentimental) experiences for history learning. Such knowledge will help to inform better design mobile digital learning environments. In addition, addressing these questions is methodologically significant as we urgently need to broaden our methods for measuring emotion in order to better account for emotional engagement in multimodal digital learning environments in which language based retrospective methods are inadequate to capture the role of real-time in-situ embodied interaction that such technologies support.

Background

Emotional Engagement and history learning

As noted in the introduction, while we focus on emotional engagement, we understand engagement with learning processes as involving social-behavioral, cognitive and emotional engagement (Fredricks, Blumenfeld, & Paris, 2004). Emotional engagement has been conceptualized as the emotions that individuals experience while completing an activity, such as excitement, joy, sadness, anger or pity (Harris, 2008; Miserandino, 1996). While the term ‘affect’ refers to an experiential shift in the intensity of experience (Shouse, 2005), the term ‘emotion’ suggests the existence of both an experiential shift and environmental stimuli responsible for causing the shift (Gross, 1998; Schwarz & Clore, 1996). Emotions are therefore understood as existing via person-environment interactions rather than residing in either an individual or the object/environment (Schutz et al., 2006). Emotional engagement is used as a central concept in this study to focus attention on person-environment interactions and how emotional responses unfold through interactions with specific stimuli in the learning environment.

There has been a growing interest among educational researchers in considering the role of emotion in learning (Schutz et al., 2006; Linnenbrink & Pintrich, 2002). Learner motivation, correlated with achievement, has been linked to the emotions that learners experience while completing a task. Students have been found to be more motivated to complete a task when they feel positive emotions towards the task such as joy and excitement (Efklides & Petkaki, 2005; Linnenbrink & Pintrich, 2002). Emotion has been shown to influence what is attended to in the environment and what is later remembered by learners (Woolfe, 2006), and emotive stimuli are more likely to be remembered after the completion of the task than neutral stimuli (Kensinger & Corkin,

2003). Both of these findings link emotion to attention and memory, and suggest that how learning unfolds is influenced by students' emotional engagement with the environment. In turn, this suggests that designing successful learning environments depends partly on considering the part that emotional engagement will play in the task.

According to Woolfe (2006, p. 37), learning depends on "whether or not it has an emotional hook" suggesting that emotional responses play a central role in the learning process. Furthermore, Woolfe argues that sensory, hands-on learning is more likely to bring learners into contact with emotive stimuli in the environment and is therefore more likely to be emotionally engaging. For example, a learning activity that involves an exploration of a local site of interest will promote emotional engagement among students as a result of students' "emotional involvement with places" (Hummon, 1992, p. 256) and if the place is familiar, the students' learning will be influenced by their "place attachment" (Hidalgo & Hernandez, 2001). According to Waite (2007), learning that takes place outside of the classroom can be highly emotive, and as a result, more memorable. The highly sensory nature of the outdoors experience played a key role in memories reported by children and adults, who demonstrated a "valuing of authenticity of experience" (p. 340). This paper reports on emotional engagement with respect to physical experiences of place, and considers the potential influence of digital augmentation via mobile technologies on how emotional responses unfold.

In history learning, emotion plays a recognized role in students' interpretations of the past and the empathy they may feel towards others' experiences. Alongside knowledge acquisition, history learning involves a developing understanding of the lived experiences of people in the past, including individuals' emotional responses to the

events that they experienced in their lifetime (Volk, 2013). Such an understanding relies on the student's emotional engagement, and suggests that a level of "emotional scaffolding" (Rosiek, 2003; see also Baum, 1996) is necessary when designing history-learning environments. On the other hand, some history educators argue that sentimentality, for example, can stand in the way of historical thinking and the process of perspective-taking that many consider to be central in genuine experiences of empathy (Davis et al, 2001). In order for empathetic responses to occur, students need to have an understanding of the historical context in which events took place, and to apply an analytical lens to human action that occurred in the past. Thus, while an 'emotional hook' (Woolfe, 2006) will make learning more memorable, empathetic historical interpretations depend on a hook coupled with the student's contextual and chronological knowledge. This suggests a need for learning environments that stimulate emotional engagement while simultaneously offering a richer understanding of historical events and a chance to interpret the human actions underpinning them through multiple sources representing various perspectives (Stuart, 2001). Digital augmentation via mobile technologies may offer an 'emotional hook' through the students' presence in a familiar outdoors environment, while simultaneously acting as a platform through which students can access the material that will enable them to develop a richer understanding of context and engage with different perspectives.

In summary we conceptualize emotional engagement for learning as related to person-environment interactions with indicators including a range of emotional expressions including empathy, care and protection, respect, pity, and excitement, with attention to links between emotion attention and memory, emotional interpretations of the past, shifts

in emotional responses and their intensity, and the role of digital augmentation as emotive stimuli in the learning environment.

Digital augmentation and in-situ learning

Digitally augmented spaces are designed to support new forms of learning. Digital augmentation creates distinct opportunities for the layering of stimuli, so that a learner's physical surroundings and their "physicality in interaction" (Price & Rogers, 2004, p. 138), along with digitally presented multimodal stimuli are drawn into the learning process (Sharples et al., 2007). When learners participate in a digitally augmented exploration of place, they can be supported in making links between the physical environment and context-relevant digitally presented information (Price et al., 2003; Rogers et al., 2004), or engaging with a virtual digital overlay in familiar physical locations (Facer et al., 2004; Klopfer & Squire, 2007). Location-sensitivity means that digitally presented stimuli can be directly linked to a learner's current physical context (Sharples et al., 2007). Furthermore, learners can digitally augment their surroundings themselves through the creation of artefacts (photographs, audio recordings, text) that relate to their physical surroundings and present experiences (Jones et al., 2003).

Research on mobile technologies in learning scenarios has typically focused on enjoyment or motivation at a general level, rather than more specific forms of emotional engagement. Quasi-experimental studies into digital augmentation in history learning, have showed heightened levels of concentration and behavioural engagement among these students compared with a group who completed similar activities using paper-based materials (Ardito et al., 2009), or no statistically significant difference in measures of

motivation between those students completing a digitally augmented exploration of the city and those who learned similar content in a classroom setting (Huizenga et al., 2009).

Research designed to look specifically at emotional engagement in digitally augmented activities has focused on retrospective accounts of emotional engagement. As part of the project *MobileBristol*, Jones et al., (2003) examined how mobile technologies to make soundscapes changes the way children emotionally engage with the spaces around them. They found that the soundscapes contributed to a “digital possession of the space” (p. 173), whereby children expressed a stronger sense of ownership and heightened emotional attachment to physical environments that they had previously associated with adults. While this research suggests that mobile technologies have the potential to influence how emotional engagement unfolds, it did not look at emotional engagement in real time. Instead, the researchers used retrospective accounts from children to access emotional engagement in relation to place. The research presented in this paper builds on this research in new ways: while it also examines emotional engagement it does so by examining emotion as it unfolds through multimodal interaction during the exploration of place.

Methods for studying emotional engagement

Psychologists measuring emotion have often used self-report measures in which participants are asked to retrospectively rate or describe their emotions in a particular situation or in relation to a particular object. This has led to the development of scales for rating emotional responses. For example, Edell and Burke (1987) developed a verbal feelings scale (e.g. ‘sad’, ‘angry’, ‘elated’, ‘confident’) to measure emotional engagement

with different forms of advertising. Bradley and Lang (1994) developed a non-verbal, pictorial scale for participants to rate their emotion on a self-assessment manikin, which consisted of a series of diagrams designed to represent three dimensions of emotional response: arousal, dominance and pleasure. Similarly, Desmet (2005) measured emotional engagement with different consumer products by asking participants to evaluate their emotions by identifying an animated cartoon character that best matched what they felt when interacting with the product.

Other researchers have developed more open-ended measures to look at children's emotions in relation to place by asking them to take photographs of a particular environment and then retrospectively reflecting on why they had taken them and how they made them feel (e.g. Orellana, 1999; Morrow, 2001; Hume et al., 2005). These measures of emotion are limited in that they focus on a 'snapshot' articulation of emotional engagement, rather than examining how emotion unfolds through the course of an interaction (Scherer, 2004), which is a central aspect of emotional engagement in the context of in-situ mobile learning. This approach to measuring emotion is unable to capture information on real time changes in emotional engagement, which play out through bodily interactions and are difficult to capture in retrospective, self-report measures. In-situ real-time observations of emotional engagement are therefore needed in order to see how emotion plays out in a particular context over time. Furthermore, this paper argues that conceptualising emotions as part of the 'person-environment interaction' (Schutz et al., 2006) or as "action positions" (Bradley & Lang, 2000, p. 242) means that they cannot be adequately captured through measures that focus on verbalization. Researchers, notably those within children's geographies, have argued that

the embodied nature of emotion has typically been ignored in favour of measures of emotion that rely on linguistic or pictorial means (e.g. Horton & Kraftl, 2006; Davidson & Milligan, 2004). According to Bradley and Lang (2000, p. 243), “we cannot expect emotional language (as in descriptions of inner feeling) to be wholly coordinate with the logistics or output of action”. Physiological measures of emotion are a response to these demands (Scherer, 2004). Past studies have used a range of physiological measures to trace emotion including event-related potentials (Lewis et al., 2007), respiration, skin conductance and heart rate (Gomez & Danuser, 2007). However, studies suggest that the experience of emotions is only weakly linked to these general physiological responses (e.g. Mauss & Robinson, 2009), while visible behaviours are more closely correlated to self-reported emotional responses (Bonanno & Keltner, 2004).

Behavioural measures of emotion have tended to focus on facial expressions. For example, Mauss et al. (2005), building on the work of Ekman and Friesen (1978) on emotional expression, asked coders to monitor facial expressions for varying levels of amusement and sadness while participants watched films designed to evoke emotional responses. Particular expressions were taken as indicators of experienced emotion, for example smiling and laughing were taken as indicators of happiness, while a furrowed brow was taken as an indication of sadness. This approach to measuring emotion posits emotional engagement as something internal to the participant that becomes visible through an external display; that is, facial expressions are taken as representative of internally experienced emotions. As this study builds on an understanding of emotion as part of the ‘person-environment interaction’ (Schutz et al., 2006) and theories of multimodality, it is argued that emotion ‘plays out’ through visible behaviours, rather

than simply being represented by these behaviours. Thus, facial expressions are taken to be not just a *measure* of emotional engagement but instead are seen as a fundamental *part* of the experience of emotional engagement, along with a wide range of other modal resources including movement, gesture, manipulation and touch which change moment to moment in the unfolding interaction.

Multimodality

Multimodality provides a set of concepts to support a complex fine-grained analysis of artifacts and interactions. Here we briefly introduce three concepts that are key to the multimodal analysis in this study: modal affordance, multimodal ensemble and multimodal layer.

The term *modal affordance*, adapted by Kress (e.g. 2010) from the work of Gibson (1979) and later Norman (2013), refers to the potentialities and constraints of different modes – what it is possible to express and represent or communicate easily with the resources of a mode, and what is less straightforward or even impossible – and this is subject to constant social work. From this perspective, the term ‘affordance’ is a complex concept connected to both the material and the cultural, social and historical use of a mode. Modal affordance is shaped by how a mode has been used, what it has been repeatedly used to mean and do, and the social conventions that inform its use in context (e.g. in this study we discuss how the students’ use of audio recording may connect to ideas of radio or television interviewing). Where a mode originates, its history of cultural work, its provenance, shapes its potential for meaning. These affordances contribute to the different communicational and representational potentials of modes.

Within a multimodal perspective, representations or interactions that consist of more than one mode are referred to as a '*multimodal ensemble*'. When several modes are involved in a communicative event (e.g. the student's interaction with the tablet, app, or one another) all of these modes combine to realize meaning. However, meaning may not be distributed evenly across all modes. Different aspects of meaning are carried in different ways by each of the modes in any ensemble. We can extend this to argue that any one mode in any ensemble is carrying only a part of a message and that therefore each mode is partial in relation to the whole of the meaning, and speech and writing are no exception to this partiality (Jewitt & Kress, 2003). Multimodal research, for this reason, attends to the interplay (e.g. tensions, contradictions, alignment) between modes and the specific work of each mode as well as its contribution to the multimodal ensemble. Modal affordance in the context of multimodal ensembles raises the question of what a mode is 'best' for as well as what other modes and their configuration is 'best' for in a particular context.

Multimodal layering is realized by linking the modal resources (e.g. gaze, gesture) available to a sign maker, in the case of this study that is students connecting digital stimuli and the physical environment, in order to produce a material layer of experience. The process of multimodal layering consists of three distinct but inter-connected stages: 1) making a physical link between the physical environment and a digital stimuli; 2) making a link to prior knowledge and experience; 3) making an emotional link with the stimuli and the environment/location to create an imagined *multimodal layer*. The layer supports a re-imagining of place, which in turn supports reflection and interpretation of multimodal artifacts.

Multimodality emphasizes situated action, and sets out to interrogate the inter-relationship between the social context, the resources available to people within that context for making meaning with, and people's situated choice of resources. Thus this approach opens up possibilities for recognizing, analyzing and theorizing the different ways in which people make meaning and the place of resources and context in this process. In this study meaning is understood as being realized in the iterative connection between the meaning potentials of the mobile app, the social and cultural environment of a school trip to the local Common in which the app is encountered, and the resources, intentions and knowledge that the students bring to that encounter. That is, we strive to connect the material semiotic resources available to the students with their expression of emotion, and what this signifies in this social context. Changes to the resources (such as the changes supported by the mobile devices and stimuli in this study) in a learning environment and how they are configured are understood as significant for communication, and in this context, emotional engagement. Our focus is not on identifying the types of emotions, for example we do not use a multimodal analysis to map the students' gaze, facial expression, tone of voice, and so forth to specific types of emotions. Rather we show how we can use multimodality to identify and interrogate episodes of emotional engagement.

Methods

Study Design

The study was designed to investigate how mobile technologies influence students' experiences of place and history learning. In the exploration task student pairs engaged with historical events and experiences of the local Common during WWII by engaging

with a set of location-based tasks via a digital environment constructed for the iPad. This study asks how a multimodal analysis of video data can enable insights into the students' emotional engagement as a result of their digitally augmented exploration of a local site of interest. More specifically it asks: how can students' emotional engagement be elicited through attention to the different modal affordances, and multimodal ensembles afforded by the digitally augmented explorations of place? How can emotional engagement be made visible through analysis of modes of bodily activity? How can emotional engagement be related by attending to interaction with the multimodal environment?

Participants

Participants, aged 9-10 years, were recruited through an inner London primary school with a primarily working class, ethnically and religiously diverse student population. Out of 60 children undertaking the exploration activity and invited to participate in the research, over a half (32) provided parental consent to participate in data collection for research purposes: 17 girls and 15 boys. These students were organized into 16 pairs selected by the teacher on the basis of working well together.

Activity Design

The activity was designed to engage students in an exploration of the experiences and events of WWII that had a particular association with their local Common. The design of the activity was based around the application *Evernote*, which allows the creation of written, visual photographic, and audio notes and for these notes to be synchronized across devices. For this study activity, fourteen notes on WWII were constructed and positioned on a map of Clapham Common (Figure 1). The overall design of the activity was one of exploration and comparison of the past and present experiences of the

Common, through a process of visual, aural, and embodied contrast and comparison. The design of the notes included the emotional dimensions, discussed later. The design was presented as an open experience rather than as a linear narrative: there was no starting or end point, and the students could explore the flags in any order they chose. The flags mark the location of a note and serve as a prompt for the students' exploration. The flags created by the students are stored on their iPads and are not shared in-situ with the other students. This was for both pragmatic and safety reasons associated with the difficulty of setting up a wireless network on the Common, and pedagogic reasons, the need to keep the students on task with activity, and to allow each student to explore the Common in their own way and pace. The design supported teachers selecting and working with shared student created notes later in the classroom, though this was not a part of this study.

Figure 1: Evernote map of Clapham Common, screenshot of app on researchers' iPad device

The pedagogical underpinning of the activity design is exploratory learning with attention to history and place, notably the making of links between the past and the present. The materials link to the primary history curriculum and the planned classroom activities of the school from which the participants were recruited. The notes were a mixture of digital media and modes including photographs, drawings, written comments and sound clips. The materials contained in the notes were selected on the basis of their relationship to WWII as it was experienced on or near to the Common and its potential interest to the participating children. The black and white photographs and written testimonies came from the local historical society archive, while sound clips were taken from online sound archives. Each note told the story of an experience or event related to

WWII e.g. photographs of people sleeping in the deep shelters (Figure 2); images of people working on war-time allotments on the Common; and immigration to South London in the post-war period - notably Caribbean immigration and the arrival of Windrush. The focus on experiences that affected people was elaborated further in some instances, through the use of imagery, words, or sounds of individuals (e.g. a letter from the reverent about the church bombing; an oral testimony from a woman talking about sleeping in the shelters).

Figure 2: Sleeping in the deep shelter, image reprinted with permission of The Times, originally published by The Times 22nd July 1944

The emotional dimensions of notes were designed by drawing attention to emotional aspects of the experiences or events depicted in the notes through the use of personal narratives that included discussion of emotions, sounds that were emblematic of the war with symbolic emotion significance (e.g. an air raid siren, soldiers marching), and the use of accompanying questions. For example, one note contained a photograph of people in the deep shelters that were built under the Common (Figure 2). Written questions invited participants to consider how the people in the image might have felt or what their facial expressions suggest about the emotions they were experiencing. Notes prompted students to engage and reflect on their experience of the current environment through questions or reflection activities. For example, one note invited students to make an audio recording about the sounds they could hear on the Common, while another asked them to take a photograph of the activity they could see on the Common today. Not all notes explicitly encouraged students to take a photograph or make an audio recording,

yet students typically used these functions, often responding to notes by creating content of their own. This reflection provided an opportunity for emotional engagement.

Notes were each represented by a flag positioned on the map of the Common (Figure 1) primarily based on the relevance of the location to the information contained in the notes (e.g. notes that referred to the church were positioned beside the church). When notes did not relate to a specific location on the Common (e.g. the note on immigration to South London in the post-war period), they were placed in an area away from other notes but within easy walking distance.

Procedure

The activity was introduced to the students in their classroom as a school history trip to explore experiences of WWII on Clapham Common and to compare the historical experiences they learn about with the experiences they have of the Common in the present day. The students were taken out of their classroom during their regular curriculum time, and walked to the nearby Common. Five pairs of students each accompanied by a researcher engaged in the activity at one time. Over the course of 2 days all 30 pairs took part in the activity, with 16 pairs having provided parental consent for data to be collected and used for research. Each pair received a five-minute interactive demonstration of the *Evernote* app and tasks from one of the researchers. In the demonstration, they had an opportunity to practice accessing and creating flag by taking photographs, making audio recordings and writing captions.

After the demonstration, the pairs competently used the application with little or no scaffolding. The researcher took the role of a 'guiding' facilitator - helping the students with any technical difficulties, and as timekeeper, responsible for ensuring that

the students returned to the meeting place after 25-30 minutes of exploration. The researcher made very occasional on the fly interventions to manage disagreements between pairs, road safety, or to prompt students to engage with the activity. This minimal facilitation was designed to ensure the interaction we observed was primed by the mobile activity. The students decided themselves how they wanted to use the iPad in their exploration of the Common and its WWII history. The pairs moved around the Common for 25-30 minutes accessing and responding to the flag on the *Evernote* map (described in the activity design). The researcher accompanying each pair captured the exploration on video with a handheld camera. While a researcher/adult to child ratio of 1-2 was required for the purposes of the study this would not be necessary for pedagogic purposes placing similar activities within the reach of a school environment.

Analysis

The analytical framework used in this study applies the multimodal concepts outlined earlier in this paper. We examine how the students' interaction is constrained and engendered in relation to their use of the iPads, the resources of *Evernote*, their interactions with one another and crucially their location on the Common. We emphasize how the students' in-situ interaction with their environment, and the iPads engages them with particular modes, modal affordances, and materiality, and how they engage with emotional meanings through their selection and organization of these to produce multimodal ensembles/layers.

A multimodal analysis was conducted on videos of the 16 student pairs' explorations to explore how this approach can provide insights on emotional engagement, with attention to episodes of emotional engagement that the in-situ use of mobile

technologies appear to prompt and support that are relevant to history learning. While this study points to a range of emotions that the students' use of mobile technologies prompted, we do not set out to provide an account of *all* aspects of the emotional engagement of *all* of the pairs; nor do we set out to quantify or map the modal expressions of emotion to specific types of emotion; or to identify missed opportunities for emotional engagement. The analytical process is a grounded process, moving iteratively across three stages, a telescopic progression (though not always in a linear way) from a wide analytical lens to a close-up lens, to focus in on specific instances in detail: 1) immersion in the data to produce a rough multimodal descriptive overview of the data, a rough multimodal transcript and to identify emerging themes; 2) intensive viewing and sampling of the data; 3) the production of fine grained multimodal transcripts and multimodal analysis of the data, in the context of emotional engagement linked to the use of in-situ mobile technologies.

The first stage of this analysis comprised repeated viewing of the video data and the production of a log of the whole video to provide an overview of the students' activity in the video, their route and the flags they engaged with etc. These logs were used to support team viewing and video data management. The research team's preliminary analytical comments generated through intensive viewing of the video were recorded alongside this descriptive overview. Emotional engagement emerged from the preliminary analysis of the data, and linked to themes in the literature notably the role of empathy and emotion in history learning and experiences of space and place afforded by mobile technologies. This iterative move between the study data and the research literature generated the focus of this paper. A first stage, transcript of the video of each

pair's interaction was produced to gain an overview account focused on their use of modes. This included movement, body action (including gaze), and their interaction with the iPad (Figure 3). 'Movement' recorded whether participants were standing still, walking, running or turning. 'Interaction with the iPad' recorded how the students were engaged with the application *Evernote* (e.g. whether they were accessing a note or creating a note of their own - taking a photograph or making an audio recording). This category also related to interactions with the GPS representation on the map (i.e. the GPS marker, a blue flashing dot) and the extent to which the students were monitoring and responding to this representation. 'Body action' recorded all other interaction such as pointing, gesturing or lifting the iPad to frame the environment. The students' speech was noted along with any of the researcher's interaction with the students. These first stage transcripts provided an additional lens with which to view the video data in order to identify and verify episodes of emotional engagement.

Figure 3 Example transcript

The second analytical stage used these overview transcripts alongside the video to identify episodes where emotional engagement was prompted or supported by the in-situ use of mobile technologies in ways that were relevant to history learning. These episodes were identified by attending to a range of multimodal aspects of the students' interaction, in the context of interaction with the mobile device and history learning: for example, the use of language explicitly referring to emotion (e.g. 'happy', 'sad'); the use of a gesture or movement associated with emotion (e.g. a clenched fist raised in the air to indicate triumph or joy); changes in movement and pace and/or the presence of a facial expression that suggests an intensity of feeling (e.g. a furrowed brow); the role of the mobile

device/software application in relation to the interaction observed; and the connection with emotion and history learning, drawing both on the explicit and implicit links made between the past and the present, and on ideas from the literature on emotion and history learning. Following Schutz et al. (2006) in the understanding of emotion as part of the person-environment interaction, these modal indicators of emotion were considered in relation to the students' experience of the environment through the mobile device. For example, a facial expression that suggested an intensity of feeling was recorded in relation to the feature of the digital or physical environment that had appeared to prompt this reaction. Through this process 35 episodes of activity (between 30 seconds and 3 minutes long) were identified. These were reviewed independently by three researchers, followed by collaborative viewing and discussion to verify each episode was an instance of emotional engagement prompted or supported by mobile technologies with relevance to history learning. Through this process the selected episodes were reduced to 25 episodes where all researchers agreed the modal interaction met the criteria for further analysis. These episodes were distributed across 11 of the 16 participating pairs, with each pair being present in 1-3 of the episodes (Appendix 1).

Stage three of the analysis focused on in-depth modal analysis of these episodes and the interaction between modes. This involved further iterative collaborative viewing by the research team of these 25 episodes with reference to the research questions outlined at the beginning of this section. A fine-grained multimodal transcription on each of the episodes included a detailed, time-stamped transcript of the episode, along with a descriptive analysis focused on bodily interaction through the modes of movement, body orientation, body posture, gaze, gesture, touch and facial expression. This fine-grained

analysis linked key qualities of the multimodal interaction to emotional engagement in the mobile learning context. Four features of the multimodal mobile learning environment were identified as central to the episodes of emotional engagement: multimodal layering; the multimodal creation of artefacts; linking of stimuli; and changes in pace. A grounded analysis of the data enabled the different types of emotional engagement to be identified that were supported by the in-situ use of mobile technologies including empathy, excitement, care and protection, respect, pity and identification. These categories identified from the data are also foregrounded as significant within the literature on history learning (Davis et al., 2001; Rosiek, 2003; Stuart, 2001). These instances of emotional engagement were then explored with respect to the multimodal affordances of mobile technologies, and how these prompted and supported emotional engagement in the context of in-situ history learning. By drawing together the analysis of modes, modal affordances, and multimodal ensembles, types of emotion and features of mobile technologies the analysis indicates how a multimodal approach can be used to study the in-situ, bodily and sensory opportunities that mobile technologies provide for emotional engagement with history learning.

Findings

The findings presented in this section provide insights into how mobile technologies can prompt and support learners' emotional engagement in the context of in-situ history learning, and demonstrate the analytical potential of multimodality as an approach. Given this, we do not set out to describe all aspects of emotional engagement, which is after all an intrinsic part of any activity, but rather focus on emotions relevant to history learning

central to this paper. Three aspects of the students' multimodal interaction with the iPads were central to the promotion and support of their emotional engagement, and provide the organizational structure for this section: multimodal linking and layering; the creation of multimodal artefacts; and changes in pace. These were developed iteratively through intensive grounded analysis of the empirical data in conversation with multimodal theory and the concepts of mode, modal affordance, multimodal ensembles and the literature on multimodal features of mobile history learning.

Multimodal linking and layering

In multimodal linking and layering, modal resources (e.g. gaze, gesture) are combined in order to produce a layer of experience. The examples discussed in this section illustrate how students connected the digital stimuli and the physical environments and how this prompted and supported their emotional engagement in ways that support history learning practices: that is, the re-imagining of place, reflection and interpretation of texts, the making of links between the past and the present, and the memorialization of events. Three examples from the study to illustrate the use of multimodal linking and layering that are typical of the data as well as the range of stimuli and student interaction. This aims to show how a multimodal analysis of situated mobile interaction can provide insights into students' emotional engagement with the events and experiences of the past, and the role of different modes in prompting and supporting this.

Example one: Guns on the Common

One digital stimulus was titled 'Guns on the Common' and displayed an image of air artillery guns and soldiers training on the common (Figure 2).

This prompted students to physically link the activity shown in the image to their location on the Common (supplementary Table S1 – accessible on-line). To do this, the students used gaze and gesture, pointing to, or looking to areas where they imagined the guns to have been placed. They expressed excitement seen in shifts in the students' embodied interaction such as jumping up and down, placing their hands on their head, making large and quick hand gestures and moving closer to the iPad. As the emotional engagement and interaction between the students unfolded, their action was directed towards linking the 'guns' in the digital stimulus to the surrounding physical environment.

This example demonstrates the interplay between students' interpretation of the digitally presented stimuli, their current physical context, and their emotional engagement with the past through their discussion of the digitally presented question "how does the idea of guns on the Common make you feel?". These staged links served to create a multimodal layer leading to the Common as a re-imagined space through which the students emotionally empathized with the experiences of the soldiers.

Example 2: Sleeping in the shelters

A similar pattern of multimodal linking and layering was observed in other instances that supported the students in processes of textual reflection and interpretation (Table 2). For example, a pair of students looking at an image of people sleeping in the shelter used gaze, gesture, and movement to link the image to their immediate physical environment. The students then moved back and forth to locate themselves directly above where they believed the underground shelters would have existed during WWII. They looked around them, directing their gaze to find a particular location to focus their attention on, and then gestured to identify these spaces to each other. In this interaction,

movement, gaze, gesture and speech were coordinated to locate the digital stimulus on the mobile device *in* the physical environment: to bring this stimulus ‘alive’ through interaction with the physical environment. The students then reflected on the images and talked about the experience of sleeping underground, through their gaze direction, body orientation and gesture they engaged with their immediate location, which though empty of any contemporary markings related to the shelter, played a central role in their imagining what the Common would have been like in the past.

Table 2

This process of multimodal layering prompted and supported the students’ empathetic reflections and their expression of concern, pity, and a degree of respect for people’s experiences in the past. In a similar episode, another pair of students stood still, looked out across the Common and reflected on what it would have been like in the past. Their talk, roaming gaze and use of gesture to pick out particular parts of the Common contributed to their re-imagining what experiences of the Common during WWII would have been like.

In response to hearing another stimulus, an audio recording of soldiers marching, all of the students responded physically to the stimulus (e.g. “they must’ve practiced marching on here”, by bobbing their head in time to the marching), and most of them responded by marching around. While it might be suggested that this embodied action in itself does not indicate emotional engagement with history, nonetheless through their embodied action, the students linked the sound of marching directly to *their* physical experience and the current environment. This led them to engage emotionally with the soldiers’ experiences and developed their reflections on what the soldiers would have felt (“maybe petrified”)

for. For example, a student pair (supplementary Table S3 - accessible on-line) first looked at a photograph of soldiers on the Common and reflected verbally, in quiet reverent tones, on the experience of soldiers during WWII and their possible fear (“Dangered. Probably scared”) and pride (“because they’re doing it for their country”), and then listened to the sound recording of soldiers marching and linked the activity of the soldiers to the wide open spaces of the surrounding environment.

Example 3: The bomb damaged Church In several of the episodes, explicit and empathetic reflections on the past were supported and developed through the students linking salient features of the physical environment to themes that they encountered in the digital environment, such as destruction, death or community. In this way the linking was less direct, but nevertheless built on experiences derived from the ongoing learning activity. For example, when one pair of students took a photograph of the plaque on the side of the church that suffered bomb damage during WWII they commented “*so that bit, where its scratched...was bombed...they’ve kept it like that...in memorial*”. Students appeared to take photographs to link the relevance of the physical environment to the past – using photographs to identify and frame features of the environment that they understood in relation to people’s experiences of the past. In this and similar examples, the process of taking the photograph can itself be seen as a multimodal reflection and expression of emotional preservation or memorialization. Taking photographs of the war memorial and other parts of the Common supported students’ emotional engagement through verbal reflection about the experience of WWII for those living near the Common.

This analysis suggests three distinct but inter-connected stages in multimodal

linking and layering.

First stage: Physical linking

The first stage of the process of linking was physical. The in-situ affordance of mobile devices encouraged the students to link a digital stimuli to the physical environment in which they encountered it. For example trying to ‘map’ an element in a photograph to what the student could see around them. The multimodal character of the stimulus was therefore central to what and how students made these physical links. The process of linking stimuli with the environment was made visible through modes of movement, body orientation, gaze and gesture, the modal affordances of these, and their configuration into multimodal ensembles.

Second stage: linking to present day experience

Having created a physical link between the ‘digital past’ and the ‘physical present’, the second stage of linking involved the students engaging with the link between the stimulus and the environment in the context of their present day experience (including their prior knowledge and experiences of other spaces). This led students to make comparisons between their own experiences and those of the people ‘depicted’ visually and aurally in the stimuli and this process of situated reflection and comparison prompted and supported students’ emotional engagement. The modal character of the stimuli and the information provided within them was significant for the comparative dimensions used by the students. Such as, when students looking at an image of people sleeping close together in the air-raid shelters (Figure 2) they drew comparisons with the space they were experiencing on the Common at that moment (and implicitly on their knowledge of other sleeping spaces).

Third stage: multimodal linking to create a layer

This emotional linking between the past and the present supported the students in achieving a third stage of linking. The students could then link their emotions, the stimuli (e.g. a digital image or sound clip), and their environment/location to create an imagined multimodal layer: a re-imagined space, for example, visualizing the inhabited shelters beneath the Common. This reimagined space was shaped by their selection of stimuli, their embodied interaction with the iPad (how they hold or carried it), one another, and the physical environment. From a multimodal perspective our findings support those of previous research on emotional engagement that the more potential connections a stimulus or idea has, the more meaningful or emotive it is likely to be (Woolfe, 2006). Analysis of the data demonstrated that it was common for students to move back and forth between physical and digital stimuli, using both types of stimuli to enrich their verbal reflections on individuals' past experiences of the Common.

A multimodal approach points to the importance of the modal affordances of stimuli and how these influence their role in the interaction. The student's emotional engagement with two connected audio and visual stimuli, related to the experience of soldiers on the Common during WWII, was enriched by the modal diversity (and different affordances) of the stimuli and the layered responses these engendered from the students. The audio stimuli afforded an immediate embodied enactment of the soldier's experience and an embodied empathetic response of identification. In instances where the physical environment had not changed in any significant way the visual stimuli afforded the linking of the events of the past with the physical environment of the present. While this linking was looser in instances where the physical environment had changed

significantly, nonetheless the visual stimuli and being in place still helped the students to place themselves via their imagination of the visual physical place in the historical context of interest. The textual prompt enabled them to reflect on the soldiers' emotional state. Collectively these affordances played a part in creating a re-imagined layer of experience that in turn, enabled the development of an empathetic response to individuals who lived in the past. The emotional engagement involved in interpreting written testimony can be observed through the links that the student established between digital stimuli, the physical environment, and their prior experience.

The specific modes used in the mobile digital augmentation played a role in shaping students' interaction, their potential for emotional engagement and enactment, and the form of multimodal linking and layering. Visual and written stimuli prompted students to reflect on and interpret the stimulus, through intense visual engagement and talk. Looking at the iPad necessarily constrained how the students moved, their use of gesture, and their pace. In contrast, audio stimuli supported students in looking elsewhere while engaging with the stimulus and enabled them to move away from the iPad held by another student. When students' interactions were solely with the digital stimuli, and their patterns of activity revolved around the digital device, there was limited emotional engagement. This points to the significance of multimodal linking between the digital and the physical in mobile learning contexts to prompt and support emotional engagement. The multimodal linking and layering enabled by students' in-situ interaction with the mobile device promoted and supported emotional engagement which in turn underpinned the students' re-imagining of the space of the Common and their making of explicit connections between the past and present. The layering of modal resources, as described

above, thus played a key role in supporting the students' development of imagined emotional spaces of the past.

Creation of Artefacts

As students explored the Common, they could make multimodal digital artefacts, photographs or voice recordings, using the Evernote application on the iPad. All pairs of students created audio notes while exploring the Common. Analysis of the video recordings of students making audio notes suggests that the process of engaging with the modal affordances of sound, and the practice of making a sound recording elicited particular forms of verbal expression and shaped the students' emotional engagement in significant ways.

Example 4: Creating audio artefacts

When students made a voice recording to highlight their enjoyment of the Common, emphasizing their current emotional relationship with the surrounding space, they altered the tone and rhythm of their speech, adopting a noticeably calmer tone and slower rhythm (supplementary table S4– accessible on-line). Here the students' use of the modal resources of speech, notably pitch, rhythm and volume, appeared to be linked to their experiences of voice recordings and their conceptions of what these should include and sound like. Students' understanding of the modal affordances of speech and conventions of voice recordings therefore played a role in how emotional engagement was expressed in the audio recordings they made.

Example 5: Creating visual artefacts

Students created artefacts, particularly photographs, in order to pay tribute to or memorialize the experiences of people. For example, in another episode, the same pair of students above created a memorial ‘from scratch’ after engaging with digital materials, including a photograph and a piece of oral testimony, about the experiences of a young woman who slept in a deep shelter under the Common during the war (Table 5). After engaging with these stimuli, but before creating artefacts of their own (a photograph and an audio recording), it was particularly important to them that they were in the exact place under which the deep shelters were shown on the Evernote map, as seen in the transcript below.

Table 5

After deciding on the exact location on which to stand, the students then took a photograph of the ground beneath their feet and made a voice recording that they linked to their photograph stating “this is where Margaret was”. The photograph and audio recording can be understood as a digital memorial to Margaret’s experience, albeit one not formally recognized by any physical markers or objects on the Common.

We also observed incidences of memorialization where students made photographic notes of physical memorials that existed on the Common, for example, the war memorial next to the church. Analysis of the students interaction, notably the modal qualities of both students’ touch and manipulation of the iPad when framing and taking the photograph is indicative of a degree of care in their process of taking the photograph (supplementary Table S6 – accessible on-line).

The students’ interaction is an act of paying tribute to experiences of the past. This exhibition of care is itself a kind of multimodal memorialization, as is the

photograph itself. Students' paying respect sometimes extended beyond their creation of artefacts. For example, after taking the photograph, one of the students picked a piece of litter out from the rosebush that surrounds the memorial, and looked directly at the researcher with a facial expression suggesting disapproval of the litter's presence: an embodied display of 'respect' both for the memorial and others' wartime experiences. In these episodes where the students took photographs in response to a physical memorial to war or wartime experience, they were making an active contribution to their own process of memorialization. The students used the creation of digital artefacts, particularly photographs, to realize an emotional, respectful engagement with the past, through participation in situated interaction with the physical environment in which those past events took place.

Example 6: creating artefacts as comparisons

The digital artefacts that students created also sometimes acted as conceptual props to support making sense of experiences on the Common in the past and present, a comparison made possible by the specific affordances of sound and image. Making an audio recording, for example, led the students to make comparisons between the sounds they could hear on the Common with the sounds they identified with people's experiences of WWII (supplementary Table S7 – accessible on-line). This pair of students described how in the current environment there are "birds tweeting" while during WWII people heard only "miserable" sounds like "gunshots" and "air raids". The students made the latter assertion in their audio recording despite having just read a piece of written factual first-person testimony that directly contradicted this by listing the various sounds that could be heard by people sleeping in the deep shelters, including

music and conversation, and stating that it was impossible to hear anything from above ground including noises associated with the air raids.

Example 7: Embodiment and the creation of artefacts

In several incidences students combined the making of a visual and an audio digital artifact, and touch interaction with the iPad in ways that prompted embodied emotional engagement between the students. For example, in one episode after taking a photograph of a plaque on the side of the church commemorating its sustained bombing damage during WWII, the students read aloud some of the names of the dead listed on it, they then repeated the names to make an audio recording to accompany the photograph. The students then replayed and listened to the audio recording. As they listened to the audio recording, the names of the individuals featured on the plaque were heard for a third time. While reading and listening to the names of the dead the students leaned over the iPad and one of the students held the iPad close to his body, so that his whole arm was underneath the device. The names of the dead were repeated in these distinct ways: during initial discovery; during creation of performance; during reception of performance. The repetition of the names accumulated new links to the students' experience of the Common. As the students listened to their recording, they were still and completely silent, each with a slight smile on their face. Their gaze shifted between each other, the iPad, the researcher and the plaque from which the names had been read. The latter gaze shift suggests that it mattered to them that the names were correct and linked to what was physically present, emphasizing the construction of the audio recording as a digital memorial of a physical memorial. The way that the student held the iPad was not observed at any other point during the student's interaction with the iPad (as it was not

customary it does not indicate a general concern about dropping it) and we therefore interpret the shift in touch: the proximity of the iPad to the boy's body, and his arm cradling as meaningful. The modal resources of touch were brought into the students' in-situ mobile interaction, which we interpret as a cradling protective gesture.

This multimodal analysis of students' processes of creating artefacts indicates that the students' decision to create an artifact was linked to their emotional engagement. Four key aspects of the process illustrate how multimodality can provide insight on the bodily opportunities for emotional engagement with in-situ mobile history experiences

1. The modal affordance and process of making a voice recording elicits particular forms of verbal expression and this shapes how emotional engagement is enacted;
2. Creating any modal form of artefact plays a role in memorializing and paying tribute to experiences of the past;
3. The creation of artefacts supported the students in making comparative links between the Common in the past and present and in doing so, fostered opportunities for emotional engagement;
4. The process of creating artefacts involved a level of emotional engagement that in turn shaped the emotional engagement that students experienced in relation to the Common and its history.

The process of creating an artefact gave the students' imagination of the 'realities' of war more significance than the factual testimonies made available to them. The process of making a voice recording that emphasizes a sharp distinction between the past and the present shaped the students' modal construction of the emotions associated with either time. Just as recordings are associated with a particular tone and pace, they are

perhaps also associated with ‘neat’ assertions and descriptions of experiences as offered by the students in this clip. This links to the concerns discussed earlier in this paper regarding emotional engagement in history learning and the trap of ‘presentism’, in which recordings comparing the past to the present view the past through the lens of the present (Wineburg, 2001: 90) rather than a more contextualized historical understanding about how people in the past viewed the world differently.

Collectively the students’ multimodal comparisons, aided by their creation of artefacts supported emotional engagement that established a distinction between the Common in the present as “free” and the Common in the past as constrained, a place in which you were “stuck”. Our analysis suggests that creating artefacts with in-situ mobile technologies serves to emotionally engage students in ways that are significant for history learning. However, it also points to the need to be critical of the limits of such emotional engagement to ensure the students’ imagination of war does not override factual testimonies that fall outside of these imagined realities, and the challenge of ‘presentism’ (Wineburg, 2001: 90). The examples discussed in this paper also suggest that the process of creating comparative artefacts is itself a part of emotional engagement, rather than merely reflecting or representing emotional engagement. Furthermore, these examples raise the need to engage critically with emotion and empathy when informing learning environment design.

Changes in Pace

Pace is understood in terms of the tempo of the students’ activity. During some episodes of emotional engagement, changes in pace were observed through the students’ use of multimodal resources in the interaction including movement, body position, gaze,

gesture, manipulation and speech. Analysis of the pace of multimodal interaction points to a link between changes in the pace of students' interaction with the physical and digital stimuli and the environment while on the Common and their emotional engagement in the context of mobile in situ learning.

Example 8: Slowing down

Visual and written digital stimuli were observed to slow down the students' interaction and to generate reflections on the past. Multimodal analysis reveals that this slowing down is a consequence of the modal affordances of image (in particular, the capacity of images to contain evocative visual information) and writing (in particular, the need to slow down in order to read a text from start to finish). In one episode, which is typical of the interaction we observed, the students stood reading the written testimony of a young woman's (Margaret Barford) experience of sleeping in the deep shelters, and looking at a photograph of people sleeping in the shelters (Figure 2). After reading aloud the written testimony one student continued to stare at the accompanying photograph. The pair stood still and both looked at the image, and after some time, one student said: "I feel sorry for them" (Table 5). Observations of other students engaged with the same photograph led to a similar slowing in pace. In another pair's interaction with this image (Table 8), the students' gaze remained on the image for nearly a minute - a long time relative to the pace of their interaction with other notes available in the application. They looked carefully at the image, pointing at features and manipulating the image (e.g. zooming in) to focus on particular details, notably the facial expressions of the people depicted in the shelters.

Table 8

Example 9: Speeding up

Several episodes of interaction among the students demonstrated that the mention of emotive subject matter in the digital augmentation prompted a change in pace. For example, when the students read out the information contained in the note ‘Guns on the Common’, the mention of guns, as noted earlier, resulted in them excitedly interrupting one another and quickening their physical movement, making exaggerated gestures or jumping up and down. In another digital note, ‘Windrush’, in response to the mention of Jamaica one student looked up from the iPad and into the distance, towards another pair completing the task. She shouted the name of one of the students in this other pair along with the instruction: “Go onto the Windrush”. She began to jog towards the pair. This was prompted by the student’s Jamaican heritage, the personal significance of this to her and her perception that it would have personal significance for other students, whose attention she drew towards the stimulus. In both of these examples, the quickened pace in response to an emotive stimulus was a material manifestation of excitement and in the latter case, an embodied act of asserting a shared identity.

Visible features of the physical environment also prompted significant changes in the pace of activity. In one example, a student holding an iPad was walking quickly around the church, primarily looking down at the iPad, and then suddenly stopped walking when she noticed a wooden cross in the ground with an inscription on it. She pointed at the stake and made eye contact with the researcher to highlight her interest in this feature of the physical environment. The abrupt change in pace, along with the pointing gesture and facial expression, involving widened eyes, suggest that the connotations of the cross were emotive to the student. A similar change in pace as a result

of physical stimuli occurred in other episodes where the students stopped walking abruptly in order to observe more closely the war memorial and the church plaque respectively.

The relative slowness of the students' interaction appeared to be key in the development of their empathetic reflections on people's experiences of WWII. This was notable in relation to their textual reflection and interpretation of the images, which focused on both the physical qualities of the context depicted in the digital stimuli, and the identification of people's emotions via their facial expressions and demeanor. Slowing down can be useful for the development of the contextual understanding necessary for historical empathy (Davis et al., 2001; Stuart, 2001), since learners have more time to investigate a particular part of the environment or a particular stimulus, and thereby build a more in-depth knowledge of what they are exploring. In addition, they have more time to reflect on what they have learned so far and make links that are crucial to building a credible historical interpretation of events and experiences of the past.

The students' engagement with the modal resources of the visual and written digital artefacts as well as stimuli in the physical environment prompted emotional engagement that manifested as changes in pace, which could, in turn, be useful for in-situ history learning. Notably, encountering emotive stimuli prompted students to either slow down – creating still spaces for knowledge-building, reflection and interpretation – or to quicken their interaction as part of an expression of excitement. These reactions, particularly the slowing down of interactions, supported students in processes of textual reflection, identification and the construction of productive links between the past and the present.

Discussion

The study demonstrates that students' emotional engagement was supported by their use of mobile devices through: multimodal layering and linking of stimuli; the creation of digital artefacts, and changes in pace. These findings are significant in furthering our understanding of how digital augmentation can foster emotional engagement in history learning. They also provide insight into the benefits of multimodality as an analytical approach for examining emotion through bodily interaction and demonstrate how such an approach can extend on what retrospective self-report measures of emotion offer.

This paper aimed to show how emotional engagement unfolds through situated multimodal interaction and how mobile technologies mediate this unfolding through supporting digital linking and multimodal layering between the physical and the digital, as well as the creation of digital artefacts. While previous studies have considered student's emotional responses to digital augmentation in terms of motivation and enjoyment (Jones et al., 2003; Huizenga et al., 2009), this study conceptualized students' emotional engagement in terms of a wider spectrum of emotion. In addition, the findings make links between emotion and the cognitive aspects of learning; in particular, the findings show how students attended to and drew the environment and stimuli/artefacts into their construction of narratives of history and their developing understanding of the space of the Common and World War II more generally.

The findings show how mobile digitally augmented spaces can transform students' experience of a familiar physical space in significant ways for emotional engagement in history learning. We showed how the ability to provide context-related digital information that is coupled with the physical environment and augments the physical space in different ways, provided the students with 'emotional hooks' and scaffolding and were central to prompting and supporting emotional engagement.

Exploring a digitally augmented Common offered new opportunities for the students to emotionally engage with historical events and experiences that had taken place on or near to the Common. Being in-situ, and coupling this experience with historical stimuli accessed digitally, acted as an 'emotional hook' (Woolfe, 2006). This enabled students to make links between the digital stimuli, their own emotional experiences, and the physical environment of the Common that in turn created a space for comparison and reflection. The more open the stimuli, that is, the more potential for connection with the student's lived experiences, the more emotive and meaningful they became. The 'being there' factor was key to the students' emotional engagement as was the space for them to bring their own interests to the digital stimuli to make links between the past and their present. Their bodily interaction was central to the linking of space and emotion – it was a part of the emotional engagement. The affordances of the mobile device and the stimuli influenced their experience of the Common and what they attended to, making historical and present day features newly available or visible to them to imagine and connect with. The findings show empathy to be a key form of emotional engagement prompted and supported by the students' use of mobile technologies. This led to a range of emotional expressions including care and protection, respect, pity, and

excitement: emotions that underpin practices significant for in-situ mobile history learning. Students' emotional engagement promoted by their in-situ experiences were also shown to be central to practices and outcomes of significance for history, including textual reflection and interpretation, making links between the present and the past, identification with people and their experiences in the past, memorialization, and the re-imagining of places through history. Historical practices which were evidenced in the findings and supported by physical and emotional engagement with the environment.

They took care in aligning their interaction in the physical environment with their interpretation of the past experiences and events that they were learning about through the digital environment. The alignment between the physical and the digital related to a wider, more powerful connection between the past and the present, which in turn prompted emotional engagement. In history learning, there is a disciplinary appreciation of being in the place in which events and experiences originally occurred; this underpins the routine practice of history field trips. Digital augmentation offered a new dimension to this notion of 'being in place' and history learning experiences because it encouraged iterative engagement across the past and the present, manifested as a trajectory moving back and forth across the digital and the physical. This iterative process supported emotional engagement alongside perspective taking. This is significant for history learning as it is concerned not only with historic facts but also with adopting a historical perspective/disposition. In the process of emotional scaffolding students have to be guided to feel and explore the appropriate emotions. As noted earlier, some history educators argue that sentimentality, for example, can stand in the way of historical thinking and the process of perspective-taking that many consider to be central in genuine

experiences of empathy (e.g. Davis et al, 2001). Our findings suggest that the accuracy and depth of the historical analysis and the power of students' emotional responses with respect to their creation of digital artifacts could be enhanced by the inclusion of a mechanism for peer or teacher-led feedback and revision in such mobile digital learning environments.

The configurations of the physical and digital enabled students to access, link, and layer together aspects of life in the past that would not have been possible through engaging with either the physical or digital stimuli alone with a focus on being there a part of which was 'feeling there'. Such experiences of emotional engagement have an impact on accessing, understanding, and remembering historical facts presented and the broader historical context.

Our findings show that photographs and sound clips are embedded in the particular context - the place, its history, the kinds of photographs and sound clips available and their content and style, as well as the instructional context in which the students encounter all of these. Given this complexity we do not set out to generalize to all artifacts using a specific mode as being the same. Rather we have pointed to some of the modal affordances of stimuli and that photographs and sound clips need to be selected well to evoke emotions and support learning, in an effort to give some beginning insights into the affordances and constraints of artifact qualities within each modal category that matter for history learning embedded in place. For instance, photographs of people in places and photographs of places without people have different evocative potential. The analysis indicated that not all types of digital stimuli were associated with the same character of emotional engagement. Some types of digital augmentation, we argue as a

result of the constraints and opportunities they offered for multimodal interaction, led to particular forms of emotional engagement with the past. Photographs, particularly those with emotive content, prompted a change in pace whereby students slowed down their interaction and visually explored the emotional and sensory experiences of people in the past. Sound clips enabled students to look and move around the physical environment while listening. This encouraged students to ‘move’ or attend back and forth between the physical and the digital, and in doing so, to link the experiences of the past with their presence in the Common in the ‘here and now’. In contrast to these heightened forms of engagement with photographs and sound clips, students’ interpretations of written testimony were not linked to a slowing of pace and did not tend to lead to dynamic connections between the past and the present. The written material took time and concentration to comprehend, and this constrained students’ simultaneous exploration of the environment through gaze, touch, manipulation or movement. Written stimuli seemed to be the least effective in emotionally engaging the students in this study with the past. Oral testimony produced a different result: we argue it did so by ‘freeing’ students’ gaze and bodies to engage with the space around them.

Creating digital stimuli also had different implications for learners’ emotional engagement depending on the type of stimuli being created. Taking photographs influenced emotional interactions in a different way from making voice recordings. By taking a photograph, students could demonstrate that a particular location or space mattered in relation to the events and experiences that they were learning about in the digital environment. On the other hand, making voice recordings appeared to prompt a shift from inquiry-led interaction to performance-led interaction. At the point of making

voice recordings, students' demeanor and expression changed and the dichotomies between past and present became more marked. Rather than bringing these time points closer together, the act of making a voice recording appeared to emphasize the distinction between them, with the students tending towards a reporter-style narrative about 'then' and 'now'. Other research has suggested that student-created content is key in designing digital environments that are effective for learning (e.g. Rost & Holmquist, 2008). This study extends this idea suggesting that the type of digital stimuli that students are encouraged to make has implications for the specific ways that they will engage with the activity.

This paper raises questions about the methods and tools that social scientists use to study emotional engagement and emotion more generally. The findings demonstrate how emotional engagement unfolds via multimodal interaction between the person and the environment (Schutz et al., 2006). In particular, certain qualities of the interaction are indicative of emotional engagement including changes in pace, linking of stimuli, multimodal orchestration and multimodal layering. These are aspects of embodied interaction that take place over time, and this temporal dimension is difficult to retain when using retrospective and language based methods. Emotional engagement is enacted through the body, with speech existing as one of a set of resources. Post-hoc questioning about emotional engagement does not focus on, and cannot capture significant elements of how emotional engagement is realized in interaction. Emotional engagement is realized through embodied interaction and this cannot be observed only through students' spoken discourses of emotion, which, in this particular context, drew heavily on collective or communal vocabularies of emotion and war. Multimodality therefore offers

tools for ‘observing emotion’ as a central facet of the person-environment interaction. We have demonstrated the potential of a multimodal approach to provide insight on the bodily and sensory opportunities for emotional engagement with in-situ history experiences that are opened up by children’s use of mobile technologies. We have shown how emotion is both experienced through and written on the body, not as a snapshot, but unfolding in place and time. Attending to the detail of the body as a material social site of meaning enabled us to focus in on emotion as it was realised through embodied interaction with the environment, others and artefacts. This enabled us to show sequences of linking activity to better understand the place and role of the digital and the physical in fostering emotional engagement. Multimodality provides a way to examine in-situ emotional engagement in the context of learning, which, this paper has argued is critical in the context of in-situ learning with mobile digital technologies. The ‘in-time’ account afforded by a multimodal approach enables researchers to get at the richness of emotional engagement in a way that is highly contextualized - linking the environment, the mediating objects and devices, and the people. This affords distinctly different kinds of data and analysis of emotional engagement from accounts produced via methods that tend to rely on the verbal, quantitative, retrospective and self-reporting of emotion. A multimodal approach also enabled us to look at the temporal dimensions of emotional engagement by focusing in on how it unfolds over time during the course of interaction as opposed to the condensed snap shot view of other methods. The focus on emotion as an embodied, physical, and multimodal experience has also shown that emotional engagement needs to be understood as realized through gaze, gesture, body orientation, movement, the manipulation of stimuli and devices as well as talk. The multimodal

approach used in this study thus enabled us to extend the conceptualization of emotional engagement as a multimodal phenomena and methods for its analysis in the context of in-situ mobile learning. Future research applying a multimodal lens to how emotional engagement is realized in different learning environments would extend our understanding of the relationship between emotion and different types of activity.

Conclusion

References

- Ardito, C., Buono, P., Costabile, M. F., Lanzilotti, R., & Piccinno, A. (2009) Enabling interactive exploration of cultural heritage: an experience of designing systems for mobile devices. *Knowledge, Technology & Policy*, 22(1), 79-86.
- Barton, K. C., and Levstik, L. S. (2004). Teaching history for the Common good. Mahwah, NJ: Lawrence Erlbaum Associates.
- Baum, R. N. (1996) " What I have learned to feel": The Pedagogical Emotions of Holocaust Education. *College Literature*, 23(3), 44-57.
- Berry, C., Schmied, L. A., & Schrock, J. C. (2008) The role of emotion in teaching and learning history: A scholarship of teaching exploration. *The History Teacher*, 41(4), 437-452.
- Bonanno, G., & Keltner, D. (2004). Brief Report: The coherence of emotion systems: Comparing “on-line” measures of appraisal and facial expressions, and self-report. *Cognition and Emotion*, 18(3), 431-444.

- Bradley, M. M., & Lang, P. J. (1994) Measuring emotion: the self-assessment manikin and the semantic differential. *Journal of behavior therapy and experimental psychiatry*, 25(1), 49-59.
- Bradley, M. M., & Lang, P. J. (2000) Measuring emotion: Behavior, feeling, and physiology. In R. D. Lane & L. Nadel (Eds.) *Cognitive neuroscience of emotion* (pp. 242 – 252). New York: Oxford University Press.
- Davidson, J., & Milligan, C. (2004) Embodying emotion sensing space: introducing emotional geographies. *Social & Cultural Geography*, 5(4), 523-532.
- Davis, O. L., Yeager, E. A., & Foster, S. J. (2001). Historical empathy and perspective taking in the social studies. Lanham, MD: Rowman & Littlefield Publishers.
- DfES (2006) Learning outside the classroom: manifesto. Nottingham: Department for Education and Skills.
- Desmet, P. (2005) Measuring emotion: Development and application of an instrument to measure emotional responses to products. Accessed online 20.02.2015: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.104.1400&rep=rep1&type=pdf>
- Edell, J. A. & Burke, M. C. (1987) The Power of Feelings in Understanding Advertising Effects. *Journal of Consumer Research*, 14, 421-433.
- Efklides, A., & Petkaki, C. (2005) Effects of mood on students' metacognitive experiences. *Learning and Instruction*, 15(5), 415-431.
- Facer, K., Joiner, R., Stanton, D., Reid, J., Hull, R., & Kirk, D. (2004) Savannah: mobile gaming and learning?. *Journal of Computer Assisted Learning*, 20(6), 399-409.

- Finn, J. D. (1989) Withdrawing from school. *Review of Educational Research*, 9, 117-142.
- Fredricks, J., Blumenfeld, P., & Paris, A. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, 74(1), 59-109.
- Gibson, J. (1979) *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.
- Gomez, P., & Danuser, B. (2007). Relationships between musical structure and psychophysiological measures of emotion. *Emotion*, 7(2), 377.
- Gonida, E. N., Voulala, K., & Kiosseoglou, G. (2009) Students' achievement goal orientations and their behavioral and emotional engagement: Co-examining the role of perceived school goal structures and parent goals during adolescence. *Learning and Individual Differences*, 19(1), 53-60.
- Goodwin, C. (2000) Action and embodiment within situated human interaction. *Journal of Pragmatics*, 32, 1489-1522.
- Gross, J. J. (1998) The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2(3), 271-299
- Harris, L. R. (2008) A phenomenographic investigation of teacher conceptions of student engagement in learning. *The Australian Educational Researcher*, 35(1), 57-79.
- Hidalgo, M. C., & Hernandez, B. (2001) Place attachment: Conceptual and empirical questions. *Journal of environmental psychology*, 21(3), 273-281.

- Horton, J., & Kraftl, P. (2006) Not just growing up, but going on: materials, spacings, bodies, situations. *Children's Geographies*, 4(3), 259-276.
- Huizenga, J., Admiraal, W., Akkerman, S., & Dam, G. T. (2009) Mobile game-based learning in secondary education: engagement, motivation and learning in a mobile city game. *Journal of Computer Assisted Learning*, 25(4), 332-344.
- Hume, C., Salmon, J., & Ball, K. (2005). Children's perceptions of their home and neighborhood environments, and their association with objectively measured physical activity: a qualitative and quantitative study. *Health education research*, 20(1), 1-13.
- Hummon, D. M. (1992) Community Attachment. In S. Low & I. Altman (Eds.) *Place Attachment: Human Behaviour and Environment* (pp. 253 – 278). London: Springer.
- Jewitt, C. (2014) *Handbook of Multimodal Analysis*. London: Routledge.
- Jewitt, C. (2013) Multimodal Methods for Researching Digital Technologies. In S. Price, C. Jewitt & B. Brown (Eds.) *The SAGE Handbook of Digital Technology Research* (250-266). London: SAGE.
- Jewitt, C. and Kress, G. (2003) *Multimodal Literacy*. New York: Peter Lang.
- Jones, O., Williams, M., Fleuriot, C. (2003) Wearable Computing And The Geographies Of Urban Childhood: Working With Children To Explore The Potential Of New Technology. In *Proceedings of the 2nd International Conference for Interaction Design and Childhood*.

- Kensinger, E. A., & Corkin, S. (2003) Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & cognition*, 31(8), 1169-1180.
- Klopfer, E. and K. Squire (2007) Case Study Analysis of Augmented Reality Simulations on Handheld Computers. *Journal of the Learning Sciences*, Vol. 16, (3), 371-413
- Kress, G. (2010) *Multimodality*. London: Routledge.
- Kress, G. and van Leeuwen, T. (2001) *Multimodal Discourse*. London: Arnold.
- Lewis, M. D., Todd, R. M., & Honsberger, M. J. (2007). Event-related potential measures of emotion regulation in early childhood. *NeuroReport*, 18(1), 61-65.
- Linnenbrink, E. A., & Pintrich P. R. (2002) Achievement goal theory and affect: An asymmetrical bi-directional model. *Educational Psychologist*, 37(2), 69–78.
- Marks, H. M. (2000) Student engagement in instructional activity: Patterns in the elementary, middle, and high school years. *American educational research journal*, 37(1), 153-184.
- Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, 5(2), 175.
- Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion: A review. *Cognition and emotion*, 23(2), 209-237.
- Miserandino, M. (1996) Children who do well in school: Individual differences in perceived competence and autonomy in above-average children. *Journal of Educational Psychology*, 88(2), 203.

- Morrow, V. (2001). Using qualitative methods to elicit young people's perspectives on their environments: some ideas for community health initiatives. *Health education research, 16*(3), 255-268.
- Norman, D. (2013) *The Design of Everyday Things*. New York: Basic Books
- Orellana, M. F. (1999) Space and place in an urban landscape: Learning from children's views of their social worlds. *Visual Studies, 14*(1), 73-89.
- Phelps, E. A., Ling, S., & Carrasco, M. (2006) Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science, 17*(4), 292-299.
- Price, S., & Rogers, Y. (2004) Let's get physical: the learning benefits of interacting in digitally augmented physical spaces. *Computers & Education, 43*(1), 137-151.
- Price, S., Rogers, Y., Scaife, M., Stanton, D., & Neale, H. (2003) Using 'tangibles' to promote novel forms of playful learning. *Interacting with computers, 15*(2), 169-185.
- Rogers, Y., Price, S., Fitzpatrick, G., Fleck, R., Harris, E., Smith, H. & Weal, M. (2004) Ambient wood: designing new forms of digital augmentation for learning outdoors. In *Proceedings of the 2004 conference on Interaction design and children: building a community* (pp. 3-10). ACM.
- Rosiek, J. (2003) Emotional scaffolding an exploration of the teacher knowledge at the intersection of student emotion and the subject matter. *Journal of Teacher Education, 54*(5), 399-412.

- Scherer, K. R. (2004). Which emotions can be induced by music? What are the underlying mechanisms? And how can we measure them?. *Journal of new music research*, 33(3), 239-251.
- Schutz, P. A., Hong, J. Y., Cross, D. I., & Osbon, J. N. (2006). Reflections on investigating emotion in educational activity settings. *Educational Psychology Review*, 18(4), 343-360.
- Schwarz, N., & Clore, G. (1996). Feelings and phenomenal experiences. In E. T. Higgins & A. W. Kruglanski (Eds.) *Social Psychology: Handbook of Basic Principles* (pp. 453–465). New York: Guilford.
- Scollon, R and Scollon, S. (2014) Multimodality and Language: A Retrospective and Prospective View, chapter 6 in C. Jewitt (ed.) *Handbook of Multimodal Analysis*. London: Routledge.
- Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.), *The Sage handbook of elearning research* (pp. 221–247). London: Sage.
- Shouse, E. (2005). Feeling, emotion, affect. *M/C Journal*, 8(6). Accessed online 20.02.2015: <http://www.journal.media-culture.org.au/0512/03-shouse.php>
- Skinner, E. A., & Belmont, M. J. (1993) Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of educational psychology*, 85(4), 571 - 581.
- Volk, S. S. (2013) How the Air Felt on My Cheeks: Using Avatars to Access History. *The History Teacher*, 46(2).

- Waite, S. (2007) 'Memories are made of this': some reflections on outdoor learning and recall. *Education 3-13*, 35(4), 333-347.
- Willms, J. D. (2003) Student engagement at school: A sense of belonging and participation: Results from PISA 2000. OECD publishing. Accessed complete online 04.02.2014 via GoogleBooks.
- Wineburg, S. (2001). Historical thinking and other unnatural acts: Charting the future of teaching the past. Philadelphia: Temple University Press.
- Wolfe, P. (2006) The role of meaning and emotion in learning. *New Directions for Adult and Continuing Education*, 2006(110), 35-41.

Appendix 1 An overview of the clips

Episode	Pair	Time	Brief description
1	O	0:37	Students reflect on the experience of ‘sleeping on the ground’
2	B	0:20	Students discuss how the soldiers in the photograph would have felt
3	C	0:26	One student reflects on the experience of working on the allotments
4	C	0:42	Students explore the area around the church
5	D	0:30	Students make an audio recording on their feelings about the Common
6	D	1:28	Students take photographs of the war monument and church plaque
7	E	0:53	Students comment on the Common today
8	E	0:24	Students comment on the Common as it would have been in the past
9	E	1:05	Students reflect on their knowledge of war and memorial
10	A	1:24	Students learn about and discuss guns on the Common during WWII
11	G	1:40	Students engage with Margaret Barford’s experiences of war
12	G	2:51	Students take a photograph of the memorial and reflect on its presence
13	H	2:07	Students reflect on the experience of sleeping in the deep shelter
14	H	1:44	Students listen to the audio of soldiers marching and reflect on it
15	I	3:04	Students make an audio recording about the church plaque
16	J	1:32	Students compare past and present experiences on the Common
17	J	0:50	Students discuss how the soldiers in the photograph would have felt
18	K	0:27	Students link the war memorial to Margaret Barford’s experiences of war

19	K	0:38	Students reflect on different parts of the Common
20	K	2:09	Students make an audio recording about post-war immigration
21	L	1:58	Students respond to notes about the Common during WWII
22	M	0:37	Students reflect on what the soldiers in the photograph would have felt
23	M	2:09	Students respond to the note about post-war immigration from Jamaica
24	N	0:46	Students discuss a photograph of people sleeping underground in WWII
25	N	1:13	Students reflect on what the soldiers in the photograph would have felt