

# The Influence of Locative Media on Social Information Sharing - a review

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## Abstract

Mobile phones and social media enable people to share information with others whenever they want, wherever they want. More recent developments allow people to augment their sharing experience by geo-tagging their information through GPS enabled phones. These 'locative media' can be used to facilitate navigation, way finding or to obtain information about a physical place or object. Other services let the users tag, rate public spaces and recommend them to other people. Furthermore, people can tell their stories by attaching their own context to a physical location.

This report is a literature review in the field of locative media. In order to get a complete overview of the research that is done on location-based social networking, the most recent developments in the field are investigated. We also look at research methods used to test the user experience of this type of social media systems. Furthermore, we investigate the influence of location based media on the sharing habits and social practices of the users of these systems.

The conclusions of this exploration in the field of locative media research lead to design guidelines and research methods that will be used in a user evaluation of a system for location based smart photo sharing.

## 1 Introduction

The mobile phone has become such an important device in our everyday lives that some people can't leave their house without it. "We romance the robot and become inseparable from our smartphones", writes the psychologist Sherry Turkle who works under the MIT Initiative on Technology and Self in her newest book "Alone Together." [34]. Mobile communication allows us to connect us to anybody, from any place at any time. We can be physically present at a particular place, but still be digitally connected to our friends and family. This causes the boundary between the physical and virtual world to become blurred. Besides supporting relationships with distant others, it can easily be used to initiate and coordinate social encounters with others in physical proximity [5]. The impact of these media became painfully clear, when in September 2012 a party that was organized through a public event on Facebook attracted 25.000 people on a very

short notice and left a small town in The Netherlands ravaged when the party escalated into riots <sup>1</sup>

The rise of GPS (Global Positioning System) enabled phones allows users to tag the information they share with geo-located content, most often GPS coordinates. Among the most popular geo-tagging services are Facebook, Foursquare, Twitter, Google Latitude and Flickr [31]. These services are called geo-social networks (GeoSNs) or location-based social networks (LBSNs) and they allow us to combine real-time location reporting with traditional social network functionality. A possible use scenario for this type of context aware service would be, "find all restaurants in a 500 meter radius from my current position that serve Italian food" [2].

This paper focuses on the influences of locative media on creating, consuming and sharing social information. Social information can be defined as the information that is created and processed by a group of people. In the context of locative media systems, this information is shared through online social networks. The focus of this study is on questions such as *how* people use locative media, *what* kind of information is shared and *what* interactions among users stem from the usage of locative media. This might shed a light on the question *why* people use locative media. A literature overview of recent research that has been conducted in the field of locative media will be presented. Several aspects of this technology will be reflected in this report, such as relevant theories from the field of psychology, research methods used to evaluate locative media systems and the actual influence and effects reported in user studies. The goal of this literature review is to obtain an extensive overview of research conducted on locative media. The outcome will be used to form recommendations for future development and evaluation of locative media systems. This leads us to the following research questions:

1. Is locative media a new topic or is it comparable to other paradigms?
2. What existing theories can be used in research on locative media?
3. What kind of research methods are used to evaluate locative media systems?
4. What is the influence of locative media on the user's sharing behavior?
5. How does locative media affect the privacy of its users?

In section 2 we elaborate on the search for literature itself, how relevant articles were found, how many and through which sources. In section 3 the developments that have led to the current state of locative media and the position of social media in society will be explained. In section 4 theories from the field of psychology are related locative media. Then an overview of the research methods used in recent evaluations of locative media systems is given in section 6. A logical next step is to look at the reported effects of locative media stated in literature in section 7. Finally, in section 8 conclusions about

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<sup>1</sup>For a Dutch article about this "Project X Haren" named after the movie "Project X" and the city of Haren where the "party" took place, refer to [http://nl.wikipedia.org/wiki/Project\\_X\\_Haren](http://nl.wikipedia.org/wiki/Project_X_Haren). (visited March 2013).

locative media are drawn by answering the research questions and recommendations for future research on this topic are given.

### Picalilly: an application for geo-locked photo sharing

In the EU Artemis project Smarcos we developed Picalilly, a mobile-phone based photo sharing application that allows its users to define geographical boundaries for sharing of their photos [35, 36]. In addition, Picalilly also allows its users to follow photo taking activities of their friends at specific locations of interest. We carried out a small scale field trial of Picalilly involving two groups of student who were part of a two-week long introduction program at a University. Our preliminary results showed two themes, 1) social navigation and 2) exploration. Overall, our early results show that Picalilly offered photo sharing that was enabled as well as restricted by geographical locations. Creative Technology students and Master students Human Media Interaction contributed to the project: design, implementation as well as taking part in user evaluations. Picalilly turned out to be a challenging project for these students.

The results of this review will be used for a second and more extensive field study about the use and user experience of this specific type of locative media application. This work will be carried out by the first author for his MSc in HMI project.

### Acknowledgment

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<sup>2</sup><http://www.smarcos-project.eu/>

## 2 Literature search

The search for literature was started by reading a review paper on locative media [5]. This gave the first overview of the research carried out in this field. A total of 11 articles dated on locative media were selected from the references. Of course, one article can not provide an exhaustive source of all relevant literature. For instance, it does not include research done after its publication and the scope of this study might not fully overlap. Therefore the bibliographic database Scopus was consulted. A search query using keywords "locative media", published since 2008 in the area of computer science and social sciences resulted in 99 hits. A total of 11 articles were hand picked from this set.

Google Scholar was used to find articles on privacy issues related to geo-tagging because Scopus did not provide satisfying results. Only one relevant article, a user study about preference for privacy mechanisms, was selected after using the keywords "geo-tagging privacy". An initial search using the keywords "geo-tagging privacy" resulted in 546 results. Refining this by excluding patents, citations and publication dates before 2008 resulted in 371 results. In total, 3 articles were selected that were estimated most useful to this study. The remaining 6 articles used in this study were found through references of other selected articles or were recommended by reviewers.

Digital copies of selected articles were stored and categorized by topic. An overview of literature on locative media that was reviewed for this study is shown in table 1.

## 3 History of locative media

In this chapter, the developments that have led to the current position of locative media in our everyday lives will be explained. This history starts at the early days of the internet. Then it will be shown how our online communication methods have moved from the private sphere into public spaces. Finally, locative media is defined and placed into the context of our everyday lives.

### 3.1 The end of web 1.0

To get a better understanding of the road that led to the popularity of location-aware media, we go nearly 20 years back in time. As Gordon and de Souza e Silva describe in their book *Net Localities* [15], in 1994, a web hosting company called *Beverly Hills Internet* was founded. They used neighborhood names to categorize web pages by people's interests. Users could host their own web page in the virtual neighborhood of their interest: an entertainments website on *Hollywood*, finance related on *Wallstreet* or music related on *SunsetStrip*. The company grew, renamed to *GeoCities* in 1995 and was bought by *Yahoo!* a few years later.

GeoCities placed links to digital documents into categories. This is a way of ordering that made intuitive sense to people. This model of interactivity is now referred to as the *Web 1.0*, where there is a one-to-one relationship between the producer and consumer

Table 1: This table shows a categorization of papers *on locative media* that were reviewed for this literature study. The *App review* column describes papers that review existing locative media applications. The *Privacy* column contains papers that discuss privacy issues, the *Review* column contains papers that extensively review other locative media literature and papers in the *Theory* column create theoretical frameworks that relate to or try to explain locative media.

Reference	User study	Design	App Review	Privacy	Review	Theory
Behrendt [1]			x			
Bilandzic and Foth [5]					x	
Bilandzic and Foth [2]			x		x	
Bilandzic and Foth [3]		x				
Bilandzic et al. [4]	x	x				
Burghardt et al. [6]	x			x		
Crawford [8]			x			x
de Souza e Silva [9]						x
Eagle and Pentland [10]	x	x	x			
Espinoza et al. [11]		x				
Friedland and Choi [12]				x		
Gordon and e Silva [15]			x	x	x	x
Humphreys [17]	x		x			x
Karapanos et al. [18]	x					
Lentini and Decortis [20]	x					x
Licoppe et al. [23]	x		x			
Løvlie [24]		x				
Lucero et al. [25]	x	x				
Morrison et al. [26]	x	x				
O’Hara [27]	x					
Pesce et al. [29]				x		
Rost et al. [30]	x	x				
Schroeter et al. [32]	x	x				
Sutko and de Souza e Silva [33]					x	x
Ruiz Vicente et al. [31]		x		x		

of this information: one person had the power to put up a webpage and another had the choice whether or not to visit it.

During the 1990s and 2000s, this way of organizing changed into a more flexible system. Search engines such as *Google* parse through information to give the user a temporary list of results based on his search query. Gordon and de Souza e Silva argue that a categorization of documents was no longer needed, since they can be found based on the individual search terms, particular context and preferences of the user. People are no longer visiting a particular site for their needs of socializing, finding news or searching for information, instead they use the web as a whole. Social networks are used to produce, consume and share small messages in the form of blog posts, tweets and status updates. The contents of the message is what drives the interactions, instead of the website or platform mediating it.

### 3.2 From private to public space

Another big change that occurred is the extension of the web to physical locations. More and more the information that we search for on the web is organized by and depending on where we are. In the early days of the internet, there was a clear distinction between the physical world around us and the virtual world wide web. We used to sit in front of a screen in order to connect to the web. This gave many the feeling that in the end, communicating with each other would be done mostly in digital spaces. There would no longer be a need to leave the house for social interactions in public space, as long as the web could make us feel physically present when connecting to other people. Mobile phones contributed to this feeling, as they too can detach us from the physical world and our social interactions. Who hasn't found himself in the situation where the person you are having a conversation with is suddenly looking down at his hand, because a distant other has something more important to say?

The internet is always present, around us and location aware, which allows for new types of interaction with both technology and other people. This changed the way we use to think about the web: today 'being connected' means that you are connected always and everywhere through your personal mobile phone and other systems surrounding us, instead of browsing the web in front of a monitor. As Gordon and de Souza e Silva describe it, *references to physical space on the web are no longer metaphors for digital information; physical space has become the context for that information.*

Crawford describes a small wireless device named *Lovegety* in her article [8] that is used for proximity matchmaking. This system is reported as the first commercial location-based social networking application and was only available in Japan, back in 1998. It allows the user to program his favorite activities and the device will start blinking when a *Lovegety* user with shared interests enters his proximity. Mobile internet has been available in Japan for years now through the so called *i-mode* service. People that have been using social network services through desktop-based applications are now catching up with the access habits of the rest of the world. The advent of high speed mobile networks and the popularity of social networking sites (SNS) enabled the transformation of SNS from the private into the public space.

Several mobile social software applications were developed in the next few years. One example is *Serendipity*, a matchmaking program using Bluetooth technology, was one of the first mobile social software applications [10]. To generalize, Crawford [8] writes that most of these applications pre-sort strangers into groups with shared interests, in order to improve the users' experience of the urban space around them in some way. These systems are designed to facilitate specific types of social encounters in a specific context such as dating or conferences [5], but the more recent location-based systems change the way we perceive the spaces around us by making its social properties visible to the users. This is achieved by making effective use of the contextual information, such as the device's current GPS location that modern mobile devices are able to register.

### 3.3 Locative media

A more general term for GPS enabled mobile devices is 'locative media', that was coined as a title for an international workshop for researchers and artists in 2003. The goal of the work shop was to explore the social interactions and implications of location-based media [5]. Later on, the term Mobile Spatial Interaction (MSI) was used at a workshop at the CHI 2007, that stands for the emerging opportunities and affordances for social navigation of space that location sensitive and Internet capable devices offer to its users [13].

At this workshop, relevant locative media applications were classified in four categories. Systems that:

1. Facilitate navigation and wayfinding in geographic places. For example, car navigation systems that help the driver find his route through interactive maps and spoken directions or mobile interfaces that let users find places of interest near to their physical location [4].
2. Augment reality by adding virtual information to real life objects in the physical world. This type of application makes use of the live camera feed and image processing techniques such as object recognition to display relevant information to the user, for example by virtually overlaying interesting sights on the recorded image of a physical map. [26]
3. Allow users to create [4, 11, 17, 32] or...
4. ... provide access to geo-tagged information attached to physical places or objects [1, 30]. These applications enables text, pictures or video to be placed in a specific geographic context by assigning latitude and longitude identifiers to it. Examples include recommendation systems or social network services named above.

The advent of the iPhone 3G in 2008 and other smartphones that would follow helped location aware applications become mainstream. The technology they offer make it easy for users to always be connected and share stories to people in their network, creating a social element to annotation. Among the first Location Based Social Networks

(LBSNS) were applications such as *Loopt*, *Whrrl*, and *Brightkite*. Users could post location-updates and photos that were displayed in order of proximity rather than reverse chronology, which was usually the case in online blogs and forums. The result of these interactions form a social narrative around a physical location. The main aspects that these applications introduced are automatically displaying the user’s location using GPS technology, eliminating the need for self-reported position and displaying this data on a map. Some LBSNs started introducing game-like elements to their interactions, such as giving virtual rewards for checking in at a physical location multiple times. This, combined with the affordances of social networking, is one of the reasons for the enormous popularity of the application *Foursquare* (see figure 1).<sup>3</sup>

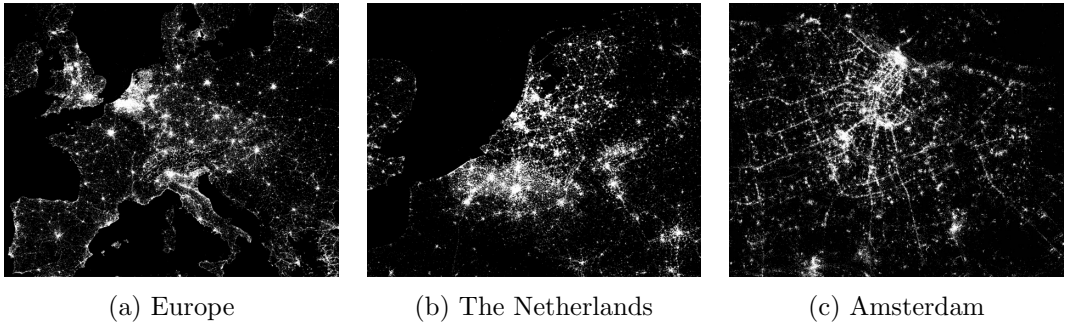


Figure 1: A geographical display of (a subset of) 500 million check-ins created in the last three months of 2012 using the Foursquare application. Note that this figure only contains check-in locations marked by a white spot on the black background.

### 3.4 Summary

The concept of annotating user created data with geographical co-ordinates has existed long before the arrival of GPS enabled devices. Webcommunities allow their users to manually attach a locational information to photographs or status updates. The increasing performance of search engines and ever growing popularity of social network sites changed the way people search for and share information. The internet has become ubiquitous by the advent of powerful mobile devices. The newest, GPS enabled devices make social properties of physical space around us visible by combining measured locational data with social network communities. Locative media has become very popular over the last few years, with millions of users divided over many different services and applications. The four main types of locative media systems are: navigation tools, augmented reality applications and applications for consuming and creating location-based content.

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<sup>3</sup><https://foursquare.com/infographics/500million>



## 4 Theory

This chapter will focus on theories that help to understand the implications of locative media.

### 4.1 Mobile media and urban spaces

Crawford [8] describes that the environment in which mobile social software is developed and put to use often is the urban space, although other places are suitable as well. New media have always shaped and influenced the urban life. Cities provide the environment that is essential for these media to develop. Furthermore, she argues that our everyday activities are so interwoven with electronic interfaces these days that they increasingly influence our experience of time, space, identity, community and sexuality. These technologies enable certain practices through their interface (so called *affordances*) while at the same time making other options impossible. For instance, the *Lovegety* system only allowed their users to choose between “man seeking woman” or “woman seeking man”. It is argued that *any speculation about creating diverse public urban space in the future will have to take [the affordances of a system] into account.*

Crawford warns that new mobile media have the tendency to strengthen relations and interactions between people that already know each other, which conflicts with the ideal of a heterogeneous urban space. Matching algorithms to find personal interests and friend-of-a-friend functionality that social software most often make use of are the main contributors to this “social cocooning”. Crawford’s main point of critique toward mobile social software are these affordances, limiting encounters to preselected matches in public space. She also indicates this does not necessarily determines the future of urban life, but the context and spirit in which this technology is used will.

### 4.2 Strangers and street sociability

The urban environment is interesting for mobile social software, because of the role that strangers play in everyday life. A person does not expect to encounter strangers in private spheres, such as home. This is also what makes mobile SNS different from SNS used in private space. Crawford argues that there is a certain openness of people towards the differences in people that one encounters in a city, which allows for random encounters that provide the opportunity to *transport us out of ourselves and our accustomed way of thinking.* Although, some people experience the encounters with strangers as a source of danger and anxiety. The potential for random interpersonal encounters, combined with the unfamiliar spaces where strangers meet and interact, make urban space unique.

Sutko [33] frames the social implications of locative media within known sociological theory by re-purposing three social theories. First of all Erving Goffman’s *presentation of the self* is applied to a new presentation of place. Goffman theorized that we make judgments about strangers based upon appearances [14]. There are intended and unintended impressions that form these judgments. This is a theory about unmediated face-to-face communication and is often used to explain how mobile communication dis-

connects us from physical places. Sutko argues that indirect communication methods do not directly disconnect us. Instead, they can connect us to surrounding spaces and people. There are multiple agents that influence the impression of a place. The owner of the place can explicitly show his intentions through design and advertising. Over time, a recognizable character of the place is developed by the people that visit it. Likewise, locative media can generate familiarity with a place by using information about the users that visit it and vice versa.

Second, there is Georg Simmel's theory of *sociability* in the modern city, about issues of trust, freedom and anonymity in public spaces. People on the street are anonymous, because they are strangers to each other and differ from each other. At the same time, this is also what unites them. Sutko explains that this is also the case for anonymous locative media systems: a group of strangers connected through the same interface. Strangers who are only temporarily collocated experience less fear of the social consequences of their actions. This allows for a more playful social environment, which is termed sociability by Simmel. In relation to Simmel's theory, it is often suggested that mobile phones give us freedom, because they don't bind us to a physical location and the distant other remains anonymous (which makes it easier to discuss private matters in a phone conversation). Sutko explains that mobile interfaces can be used to filter relevant information in situ, which helps to manage interactions with city space.

Finally, Sutko uses Turo-Kimmo Lehtonen and Pasi Mäenpää's theory of *street sociability*. They emphasize the playful nature of social interactions and the excitement of random chance encounters in the street. The presence of strangers in a familiar place may be acceptable, because of the person's prior knowledge of that place. We assume that others are like us and will behave like we would. Therefore, people are not likely to visit places where they might encounter a more diverse population. The balance between trust and unpredictability creates sociability in urban spaces. Locative media applications focus on interactions between the spatial and the social. By showing groups of people with similar interests, a sense of familiarity with the place and the people visiting it is created.

Overall, Sutko argues that location based social networks create a tension between the anonymity and the intimacy, or the strangeness and familiarity in urban life. Locative media do nothing more than support already established social norms. However, there is a tradeoff in which users of locative media engage more in direct coordination and less in direct communication. This can lead to unexpected and pleasant social experiences.

### 4.3 Summary

Mobile media and urban spaces have always influenced each other. Developers have to carefully consider the affordances of technologies in order to maintain the heterogeneity of urban spaces. Social cocooning is the effect that people that already know each other form preselected groups. Strangers play an interesting role in locative media. Theories about sociability in public space and presentation of self can be used in order to understand locative media. Locative media support existing social norms for street sociability and can facilitate unexpected encounters through the tension between anonymity and

intimacy.

## 5 Design of locative media systems

Several different aspects of designing locative media are discussed in this chapter. It is shown how the choice for a particular technology or interaction method can influence the use of a locative media system. Various examples and properties of these systems are given.

### 5.1 Technology

The choice of a certain type of hardware or protocol for the development of locative media might influence the interactions that the final product of a system can facilitate. In the early 2000's Bluetooth technology enabled wireless devices to detect and communicate to other Bluetooth devices in a short range (up to 30 meters) [10]. More recent developments made it possible to be connected to a wireless network anywhere, at public hot spots, in public transport or city-wide WiFi coverage.

Nowadays, there is a plethora of GPS enabled mobile devices available to the general public (see Figure 2) and therefore cross-platform availability of an application is an important factor to achieve a high level of user participation. Although there is a lack of cross-platform programming standards, developers can still focus on open source development and use open data formats to make it possible for users and developers to adapt the application to other devices. Hybrid positioning systems are an important part of locative media, because the positioning methods for mobile devices are somewhat limited: GPS technology often needs to be used outside, while triangulation by cell towers and wifi networks might not provide sufficient coverage in rural areas [24]. Løvlie further suggests a secondary mode of access that does not require GPS technology, such as a web interface showing data on a map, which is still supported by many mobile devices.

### 5.2 Interaction methods

Many different design choices can be applied to locative media systems, depending on the goal of the application and its intended interaction methods. Several characteristics and their consequences that can play a role when developing and designing locative media systems are explained below [2].

#### 5.2.1 Visual vs. aural

One of the few locative media applications that base their interactions on sound is *The National Mall* as described by Behrendt [1]. She argues that there is a visual bias to locative media. Løvlie explains that sound is particularly well suited for locative media [24]. The user is already accustomed to walking around and listening to media

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<sup>4</sup><http://www.businesswire.com/news/home/20121101006891/en/Android-Marks-Fourth-Anniversary-Launch-75.0-Market>

Operating System	3Q12 Shipment Volumes	3Q12 Market Share	3Q11 Shipment Volumes	3Q11 Market Share	Year-Over- Year Change
Android	136.0	75.0%	71.0	57.5%	91.5%
iOS	26.9	14.9%	17.1	13.8%	57.3%
BlackBerry	7.7	4.3%	11.8	9.5%	-34.7%
Symbian	4.1	2.3%	18.1	14.6%	-77.3%
Windows Phone 7/ Windows Mobile	3.6	2.0%	1.5	1.2%	140.0%
Linux	2.8	1.5%	4.1	3.3%	-31.7%
Others	0.0	0.0%	0.1	0.1%	-100.0%
Totals	181.1	100.0%	123.7	100.0%	46.4%

Figure 2: The top six smartphone mobile operating systems, shipments and market share as of Q3 2012 (volumes are in millions).<sup>4</sup>

at the same time. The immersion in sonic media works differently from visual or screen based interactions with locative media. The need to look at a screen will distract the user from experiencing his surroundings (and might even risk traffic injury, especially when combined with listening); the only exception is augmented reality applications that overlay information onto live video images. The main form of interaction with locative sound is walking, which gives the user some agency in locative sound. Because the locations of specific sounds are unknown, the user is encouraged to explore his surroundings. The exploration and the element of surprise enrich the quality of the experience. Behrendt emphasizes that the focus on sound highlights how problematic it is to reduce locative media experience to representation through a point on a map. These interaction do not only happen on this location, they unfold over time.

Other examples include location based narratives, where users hear a story that is related to their physical location. This kind of application is common in museums and city tours. User studies on these systems report that location bound narratives can increase immersion in the user's surroundings and make the interactions more fluent by walking from one place to the other. [28, 18]

### 5.2.2 Remote access vs. in situ access

This comparison is about the way users access their information. *In situ* access means that the user can only view, produce or share information at the location where a system is situated or where the system allows these interactions. We will look at a few different examples of systems that allow their users to interact only when they are at a particular physical location. Remote access on the other hand entails interactions where the user can access location based information from anywhere at any time. A mixture of these modes of access is also possible. For example, this is the case when the user can only create new information in a particular place, while it can be viewed from any location.

Løvlie describes in his article [24] that locative media projects based on spatial annotation can be distinguished by their spatial range. Projects such as city tours and museum guides usually span a small geographical area, up to a few city blocks. They are typically only accessible through a custom interface or platform and do not allow user input. On the other hand there are projects with open boundaries, potentially encompassing the whole world.

The Columbus system, a typical example of in situ access, is a mobile application that lets users explore their physical surroundings by viewing geotagged photographs on a map based interface. The user has to move around to unlock photographs in the vicinity, which according to the authors promotes exploration of the physical world (see Figure 3). Previously explored areas can be viewed at any time [30]. In order to provide a more complete experience to the users, it is suggested to provide alternative methods of access to user generated content. For example, online communities and forums can allow users to access geotagged content they have produced earlier, even when they are not able to use a GPS enabled device at that moment [22, 26].

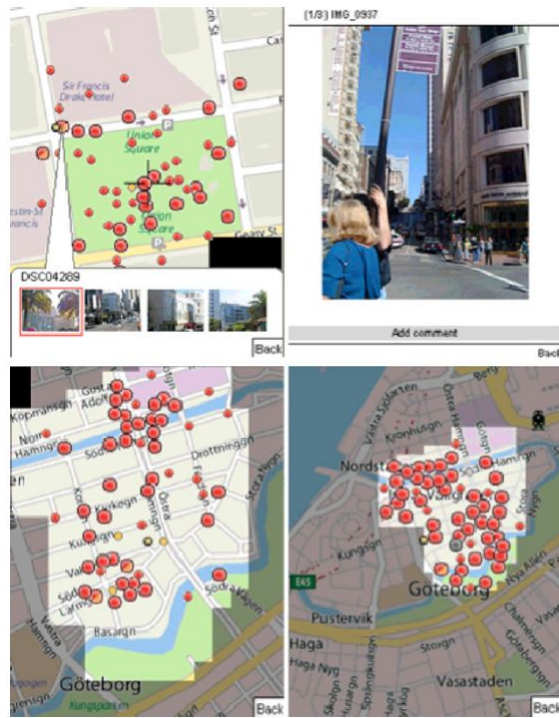


Figure 3: The Columbus map interface showing geotagged photographs. The top images shows pictures unlocked at the user’s physical position, the bottom images shows areas that were previously explored. [30]

Another example of in situ access are systems with which the users interact through large screen displays. Most often users can submit messages to these systems using their own mobile devices, which will then be displayed in a central location where many users

convene. Schroeter et al [32] investigated what influenced the sharing behavior of people using a large public display, to which everyone could send text messages through SMS or Twitter. The goal of the system is to get valuable feedback about specific topics or issues of civic and/or local nature (with topics such as “How would you like to see the city grow?”). Eight different case studies were conducted to determine the sweet spot for application of such a system, which the researcher describe as a place where the system collects user input frequently and content is of high quality (relevant to the discussion).

Behrendt also explains how applications such as The National Mall discriminate in terms of geographical location of the user. The user has to be at one specific place to experience interactions, others who can not travel to the location are excluded. This illustrates the tension between the promise of mobile media to have access anywhere and at any time and on the other hand the potential of locative media to interact at very specific sites.

### 5.2.3 Push vs. pull messaging

This concept relates to the way the user accesses the information in the system. A user can automatically receive a message when a certain event occurs (*push* notifications). For example, when a message is submitted in which a user mentioned, he may automatically receive a notification, including (a link to) the contents of the message. In a more location aware context, such a notification might happen when a user is in the vicinity of a physical object or place of interest. In a *pull* scenario, the user actively searches for information. In relation to locative media, the user might for instance search for specific locations or limit a search query to results from a particular geographical area. Mixed scenarios with both push and pull interaction can also occur.

Espinoza et al [11] describe that push notifications can be a disturbance rather than a help, but in public spaces users are often more leisure oriented, where they are more curious about their geographical and social surrounding than in a workplace environment. Still, information pushed onto the user has to be informational or socially relevant to the user and the user should be able to configure how often he receives push notifications.

Locative media offers new possibilities for notifying the user about event occurring in his vicinity. For example, the user can be notified when content has been submitted to a geographically relevant area or when the use physically enters a particular area of interest.

### 5.2.4 Direct vs. indirect

Indirect interaction methods are the most common in mobile social software. The usual interaction method involves the user querying the system for content that was submitted earlier by a differnt user. Only few examples of locative media exist that facilitate direct communication methods, where two users directly interact through sms or voice-link.

The CityFlocks system tried to facilitate both direct and indirect social navigation in an urban mobile information system. Residents of an Australian city could share their recommendations of local services, shops and other urban places through the system.

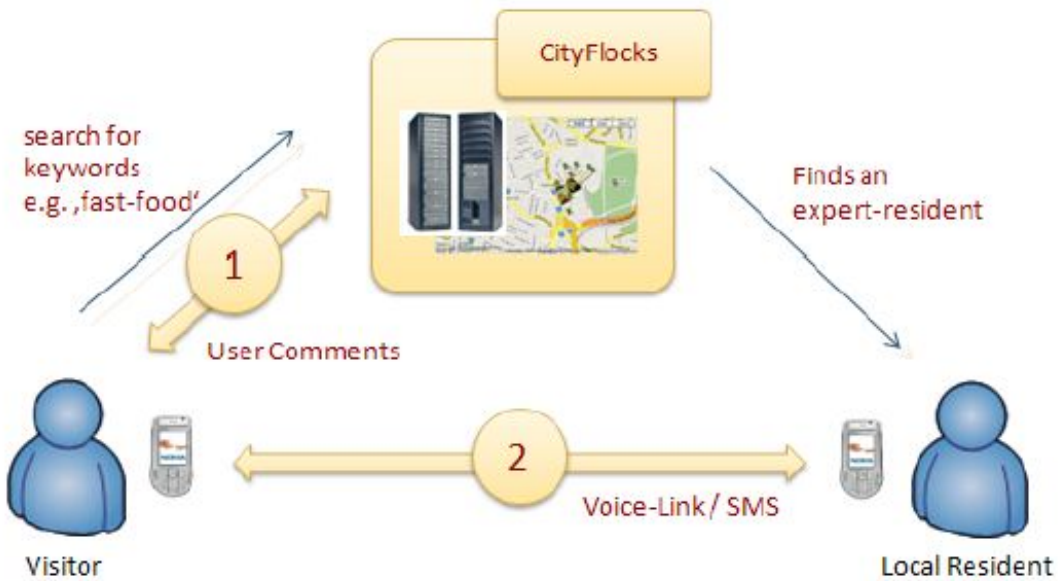


Figure 4: Direct (2) and indirect (1) interaction in the CityFlocks system [2]

Participants in the study were then asked to solve a specific problem-based scenario, such as “find a good food outlet near your location that is not too expensive, using CityFlocks”. The users could search through a database of dynamic tags and find text based recommendations. They were also offered the option to directly call or send an SMS to the author of a recommendation in order to ask for advice [4].

Although the researchers indicated that direct communication could provide a much richer advice, results showed that users refused to use this feature. As an explanation users indicated that they were too scared to talk to a complete stranger, the language barrier made them insecure or they found it inappropriate to bother or interrupt a person for relatively unimportant information. A solution to these problems, as the researchers indicate, could be to show a bit of contextual information about the author of a recommendation (but not too much to make it a privacy issue) and indicate through the interface which users are really available for answering calls. Indirect recommendations by the local residents were perceived as very useful information when navigating urban environments, as they reflected the people’s uncensored opinions.

### 5.2.5 Anonymous vs. eponymous

Sutko [33] explains that the majority of LMSNs can be classified as eponymous or anonymous. The first type allows users to find a specific person in urban places. Users can typically be identified by username and location that are available to either select friends or complete strangers. The latter promotes awareness of the location of unknown masses. Anonymous applications do not identify the user or at most aggregate user activity, for example, as a “heat map” of a city. Sutko relates how LMSNs deal with anonymity to

sociological theories about street sociability. This theory emphasizes the playful nature of social interactions and the value of random encounters that urban spaces facilitate. The anonymity allows individuals on the street to create a more playful social environment, because there is less risk for social consequences of their actions. Eponymous interfaces might cause avoidance of social behaviour, as further described in section 7.

*Citysense* is an application that let users see activity of people in a city represented by hotspots on a map. Sutko argues that users seem to prefer indirect methods of communication when finding their way in a city for the same reasons as with the CityFlocks system described above. Therefore, anonymous interfaces can be important when users try to find locations, instead of other people. This type of coordination can lead to chance encounters.

### 5.3 Locative media games

Locative media games are applications that make use of GPS enabled mobile phones and the internet to facilitate multiuser games in urban spaces. These applications use the city as the game board and users interact with each other based on their physical location. *Botfighters* is a shooter game in which the users have to move around physical locations to “fight” their battles with other users. Depending on their relative position, players can shoot text messages at each other. Their distance and the virtual weapons players carry determine the accuracy and success of each shot [9]. Players of the game *Mogi* sometimes took a different route to work in order to find virtual objects and complete their in-game collection [21]. Many LBSNs also introduce game-like elements to their applications. *Foursquare*, for example, allows users to ‘check in’ at a physical location in order to gain points and badges.

Locative games connect players to other players, but maybe more importantly players to places, as far as the gameplay requires it. These applications encourage players to explore their surroundings by playing the game. While locative social networks can be used to organize and coordinate congregations with people (who might become familiar with places while doing so), the main concept of locative games is to explore physical places and by chance meet other players and socialize with them. Thus, locative media games transform urban spaces into playful environments [33].

#### 5.3.1 Geocaching

*Geocaching* can be described as a technology-enabled treasure hunt. Members of the geocaching community hide a container in a publicly accessible location and publish the coordinates on a geocaching website for others to find. Sometimes a cryptic puzzle is included to make it harder to find the cache. The cache usually contains a small logbook listing all the finders and possibly some small trinkets that are meant to be exchanged for something of similar value. Geocaching is interesting for locative media research, because it exists since the year 2000, it has a large, active community and it is an ongoing everyday practice. This allows for research on user participation in the creation of location-based experiences. Furthermore, geocaching is comprised of both online and





Figure 5: The map interface of the locative game *Mogi* [21] and the locative media game *Botfighters* [9].

in-situ activities and the relation between them might be an interesting research topic. [27]

#### 5.4 Representation of user data

A common way for locative media applications to represent geo-tagged user data is by showing location of the geo-tagged content as a point on a map. This allows the user to easily see what is around him, sometimes even relative to his own position if the device is GPS enabled.

Rost et. al. [30] describe that in a pilot study, users of the Columbus system appreciated seeing an overview of pictures in addition to the map interface, instead of viewing one picture at a time (see Figure 3). Secondly, not knowing the actual location of a photograph was sometimes frustrating to the users. This could be related to not knowing the direction in which the picture was taken or the photograph not being tagged correctly or taken from inside a building. Finally, if a picture is located too far from the user's position, the sense of locality is lost, therefore the radius of viewable pictures around the user should be small. Interest in content decreases with distance from the user. Especially in systems that support exploration or provide localized content, the user should be able to deduce the location of the photo, allowing him to experience the photograph in unison with his location. Otherwise the picture will essentially be useless to him.

Annotative locative media systems should pay attention to the representation of its information (as what size and shape should a point of interest be shown on a map?): the issue of *granularity*. If the representation is too small it might not be noticed by many

users. On the other hand, if the representation is too small, the connection between message and place might lose its meaning [24].

## 5.5 Other properties of locative media

Løvlie proposes a set of principles and challenges for the design of annotative locative media [24]. *Serendipity* means the ability to have unplanned casual encounters that hold some kind of value. In case of locative media, this can be explained as the way a user chooses his own path (more or less randomly), leaving it to the system to establish where he is and what information to present based on his location. As with the locative sound application described above, this encourages the user to explore his surroundings. For such a system to reach its full potential and become truly ubiquitous, it should cover the largest possible area. A high degree of user *participation* is required to allow for serendipitous encounters.

## 5.6 Summary

Choosing a particular technology or interaction method can greatly influence the way an system is used. Providing alternative methods of access can offer a more complete experience to the user, even when a specific service is temporarily unavailable. There seems to be a bias towards visual representation in locative media, while aural techniques can a more natural and fluent experience. The *in situ* mode of access only let the user access content from a particular location. Content can be actively pulled by the user or automatically pushed to the user. There are different settings in which each of these modes are appropriate. Another distinction can be made between direct and indirect communication between users. Often, the latter is preferred. Anonymous interfaces hide the identity of the user, while eponymous interfaces make the user identifiable through personal information. Game-like aspects of locative media can stimulate participation and playful behaviour.

# 6 Research methodology

In this section a review of user studies on locative media systems is described. These user studies are all part of the literature reviewed for this research. Then evaluation methods for locative media will be examined in a more general sense. Finally, some of the problems that were encountered during user studies on locative media will be explored.

## 6.1 Review of user studies

Many of the investigated studies try to establish whether the system in question directly facilitates the interactions that the developers had in mind to a satisfactory level. Only a few, however, look at the long-term effects on social interactions in our everyday lives [17, 27, 32]. This is probably owing to the duration and scale of the studies. Humphreys

[17] argues that physical and social spatial practices are relatively neglected in the field of computer mediated communications, while this field still influences everyday communication. Instead, the focus was mostly on its ability to overcome time and space.

Most studies conducted qualitative analysis through user interviews and group sessions [17]. Schroeter et. al. describes studies of social interaction benefit from open-ended methods, because they allow users to describe the interactions they experience in their everyday lives in their own words [32]. A few studies used quantitative analysis [10, 18] to draw conclusions about the users' behaviour.

In most cases, interviews were conducted face-to-face and directly after the trials. Sometimes remote communication was used when participants were more geographically dispersed [17, 32]. The use cases that participants were asked to fulfill ranged from goal-oriented tasks (such as "walk from location A to location B" or "find location A in city X" [18, 4, 26]) to more open-ended tasks in which the interactions among users and creative use of the system are examined [25, 17]. All the reviewed papers are examples of field studies, with the exception of the MobiComics system [25], which was tested in a laboratory and a very controlled environment.

Content analysis is often applied as an approach to find thematic categories for content that users produced during the trials [17, 20, 25, 30]. Humphreys continuously collected and analyzed field data to identify themes and categories, instead of sequentially gathering data and analyzing everything afterwards. This process continued until all new data could be categorized and accounted for based upon previously collected data. Furthermore, Humphreys suggests to check analysis results with participants and domain experts to ensure validity of qualitative research. Finally, collecting data from various sources can strengthen conclusions drawn from it [17]. Please refer to Table 2 for an overview of user studies that were examined for this research.

## 6.2 Evaluation methods

The type of evaluation method that is suited for measuring user experience of locative media systems strongly depends on the type of interactions that the system facilitates, the duration of one session and intended frequency of use. Systems that are only used for consuming geo-location based content can be tested in a controlled environment. A city tour application, for example, will mostly provide new and unseen content to the user. Typical user scenarios involve the user trying to find a relevant location through the system. Such a task can perfectly be evaluated by observation in relatively short trial sessions. Several studies put this method to use in a scenario where the user tries to find his way in an unknown city [4, 30, 18]. The researcher directly observes the user's interactions and assists the user if necessary.

In the early stages of development, it might be useful to conduct user trials in a lab environments. Paper prototypes can be produced quickly and cheaply and allow for quick feedback about interactions and user interfaces [4]. These can be used in *Wizard of Oz* type of evaluations, where the researcher plays the role of the system, reacting to user input and moving around pieces of the prototype [30].

However, in later stages fieldwork is inevitable for the evaluation of locative media

Table 2: An overview of all user studies that were reviewed for this literature study. Studies of longer duration are mostly the studies that monitor continuous use of the application and everyday practices.

Reference	System / Topic	Participants	Duration	Methods
Bilandzic et al. [4]	CityFlocks	6	Undefined	Paper prototype, focus groups, observations
Burghardt et al. [6]	Privacy enhancing mechanisms	25	2 weeks	Questionnaires, statistical analysis
Eagle and Pentland [10]	Serendipity	100	1 year	Statistical analysis
Humphreys [17]	Dodgeball	21	1 year	Structured interviews, observations
Karapanos et al. [18]	Location-aware narratives	45	15 minutes / session	Interviews, observations, questionnaires, statistical analysis
Lentini and Decortis [20]	Experience of place	52	4 days	Observations, focus groups, interviews
Licoppe et al. [23]	Dragon Quest 9	12	Several days, short sessions	Observations, interviews
Lucero et al. [25]	MobiComics	36	2 hours / session	Semi-structured interviews, observations
Morrison et al. [26]	MapLens	37	3 days, 90 min/session	Questionnaires, semi-structured interviews
O'Hara [27]	Geocaching	14	3 weeks	Diary study, interviews
Rost et al. [30]	Columbus	11	1 hour / session	Transcripts, observations
Schroeter et al. [32]	Public Urban Screen (DIS)	Varying	8 studies, varying from 5 hours up to 9 months	Quantitative data analysis, observations, interviews

systems. As described in section 5.2.2, one of the main types of interactions in locative media systems that provide in situ access is walking. This also applies to systems that

provide remote access, perhaps in lesser amount. The user will probably experience different content at different locations, so in order to get a satisfying user experience, the user will need to travel between several physical locations. Furthermore, outdoor testing will be required, given the fact that most GPS enabled devices need to be used outside for the GPS triangulation to work.

Kardes [19] argues that experiments conducted in a natural environment can be useful, although they are often overrated, for several reasons. People prefer to rely on prior subjective beliefs rather than objective data when attempting to assess the relation between two variables in a natural setting. Standards for making judgments may change over time, which causes people to change their conceptions about the past to fit the present. This can make it difficult to learn systematically from unstructured natural experience. Finally, learning from experience can be hindered by a very limited or selective set of hypotheses. Even if very weak or ambiguous evidence is found to support the focal hypothesis, the search for additional evidence is often prematurely terminated. Artificial research settings on the other hand are underrated, according to Kardes. These artificial settings and conditions are used to isolate the effects of specific causal variables.

Still, conducting the evaluation of locative media applications in a natural setting might be preferred. User trials of relatively short duration, in which the user has to perform a specific goal-oriented task could be conducted in a laboratory environment. However, the user should be able to experience localized content in unison with the direct surroundings in order to increase the immersion in the experience [30, 18].

User observations can provide useful insight into the user's interactions and his experience. When the user is required to create content and when the main form of the users' interactions is not goal-oriented (a goal-oriented task could for example be navigating your way in an unknown city), a lot changes with regard to viable evaluation methods. For instance, the user might not feel comfortable being watched when writing a message to another user (perhaps a close friend). Furthermore, as described in section 5.5, user participation is required for meaningful interactions. This is a process that takes time, which will probably take too long for a user observation session. This implicates that lengthy user trials might yield better results, but also produce more user created content for the researchers to process. The main point here is that when the user's task is a teleological one, direct observations and short user trial sessions might be well suited. Otherwise, long term studies that involve multiple cycles of analysis, design and re-design might be more practical when the everyday practices of users are investigated [5].

Coyne [7] describes that *the move towards the everyday promotes methods of research that engage with narrative and socially situated ethnographic study, rather than the transportation of phenomena to the laboratory, or isolation into the calculative world of variables and quantities*. Ethnographic study can be useful to understand social phenomena and contextual setting. In doing so, it can inform the overall role that technology might play. However, it is regarded as a prolonged activity, which can be an issue when it is used to inform about system design. Quick and dirty methods such as cultural probes

or quick user interviews can be applied in such cases. The downside of this approach is that important social contexts required to understand what role technology should play might be overlooked. [5]

Regular (weekly) feedback sessions and unstructured interviews are very helpful for both participants, as they can ask for assistance. Researchers can benefit from this as well, because it provides interim results and ensures participants complete their required tasks. Group meetings can help collaborative thinking and showing the participants' created content can provoke interesting reactions. Furthermore, group sessions are more time efficient than individual interviews. However, the the more quiet and introvert participants might get excluded from the discussion. Another downside of group sessions is the issue that opinions might converge. This could yield a smaller number of contributions than in individual sessions.

### 6.3 Problems

In this section the pitfalls that may be encountered during evaluation of locative media systems will be described. A lack of user participation is probably one of the biggest issues that locative media research can suffer from. Many studies indicate that a low barrier of entry is crucial for adoption of a system [32], especially if it is used in a less controlled public environment. Factors that prevent people from sharing information through a system, thus creating a lack of user input, include:

- The “social awkwardness” of performing input to a system in public. [32, 25]
- Being unfamiliar with the relevant technology (for example, due to a generation gap). [32]
- Bothering other people by interacting through the system. [2]
- A language barrier between users or users and the system. [2]
- Simply not being comfortable sharing their information for a variety of reasons. [2, 32]

Most of these problems are certainly not unique to evaluation of locative media applications, though issues that relate directly to the relatively new type of interactions afforded by locative media are more characteristic. This has to do with the privacy related issues, caused by the transition of social media into the public domain. Users now have to contemplate the consequences of publicly sharing their location in addition to the content they used to share. Privacy issues are further discussed below.

### 6.4 Summary

Several user studies of locative media systems have been investigated. It was shown that field studies about the long term effects on everyday practices of users are mostly

neglected. In the early stages of development, user trials can be conducted in controlled environments. Simple prototypes can be used to get results quickly and cheaply. Depending on the type of use scenario, different methods might be suited for later experiments. A natural environment is recommended for long term studies. Direct observations and more structured interviews are recommended for trials of short duration. Several problems might occur during user experiments that can prevent user participation and thereby influence the results negatively. Privacy issues are often the cause of these problems.

## 7 Influences of locative media

In this chapter, the influences of locative media on user interactions, spatial awareness and privacy are investigated. Finally, the social acceptance of locative media in society is questioned.

### 7.1 User interactions

Bilandzic and Foth [5] explain that our person-to-person relationships have become more complex by mobile technologies. They allow us to be connected to anyone while not being physically present. Locative media contribute to this phenomenon by mapping our communications and interactions to physical space around us. These locational messages are virtual traces that show a history of interactions and can be used by others to make inferences about a place.

As Gorden and Souza [15] describe, public spaces are inherently social. Location aware mobile applications tend to alter the ways we experience our surroundings. Therefore they can reconfigure the social interactions within them. One of the main influences of locative media on user experience is the changing sense of proximity. Location aware applications let users who are not physically present connect with each other and (more importantly) create a sense of familiarity with other users and the user's surroundings [20]. Locative media influences how users think about their surroundings when creating localized content and how they might use other peoples' messages to form personal relationships.

Opinions diverge on the influence of locative media on personal relationships. Crawford [8] explains that matchmaking algorithms pre-sort users into groups of demographically compatible people, which causes mobile cocoons of similar people. Furthermore, new media tend to connect people who already know each other through friend-of-a-friend suggestions [17, 33].

On the other hand, there are also examples of studies that indicate the ability of locative media to facilitate random encounters with strangers. Locative applications can lead to unexpected and pleasant social and spatial experiences by facilitating coordination in urban spaces. Especially anonymous interfaces afford personal chance encounters with strangers [33]. Locative media games encourage players to explore their surroundings and meet other players [22, 21]. Humphreys concludes that mobile social networks do

not change who is interacting with whom in public space. They rather *encourage a participation of the public realm by relying on and simultaneously showcasing the aesthetic pleasures of the public realm including public sociality, unexpectedness and crowding.* [17]

O'Hara [27] explains that the results of a study into geocaching is interesting for the field of locative media, because it is an ongoing everyday practice that exists for years now. This allows the researcher to highlight social motivations and behaviours related to it. For many people, geocaching provides a social occasion, to walk with friends or family. It motivates people to get involved in social activities, while the technology is not a dominant factor during the interactions. O'Hara explains that just looking for explanations of behaviour that was observed in one discreet experience is overly simplistic. It is emphasized that geocaching, like other location-based experiences, is an ongoing activity. Behaviour and motivations related to locative media are built up over time.

A lot of applications have been designed to facilitate particular types of interactions, such as dating (the Lovegety system [8]), conferences [10] or finding a specific place of interest [2]. More recent LBSNs such as Foursquare and Dodgeball [17] do not have those explicit goals, but make social properties of physical space visible. By changing the perception of public space our social interactions and practices are also affected.

Community driven services can empower people in urban settings to harness the collective intelligence and discuss local community issues. This allows for the urban public to engage in questions of city planning and design [32].

## 7.2 Spatial awareness and perception of place

Humphreys describes in his paper [17] how Dodgeball caused *parochialization*. This means that people share social and locational information in public space in order to have a sense of commonality with each other. For instance, groups of friends could coordinate congregations by broadcasting location information among the group. Humphreys argues that *redirection* is an important aspect in this process. Redirection can be defined as the ability of people to act on the information to receive and possibly change their planned route as they go. Timing, distance and traveling time are important factors that influence redirection. The information shared through Dodgeball was in some cases also used to avoid congregation, which highlights the complexity of social interactions and spatial practice in everyday life.

Sutko [33] explains that the *CitySense* application shows hotspots of user activity on a map. If a user sees his favourite bar is crowded with people, he might infer that there might be people he might like to meet. The presentation of place performs coordinative functions for the user. This means that the user can make decisions and judgments about people in a particular place, based on previous experiences with this place. The opposite is known as *crowd sourcing*: recommendations by (un)known people about a place can help the user make his decisions about it.

Rost [30] describes that our perception of place is not just dependant on geographical coordinates alone. A place is transformed into something meaningful and identifiable by interactions and activities. Previous local knowledge about a place might influence



how localized content is appreciated. If users are familiar with the location, they look for recognizable sights, while users unfamiliar with the location use the application in a more exploratory fashion.

### 7.3 Privacy

Höflich [16] describes that the boundaries of what is public and private are constantly shifting and media contribute significantly to this, as their influence on our everyday communication becomes larger and larger. These boundaries are not static and depend on historical and cultural differences. Socio-economic factors also play an important role in the explanation of behavioural patterns observed in different cultures. Höflich explains this shift is more readily accepted these days. Various media previously based in the home can now easily be experienced in public spaces. The mobile phone is a special case, because this device causes both public and private domains to merge.

The mobile phone network consists of people who already know each other, which makes it a rather private medium. Whether this also holds true for locative media remains the question. As described in section 4.1, matchmaking algorithms implemented in these new social media can cause social cocooning. On the other hand, systems that promote exploration can also facilitate heterogeneity and random encounters. The next question is whether sharing your whereabouts with random strangers is desirable.

#### 7.3.1 Control over personal privacy

Information about our physical location becomes more and more important in digital (social) networks, which means control and access to this information also require attention. Some applications require personal locational information in order to work, therefore people must be willing to share it. This might lead to a feeling of anxiety if it is unclear who is able to access your information. In other words, this fear is caused by the concerns of *losing control* over one's personal location information. When this information is aggregated, it can be used to predict people's behaviour in the city. This type of data mining could lead to location-specific profiles of an area or exclusion of users based on their location. The fear of losing privacy can either be the fear of top-down surveillance (by governments or companies with commercial interest) or the fear of collateral surveillance (disclosing information to other people).

The shift from private to public can be illustrated by the Google Street View service, that adds street level photographs to Google Maps. Several lawsuits have been filed by people who feel their privacy is violated by publicly displaying their private property. Privacy laws in the United States do not protect against being photographed in public space. Several European countries have stricter privacy laws and insist that faces and license plates are blurred. Then there is still the issue of photographing private property. Google complied in most cases where people asked to take down photos taken in private streets. This shows a certain discomfort of being publicly mapped, which is caused by the sense of losing control over personal information. *Making the world searchable is*

*equated to locating and identifying users. Making everything findable presupposes that everyone wants to be found.*

### 7.3.2 Privacy and location based services

Most of the location based services (LBS) for finding localized information (such as tourist information applications, Google Maps, *WikiMe* (a mobile phone application showing local Wikipedia articles)) do not publish a user's location and users must allow the service provider to pinpoint their location in order to provide the service. However, most users don't know that this information is sometimes shared with commercial partners. Location based *social networks* (e.g. *Foursquare*, *Google Latitude*, *Loopt*) do often share the user's position in order to facilitate meetings and other social behaviour.

These location based services are often monetized by advertising. Users can access the service for free, but when near a store, for example, they can find coupons for this store to stimulate impulsive purchasing (so called *just-in-time* model for advertising). The users are willing to put up with this as long as they see the value of using the service. The problem is that the privacy policy is often unclear about which companies receive their location information or what happens with it. Designers usually allow users to control their privacy settings. Users can *opt-in* by downloading the location aware application and explicitly allowing personal location information to be used. Sometimes, the user can *adjust the accuracy* of the information by specifying how precise his location can be tracked or by manually submitting the information [31]. Still, for many users it remains difficult to understand what the implications of the privacy settings are or whether they can be controlled at all [15].

Publicly disclosing location based information can become dangerous when this information is used to mount real-world attacks. Users are sometimes not aware of the risks of publishing such information or even *when* they publish it. For example, the newer iPhone models automatically embed locational data inside the meta-tags of all photos and videos taken with the internal camera by default [31]. Furthermore, some LBSs allow users to reference others users in resources (so called *co-located privacy* or *multi-user privacy*), which is generally hard to control [29]. This privacy threat is even increased by the ease of searching for location based information. Combined with the large amount of data and services available, this makes it easy to combine information to mount systematic privacy attacks. For example, geotagged photographs of valuable items posted on Craigslist or real-time published holiday videos on YouTube might be used by burglars to plan break-ins. [31]

### 7.3.3 Improving locational privacy

Friedland and Choi offer several suggestions to improve locational privacy. First, users should be put into the position to make informed decisions. Second, users should be sufficiently protected by location based services unless they opt-in to potentially risky exposure [12]. Vicente et. al. [31] suggest using the principle of *k-anonymity* to improve locational privacy. This means that a user reported location is altered so it can be asso-

ciated with at least  $k$  users, in order to prevent (re-)identification. This can be achieved by query enlargement techniques such as *temporal* and *spatial cloaking*. Spatial cloaking generalizes the location of the message to a region (as described above) and temporal cloaking generalizes the temporal information to, for example, an entire day. Burghardt conducted a user study about user preferences and awareness with regard to privacy [6]. In addition to  $k$ -anonymity, other mechanisms to improve privacy are suggested, such as disabling tracking in marked areas and fine grained control for each piece of shared information. Results showed that participants preferred privacy increasing mechanisms that were easy to understand. Mechanisms that required constant personal attention (a switch to turn GPS tracking on or off) failed in practise.

## 7.4 Social acceptance

A topic that is closely related to privacy concerns expressed above is the social acceptance of locative media. Höfllich [16] explains that especially in big cities people need to create a distance from each other, despite the conditions of close proximity. This is a form of civility, meaning that personal matter not intended for others are held back to avoid awkward situations. Proximity and distance are strongly connected to social and communicative rules, for example, to determine whether usage of a medium or face-to-face communication is appropriate in a particular situation.

The issue of stalking was encountered in the locative media game *Mogi* [23], where a female player felt threatened by an individual player located on the game map that remained anonymous, despite the messages sent by the female. Licoppe and Inada compared it to the feeling of safety when being in a mass of strangers while encountering an individual in an alley can create a sense of danger.

Furthermore, locative media can create a tension with regard to social norms such as greeting a acquaintance on the street. It might be considered rude not doing so, but what if locative applications become the norm? Would it also be rude to not visit a friend if you located him nearby through this application? [33]

## 7.5 Summary

Locative media influence the way we experience our surroundings by making the social properties of physical space visible. Virtual traces left by users in the form of geotagged messages enable users to make judgments about a place based on the people that visit it (or vice versa). Locative media influence both interactions with other people and our perception of place. Location-based content makes it easier to coordinates congregations and gives users a sense of proximity to others. By experiencing people with similar interests near the user, feelings of familiarity with the people and the place can arise. Communication that exists only among demographically similar people can cause on social molecularization. On the other hand, locative media can encourage users to explore their surroundings, which can lead to pleasant and unexpected encounters with both people and places. Users of locative media can have concerns about privacy when the sense of control over their locational information is lost. Developers can improve

locational privacy by letting the user make informed decisions about privacy settings. Temporal and spatial cloaking can be used to make it harder to identify the user and hide sensitive information. Finally, locative media challenge social norms about social behaviour in the street.

## 8 Conclusions

Locative media have become popular through the rapid improvement of mobile consumer products and the growing influence of social media on our everyday lives. These developments have caused (and are still causing) a shift in usage of social communication methods from the private to the public domain [9]. New mobile media promise to connect us everywhere and anytime to distant others. Locative media contribute to this by measuring the user's physical location. This locational data is then utilized to filter relevant localized information in the proximity of the user.

Several theories about street sociability and urban spaces from the field of social psychology exist that can be used to explain the impact of locative media on society. Rules about civil inattention (i.e. to consciously ignore strangers on the street and to avoid forcing one's personal matters upon strangers [16]) in city spaces still apply when locative media are involved. Locative media is not a completely new phenomenon. Locative practices such as geotagging user created content have existed for a while, although this had to be done manually at first. The advent of GPS enabled mobile devices takes away the need for manual annotation and allows for new practices and interactions [5].

The type of interactions that are afforded by these locative applications mostly depend on the intended use and design choices. Some examples of goal-oriented applications have been reported that enable the user to navigate to places of interest in unknown spaces [4], facilitate face-to-face encounters through matchmaking algorithms [10] or coordinate congregations with nearby friends [17]. These applications are criticized in some studies, because they neglect the heterogeneity of urban spaces by further strengthening the connections between people who already know each other [17, 8]. It is argued that locative media applications take the 'chance' out of random chance encounters.

On the other hand, there are applications that stimulate the user to explore his surroundings. Game-like elements such as virtual rewards for visiting a particular location can be the incentive to take random walks and rediscover familiar places by looking at it from a different perspective [26, 23, 21]. Anonymity of the user [33] and indirect communication [4] can also provoke playful behaviour and creative use of the application, because lower social stakes are involved in these cases.

The geotagged messages left by others can inform us about the nature of a place. Users can recommend places worth visiting by assigning a rating to them. Conversely, familiarity with a place can help us make judgments about the people that visit it. Locative media can make the user aware of his surroundings in unexpected ways and thereby influence the way a place is perceived [30].

Designers should think carefully about the choices they make while developing loca-

tive media applications. Many different factors can influence the interactions that a system affords, as was shown in section 5. For example, if content can only be accessed on a particular physical location, users might be excluded from parts of the content. Providing remote access or alternative methods of access, such as a web community, can provide a more complete experience for the users [22, 26]. Likewise, the choice for a particular technology or product might exclude a large part of the potential users.

Evaluation methods for locative media applications have been explored by investigating recent user studies described in the literature. It was shown that field studies are often preferred to obtain an understanding of the users' experience. However, so far there is a shortage of long-term studies into the everyday aspects of locative media [26]. User observations and unstructured interviews are often applied as methods in evaluation sessions of relatively short duration. Testing locative media in a laboratory setting can be useful in early stages of development, because feedback can be produced in a time and cost effective manner in this way. Field work seems to be inevitable in later stages to fully capture the user experience. To gain a better understanding of the long-term influence on everyday practices, the user needs to experience the locative media system in a natural setting. Immersion in the experience can be increased when the user consumes the content in unison with the physical location. Furthermore, usage of GPS devices is more practical when applied outdoors for technical reasons.

Locative media can have serious implications for personal privacy. Concerns about privacy arise when the user has the sense that he has no control over his locational information. Disclosure of locational data can be used to scheme for privacy attacks. In some cases the user even is unaware of the fact that he is publishing geotagged information. Privacy policies and the implications of privacy settings are often too unclear, even for the more advanced users. Geotagged data has become easily searchable, which makes it easier for an attacker to identify a person or uncover other sensitive information. Developers can influence this by letting the user make informed decisions about privacy settings and generalizing the information that is displayed.

Finally, the question can be raised whether users actually want to be mapped. Location based services often require the physical location to be displayed in detail in order to deliver accurate results. A single user can feel threatened if he knows he can easily be identified, while nearby strangers remain anonymous [23]. Locative media can also challenge existing social norms about civility in public spaces [33]. The desirability of locative media embedded in our everyday lives has not been thoroughly discussed in this study, but this might provide an interesting topic for future research.

## 8.1 Future work

The goal of this literature study is to explore the current state of locative media. This overview is used to form recommendations for future research on locative media. In this section, a few practical suggestions for the development and evaluation of locative media applications are proposed. Of course, these suggestions cannot provide a definitive solution for every locative media application, since every application has different requirements and intended use cases. Rather, this list should make developers think

more carefully about the implications of the choices they make during development of locative media.

- The choice for a particular technology or interaction method (such as only allowing in-situ access) might exclude potential users or usage of the application. This might be because they are simply not able to obtain the product or because they are not able to travel to the specific physical location to use the application.
- Providing an alternative method to access the user generated content (such as a desktop application or website) can offer a more complete experience of the application.
- In order to facilitate random chance encounters, algorithms for matching demographically similar people should be carefully applied.
- Introducing game-like elements to regular interactions can provoke playful and creative use of the application. This might encourage users to explore their surroundings, which in turn can lead to new and pleasant experiences.
- Laboratory research or an artificial setting can be useful for testing a locative media application during the early stages of development.
- Field research about the everyday practices of users in the area of locative media seems to be neglected in existing literature. Long-term studies can be preferred, although time or money constraints might not always allow this.
- Suggested evaluation methods for locative media include observations, unstructured interviews, regular feedback meetings, focus groups and user diaries. These methods allow the researcher to capture open, qualitative information. In user sessions of short duration, observations and other methods where the researcher is present are suitable for goal-oriented tasks. On the other hand, direct observation is less recommended for long duration studies. In that case, interim feedback sessions and interviews provide continuous results and ensure the participant completes his task.
- User diaries provide useful insight into the participant's ongoing experiences. This user created content can be discussed during feedback sessions, to verify any analysis performed on this data.
- Locational privacy is one of the biggest issues that designers of location aware applications have to deal with. The users should be well informed about the implications of disclosing locational information. Furthermore, users should be able to control several privacy aspects, such as the accuracy of their published physical location.

These recommendations will lead us in the design and evaluation of a smart location based photo sharing application [35, 36].

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