Does Place Affect User Engagement and Understanding?
Mobile Learner Perceptions on the Streets of New York

Anthony Cocciolo and Debbie Rabina

Abstract

Purpose: The aim of this research project is to uncover if place-based learning can increase learner engagement and understanding of historical topics.

Design/methodology/approach: To study this, learners will use GeoStoryteller to learn about a historical topic on the places where significant events occurred, and then be interviewed by the researchers. GeoStoryteller is a tool developed by the researchers that runs on smartphones, such as an iPhone or Android. It provides the user multimedia stories about the historical sites, delivered via the mobile web or through Layar, an augmented reality web browser. The initial application of this technology focuses on German immigration to New York City between 1840 and 1945 through a partnership with the Goethe-Institut, the Federal Republic of Germany’s cultural institution. After using GeoStoryteller to learn about this content, N=31 participants were interviewed by the researchers, and transcripts were subjected to a quantitative content analysis.

Findings: Results indicate that the use of place increases learner perceptions of their engagement and understanding of historical topics; however, novel user interfaces like augmented reality impose significant usability issues, and more standard interfaces are preferred by users.

Originality/value: The use of place in mobile learning environments provides a meaningful entry point into historical content. Teachers of history and social studies, as well as those working in memory institutions (museum, libraries, and archives), should be encouraged in using place in their teaching and mobile education initiatives.

Keywords: Digital humanities, GeoHumanities, Location-based learning, User studies, Augmented reality, Mobile learning.

Introduction

Over the past ten years, there has been an explosion of new technologies and applications that make use of geographic information. From GPS-enabled navigation devices, to useable GIS software like Google Earth and Maps, to educational projects like PhillyHistory.org, geographic data has become incredibly accessible to wide audiences (Boyer, 2011). However, geographic information is not simply data, such as dots on a map or coordinates in a database, quickly deliverable to a digital device. Geographic information is necessarily bound up with issues of culture and history, prompting questions like “was this locale always like this?” and “what has happened here?” When a location has become meaningful to an individual or community, it becomes place, or a space invested with human understanding and value (Harrison and Dourish, 1996).
The intersection of geography with issues of place, culture and history was made readily apparent in 2010, when an international debate erupted over the erection of a mosque several blocks from the Ground Zero site in Lower Manhattan. The issue was divisive, as evidenced by a New York Times/CBS poll that found 50% of New Yorkers opposed the building of the mosque cultural center (Barbaro and Connelly, 2010). This issue brought geography and culture to the forefront. Questions raised include: How close to the disaster site is too close: two blocks, five blocks, ten blocks? Should it matter, since the First Amendment guarantees freedom of religion?

Despite the importance of place, it is rarely used in the teaching of history and social studies. When it is used, it is usually only in the abstract geographic sense, such as through a map (Hsu and Chen, 2010). Students are rarely brought to the place where the historical event actually occurred (Tuthill and Klemm, 2002). This is in many cases practical, given the time demands of educators, but makes little sense for students who already reside in areas rich in national and global history, such as New York City. Similarly, libraries and cultural heritage organizations rarely make use of place in teaching history and social studies. Rather, they have relied most heavily on the use and circulation of printed books.

This paper details the research and development of GeoStoryteller, a project where learners—using smartphones such as Androids or tablets like the Apple iPad—engage with archival photos and multimedia narratives in historically relevant places. Using a combination of augmented reality technology and web-based delivery, the ultimate aim of the project is to uncover if place-based learning can increase learner engagement and understanding of historical topics.

Why would the use of a place (e.g. the ability to stand in front of a building and engage with multimedia content that details the significant historical events that transpired there) lead to greater engagement and understanding than other ways of learning this same material? The researchers hypothesize that learners—when they perceive a meaningful personal connection to the historical topic because of their preexisting relationship with the place—will feel a heightened involvement in the experience. An increase in engagement will lead learners to invest more cognitive resources in the learning experience, which will subsequently lead to greater understanding and comprehension of the topic.

Place provides the learner with a meaningful entry point to the topic, and one that increases the topic’s prominence within an information environment that is seemingly limitless. This environment—for those who have broadband connections to the Internet—is constantly growing in interesting facts and resources, yet increasingly users have difficulty determining what is worth knowing, creating what individuals often describe as “information overload” (Shirky, 2008). Whereas the Internet is seemingly unbounded, geographic space has the advantage of being finite and inherently understood. The researchers’ hypothesis states, in part, that providing users with meaningful entry points to information—for example, through
the use of already-familiar places—will increase engagement and subsequent understanding.

Using qualitative research methods supported with quantitative content analysis, the researchers interviewed N=31 participants to uncover if the use of place in the teaching of historical content through the use of mobile technology can increase learner perceptions of their engagement and understanding of the historical topic. In doing so, the researchers will discuss those factors that do lead to greater engagement and understanding. However, before the study is presented, the thinking that influenced the research and development of this project should be introduced.

**Literature Review**

This project builds upon and is reliant on a series of ideas, technologies and projects from a variety of domains. These will be discussed in terms of *Place, Geography, and Mobile Technology; Place and Cultural Heritage Institutions; Augmented Reality; and Learner Engagement.*

**Place, Geography, and Mobile Technology**

Interest in the use of place as a factor in mobile computing environments—for educational or other purposes—has grown within diverse fields such as the humanities, human-computer interaction (HCI), information and library science and design. In the field of HCI, Hecht, Schoning, Erickson, and Priedhorsky (2011) put forth the notion of geographic HCI, which is human-computer interaction work that takes a geographic approach, with geographic referring to the “processes that occur on or near the Earth’s surface over any time period, but … typically limited to processes that vary over scales greater than a meter or so” (p. 448). Messeter (2009) argues for an approach that goes beyond geography and location-awareness to one of place-specific computing (PSC), which he describes “as computing in which the designed functionality of systems and services, as well as information provided by these systems and services, are inherently grounded in and emanating from the social and cultural practices of a particular place” (p. 32). In his conception, place-based information is not merely delivered to the user but the interaction of the system is designed with a particular place in mind. The goal is of this perspective is “to enhance places through digital media and technology that are grounded in the specific socio-material circumstances offered by a place” (p. 39).

The term “GeoHumanities” highlights the intersections between geography and the humanities and is an emerging subfield of the digital humanities. While collaboration between the disciplines of history and geography has a long tradition in the humanities, the introduction of digital technology has opened up new opportunities for both fields. For example, GeoHistory—yet another subfield—is described by Richardson (2011) as using geographic information systems to produce creative historical iterations of space and time.
Dear (2011) identifies the beginnings of GeoHumanities in the 1970s and traces its theoretical development to postmodern thought and changes in conceptions of the material world brought on by the information revolution. These changes led to a transdisciplinary research approach that brought together scholarly domains that were previously studied and practiced in silos. Geotechnologies, such as GPS, digital mapping services and coordinate-based augmented reality, evolved within the field of geography and consequently made it relevant to the humanities. In a related development, geographers became interested in “human geography,” which borrowed from the social sciences and humanities and was expressed by the use of mixed methods (qualitative, quantitative, textual and visual) and by both large-scale collaborative projects and lone scholars (Dear, 2011). This assortment of methods should not be mistaken for lack of focus, but rather it represents what Dear describes as “a deliberate, creative methodological pluralism” (2011, p. 312). Mixed methods support the transition from space as an abstraction to place as a social construct (Dear, 2011, p. 313).

In the field of Information and Library Science, Fisher has extensively explored the issue of place through theoretical development and empirical investigations in such contexts as the Seattle Public Library, the Queens Public Library and in mobile contexts (Fisher et al., 2007; Fisher and Naumer, 2006; Counts and Fisher, 2008). In this work, she uses the notion of information grounds, which pays “deep attention to the nature and impact of social settings on information flow” and suggests moving “social settings to the forefront and study them holistically as an equal and motivating partner in the phenomenon of information exchange” (Fisher and Naumer, 2006, p. 97). Fisher argues that an information grounds perspective is useful in thinking about the role of information use in space and can act to compliment established notions of place, such as those developed by Cresswell (2004) and Oldenburg (1999).

**Place and Cultural Heritage Institutions**

From the cultural heritage perspective (e.g., libraries and museums), the creation of place-based multimedia narratives using digitized primary sources is a relatively new phenomenon. Most digitized collections continue to reside within the institution that owns the physical objects, and digital narratives have been used more widely in gaming and entertainment (Murray, 1997; Wolff et al., 2007; Lebowitz and Klug, 2011; Spierling et al., 2002).

Mass digitization projects undertaken by libraries have attracted mostly fans but some foes, with foes expressing concern over the loss of the tangible objects (Mann, 2001) and fans expressing enthusiasm over increased access (Gleick, 2011; Rimmer et al., 2008). The discussion regarding the pros and cons of digitization tends to focus on the transition from the physical to the digital objects (Borgman, 1999; Saracevic, 2000). Other research themes investigate specific digital collections (Borgman et al., 2002; Lee and Smeaton, 2002) and their users (Tong et al., 2002;
Research done regarding digitization consists of case studies and technical reports describing such projects (Bulger et al., 2011; Rydberg-Cox, 2006).

Libraries and cultural heritage institutions are using mobile devices to integrate place into their digital services. A particularly salient example is the National September 11 Memorial and Museum mobile application, called “Explore 9/11,” which was released on September of 2010. The application allows visitors to go on a walking tour of the site accompanied by audio and photo. This project is notable because it illustrates how an educational experience can be developed and delivered through the mobile phone by making use of mapping, narration, photos, and place. Another cultural heritage project that makes use of place and mobile technology is the WolfWalk project from North Carolina State University, which allows users to explore the campus using a location-aware interface optimized for a mobile device (Sierra, 2010). Similarly, the PhillyHistory.org project allows users to pull up primary-source material related to the history of Philadelphia, Pennsylvania, based on user location (Boyer, 2011). Likewise, Carnegie Hall has developed a mobile, location-enabled walking tour of the sites visited by Pyotr Tchaikovsky during his 1891 visit to New York, with reenactments of his thoughts on various sites from historic transcripts (Carnegie Hall, 2011). Other projects focus on archeological sites, such as the Explore! Project, where geotechnology is used to augment student learning at the site of ancient Italian ruins (Ardito, Buono, Costabile, Lanzilotti and Piccinno, 2009).

Several mobile projects that make use of place have also incorporated a storytelling aspect. For example, Tracking Agama allows players to engage in a narrative-based exploration of Los Angeles, with the goal of finding a lost person using various clues available from the mobile phone (Stein et al., 2009). Likewise, the Mobile Digital Narrative project (mobileDN) allows participants to create multimedia digital narratives using their mobile phones (Arnedillo-Sanchez and Tangney, 2006). The AMULETS project (Advanced Mobile and Ubiquitous Learning Environments for Teachers and Students) bridged classroom and outdoor activities through student work that required exploration, discussion, negotiation, collaboration and reflection (Sharples, Arnedillo-Sanchez, Milrad and Vavoula, 2009). And finally, the Mobltz project is a “mobile digital storytelling environment” designed so users can “convey experience, form a narrative or express an opinion” (Lewis et al., 2010).

Augmented Reality

A method for incorporating information in place is augmented reality (AR). Pogue describes augmented reality as a term that “usually refers to a live-camera view with superimposed informational graphics” (Pogue, 2011, p.38). Pence (2011) describes it more broadly as “the combination of digital information with the real world,” and notes that it has been discussed since the 1960s, but only recently has it become useable in practice because of the wide availability of smartphones (p. 137). One of the more popular applications for creating augmented reality experiences (as used here in this project) is Layar. Layar allows developers to create points of
interest (POIs), and then project two-dimensional (e.g., photos) and three-dimensional objects in that space, visible through a smartphone such as the Apple iPhone or Android. The application makes extensive use of the phone's compass and GPS unit to ensure the object is positioned within geographic space correctly. One possible use of this type of technology (as used here) is to project historical photos onto present day imagery. As Pogue describes it, the phone “becomes a magic looking glass” where the past is re-projected back into the present (p. 38). From a given POI, a user can click out to learn more about the POI (via a hyperlink to a webpage), or view the other POIs nearby. Despite the potentials made possible by this technology, Pogue notes that AR applications “mean walking through your environment with your eyes on your phone, held at arm’s length—a posture with unfortunate implications for social interaction, serendipitous discovery and avoiding bus traffic” (p. 39).

Learner Engagement

Boland (2002) remarks, “Real places provide substance to the themes and events students read about in textbooks. Real places from their own communities make an even stronger connection for students, and may spark an interest in history that helps them reach beyond themselves to learn of other times, places, and cultures” (p. 19). In developing mobile learning opportunities for youth, Squire (2009) agrees that “learning experiences are rooted in particular places” and that curricular content should be “tied to the social history of place, providing students ready entrée for their developing understandings” (p. 72). Woerner (1999) has suggested a number of ways that entering the field (or an actual place) can affect learner engagement. These include:

- Providing input from all five sensory modes (Lovedahl and Tesolowski, 1986).
- Fulfilling a need for concrete experiences (Novak, 1976).
- Students constructing their own records of the scene (MacKenzie and White, 1982).

Learner engagement is salient because increases in interest or engagement can lead to heightened levels of understanding and knowledge building (Blumenfeld et al., 2006). Blumenfeld, Kempler, and Krajcik (2006)—from the field of educational psychology—note that “interest may lead to deeper engagement with the material which results in increased skills and knowledge” (p. 475). Thus, understanding and knowledge building is more likely to occur when the student is engaged and interested in the material.

Study Context and System Design

The GeoStoryteller project was developed initially through conversations between faculty at the Pratt Institute School of Information and Library Science and librarians at the Goethe-Institut, the Federal Republic of Germany’s cultural
institutions. Like other cultural institutions (museums, libraries, archives), the Goethe-Institut is interested in finding ways of connecting with new audiences and promoting learning within their particular mission area, which is in German language, literature, history, art and music. Further expanding this educational mission into the United States is an interesting challenge because of the strong ties and dissonances between the United States and Germany. First, the strong ties: according to figures from the US Census Bureau, in the year 2000, 42.8 million Americans, or 15% of the total population, stated that they were of German or part-German ancestry. However, this massive German influence is nearly invisible today. Particularly from the outset of the twentieth century, the history of German-American relationships in World War I and World War II has yielded calls to change American place names such as Berlin or German to “Liberty” or “Victory” (New York Times, 2 June 1918) and led individuals to actively hide their German ancestry. For example, President Herbert Hoover may have avoided making his German heritage known. Only after the reunification of Germany in 1990 did a growing interest in German-American roots begin.

Germany is one of the United States’ closest allies, second perhaps only to Great Britain, yet many Americans—despite the heavy ancestral ties—know little of this German influence. For example, a recent New York Times article cited the belief that many in the United States know little about Germany other than simple stereotypes such as “Oktoberfest, auto factories, [and] the Holocaust” (Kulish, 2010). In our conversations, it became clear that Germany’s rich traditions in literature, music, architecture and design are less well-known than either more nefarious topics (“Nazis, Hitler”) or less consequential topics (“Beer garden, BMW”). Our goal became to develop a project that would advance a deeper and more nuanced understanding of the relationship between Germany and the USA; two nations with deep ancestral ties and increasing economic interdependence.

Once we agreed on this goal of developing a project that would help learners develop a more intricate understanding of the relationship between Germany and the US, we proceeded to identify the content that we would use to develop this understanding. We turned to historical accounts in published, non-published, digital and non-digital sources around the history of German immigration to the United States. Particular aspects of this history were especially compelling. For example,

\[1\] Documentation of this is available only through secondary sources. In a book titled The Strange Career of Mr. Hoover under Two Flags, a somewhat wild-eyed rant accusing Hoover of being a sort of fifth columnist for various European nations, author John Hamill says that Hoover biographer Rose Wilder Lane “claimed stoutly that he was of French Huguenot origin....However, the genealogists...have traced him back to the German Fatherland.” Lane does indeed claim Hoover was descended from French Huguenots. But her biography is unauthorized, and there is no indication in either her book or Hamill’s of where this information might have come from.

starting in the 1840s, large numbers of German immigrants entered the United States by way of New York City, creating Little Germany or Kleindeutschland, which today makes up a large portion of the East Village and Lower East Side of Manhattan (Nadel, 1981). Between 1855 and 1880, New York had the third largest German-speaking population of any city, behind only Berlin and Vienna (Nadel, 1981, p. 1). Also interesting was the move of the German population uptown, to what is known today as the Yorkville neighborhood of Manhattan, during the early part of the twentieth century (Jalowicz, 2009).

Using this growing content base, we combined some of our other passions—New York City and digital mobile devices—and through extensive discussions and debates arrived at the idea of the GeoStoryteller project. Our idea was to develop multimedia narratives that combined voice with archival photos and deliver them to users’ mobile phones at the places where these events occurred. Users could then in effect go on a walking tour that chronicled the history of Germans in New York. To deliver the multimedia content, we developed two interfaces for mobile devices. The first makes use of the web browser that most mobile devices with Internet access already have. The mobile website allows users to create a custom walking tour of German history in New York using their current location, available via GPS. Alternatively, users can access the multimedia content through Layar, an augmented-reality browser for mobile phones developed by a team in the Netherlands. Using this technology, users are able to hold up their mobile phones and see archival photos layered on top of the images visible through the camera’s phone. For example, users can find such sites such as the Ottendorf Library, the oldest public library in Manhattan, opened originally to support the German immigrant community in Kleindeutschland (see Figure 1). We included augmented-reality photos not only for the “cool factor” but to reveal changes over time between US and German relationships. With the Ottendorfer library, the signage in German was temporarily covered over during the 1940s and 1950s with an English sign. Today, the original German sign announcing the existence of a “Bibliothek” is visible.
Layar allows for other ways to navigate the sites other than augmented reality. For example, users can navigate using a map or using a list of nearby sites (see Figure 2). Once a user finds a site they are interested in, they can click “Explore this Site,” which will take them to a page with the multimedia content, transcript of content, and trivia game to test their knowledge on a site.
We recognized early on that one limitation of our approach was that we could not possibly present all of the interesting stories that chronicled the history of Germans in New York. We therefore selected to deliver only 37 in detail. However, we realized that the significant advantage offered by web-based technology is the ability for users to contribute their own stories and make them available to others. Hence, we developed interface features that allowed users to create their own stories and add them to GeoStoryteller (see Figure 3). The GeoStoryteller software—developed by the researchers—is available as free open source software (download at http://www.geostoryteller.org), which includes modules for creating GeoStories, sharing those stories through a mobile website, and a module for connecting GeoStoryteller to Layar.
Thus, our conversations led us to the idea of GeoStoryteller: a platform for delivering GeoStories, or multimedia narratives about geographic places. We decided that the first use of the GeoStoryteller platform would be a site called German Traces NYC, which would use the platform to deliver the content to interested learners. German Traces NYC was actively promoted on the webpage germantracesnyc.org, as seen in Figure 4.
Figure 4. German Traces NYC is available to the public at germantracesnyc.org.

The German Traces NYC website was made public on September 27, 2011 and has received 9,333 unique visitors (as of April 22, 2012, as measured by Google Analytics). The completely bilingual website was actively promoted in media outlets in Germany such as television, newspapers, and radio, and was prominently featured in a major New York newspaper (Zweites Deutsches Fernsehen, 2011; Frankfurter Allgemeine Zeitung, 2011; Sarre, 2011; Sheftell, 2012). The researchers collect usage statistics from the site using Google Analytics, and receive comments and feedback about the site via email. The comments received are positive and encouraging, and the most frequent issue is related to exclusion of a particular historical site, usually in the boroughs of Queens or Brooklyn. In these cases, the researchers have encouraged community members to contribute their own stories to the site using the GeoStoryteller platform since it is impossible for a single group to capture all the interesting stories that may exist.

Research Approach
The research and development approach used in this project can best be summarized in four concentric rings and could be used more generally by other digital humanities projects (see Figure 5). At the core of this approach is what could be considered traditional humanities research and development. In the case of this project, we used print, non-print, digital, non-digital, archival, and published sources to construct historical narratives of German immigration in New York. Placing the humanities research and development at the core of this approach highlights what distinguishes a digital humanities project from other digital projects. Additionally, this type of research and development could be done with other fields of the humanities, including philosophy, literature, and the arts.

Using this humanities research base, we proceed to the “Theory and Interface Development” ring. At this stage, researchers must consider the theory that will motivate their project, and how this theory will be reflected in the user interface available to the learner. For example, some of the theoretical questions we asked included, how does situating historical content in physically relevant locations affect learner engagement? And does making augmented reality content available to learners affect their engagement? These types of questions necessarily lead to decisions about how to present the content within a digital interface.
In the third ring, learners engage with the socio-technical environment created in part by the researchers. In the case of the GeoStoryteller project, this includes not simply a user interface, but also the physically relevant locations that the interface prompts the user to explore. Additionally, social interactions may occur during this stage among multiple learners or simply among others in the environment (e.g. a librarian at the Ottendorfer library). It cannot be assumed that the best learning experience comes from the digital device; it could result from the serendipitous interaction in the real environment.

From this stage, we proceed to the fourth ring, which is the formal user research. In this stage, we use traditional social science research methods (e.g. surveys and interviews) or digital methods (e.g. web server log analysis) to uncover the working of the interface, as well as address the theoretical questions. In this particular study, we will use more traditional qualitative research. However, further studies could analyze the digital traces left behind by users that would be evidenced in web server log. This type of data could provide a better background of how people are using it “in the wild” (or user behavior produced without the researchers involvement). Formal user research can inform earlier stages of development (e.g. specific areas of content that did not engage the interest of learners could be revised, confirming or
refuting the learning theory, or requiring changes to the user interface). During earlier stages of system development, user feedback was used to modify features available in the project. For example, several users reported that they would like to see the address of the building that they are trying to find, rather than rely solely on the GPS-enabled navigation device provided by the augmented reality environment. This feature was included, and user reports of trouble finding specific sites diminished.

This model shares similarities with rapid software development models, where user feedback is incorporated into the software as it is being developed (Martin, 1991; Maurer and Martel, 2002). It also shares similarities with design-based research from the field of educational, where formal assessments of user learning and engagement inform successive iterations of technical development (Barab, 2004). However, the model is different from the rapid software development model in that it is not only interested in fixing usability issues, bugs, or add features, but also adds the need to adjust the humanities research and development depending on feedback from users and project team members. For example, GeoStories would often go through several rounds of revision until all of the historical facts presented could be verified, and the stories were sufficiently engaging or entertaining. In this respect, the model presented here shares similarities with design-based research, where the aim of design and technology is to promote learning by taking into account not only informational attributes but also human motivation. However, where design-based research is a general approach, the one put forward here is specific to digital humanities research and development in that the core of the model is humanities content research and development, with successive stages of design and development used to support users learning about this content-base. In this sense, the term “research” refers to the historical research needed to construct the narratives, and the research to ensure the usability of the constructed environments and uncover if users are learning things they find interesting.

**Research Questions**

The aim of this research project is to uncover if place-based learning can increase learner engagement and understanding of historical topics. To study this, the following research questions are posed:

1. Does situating historical content in physically relevant locations affect learner perceptions of their engagement and understanding?

2. Does the use of augmented reality affect learner perceptions of their engagement and understanding?

3. Which factors (such as user background and environmental conditions) contributed to learner perceptions of their engagement and understanding?

**Methods**
Study participants were recruited from the Pratt Institute School of Information and Library Science population via the school’s listserv and were incentivized with a $25.00 gift card. This group of participants was used not only because of ready availability but also because of their diversity and ability to represent a variety of learners (e.g., various ages, backgrounds, and interests). Participants signed an informed consent form for the research study, and were loaned an Apple iPad (with headphones and cellular Internet access) for several hours. Participants were also given the option to use their own smartphone such as an iPhone or Android. Each participant was given a brief introduction to the project and the device on campus. The participant then left the campus to explore the historic sites on his or her own. Upon return, the participant was interviewed individually by one of the researchers. A participant’s typical movement through geographic space is illustrated in Figure 6. The interviews took place in a private office. They lasted approximately 25 minutes, with the interview audio-recorded. The interview protocol included basic demographic questions, interest in local history and mobile technology, and questions related to participants’ experience engaging with the technology and the content. The interview protocol is available in the appendix. Interviews were transcribed and coded by two independent coders. The coders assigned a scale value (5 = Strongly Agree and 1 = Strongly Disagree) to each of the below questions:

1) Being on physical location increased participant interest in the topic.
2) Being on physical location increased participant understanding of the topic
3) Augmented reality content increased participant interest in the topic.
4) Augmented reality content increased participant understanding of the topic.
5) Subject would use this type of application again to learn about other historical sites
6) Technological comfort is high
7) Subject Interest in history is high
8) User could not get augmented reality to work or experienced significant problems with it
The agreement between the two independent coders was ascertained by using Cohen’s Kappa (Cohen, 1960). Cohen’s Kappa was calculated by uploading the coded data into an online system designed to calculate this value (Geertzen, 2012). The results of the coding were subjected to quantitative content analysis, which is “a research technique for the systematic, objective, and quantitative description of the manifest content of communication” (Berelson, 1952, p. 18). Additionally, select participant quotations that augment the numerical results and point to other issues or trends are included in the results.

To address the third research question, the factors that influenced user perceptions of their engagement or understanding, a Pearson correlation analysis in SPSS was undertaken, using the reports of engagement and understanding as a dependent variable and the following factors as independents:

- Environmental
  - Temperature
  - Precipitation (Rain, Cloudy, Partly Cloudy, Sunny)
  - Technology used (iPad, iPhone, Android)
  - Time taken
- Subject demographics
Age
- Gender
  - Subject reports on
    - Technological comfort
    - Interest in history

Statistically significant correlations are reported in the Results section.

Participants and Environmental Factors

Thirty-four individuals participated in the study between the dates October 22, 2011 and November 19, 2011. Three interviews had to be excluded because of problems related to the audio recording device, bringing the final number of participants to 31. Participant demographics can be found in Table 1.

Table 1. Subject demographics

<table>
<thead>
<tr>
<th>Gender:</th>
<th>74% female, 26% male</th>
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<tbody>
<tr>
<td>Ethnicity:</td>
<td>88% White, 3% African American, 3% Asian, 3% mixed ethnicity, and 3% Native American</td>
</tr>
<tr>
<td>Education:</td>
<td>93% Post-college graduate studies, 7% College graduate</td>
</tr>
<tr>
<td>Device Used:</td>
<td>65% Apple iPad, 22% Apple iPhone, 13% Google Android</td>
</tr>
<tr>
<td>Age:</td>
<td>55% in their twenties, 33% in their thirties, 6% in their forties and 6% in their fifties</td>
</tr>
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On average, participants spent two and a half hours (SD = 54 minutes) exploring the neighborhood and using a mobile device (either their own device or an iPad borrowed from the researchers). The average temperature was 52.4°F (SD = 8°F). Interviews scheduled for days with substantial rain or snow were canceled and rescheduled for other days with more amenable weather.

Results

Interview transcripts were independently coded using the aforementioned scheme. To ascertain inter-rater reliability, Cohen’s Kappa was calculated for each coded variable. The average Cohen’s Kappa value was 0.90 (the highest was 0.96 and lowest was 0.79). This indicates very high agreement, with a range from substantial agreement to almost perfect agreement (Landis and Koch, 1977). Because of this agreement, a single rater’s codes will be used for further calculations.

Results from the quantitative content analysis indicate that learners agree or strongly agree (90.32%) that being on physical location increased their interest and understanding of the historical topic. Participants—in attempting to make sense of the experience—sometimes made comparisons to a museum visit, but found that this type of experience had some strengths not found in a museum. For example,
one female participant in her twenties noted that the experience “helps in a sense of a guided tour that, inside a museum, would not so much be a tour, and in this way you’re seeing actual elements of history and architecture in a very modern environment. Very illuminating.” This comment speaks to the experience of seeing historical artifacts situated in a modern environment. A female participant in her thirties concurs, finding that “it was like being in a museum, I was just kind of in a different zone....” Another female participant in her thirties noted:

*I felt sometimes that I was like in an outdoor museum, because they give you those things in the museum all the time.... it’s nice that you’re there, because it’s so much more meaningful, because like when a question asks you—“What’s the inscription on the building?”—you’re looking up and taking that in. There’s an inscription on the building, which in a photograph in a book is not going to make as much of an impression on you.*

This comment highlights how participants—in attempting to make sense of the experience—would compare the experience with respect to earlier technologies.

Participants were most enthusiastic when they received new information—primarily through the video-enhanced podcasts—on familiar physical surroundings. For example, a male participant in his twenties remarked:

*I had a lot of fun, that’s why it took so long. A lot of these buildings I had actually seen before, and just noted because they were pretty and I was just in the neighborhood, but to actually get the context was really incredible. And the interface was really easy to use. I didn’t have a problem finding anything, and also I noticed myself stopping and reading other signage, like up upon other buildings, and trying to get more content. So, I had a great time. And, also it was beautiful outside, so it was a great day to do it.*

Another male participant in his twenties said:

*I thought it was a lot of fun. I am up and down Second and Third and Fourth Avenue all of the time, and I never noticed some of those buildings, and the busts, and the architecture, and it was really fascinating. Made me want to show other people.*

Similarly, participants occasionally connected this historic information with present day topics, such as this female participant in her thirties who drew a parallel between the earlier social unrest in Tompkins Square Park and the Occupy Wall Street movement:

*I actually had no idea that there was an East Village presence [Germans in New York]. I guess it sort of predates Yorkville a little bit. But I particularly loved hearing the Tompkins Square part. I’m woefully unaware of its history.*
Particularly now when you’re thinking about a very similar movement happening downtown. Thank God, less violent.

Most participants who were interviewed did not find the physical environment so distracting as to make the material difficult to comprehend. For example, one female participant in her twenties remarked:

_I mean, you’re going over to St. Mark’s. You know it’s annoying over there. So as you’re turning the corner you take a breath and suck it up, because it’s crowded over there. But I didn’t have a hard time finding a spot to stand on the sidewalk, and looking up or across the street is easy._

However, occasionally a participant would make note of the possibility of too many stimuli. As a woman in her twenties remarked:

_One of the things that was difficult for me, and maybe this is just my learning style, was that it was almost difficult to absorb some of it, because you’re standing in the middle of it. You’d think that that would be really cool, and it is, kind of, because you’re like, oh, there it is! It’s right there in front of me, you know, how exciting. But at the same time there’s all of this stuff going on around you, like you hear cars and sirens, and there’s people, and you’re trying to make sure nobody’s going to sneak up on you and steal your iPad. So it became kind of difficult for me to actually, like, pay attention in that kind of environment, and absorb that. But I really like the GeoStorytelling. I think it’s a fun idea._

Learners were quite adamant in agreeing or strongly agreeing (72.43% of participants) that they would use this type of application to learn about other local history sites in New York or other cities.

However, learners on average did not feel that the augmented reality contributed to their understanding or engagement, because many (64.52%) experienced significant usability issues. Although all participants were given a brief introduction on how to use the augmented reality function while indoors and on campus, once they were outside, the problem most often experienced was one of the following: a) the participant did not really understand how to use the augmented reality technology and was unable to learn it on his or her own, b) if the participant tried and did not get desirable results, he or she would give up and not try again, or c) the participant would try several times but was repeatedly disappointed with the results. For example, one male student in his twenties remarked the following:

_I was really excited and then subsequently disappointed when the camera function of Layar didn’t work. I thought that was—I mean, I knew that augmented reality existed and you could do things like that, but I had never done it before with my phone or iPad, so I was really interested to, not only to see the old buildings, but just to experience my technology interacting with the_
places. I’m not sure if it was a question of my phone or what, but I was a little disappointed that I couldn’t get that to work.

Some participants expressed concern about trying to learn how to use a new technology on a conspicuous device in an uncontrolled environment. One female student in her twenties said:

...It was kind of hard. You had to, like, kind of turn the iPad and try and figure out if you could see, like, one of the things pop up. I was a little hesitant to do that too much, because with something like an iPad, it’s kind of big, so you feel kind of vulnerable, and you’re like, I don’t want someone to run by and steal this! I think I would have felt more comfortable with, like, an iPhone or something smaller.

A participant in her thirties made note of how using such a conspicuous technology can be irksome, saying, “It’s a little weird to walk around the Village clutching your iPad. It’s like a little worse than a guidebook, yuppie guidebooks.”

And some participants simply avoided using a new technology with which they were unfamiliar. For example, one female participant in her 40s, when asked if she used the augmented reality, simply responded, “I did not. I did not use it at all.”

Interestingly, however, participants who already had significant knowledge of augmented reality technology did not experience technical problems and found the augmented reality function increased their interest and understanding of the topic. A male participant in his twenties, who had recently written a class paper on augmented-reality technology, noted:

I think the camera was probably the most interesting, how it, like, takes the older image of the building and puts it over the newer building. I think, you know, the technology is bare bones at the moment but I think that’s the most interesting and probably where the most improvement could be, in the future. Like, layering different objects over various points of the city for tours.

Similarly, a female student in her twenties who had also written a class paper on augmented reality technology noted that she liked the technology and did not have any technical problems with it.

A Pearson correlation coefficient revealed a significant correlation between outdoor temperature and user reports of their engagement. Specifically, temperature positively correlated with user reports of their understanding\(^2\) as well as reports of their willingness to use this kind of application again to learn about history\(^3\). In essence, the warmer the temperature, the more likely the learner was to make

\(^2\) \(r(28) = 0.443, p = .016\)
\(^3\) \(r(25) = 0.434, p = 0.027\)
positive reports of his or her perceived understanding and willingness to use this

type of application again. This indicates that cold temperature can have an adverse

impact on learner experience, which is understandable because using a mobile
device such as an iPad—especially without gloves—can be uncomfortable in cold

weather.

User reports of technological comfort were also significantly correlated with their

ability to use augmented reality. This is a reasonable finding: those uncomfortable

with technology more generally will likely find it more of a challenge to learn a new

technology such as augmented reality.

Discussion and Limitations

This study indicates that learners perceive that the use of place—having physical,

outdoor access to the places where significant events occurred—increases

engagement and understanding of historical topics. This engagement is the result of

discovering new information about familiar surroundings using standard mobile

user interfaces (lists, maps, videos), and not from more novel user interfaces

(augmented reality).

User engagement is significantly affected by temperature, meaning that cold
temperature (45°F and below) can negatively impact user reports of their learning
experience. This study did not include any high temperature conditions; however, it
is plausible to believe that high temperature (which would also produce physical
discomfort) would also have a negative impact.

Users who have significant personal investment in augmented reality technology
report that it works well and it is useful; however, users without this background
report that it is difficult to use. Similarly, users who are less comfortable with
technology are more likely to have trouble using augmented reality. This would
indicate that additional training is needed for users to fully take advantage of
augmented reality. One way the training could be made more effective is to do it
outdoors using a realistic context (e.g., providing a historical photo overlaid against
present-day camera imagery). Psychologists acknowledge that learners are more
likely to apply training when they learn it in the same context in which they will use
it (National Research Council, 2000). The training provided by the researchers to
the participants took place indoors, and did not make use of a realistic scenario,
which could be improved upon as suggested. At present, it would be incorrect to
assume that the general user already understands augmented reality or could easily
learn how to use it without deliberate instruction.

A limitation of this study is that it reports learner perceptions of engagement, and
does not measure these factors against a control group that did not get to

experience the physical location. Similarly, learners reported their own perceptions

\[ r(29) = -0.420, p = 0.021 \]
of their understanding and were not formally assessed against some objective measure of comprehension. Further, a factor that was not controlled for is the possibility that the novelty of being able to learn historical topics outdoors using mobile technology was the factor that increased engagement, rather than the educative factor the physical environment made possible.

**Conclusion**

In conclusion, the use of place in mobile learning environments can increase learner perceptions of their engagement and understanding. This is especially true when the physical environment (e.g., temperature) is conducive to being outdoors. The use of place provides a meaningful entry point into the historical content, and provides the “backstory” on a familiar and finite environment. This arrangement is quite different from the experience of using the World Wide Web, which can leave some users feeling a sense of information overload because of the unbounded and unfixed nature of this environment. Teachers of history and social students, as well as those working in memory institutions (museum, libraries, and archives), should be encouraged in using place in their teaching and mobile education initiatives.

For researchers, we described our approach to digital humanities research and development that reflects our experience with the GeoStoryteller project. This approach put humanities content research and development at the core, with successive stages of design and development used to support users learning about this content-base. We invite users to try out German Traces NYC on their next visit to New York City, and encourage developers to use GeoStoryteller in creating their next mobile learning project.

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Appendix

Interview Protocol
[Participant arrives. ]

Have participant sign informed consent form. Give them iPad if not using their own device.

Turn on cellular data. Sanitize headphones if using shared iPad.

Remind to be mindful of cars and theft. Give participants business card with cell phone number.

[Participant returns 1-2.5 hours later] [Turn on audio recorder]

Brief introduction to interviewee: Thank you for agreeing to let me interview you this morning/afternoon/evening. The intention of this interview is to collect your feedback on the experience of using mobile technology as an educational device. I have some questions for you about your experience, followed by some basic background questions. Your responses will be anonymous, and will be used for enhancing this project and others like it, so we ask you to feel free to be as candid as possible. Also please note that this interview is being recorded. Are you ready to begin?

1) How was your experience this morning/afternoon/evening?
2) Which part of the application did you use (podcast, trivia, augmented reality, map, etc.)?
3) Which parts appealed to you the most?
4) What did you like and/or dislike about it?
5) Are you more interested in the topic [German Traces] after this experience?
6) Do you feel like you got a good understanding of the topic from this experience, or not?
7) How would you describe you experience using the Augmented Reality Content?
8) Do you think being on location in these historically relevant sites increased your interest and/or understanding of the topic?
9) Would you use this type of application to learn about other historical sites in New York City?
10) Minimal demographic questions (age group (20s, 30s, 40s, 50s), full time/part time student, working, non-working).
11) How would you describe your level of comfort with the iPad (or you own mobile device)?
12) How would you describe your level of comfort with mobile technology and computing more generally?
13) How would you describe your interest in local history, such as topics of European immigration to New York? Are you more interested in the topic after having had this experience or not?

14) What motivated you to volunteer for this project?

[Turn off audio recorder, save file.]