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HOW LOCATION-BASED SOCIAL NETWORK APPLICATIONS ARE BEING USED

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ABSTRACT

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Location-based social network applications have globally become very popular with the expansion of smartphone usage. Location-based social networks (LBSN) can be defined as a site that uses Web 2.0 technology, GPS, WiFi positioning or mobile devices to allow people to share their locations, which is referred to commonly as a check-in, and to connect with their friends, find places of interest, and leave reviews or tips on specific venues. The aim of this study was to examine how location-based social applications are being used. The methods of this study comprised of a literature review and a discussion on prior research based on a selection of user studies on location-based social networks. This study also aimed at answering a number of sub-questions on user behavior such as activity patterns, motivations for sharing location, privacy concerns, and current and future trends in the field. Twelve LBSN user behavior studies were reviewed in this study. Eight of the user studies reviewed involved the application Foursquare. Research methods on eight of the reviewed studies were studies utilizing databases of the check-ins from the application itself or utilizing Twitter in their analysis. Four of the reviewed studies were user studies involving interviews and surveys. Three main themes emerged from the articles, which were activity patterns, motivations for sharing, and privacy concerns. It was found that activity patterns included common check-in venues such as restaurants, bars, shops, and entertainment venues along with the same times of day (early morning, lunchtime, and early evening) and having larger check-ins occur in urban areas. Motivations for sharing location showed that users share their location to showcase it to their friends and also to present one's self. Concerning privacy, it was commonly found that users do not like to share their location with strangers. Future research could include looking at how gender, different age groups, and social media usage correlate with LBSN application usage in addition to how differences between iPhone and Android users correlate with it.

Keywords: location-based services, location-based social networks, LBSN, activity patterns, sharing location, privacy, user studies

TIIVISTELMÄ

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Paikkatiedon jakamiseen perustuvat sosiaalisen median sovellukset ovat maailmanlaajuisesti tulleet hyvin suosituiksi älypuhelimien yleistymisen myötä. Paikkaan perustuvat sosiaaliset verkostot (engl. location-based social networks, LBSN) voidaan määritellä sivustoina, jotka käyttävät Web 2.0-teknologiaa, GPS-teknologiaa, WIFI-paikannusta tai mobiililaitteita. Sivustojen kautta ihmiset voivat jakaa sijaintinsa, kirjautua sisään paikkoihin, olla yhteydessä ystäviinsä, löytää kiinnostavia paikkoja sekä jättää arvioita ja suosituksia tietyistä paikoista. Tämän tutkimuksen tarkoituksena oli tutkia, kuinka paikkatiedon jakamiseen perustuvia sosiaalisen median sovelluksia käytetään. Menetelmänä tutkimuksessa oli kirjallisuuskatsaus ja tulosten pohdinta pohjaten aiempiin käyttäjätutkimuksiin paikkatiedon jakamiseen perustuvista sovellutuksista. Tässä tutkimuksessa myös pyrittiin vastaamaan kysymyksiin sovellutusten käyttämisestä, kuten aktiivisuuden vaihtelusta, motivaatiosta käyttää sovellutuksia, yksityisyyteen liittyvistä huolista, sekä nykyisistä ja tulevista trendeistä alalla. Tässä tutkimuksessa luotiin katsaus kahteentoista (12) käyttäjätutkimukseen paikkatiedon jakamiseen pohjaavista sovellutuksista. Kahdeksan niistä koski Foursquare-sovellusta. Tutkimuksissa kahdeksassa tutkimusmenetelmänä oli kirjautumisten oman tietokannan analysointi tai Twitterin päivitysten hyödyntäminen aineistonkeruussa. Neljässä tutkimuksessa tutkimusmenetelmänä käytettiin haastatteluita ja kyselyitä. Kolme pääteemaa nousi esiin artikkeleista, jotka olivat aktiivisuuden vaihtelu, motivaatio jakamiseen, sekä huolet yksityisyydestä. Aktiivisuuden osalta tuli esiin, että yleisimpiä paikkoja kirjautumiseen olivat ravintolat, baarit ja kaupat. Yleisintä kirjautuminen oli samoihin aikoihin päivän mittaan (aikainen aamu, lounasaika ja aikainen ilta), sekä kaupunkialueilla. Motivaatioita jakamisen takana olivat niin sosiaaliset syyt kuin oman itsen esittely. Yksityisyyden suojaamisen takia käyttäjät eivät halua jakaa sijaintiaan vieraiden kanssa. Tulevaisuudessa olisi kiinnostavaa tutkia sukupuolen, eri ikäryhmien ja sosiaalisen median käytön suhdetta paikkatiedon jakamiseen pohjautuvien sovellusten käyttöön, ja lisäksi vielä mahdollisia eroja iPhone- ja Android-käyttäjien välillä näissä ryhmissä.

Asiasanat: paikkatietoon pohjaavat sosiaaliset verkostot, paikkatiedon jakaminen, sosiaalisen median sovellukset, käyttäjätutkimukset, aktiivisuus, motivaatio, yksityisyys

FIGURES

TABLES

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background and Research Questions

Location-based applications have become very popular in recent years. These applications use the phone's GPS coordinates, a cellular network or through WiFi connections in order to track one's location (Toch et al., 2010). A number of these applications allow you to check-in, which lets the user to opt-in to show their location to their family or friends on the same application, or through a social media website such as Twitter or Facebook. Some applications even share one's location even without opting-in. They also offer the availability to showcase nearby goods and services for the user.

A comprehensive overview of these types of applications and how they are used has not been presented yet, which is why this topic has been chosen.

That brings to the research question trying to be answered, which is:

1) How are location-based social networking applications being used?

With this question being posed, it also brings a number of sub-questions, which are:

a) What types of activity patterns are being shown with the use of these types of applications?
b) What are the motivations for people sharing their location in these applications?
c) What privacy concerns are there for using these types of applications?
d) What are the current trends in location-based social network applications?
e) What are some future trends that could be developed with these types of applications?

It is hoped by answering these questions and providing a comprehensive overview of how location-based social network applications are used, this research can be used as a basis for future research.

1.1.1 Overview and History of Location-Based Services (LBS)

To give a bit more insight in to location-based social network applications, the concept and a brief of location-based services must be first explained in further detail. According to Schiller and Voisard (2004), location-based services can be defined as services that integrate a mobile device's location or position with other information so as to provide added value to a user. Dey (2001) has a definition of the term *context aware* that also relates to location-based services. Context aware can be defined as when a system uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task.

The origins of location-based services can be traced back as early as the 1970s with the Global Positioning System (GPS) and in the 1980s, the U.S. government, who owns GPS, allowed it to be freely available for other industries all over the world. Then in 1997, it really started to take off when mobile phone operators were springing up around the USA, Asia, and Europe when they were starting to offer data services as to stabilize for future growth. Examples of services being offered were Short Message Services (SMS), with Multimedia Message Services (MMS), Instant Messaging (IM), Email, and Wireless Application Protocol (WAP) – Internet capabilities – soon after (Schiller & Voisard, 2004). Additionally, although it is not directly correlated, it is good to note that in 1996, the United States Federal Communication Commission (FCC) made it mandatory for all US mobile operators to be able to locate emergency callers. It used a mechanism called Selective Availability to complete this task, however, it turned out to be quite inaccurate even up to 100 meters (with this being repealed by the government later in May 2000) (Grewal, Weill & Andrews, 2007).

According to Tsai, Kelley, Cranor, and Sadeh (2010), there are four positioning technologies which are typically utilized to determine the user's location which are GPS, WiFi, cellular identification and IP address. The location information data can be either text-based or map-based. An example of it being map-based can be shown below in figure 1 with the app Foursquare.

FIGURE 1 Example of a Location Sharing Technology Being Map-Based (cnet.com)

The first of the four types is GPS. This was briefly touched upon before as one of the locating technologies. The way that it works is that it locates a user through communicating with multiple satellites. A triangluation of multiple satellites is then able to locate the device the user is on. This arguably makes GPS the better positioning method of the three locating technologies. However, a drawback is that it is very resource intensive and can drain your battery a lot quicker than some of the other types. However, another good thing about GPS is that it is completely cost free. Additionally, the most prevailing method of going the route of GPS is to use Assisted GPS, commonly referred to as A-GPS. According to Van Diggelen (2009), A-GPS improves on standard GPS performance by providing information, through an alternative communication channel, that the GPS receiver would ordinarily have received from the satellites themselves. The assistance data is provided usually through a wireless network (although not exclusively) and over a cellular network. This makes the approximate position of the A-GPS receiver formed from a database of cell tower locations (Van Diggelen, 2009). To be even more specific, A-GPS is dependent on a connection to an ISP to work. There are three configurations of A-GPS which are Mobile Station Assisted (MSA), Mobile Station Based (MSB), and Mobile Station Assisted/Hybrid. Mobile Station Assisted receives

acquisition assistance, reference time, and other assistance from a mobile phone operator. The operator logs the GPS information from satellites with a A-GPS server in its system which then calculates the position and sends it back to the user's phone. Mobile Station Based has the mobile device connected to the network and uses GPS signals in addition to a location signal from the network. Mobile Station Assisted/Hybrid is similar to MSA, however network functionality is still present. This is in areas with great network coverage (Rubino, 2009).

The second of the four types is wireless positioning, or WiFi. With more and more WiFi hotspots becoming readily available, this is a good alternative to GPS. The WiFi hotspots enable the user to be pinpointed via mapping points to WGS-84[1] encoded locations. This isn't as accurate as GPS, however, it helps to locate users since they are on mobile devices and this allows for location information to be accessed even when indoors.

The third of the four types is cellular identification (2G-4G networks). The way this works is that it approximates the position of the device with the position of the base station that the device is communicating through. This idea is similar to the WiFi positioining. However, because of the way that this works, and depending on the cell size, it is not as accurate as GPS or WiFi, but more widely available to utilize on mobile devices when WiFi isn't available and the user doesn't want to have GPS turned on their phones.

The last of the four types is used when none of the others are available. It is the IP location. The way that it works is that devices connected to an Internet network are given an IP address. These IP addresses are limited in number, and based on a certain range, can be geographically associated (Tsai, Kelly, Cranor & Sadeh, 2010).

1.1.2 Overview of Location-Based Social Network Applications (LBSN)

With the concept of LBS's explained in the previous section, an overview of location-based social networks (LBSN) can now be discussed in more detail. A LBSN can be defined as a site that uses Web 2.0 technology, GPS, WiFi positioning or mobile devices to allow people to share their locations, which is referred to commonly as a check-in, and connect with their friends, find places of interest, and leave comments on specific places (Gao & Liu, 2014). This definition closely coincides with Kaplan and Haenlein's (2009) definition of *social media* which is defined as a group of Internet-based applications that build on the ideological and technological foundations of the Web 2.0, and that allow the creation and exchange of User Generated Content. They describe Web 2.0 as a platform where content and applications are continuously modified by all users in a participatory and collaborative fashion. User Generated Content is defined as various forms of media content that are publicly available and created by end-users (Kaplan & Haenlein, 2009).

[1] WGS-84 (World Geodetic System) encoded refers to coordinates that represent the geographic position as the numbers representing latitude and longitude (Laurent, 2013).

In LBSNs, when a user checks in at a physical place on these types of applications, it posts their geographical location thus allowing their activity to intersect between the real world and the online world. It should be noted that the coordinates of the places must be stored or accessible from the social media site, otherwise there would be no match found (Gao & Liu, 2014). A graphical representation on how LBSNs work can be seen on the page below in figure 2.

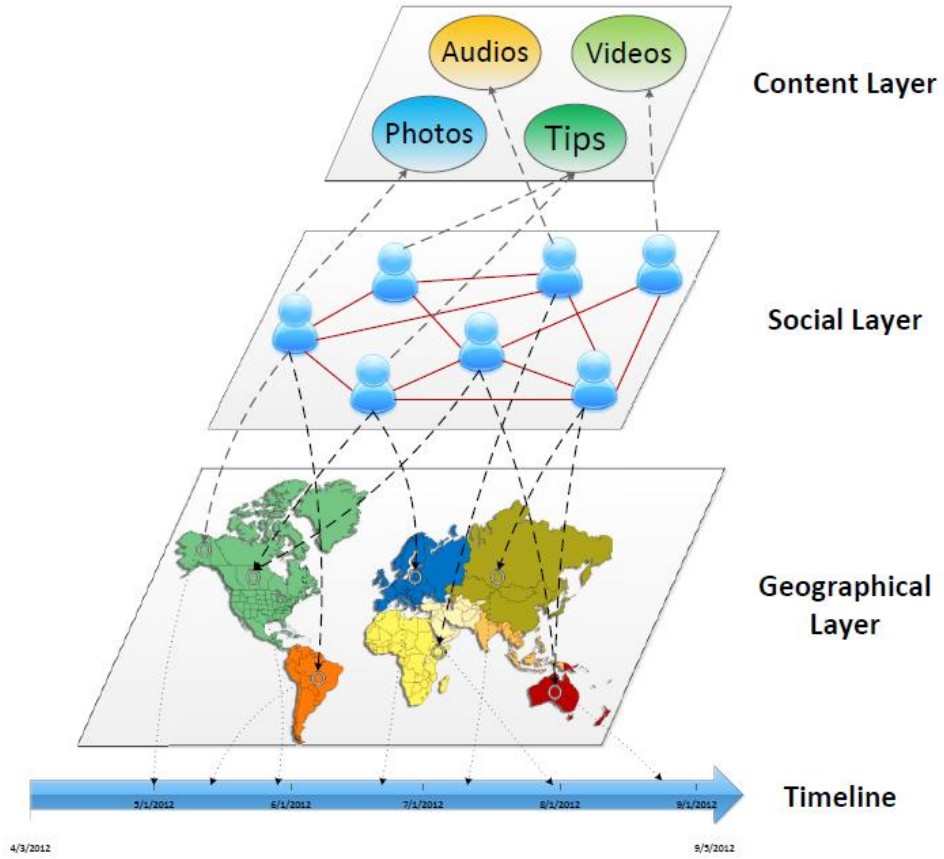

FIGURE 2 The Information Layout of Location-Based Social Networks (Gao & Liu, 2014)

According to Gao and Liu (2014), there are three different layers to the information make-up of a LBSN and they include the geographical layer, the social layer, and the content layer. In the geographical layer, the historical check-ins of users are contained while in the social layer is containing friendship information. Lastly, in the content layer, user feedback and tips about various check-in points and places are stored. As a result, these three layers share one timeline which indicates the temporal information of the user check-in behavior.

This information layout is commonly referred to as a "3+1" framework, which means 3 layers and 1 timeline (Gao & Liu, 2014). Some examples of these types of applications can include Foursquare/Swarm, Facebook Places, and Yelp. A more comprehensive overview of these apps and more will be given in the next chapters.

1.2 Aim of the Research

The aim of this research is to answer a number of questions concerning location-based social network applications and how they are used. It will cover topics concerning activity patterns, motivations for location sharing, privacy concerns as a result of using these applications, and current and future trends. The research will assist in answering these questions and facilitating further discussion so that this research can continue in the future. This will in turn give an overview to the topic discussed from a critical viewpoint.

The results expected from this thesis are:

- Understand current and future trends from the use of location-based apps
- Understand the commonalities and differences of the use of location
- Understand privacy risks associated with location-based apps

1.3 Research methodology

The method of research will be a comprehensive literature review through a variety of sources. These sources will include NELLI, Google Scholar, Web of Science, and the world wide web. Through utilizing these sources, scientific articles and conference papers as well as Internet news articles will be able to answer the questions that are being posed.

1.4 Structure of the thesis

The structure of the thesis will be as follows. Chapter 1 will be an introductory chapter with some background information on location-based services and location-based social network applications, aim of the research, research methodology and a brief explanation of the structure.

In Chapter 2, an overview of the current different types of LBSN applications with examples will be given.

In Chapter 3, prior research conducted on LBSN applications will be discussed. These will be from past studies and will cover a number of topics including the results of the studies, activity patterns, motivations for sharing location, and privacy concerns.

Chapter 4 will be a discussion of this prior research. Limitations of the user studies will be discussed in addition to implications for further research. Current and future trends will also be discussed.

Lastly, Chapter 5 will be the concluding chapter in which the main points found in the thesis will be summarized.

2 TYPES OF LOCATION-BASED SOCIAL NETWORK APPLICATIONS

The following chapter will provide an overview of the different types of LBSN applications that are being used and available on the market currently. It is hoped to provide more insight into how they are used along with showcasing a handful of examples of that people are using. The aim is also to bring light to the current trends in the field. A classification of the categories to social apps, health and fitness apps, and food and entertainment apps are used. With this knowledge attained, it will help in analyzing the user studies that are presented in Chapter 3.

2.1 Social Apps

These types of applications are focusing more on the social aspects of LBSN apps, meaning people are using them to interact with one another, share location with friends, and even meet entirely new people. The apps in this section that will be discussed are Foursquare (now referred to as Swarm), Facebook Places, and Tinder. These are some of the more popular apps at the moment.

2.1.1 Foursquare/Swarm

Arguably one of the more known location-based social network applications, Foursquare came to fruition in 2009 as a means to make cities easier to use and explore. It uses a gaming aspect to allow users to explore new things and rewards them for doing so (Cranshaw, Hong, Lindqvist, Wiese & Zimmerman, 2011).

More specifically, Foursquare allows you to check-in using either its website (accessed by a laptop or the user's mobile device) or a native app for the user's mobile device. The user selects the "check-in" button on the app and it will bring up a list of venues close by. The user then selects the place or venue

and checks in, thus sharing their check-in with friends on their list, or then allowing them to share that check-in to social media websites such as Facebook or Twitter. When a user checks in, they are awarded points and even badges depending on the type of venue that they are at. This type of gaming aspect allows friends to compete against one another for the most badges and points. Additionally, if a user checks in the most to a venue, they are awarded a mayorship of that venue until they can be beat by somebody else. There can be many mayorships awarded to a single user depending on how often they check-in to a certain location. It should be noted though that if the GPS or network location do not match the venue, that user will not receive points, thus discouraging cheating (Cramer, Rost & Holmquist, 2011). Furthermore, users can leave tips and rate the venues that they check-in which adds to the ever-growing database of places and adds a sense of contribution from the users. An example of the check-in process and some examples of badges and mayorship list can be seen in figure 3 and figure 4 respectively.

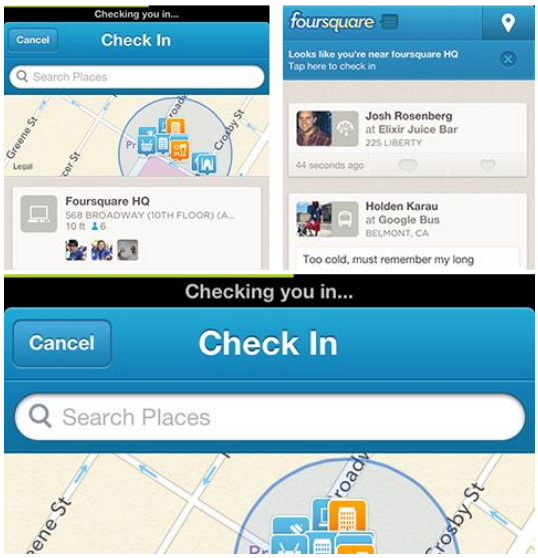

FIGURE 3 Example of the Check-in Process on Foursquare (Olanoff, 2013)

FIGURE 4 Example of the Now-Defunct Foursquare Badges and Mayorship List (Jary, 2010)

With competition from other check-in apps, the creators of Foursquare decided to go in a different direction in November 2013 with a completely revamped version of the application. In this new version, they were redesigning it as an app to help users find restaurants, bars, and other venues along with user reviews of them. This is similar to an app called Yelp which will be explained later in this chapter, which is something they wanted to compete against.

However, according to Popper and Hamburger (2014), going in this direction meant that they wanted to create a completely separate application for allowing users to check-in to different places, thus the creation of Swarm came about in Summer of 2014. This app allows Foursquare users to check-in to the location of their choice, and with the bundling of the Foursquare app still allows them to find new places to discover. Swarm also allows for users to create plans with their friends as it detects if the user is nearby, allowing that user to join in if they wish (Popper & Hamburger, 2014). Additionally, instead of badges, Swarm allows users to earn stickers to post to their check-ins (such as a Beer if they check in to a bar). An example of the revamped Foursquare and the newly launched Swarm can be seen in figure 5.

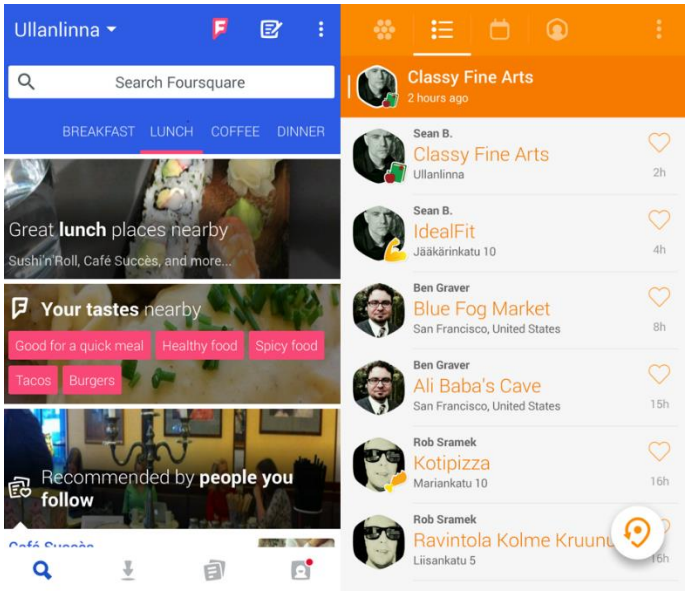

FIGURE 5 Example of Newly Revamped Foursquare (Left) and Swarm (Right)

As Swarm is still fairly new, users so far aren't so happy about the split, but time will tell if Foursquare made the right decision in splitting the app in to two different ones.

2.1.2 Facebook Places

To compete with the likes of the older version of Foursquare, Places was launched in August 2010 from Facebook. The way it works is very similar to the older version of Foursquare in which users check-in to different places to showcase their location to their Facebook friends through either the Facebook website or the Facebook mobile app. The check-in shows up in the user's Facebook news feed. It differs slightly from Foursquare in that there is no gamification of any kind. Users don't get points or badges for checking in (Chang & Sun, 2011). However, it is arguably as popular or more popular than Foursquare as Facebook exceeds over 1.3 billion users as of January 2015, thus allowing to reach a much wider audience with check-in information (Statista, 2015). An example of the check-in process in Places can be seen in figure 6.

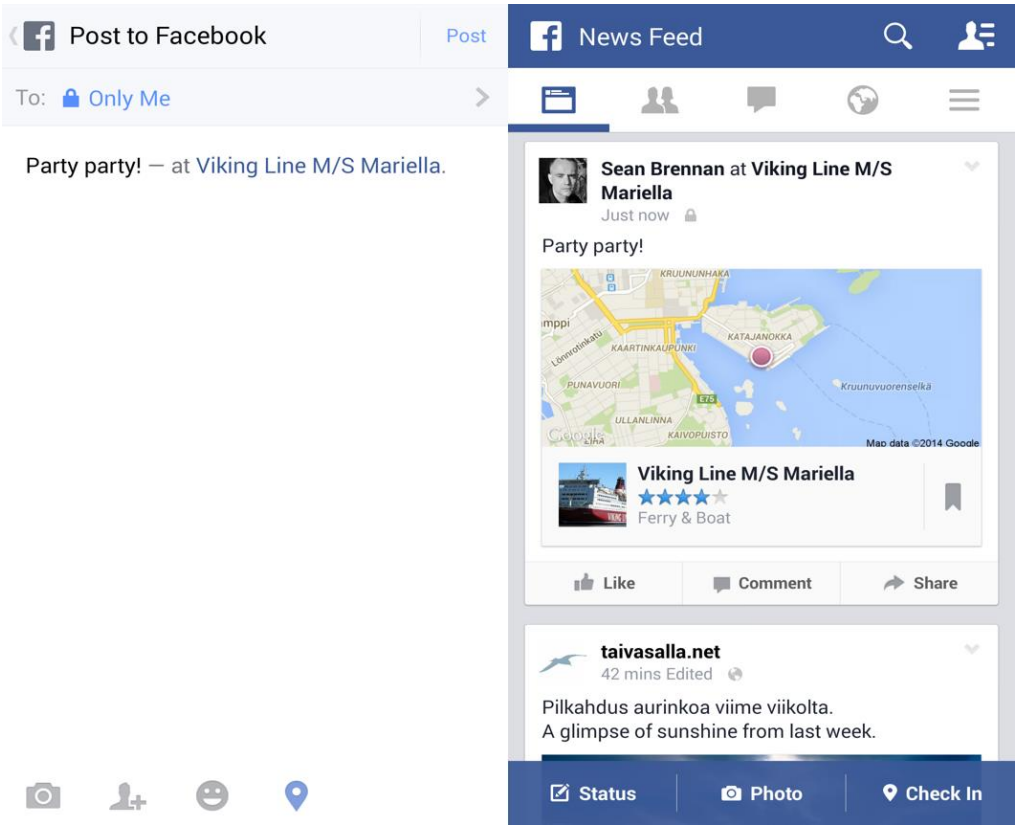

FIGURE 6 Example of the Check-in Process in Places

In 2013, Places started to add a review button to the check-in points on Facebook as to further competition with Foursquare and Yelp (Cohen, 2013). The reviews button is thought to encourage users to post more public information, which Facebook can leverage. Even with Facebook's large user base, it is still yet to be seen whether they will be able to dominate giants such as Yelp (Knibbs, 2013).

2.1.3 Tinder

The two application examples above demonstrate a way to use one's location to engage with people whom they already know, but Tinder allows users to meet new people searching for romantic interests. It was launched in 2012.

The way that it works is that it utilizes the user's Facebook profile to gather basic information about the user such as name and age and allows the user to select a few photos to have as profile pictures. The user can then select a location radius depending on how far they are willing to meet a potential match. After the profile is set up, the user goes through profiles of users in their designated area, and swipes to the right if they are interested in them and swipes to the left if they aren't interested in them. If two people swipe to the right for each other when they have each gone through that person's profile, then they become a match and are able to chat with each other in the in-app

chat program to get to know each other better. An example of an illustration of the Tinder app works seen in figure 7.

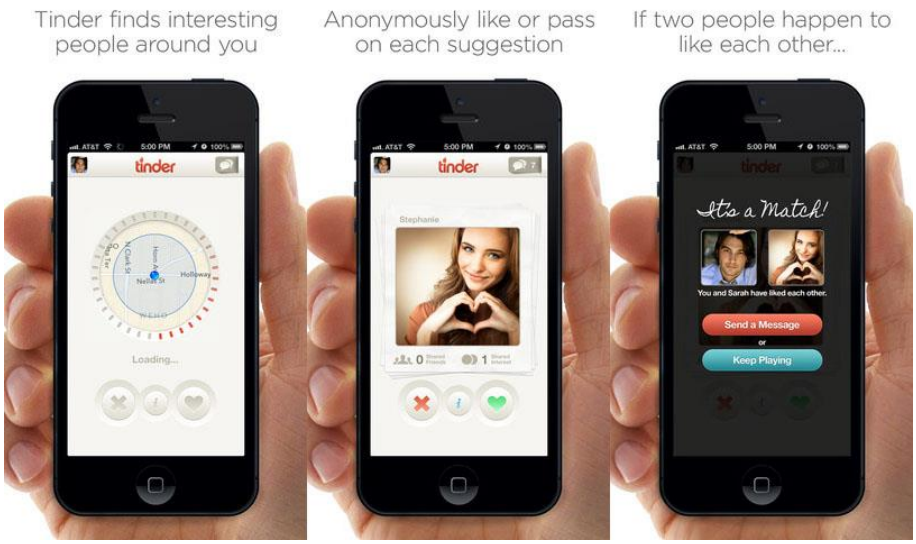

FIGURE 7 How To Use Tinder (Apptinder.com, 2014)

This section described a few examples of apps that are used to socialize with friends by sharing your location or even meeting completely new friends. In the next section, some apps that use your location in order to improve your health will be discussed.

2.2 Health and Fitness Apps

The health apps for mobile devices are growing in number daily and using one's GPS positioning or network positioning on their phone in order to assist with tracking exercise routines. In this section, three examples of these types of apps will be discussed, which are Sports Tracker, EveryMove, and Zombies! Run!.

2.2.1 Sports Tracker

Originally launched in 2004 from mobile developers at Nokia, Sports Tracker started on the Symbian S60 platform and is now available on all major smartphone operating systems. It uses the GPS sensor in the user's mobile device to track the user's movement in real time. From this movement, it gathers the user's location, horizontal speed over ground, in addition to course over ground, altitude, and time. It is able to broadcast live measurements over a 2G or 3G connection to the Sports Tracker's back-end server using regular IP traffic. The user is then able to share their stats via social media websites or on their own website.

The purpose of this application is to use location data in order to motivate the user by showing their statistics and the ability to share those with others. It also enables a gaming type feature in the sense that it encourages the user to beat their own record or compete with their friends (Ahtinen et al., 2008). A premium version of the application allows for even more functionality such as allowing the user to follow other user's tracks for a new workout, the ability to access historical statistics, and the ability to set targets (Sports-Tracker.com, 2014).

FIGURE 8 Overview of the Sports Tracker Application's Interface (Windowscentral.com, 2014)

Figure 8 gives an overview of the interface for the Sports Tracker application. It shows the user's profile, the weekly summary indicating statistics such as distance, duration, and average pace, along with the current statistics showing distance, speed, calories burned, and altitude. Overall, it is a fairly comprehensive application that makes it one of the more popular health and fitness apps on the market.

2.2.2 EveryMove

This application, similar to Sports Tracker, is a fitness tracker using the mobile device's GPS sensor or network services. Every move is recorded in the app and with this allows the user to earn points. These points allow users to level up and compete with friends along with the possibility to earn badges. Additionally, these points can be spent on rewards such as discounts on health foods at local retailers in the USA (where the app uses the location-based services to determine the closest stores). The app also integrates with other fitness tracking apps out there so there is no need to start over with tracking statistics. An overview of the app can be seen in figure 9.

FIGURE 9 Overview of EveryMove's Interface (Jane, 2014)

2.2.3 Zombies! Run!

Launched in 2012, this application is a bit different than the other two applications described above, and is more geared as a game than anything that encourages the user to run to various points in their respective locations. The app uses the device's GPS sensor and network services to track the user's movement.

The user plays as a character named Runner 5 that is caught up in a zombie apocalypse. The app provides missions on a map in the user's location that encourages them to run there to different points marked as fast as possible to pick up supplies and to outrun zombie hordes. It also incorporates the user's own music on their device to give that extra boost of encouragement in getting from point A to point B. Users can share their stats via social media websites such as Facebook and Twitter and on the app's own website as well. An example of the app is shown in figure 10.

FIGURE 10 Example of a Mission In Zombies! Run! (Zombiesrungame.com, 2014)

There are currently over 800,000 players worldwide which makes this quite a popular application (Zombiesrungame.com, 2014).

This section has looked at some of the practical uses of LBSN applications in the health and fitness sector. It looked at how these apps can motivate the user to exercise more and to keep track of their achievements along with competing with other users. The next section will look into some food and entertainment type applications.

2.3 Food and Entertainment Apps

This part of the chapter looks at some examples of food and entertainment LBSN applications. Three examples will be looked at which include the popular app Yelp, and then Groupon, and finally Untappd.

2.3.1 Yelp

Formed in 2004 by former PayPal employees, Yelp is one of the largest search and review services out there for businesses. Their main focus is on restaurants, hotels, bars, dentists amongst others. They utilize their own website (www.yelp.com) in addition to having a Yelp app available for mobile devices

(Team, 2012). The user sets up a profile either through the Yelp website or through connecting with Facebook. This app utilizes your location either through the device's GPS sensor or through WiFi or mobile networks to determine the user's location. The app has a "Nearby" button which lists all of the local businesses around the user complete with ratings and reviews. Much like Foursquare, the user can also leave reviews and tips on a specific venue. It also allows the user the ability to "check-in", much like Swarm (and formerly Foursquare) does, except it is done all in the same app. The user can not only compete with their friends, but also with others in the area depending on which neighborhood they are currently in, which adds another type of gamification aspect to it differentiating it from the likes of Foursquare/Swarm. Additionally, a user can start a conversation with other users in the area where they can request information (i.e. where the best Indian restaurant is, or where the user can buy a room divider). An example of the interface and the conversation board can be seen in figure 11.

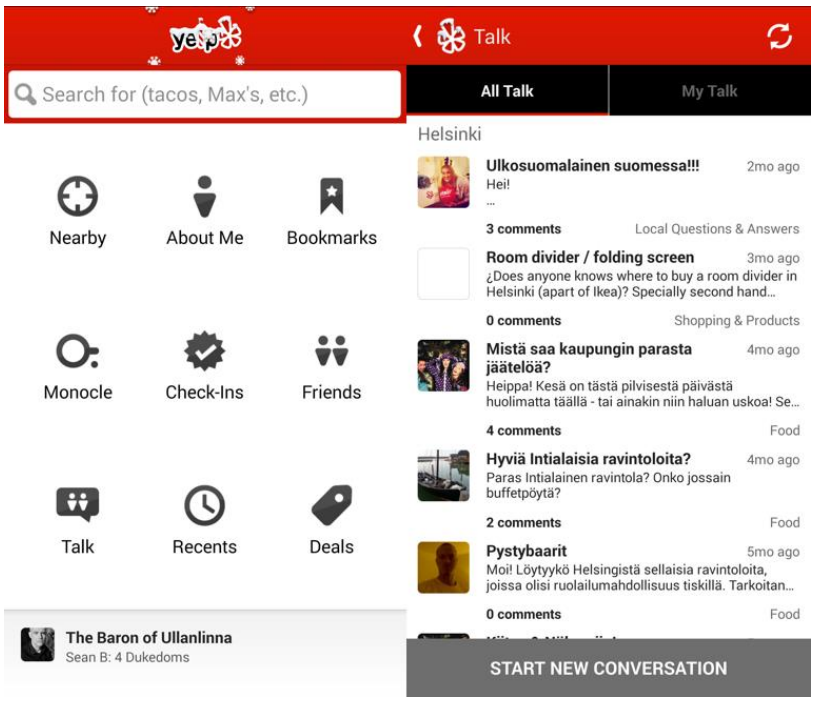

FIGURE 11 Example of Yelp's Interface

As of 2014, Yelp is available in the US, Asia, and Europe with 139 million monthly users and 67 million reviews making it one of the largest kind of these sites out there (Yelp.com, 2014).

2.3.2 Groupon

Groupon was launched in November 2008 and is a "deal-of-the-day" website along with their own app that tracks the user's location through GPS, WiFi, or mobile network signals. The user can sign up by email or connect through

Facebook and based on what the user searches for, it learns the user's likes in order to alert them if there's a good deal nearby. It also lets the user search by category. The way that it works is that it offers one Groupon per day in each market it serves. If enough people sign up for the offer, then it becomes available for everyone. However, if the predetermined number of people signing up aren't met, then the deal won't happen that day. As of 2014, Groupon runs in 500 markets and 48 countries (Groupon.com, 2014). An example of the app can be seen in figure 12.

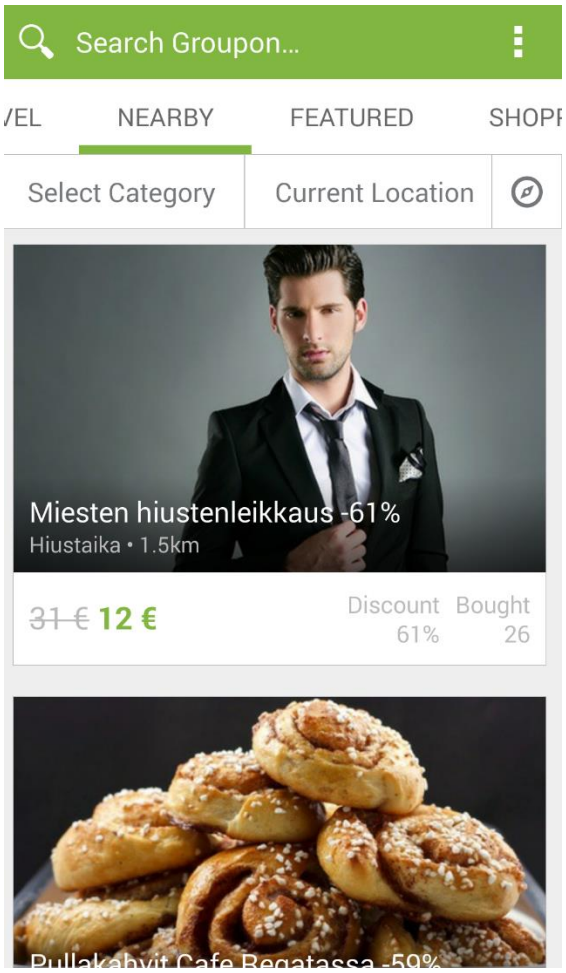

FIGURE 12 Example of Groupon's App Interface

2.3.3 Untappd

Lastly in this section, the mobile app Untappd will be discussed. This is an app, which arguably could be compared to Foursquare in the sense that allows users to check-in to various places (bars and restaurants in this case), but also showcasing what beer the user is currently drinking along with the ability to rate that particular brew. Like the other applications, it uses the phone's GPS sensor, WiFi network or mobile network to determine the user's location. These check-ins allow the user to earn badges for drinking different kinds of beers and also the ability to share with their friends on the app along with social media

websites such as Facebook and Twitter. Additionally, it allows the user to see what other users are sharing in the app, regardless if they are friends or not. The user can select to see what is happening globally, or then nearby depending on the user's location. It also lets the user try to find beers and bars that are nearby serving their fizzy drink of choice or beers that are trending locally in the area (Minsky, 2012). An example of the app can be seen in figure 13.

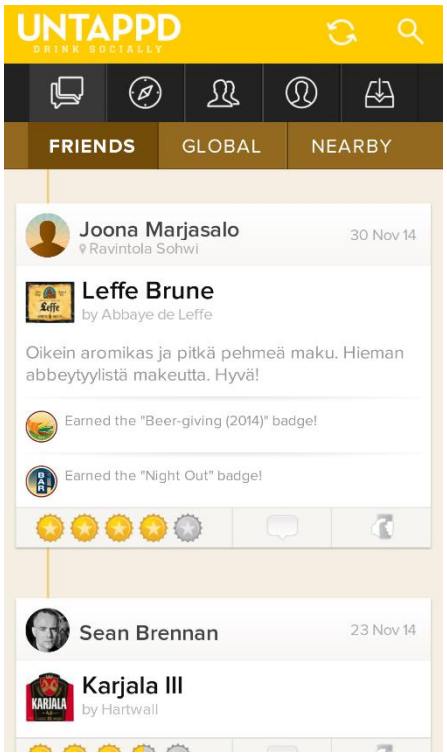

FIGURE 13 Example of Untappd's Interface

In summary, the contents of this chapter was to give an overview of the current types of location-based social network applications and some examples of the most popular types of apps out in the market in the social, health and fitness, and food and entertainment sectors. It explains how they work and are used. It is hoped with this information that the following chapter will be a bit easier to follow as the user studies on LBSN applications are discussed and analyzed.

3 ANALYSIS OF SELECTION OF APPLICATIONS

This chapter comprises of overviews of 12 studies reviewed on the use of LBSN applications. Studies involving Foursquare, Instagram, Facebook Places, Loccacino, Sports Tracker and a multiple application study that includes Foursquare, Twitter, and Gowalla will be thoroughly reviewed and analyzed. These studies that are included differ partially from the apps discussed in the previous chapter as there has not been research on all of them at the time of this thesis.

3.1 User Studies Overview and Results

3.1.1 Foursquare

A number of studies have been looked at so far regarding the Foursquare application. One study conducted by Noulas, Scellato, Mascolo, and Pontill in 2011 involved a large-scale study with data from 700,000 users on user behavior and the methods used were a combination of data collection from Twitter shares per check-in and the number of total check-ins through each venue. Another way they measured the data was through geo-temporal rhythm check-in dynamics activity transitions. It was studied to get a deeper understanding of human mobility and how developers could take advantage of such systems to enhance their applications. Results showed that a few places received a higher level of check-ins than others (for example a central train station compared to a small park). Additionally, results concluded that on weekdays, there were three peaks of activity: in the morning when people go to work, at lunchtime, and then between 6-8pm when people are commuting home or going to bars or malls. Weekends showed a more rising plateau of activity between 12pm-10pm. Other results also concluded that 20% of subsequent checkins occur within a distance of 1km, 60% between 1km and 10km, and around 5% at over 100km. This could be correlated since motion between longer distances takes a longer period of time (Noulas et al., 2011).

The second study, researched by Lindqvist, Cranshaw, Wiese, Hong, and Zimmerman in 2011 involved using Foursquare. It was the results of three different studies (interviews and two surveys) both done quantitatively and qualitatively to understand why people use location-sharing applications and how they manage their privacy. In the first study, which were interviews, the participants were four men and two women ranging in age between 21-38 of whom were early location-based system adopters. The results that they concluded on why the interviewees were using Foursquare were because of the following:

a) Personal tracking – Three of the six persons stated this as a reason of use.
b) Intimate sharing at a distance – Three of the six persons found this useful for themselves.
c) Discovery of new people – Four of the six persons used the app for this purpose.
d) Running into friends – Three of the six persons found the app useful for this purpose.
e) Gaming aspect of Foursquare – Two of the six persons used Foursquare for this reason.
f) Seeing where friends have been – Three of the six persons found this feature useful.
g) Routine vs non routine places – All participants expressed reluctance to check-in at home or work, and stating that they enjoyed checking in to places that are unique to them and their friends.
h) Potentially private places – One participant expressed that they made it a point not to check-in at places such a friend's apartment. The other participants have not commented or it was not explained in this research.
i) At large events – Only one participant expressed that they checked-in more often at large events as to keep his friends as up to date as possible on his whereabouts. The other participants have not commented or it was not explained in the research.

The next two studies from Lindqvist et al. (2011) were surveys that explained why and how people used Foursquare. The other survey explained the same, but delved deeper and focused on quantitative results. In the first survey, 25 people were involved, but it went down to 18 because seven never checked-in. Nine were male, and nine were female. Fifty-five questions were asked that were open-ended and had to do with the benefits and drawbacks of using Foursquare. The results concluded that people used Foursquare mostly for friends (sharing their location), but also discounts and discovering new places came into account. Half of the participants had privacy concerns, but were able to use the privacy controls to control what was shared. The reasons people didn't check in varied, including self-representation issues, and getting spammed by others if the users posted the check-in to Facebook and having their Facebook friends know where they are. Safety was also a concern for one

participant. In the second survey, 219 participants were involved (158 from the US and 46 from European countries). They focused on five themes:

a) Why people use Foursquare
b) Where they check-in
c) Usage of Foursquare by newcomers vs. long term users
d) Privacy
e) Meeting new people

For the first theme, the major factors on why people used it were badges and fun, social connection, place discovery, keeping track of places, and gaming with yourself. The second theme, where people check-in, shows that people mostly check into restaurants, bars, and work, where doctors, home, and school aren't checked-in so many times. In the third theme, newcomers vs. longer-term users, not much is shown here since the time of the article being published, Foursquare was only two years old at the time and had roughly 7 million users (Rao, 2011). However, it has shown so far that the most usage is in the first 200-300 days, then the usage declines. The fourth theme, managing privacy, showed that 74% of participants had a public profile picture, and 70% showing their phone number, email address and links to their Facebook or Twitter profile. However, only about 11% actually get posted to their Facebook wall to avoid spamming their friends. Lastly, the fifth theme, meeting new people, shows that 30% of participants met new people using the application.

Regarding Lindqvist et al.'s (2011) design implications of the study, it showed that a location sharing application designed as a game got people to want to check-in more. Concerning privacy, it should be noted that user activity is required to show their location. It should also be noted that if more businesses adopt Foursquare, it would be more of an incentive to check-in, thus building the total network.

According to the researchers, the limitations to these two surveys and questionnaire was the self-reporting nature of the studies. They were not able to access histories of Foursquare users, so they could not draw usage patterns without survey data. With the interview not having a large sample size, this limited their findings. Additionally, without the first survey being conducted, they would not have been able to delve deeper as they did with the second survey. Another limitation was the sample bias. The people in these studies have already signed up for Foursquare before these studies were conducted, so they knew about location sharing and privacy concerns. Lastly, at the time of the article was written, Foursquare was still an evolving service which limits the generalizability of the findings (Lindqvist et al., 2011).

The third study involving Foursquare, conducted by Cramer, Rost, and Holmquist in 2011 involved looking at 20 in-depth interviews and a survey with 47 respondents concerning users on Foursquare and their check-in habits. It looked at why people do so, whether it is convenient or inconvenient and whether there are privacy issues. It also dove in to the perspective of others concerning a check-in; when other users check their friends in, and discussing it from the perspective of the audience, through both the application itself and the

people physically there with the person during their check-in. Results concluded that utilitarian uses for coordination and communication were a big factor for checking in. Additionally, they also found that social driven uses such as sharing events and sharing information that enhances the person's self-presentation were also major factors. Concerning privacy, only 19% of the users made their check-ins private with the reason being that they checked in for a personal achievement or bookmark for themselves. Next, regarding the audience of a check-in, the results included:

- 91% of participant's friends on Foursquare are their actual friends in real physical life
- 53% of the respondents have colleagues as friends and 51% have other work contacts as friends
- 17% have supervisors
- 17% have partners
- 4% have siblings
- 15% have other family
- 2% have parents
- 21% have people that they don't know who have specifically requested that they become friends. It is not explained as to why this correlates with 91% of users friends are their real-life friends, but the researchers speculate it could be due to a difference in how users value sharing their location or a different indication of not knowing someone.
- 62% of respondents using the application did not want to add people they don't know, 32% did not want to add parents, 28% did not want to add supervisors, 15% did not want to add other work contacts, and 11% did not want to add colleagues

According to the researchers, results show that there are many different reasons for checking in. There are different motivations and one person at any given time might have different motivations so it is hard to pinpoint. Additionally, these motivations also can coexist with one another (i.e. play, expressive, utilitarian uses). As a result, this could help designers make a more user-centric platform when designing these types of applications. Also, designers could take into consideration for future design that check-ins could perhaps expire, or possibly even make the user authenticate an extra time (in addition to them already be authenticated when logging in to make a check-in either through the app or through their authenticated Twitter account) when that user makes a private check-in (perhaps a home). Additionally, perhaps some check-in places could only be shared within a specific group of that person's friends list so they are enabled to secure their privacy even moreso. Another interesting point to note is that when one is using such location-based social network applications, that they cannot be viewed in isolation from existing social networks. Furthermore, it is interesting to note that over the years location sharing has gone from being fully automated (using the GSM Network or GPS positioning to record where you are at all times) to something that you choose to share,

otherwise known as a performative model. Foursquare is a great example of this type of implementation (Cramer, Rost, & Holmquist, 2011).

A fourth study involving Foursquare by Pontes et al. (2012) focuses on the privacy aspect of LBSNs. The main purpose of the study is to see whether a user's location can be revealed from their mayorships or tips despite having private data that the user may wish or not wish to reveal. The researchers collected a large dataset using the Foursquare system Application Programming Interface (API) which tracked the user profile data, user type, home city, list of friends, mayorships, tips, dones (meaning when a tip from another user has been completed), and the total number of check-ins. The study ran from August to October 2011 and collected this data from approximately 13.6 million users. Of that datasest, there are approximately 10.6 million tips, 10 million dones, and 15.1 million mayorships at 15.9 million different venues collected. It should be noted that the user's home city is an open text field when creating a user profile and therefore not enforced by Foursquare's system so this can cause some invalid locations. But unlike the user's home city, the venue's home city and address must be filled in before it can be created as an actual place. However, the researchers only analyzed the amount of valid information in the dataset. The way that they did this was by creating a dictionary of city names using Yahoo! PlaceFinder, which is Yahoo's geo-coding API. This was able to verify the validity of the locations. Results from the dataset concluded a number of things in the researcher's analyses. They include the following:

- 98% of users in the dataset have provided a valid location for their home city, while 0.2% left it blank
- 73.5% of venue locations are valid based on the coordinates of the data found from Yahoo! PlaceFinder. It should be noted that for some queries Yahoo! PlaceFinder returned multiple ambiguous answers which have shown alternative locations with the same name.
- 30% (around 4.2 million) of users in the dataset have at least a mayorship, a tip, or dones. 69% of those users have two or more mayorships, tips, or dones
- Across larger cities in the study, more mayorships, tips, and dones are found as compared to smaller cities and towns.

Regarding whether one can infer the user's current location based on information that is only publicly available on their Foursquare profile page, the researchers use seven different models to compare the potential of each attribute. The first model is the Mayorship model, which uses only the locations of the mayorships to try to determine the user's home location. The second and third model, Tips and Done, use only the locations of those tips and dones. The fourth, fifth and sixth model, Mayorship+Tip, Mayorship+Done, and Tip+Done, take information from two attributes. The seventh model, All, takes information from the first three models. The results from the data in these models can be seen in table 1.

TABLE 1 Home Location Inference (Pontes et al., 2012)

Classes Distribution									
	Home City			Home State			Home Country		
Features	Class 0	Class 1	Class 2	Class 0	Class 1	Class 2	Class 0	Class 1	Class 2
Mayorship	727,179	847,876	239,129	707,953	913,166	110,110	727,179	1,053,703	33,302
Tip	725,073	671,576	192,781	702,583	727,219	99,672	725,073	835,532	28,825
Done	546,815	541,795	106,297	524,137	561,165	55,115	546,815	630,937	17,155
Mayorship+Tip	898,293	1,322,214	300,831	878,578	1,398,351	146,526	898,293	1,581,654	41,391
Mayorship+Done	825,009	1,213,917	270,974	805,029	1,278,784	130,439	825,009	1,447,581	37,310
Tip+Done	831,759	1,038,268	223,093	807,091	1,089,638	116,549	831,759	1,228,043	33,318
All	939,888	1,573,471	310,045	919,938	1,643,825	153,955	939,888	1,840,850	42,666
Accuracy									
	Home City			Home State			Home Country		
Features	Class 0	Class 1	Total	Class 0	Class 1	Total	Class 0	Class 1	Total
Mayorship	**51.61%**	**67.41%**	60.12%	**71.27%**	**80.92%**	**76.70%**	89.79%	92.92%	91.64%
Tip	51.52%	67.29%	59.11%	70.29%	80.59%	75.53%	**90.12%**	**93.67%**	**92.02%**
Done	50.09%	61.74%	55.89%	70.16%	78.38%	74.41%	89.12%	92.38%	90.87%
Mayorship+Tip	51.57%	66.24%	**60.31%**	70.21%	80.27%	76.39%	89.71%	93.13%	91.89%
Mayorship+Done	51.05%	65.27%	59.51%	70.01%	79.89%	76.07%	89.18%	92.78%	91.47%
Tip+Done	51.18%	64.16%	58.38%	69.76%	79.28%	75.23%	89.52%	93.04%	91.62%
All	51.46%	64.86%	59.85%	69.74%	79.53%	76.02%	89.29%	92.89%	91.67%

Besides the models described, the table also shows the users grouped in to three different classes: Class 0, Class 1, and Class 2. Class 0 consists of users who only have a single activity such as a mayorship, tip, or done. Whichever activity they choose in this case is set to the user's home location. Class 1 has users who have multiple activities with a predominant location. As for these users, their location that is inferred matches the most often encountered location of their activities. Finally, in Class 2, these users have done multiple activities in which no single location stands out. The researcher's inference approach could not be applied to this class.

Results from the table show that the majority of the users (between 87% and 91%) are in classes 0 and 1. The models' accuracies shown in table 1 are shown to produce only marginally different results both per class and overall. However, the Mayorships are shown to be the best single attribute to infer the user's home location while the Dones produce the worst results. Of course, the All model is the best one overall to infer the user's home location since it combines all categories (Pontes et al., 2012).

The fifth study involving Foursquare from Vasconcelos et. al (2012) tries to uncover user behavior profiles based on three features: tips, dones, and to-dos. It involves a dataset consisting of information from 1.6 million venues over a span of eight weeks from May to July 2011. The researchers gathered tips left by users on venues, the to-dos and dones associated with those tips, the number of actual users who posted those tips, the category in Foursquare in which that venue was assigned, and its location. The study is conducted in two main phases. The first phase consists of characterizing the venues and users with respect to the number of tips, number of dones, and to-dos in addition to the percentage of tips containing links (i.e. URLS or email addresses). The second phase consists of applying a clustering algorithm to group users into profiles based on three attributes which were the number of venues tipped by the user, the total number of dones, and to-dos associated with the user's tips, and the percentage of the user's tips containing links. As a result of this study, four different user profiles were created. Two of the profiles correspond to users

with different levels of activity in the system. The first corresponds to occasional users that post tips to only a few venues and receive a few dones and to-dos. The second contains the vast majority of clustered users and consists of more active users who also tend to get a lot more feedback from their tips. The third contains users who are characterized by tipping a large number of different venues therefore receiving a very large number of dones and to-dos in return. The last profile contains a large percentage of tips with links posted at many venues, a behavior that is consistent with spamming according to Foursquare's terms of service. However, it is shown that these potential spammers did get lots of feedback, both positive and negative, from other users which can indicate that dealing with tip spamming in Foursquare is a difficult task that can be quite controversial.

The results of the analyses were broken down in to two sections; the first one containing the venue and user analyses and the second one containing the user profile analyses. During the venue analyses, the researchers characterized each venue in the dataset in terms of the number of tips and the total number of dones and to-dos associated with all the tips posted at the venue. It is found that approximately 57% of the venues have only one tip whereas some venues (approximately 500) are very popular among users and receive more than 100 tips each. It is also found that around 200 venues have received tips that got a lot of feedback. The total number of dones and to-dos here exceeded 1,000. This implies that tipping can be an effective way to attract visibility to a venue. The dataset also broke down each venue by category and shows the results found in figure 14 (Vasconcelos et al., 2012).

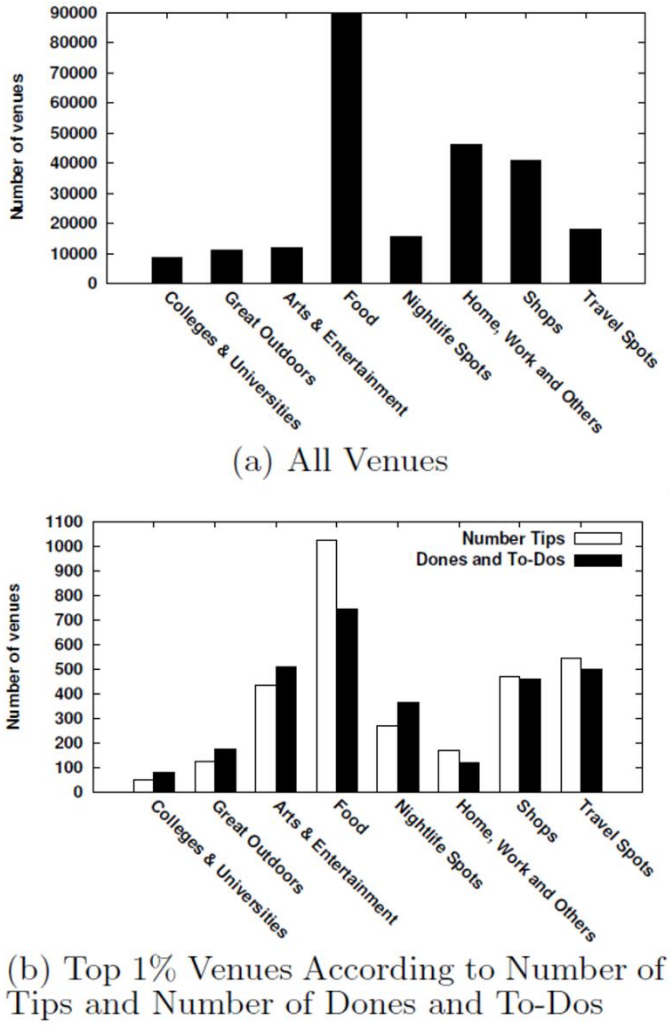

FIGURE 14 Distribution of Venues Across Categories (Vasconcelos et. al, 2012)

It can be seen here that the "Food" category has the largest number of venues both in the top 1% most tipped venues and in the top1% venues with more dones and to-dos. The second category with more venues is "Travel Spots" followed by "Arts and Entertainment". The largest number of tips are found here in these categories because of the Super Bowl Event and because of Jarkarta Airport. The largest number of dones and to-dos in these categories are because of Grand Central Terminal and Madison Square Garden.

During the user analyses, the researchers focused on how users exploit tips, dones and to-dos. They look at the total number of tips posted by each user, the total number of dones and to-dos received by those tips and the number of venues tipped by them and the percentage of their tips containing URLs. Results show that 66% of the users posted only one tip and 70% of the users posted tips at one venue only. It also showed that 67 users posted more than 100 tips and 39 posted tips at more than 100 venues. The majority of the users who posted at least one tip did not add any link in their tips' content. But around 200 users were noticed to have links in about 60% of their tips. The researchers found a strong positive correlation between the number of tips and

the number of venues tipped by a user, which could suggest that users who add tips more often tend to spread them across more venues.

In the analyses on user profiles, the researchers applied the Expectation-Maximization clustering algorithm, which is used for clustering in the context of mixture models. A breakdown of the clusters can be seen in table 2.

TABLE 2 Summary of User Attributes Across Clusters (Vasconcelos et. al, 2012)

Attribute	Cluster 0		Cluster 1		Cluster 2		Cluster 3	
	avg	cv	avg	cv	avg	cv	avg	cv
Number of Venues	21.99	0.94	1.97	0.52	13.23	0.52	43.81	1.41
Percentage of Tips with Links	83.11	0.20	3.88	2.35	0.62	5.21	7.02	1.71
Number of Dones and To-Dos	20.41	1.82	7.35	1.52	29.53	2.09	1350.58	5.48
Number of Users	222		190		5660		477	

It should be noted that the percentage of users from this table represent approximately 0.09% of the total Foursquare userbase in 2011 (Rao, 2011). Cluster 0, which is 3% of all clustered users is characterizied by a larger percentage of tips with links (83%). The number of tipped venues is also large, but is smaller for users in cluster 3. This pattern is consistent with spamming behavior. Cluster 1 has users who are neither very active or influental. They tend to post tips at only a few venues and don't receive many dones or to-dos from other users. However, cluster 2 users are much more active and tend to tip at a higher number of venues that don't include links, therefore getting more dones and to-dos. Cluster 3 contains around 7% of the users and is characterized by the largest number of dones and to-dos. Here, it can be expected that most of these very influencial users target a large number of venues (Vasconcelos et al., 2012).

The final results of the study found two important findings. The first was that spamming activity was found, as in many other social systems such as Facebook and YouTube. As a result, it can be said that a number of efforts towards desigining strategies to detect and remove spam from these systems are available. The second finding shows that apps like Foursquare are changing the way people interact with each other as well as people with a local opinion such as small businesses and online customers. These tips, to-dos, and dones are great ways for businesses to receive feedback while for users it is very helpful in choosing places to visit (Vasconcelos et al., 2012).

A sixth study involving Foursquare from Qu and Zhang (2013) looks to see how User Generated Mobile Location Data (UGMLD) involving check-ins can be used in Trade Area Analysis (TAA). This is to be able to analyze customers' visits to a business which can in turn show the nature and performance of a specific venue. The data was collected over a ten month period in 2012 from January 1st to November 1st and contained approximately 31.5 million check-ins at 980,686 places from approximately 1 million users. The data includes latitute, longitude, time of the check-in, venue name, venue category and tips from those venues. Figure 15 shows a graph of the top 80 categories of frequently visited venues.

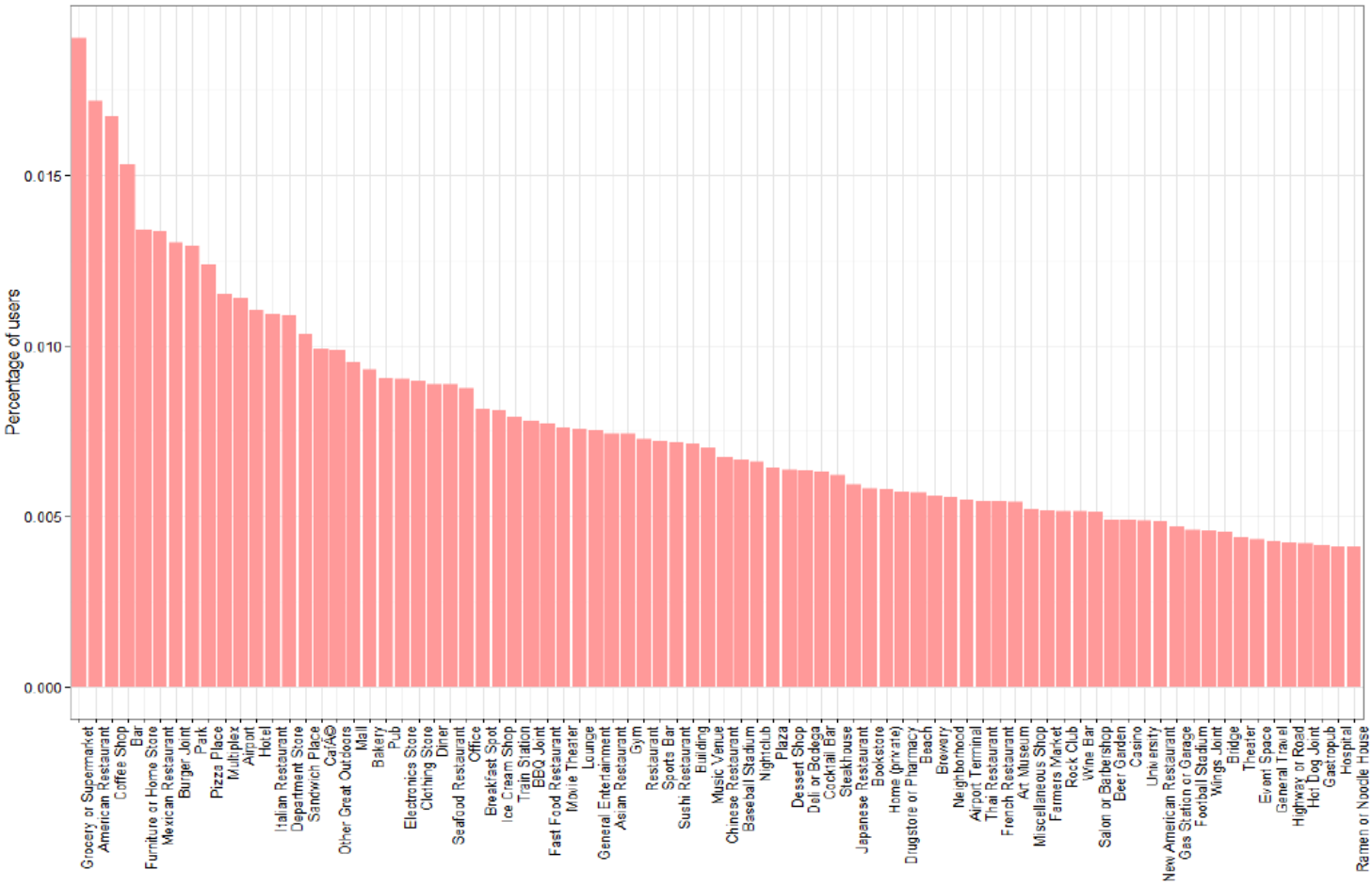

FIGURE 15 Top 80 check-in categories (Qu & Zhang, 2013)

It should be noted that the Y-axis shows the total percentage of the user population check-ins to a specific category from the resesarcher's data set only. The "Grocery or Supermarket", "American Restaurant", and "Coffee Shop" categories (the first three listed) are shown to be very popular check-in places, while "Gastropub", "Hospital", or "Ramen or Noodle House" (the last three listed) are much less common check-in places. Coordinating with friends or signal ability or presenting yourself are reasons for checking in places that have a high frequency of check-ins while the lower ones could be seen as embarrassing for the user or just not that common of a place. This can also be seen as more reliable for TAA in the more popular categories since there is more data and can also be seen as less biased since there are much more check-ins than in the lesser known categories. The researchers then went on to explore if they could generate trade areas using the check-in data. They looked at four different stores in different types of locations to get a better comparison. These can be seen in table 3.

TABLE 3 Selected Stores (Qu & Zhang, 2013)

Store Name	Category	Location	# Checkin Customers
Whole Foods	Grocery store	Union Sq., NYC	682
IKEA	Furniture store	Canton, MI	380
Starbucks	Coffee shop	Union Sq. NYC	420
Macy's	Department store	Downtown, SF	120

The data they received shows that the top 20% of Starbucks' customers made about 70% of their check-ins while at the same time the top 20% of IKEA's customers made only about 41% of their check-ins. From this data, it shows that since Starbucks is a convenience rather than a destination venue like IKEA that there would be more customers who visit on a daily basis (Qu & Zhang, 2013).

Throughout this study, the researchers used the dataset to analyze check-in patterns to study user profiling, study competition between stores, loyalty of businesses, distance between a customer's household and that store within the trade area, and check-in sequences. The final results show that it is possible to build meaningful trade areas based on the dataset which include distance/time boundaries, generate customer profiles, and weigh competitive factors. This creates business implications for that venue such as location-based mobile advertising since this user generated data can inform businesses about the areas their customers visit. Furthermore, the location histories with plenty of contextual information can be used to model customer behavior. This can also help businesses target potential customers more accurately.

According to the researchers, there were some limitations to this study. The dataset was limited and could be seen as biased. The researchers also limited their trade area analysis to four specific business venues and only provide details of two of them due to space limitations, advising caution when interpreting the results. Lastly, the researchers wanted to explore each step of the TAA analysis more deeply, but since this was a new topic for them, they wanted to establish a conceptual framework first (Qu & Zhang, 2013).

The last study involving solely Foursquare in this user study review looks at the perspective of travelers' behavior in LBSNs. The research from Long, Jin, and Joshi (2013) looks at check-in data from the city of Pittsburgh, Pennsylvania in the United States and it investigates temporal features of travelers' check-ins and the evolution of check-ins created at venues related to four categories using spatio-temporal information. The researchers also aim to look at the diversity of the travelers' check-ins along with using the Latent Dirichlet Allocation (LDA)[2] to generate travelers' mobility patterns.

[2] Blei, Ng, and Jordan (2003) describe LDA as generative probabilistic model for collections of discrete data such as text corpora. LDA is a three-level hierarchical Bayesian model, in which each item of a collection is modeled as a finite mixture over an underlying set of topics. Each topic is, in turn, modeled as an infinite mixture over an underlying set of topic probabilities.

The data contained 8,476 users, or travelers, with 104,887 check-ins at 8,016 venues during the period of February 24th to July 30th, 2012. The researchers define traveler as a user whose hometown is more than 310 miles away from downtown Pittsburgh. It should also be noted that the Foursquare data was collected directly from the application, rather than check-ins posted from Twitter, which makes this dataset a bit more thorough than some other studies previously done.

The study first looks at the distribution of venues and distribution of check-ins in order to determine a traveler's preferences of types of places they would like to visit. A visual representation of this can be seen in figure 16.

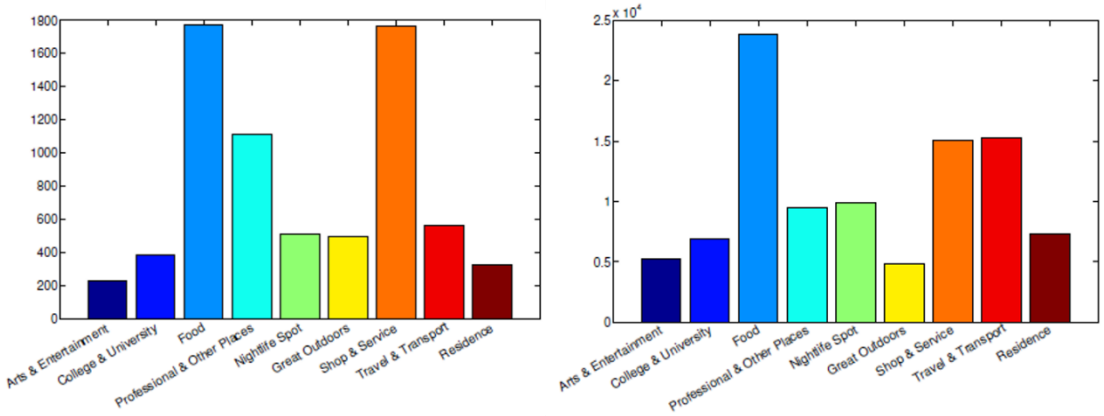

FIGURE 16 Distribution of Venues in Top 9 Categories (left) and Distribution of Check-ins in Top 9 Categories (right) (Long, Jin, & Joshi, 2013)

The "Food, Shop and Service" and "Professional and Other Places" categories appear to be the most popular for the type of venue while the "Food" category takes the top spot for the number of check-ins along with "Shop and Service" and "Travel and Transport" coming not too far after. This is quite common though as travelers' to foreign places would tend to go to these types of places the most.

Another interesting factor of travelers' preferences can be seen in table 4, which shows the average properties of the top 9 categories which includes check-ins per user and check-ins per venue.

TABLE 4 Average Properties of Top 9 Categories: Check-ins per user (C_u) and Check-ins per venue (C_v) (Long, Jin, & Joshi, 2013)

Category	C_u	C_v
Arts & Entertainment	2.3644	23.4330
College & University	8.5643	17.8646
Food	4.9374	13.4508
Professional & Other Places	6.1910	8.5482
Nightlife Spot	3.7003	19.4960
Great Outdoors	3.2279	9.9128
Shop & Service	6.1566	8.5385
Travel & Transport	2.8815	27.3584
Residence	23.1073	22.7484

From the data shown here, the residence category is one of the highest amount of check-ins shown which infers that some travelers are going to another place to visit friends or family and are constantly returning to these types of places. Additionally, the "Travel and Transport" along with the "Arts and "Entertainment" categories attract a lot of travelers initially, but not for subsequent times, which can be expected for a lot of travelers wanting to see the sites and need some method of transport getting around the city (Long, Jin, & Joshi, 2013).

The study then goes on to use the LDA model previously mentioned to mine the latent topics from the check-ins to explore the travelers' choice of preference of the types of venues on the crowd level. The researchers looked at three different category topics when applying this model: Sports, higher education, and transportation & hotels. Results in the sports category concluded that watching sports games is one of the main goals to travelers of Pittsburgh as hotels, the hockey arena, and baseball stadium all had high amounts of check-ins per traveler. Regarding the higher education category, it was found that one of the main reasons travelers come to Pittsburgh are to visit one of famous univerisities that are located there; Carnegie Mellon University and the University of Pittsburgh. The highest amount of check-ins were at various buildings on either one of those campuses. Lastly, in the transportation & hotels category, hotels and airports were the most checked-in along with bars and restaurants near these places. This can be useful in recommending bars and restaurants to travelers who come to Pittsburgh in the future.

Implications for future research will include clustering the venues based on both the functionality of the venues and the spatial features associated. There are also plans to study the travelers' moving patterns (Long, Jin & Joshi, 2013).

3.1.2 Foursquare and Instagram

A study by Silva et al. (2013) using datasets from both Foursquare and Instagram was conducted to investigate whether the researchers could observe the same users' movement patterns, the popularity of regions in cities, the activities of users who use these applications and how users share their content

along this time. This is to understand location-related information better. Instagram is an online photo-sharing and social networking service that lets users take pictures, apply filters to them and share them via various social networking sites. It also allows the user to tag their photos by location using their mobile device. Users can also follow each other via the Instagram app to keep up to date with their friends if they don't post the photos on any other social media website (Silva et al., 2013). As of January 2015, they have approximately 300 million users (Statista, 2015).

The datasets were collected via Twitter as in many earlier studies since Instagram photos and Foursquare check-ins are not publicly available by default. The datasets were collected in three different cities, New York, Sao Paulo, and Tokyo during the period of April-August 2012 involving approximately 9.1 million check-ins and 3 million photos. The data looked at a number of different categories such as user behavior, popularity of the areas, and routines and data sharing. The data from the user behavior category looks at three classes: users that only participated in Instagram (Class 1), users that only participated in Foursquare (Class 2), and users that participated in both (Class 3). The researchers looked at the frequency of sharing content per class which shows the intersharing time in minutes between consecutive content sharing. They found that Classes 1 and 3 contribute more content in shorter intervals then Class 2. This could suggest that users tend to share more content in the same place with using Instagram. For example, Instagram users could share multiple photos of them in a night club while with Foursquare they would only check-in once there.

In the popularity of areas category, the researchers divided the areas of the three cities in a 10x10 grid and then verified the number of photos or check-ins shared in each cell of the grid. They correlated the number of content in each cell using the Pearson correlation[3]. The results showed that there was a very high correlation between all of the datasets from the cities and the use of Foursquare and Instagram, which suggests that the popularity of regions inside cities is the same regardless of the application used over time. They then measured the data to see if the popularity of a city is consistent across both systems. For this they measured 29 different cities all around the world using the Spearman correlation[4]. The results that were found showed that the popularity of cities, measured by the amount of content shared on it, tended to be very correlated over time for the same system, but not for different systems. This could mean that users use Foursquare and Instagram in different ways for different cities.

In the routines and data sharing category, the researchers looked at the temporal sharing patterns for both applications for both weekdays and weekends in New York, Sao Paulo, and Tokyo. Results showed that the Foursquare datasets varied more than Instagram ones. This could suggest that

[3] The Pearson correlation shows the linear relationship between two sets of data (StatisticsHowTo.com, 2013)

[4] The Spearman correlation measures the strength of association between two ranked variables (Laerd Statistics, 2015).

the sharing pattern from Instagram could be a result of different cultural traditions that are less susceptible to changes over time.

The final results that the researchers found in this study included the following:

- Both application's datasets might be compatible in finding popular regions of cities
- The temporal sharing pattern did not vary considerably over time for the same application, but the sharing pattern for each application during weekdays are distinct
- Both applications might be used to capture particular signatures of cultural behaviors, however Instagram offers a more distinguisable one that is less susceptible to changes over time
- Foursquare is better to express typical routes of people inside cities

Considering future research, the researchers would like to see if these applications can be used as a tool to identify cultural differences and to understand city dynamics better as a means to offer smarter services in those cities (Silva et al., 2013).

3.1.3 Facebook Places

In a study by Chang and Sun (2011) involving Facebook Places with a dataset of user check-in habits, the researchers looked to understand better the factors that influence where people and their friends check-in along with building a model to predict where they will check-in next. It was completed between August 2010 and January 2011 in San Francisco, California.

The method that the researchers used was quantitative and they utilized the Latent Dirichlet Allocation (LDA)[2] model to analyze their findings. The number of exact check-ins or number of users was not described in the study, which is a limitation for any outside analysis.

The results concluded that many users check-in to the same venue repeatedly over time. They also found that age is a significant factor which governs usage, however, it was not shown which age groups check in the most or the least, which is another limitation of this study. Time of day has little significance and the day of the week has no significance. Additionally, they found that the physical distance (measured in kilometers) between the viewer (the one who sees the user's check-in) and the user (the one who checks in) is the only predictive feature of likes. They also found that the check-in data shows that pairs of users who check in to the same places are more likely to be friends with each other. Also, since Facebook Places has no gamification of any kind unlike Foursquare, their main motivation for sharing location was to share it with their friends (Chang & Sun, 2011).

3.1.4 Locaccino

A study conducted by Wagner et. al (2010) aimed to present insights relating to location-sharing practices and looked at the use of third-person scenarios to elicit privacy concerns. It involves the application Locaccino, which has been developed by Carnegie Mellon University and lets users check-in to venues and share that information via the app or through Facebook. The way they claim they differ is they give their users a higher level of control over their privacy when sharing location. As of late 2013, the app is no longer in service (Locaccino.org, 2013).

The study consisted of training, the collecting of data via a questionnaire and a sorting activity, a semi-structured discussion about location sharing driven by two sets of scenarios (a predefined scenario as well as one constructed on the fly), and a semi-structured dicussion about third party location sharing driven by a set of predefined scenarios. It involved 15 participants (ten males and five females) between the ages of 20 and 30 years whom were either students or employees at Carnegie Mellon University. There were three sessions involved. In the first session, the participants were asked to list people they relate to and group them as they saw fit. Additionally, they were to list places they had visited in the last year. In the second session, they were asked a pre-defined set of questions/scenarios and were asked whether or not they would share their location in that situation. This followed by receiving on-the-fly constructed scenarios using permutations of people and places from session 1 along with random times of day. The third session involved a predefined set of scenarios with fictional characters. The participants had to decide if the location of the main character should be disclosed or not.

The results included a number of interesting findings. The first being that they suggest a strong hierarchical distinction in how participants choose to disclose their location when they are at home. Most had no qualms revealing to friends, family, and coworkers that they were home, however they were not happy to reveal this to strangers. It is also interesting to note that the participants' responses in the home scenario were quite different when disclosing the location of the fictional characters. They were much more cautious. While all participants chose to let their colleagues know that they were home, only 38% decided to share that information for their fictional characters.

In addition to the quantitative data found, there was also interesting qualitative data found in the results. The researchers determined the following results based on the findings:

- Location information is preferably shared on a need to know basis, not broadcast
- Highly detailed location information is shared when there is a need for it

- Locations are associated with actions
- Disclosing location at the granularity of a city is perceived as disclosing nothing
- Being found is associated with being available
- Users are more cautious when sharing others' location

Implications for future research based on these findings is focusing on identifying mechanisms for sharing location with the bias of assuming users are available when disclosing their location is minimized (Wagner et al., 2010).

3.1.5 Multiple Applications

A study conducted by Cheng, Caverlee, Lee, and Sui (2011) involved investigating 22 million check-ins across 220,000 users through multiple location-based service applications. The aim of the quantitative study was to assess human mobilty patterns by analyzing the spatial, temporal, social, and textual aspects associated with these check-ins. Since a lot of the check-in information is restricted to a certain person and their social circle, the public feed from Twitter is used to gather locations from apps such as Foursquare and Gowalla. A more detailed breakdown of the sources of check-ins gathered is shown in table 5.

TABLE 5 Distribution of Sources of Check-ins (Cheng, Caverlee, Lee, & Sui, 2011)

Name	Percentage
Foursquare	53.5%
UberTwitter	16.4%
Twitter for iPhone	10.2%
Twitter for Android	3.4%
TweetDeck	3.1%
Gowalla	2.9%
Echofon	2.0%
Gravity	1.3%
TwitBird	1.1%
Others	6.0%

The tracking of the data ran from late September 2010 to late January 2011. During this time, data was collected from 225,098 users from 22,506,721 unique locations throughout the world. A more detailed distribution of the location of the check-ins is shown in figure 17.

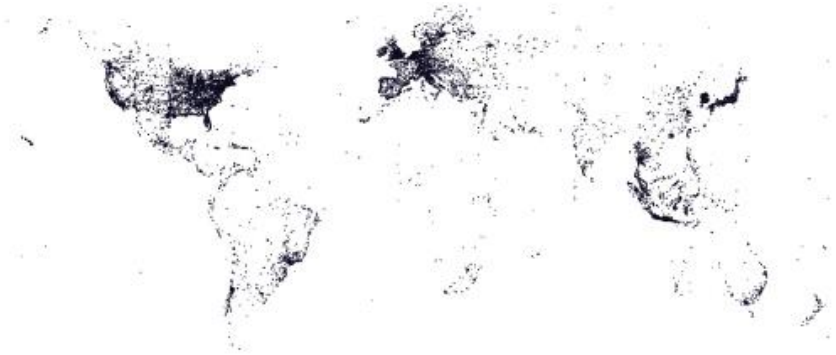

FIGURE 17 Global Distribution of Checkins (Cheng, Caverlee, Lee, & Sui, 2011)

While the checkins are globally distributed, it can clearly be shown that the highest density of checkins are in North America, Western Europe, South Asia, and Pacific Asia. The data also shows that the most popular checkin venues are restaurants, coffee shops, airports, stores, and generally places that reflect the user's daily activities. The researchers also aggregated the daily and weekly patterns of the users from the data. It was shown that there were three major peaks: 9am, 12pm, and 6pm. It can be inferred that these peaks are at these times since users are going to/from work, and also taking breaks for lunch times, so that they will tend to checkin at a higher rate. Delving further into these peaks of activities, the researchers focused on three different cities, New York, Los Angeles, and Amsterdam. A detailed view can be seen in figure 18.

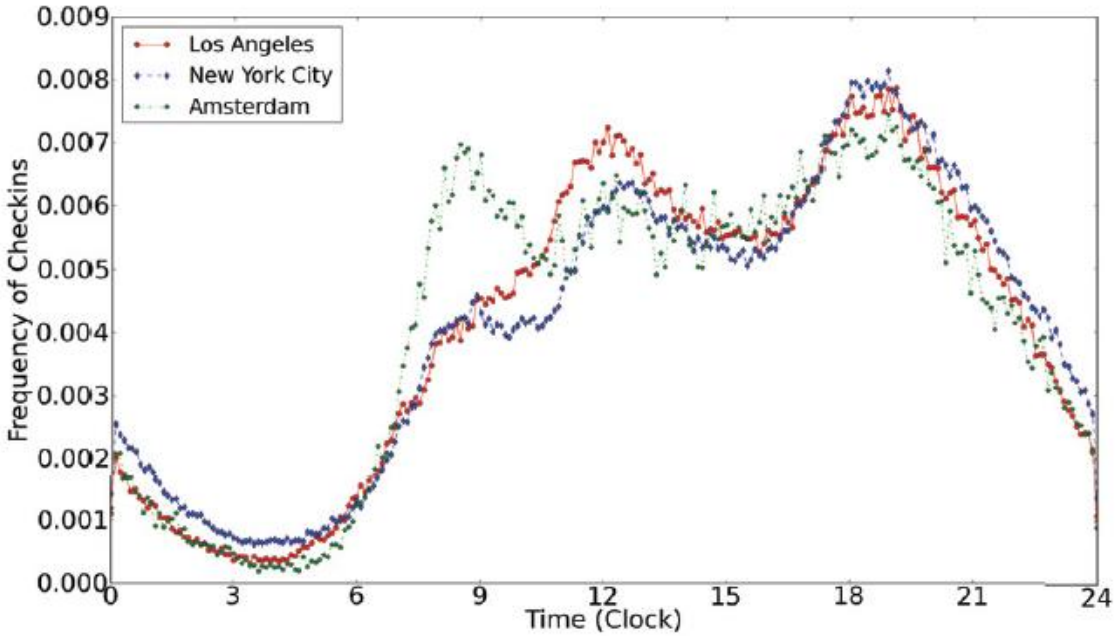

FIGURE 18 Daily Checkin Patterns: NYC, LA, Amsterdam (Cheng, Caverlee, Lee & Sui, 2011)

It should be noted that the y-axis refers to the frequency of check-ins in millions and corresponds to a specific time of day (x-axis). The results showed that

Amsterdam reflects an early rising city with more activity in the earlier hours than the other two cities. On the other hand, New York has the most checkins during the night hours. This could have implications for further research as it could have to do with cultural differences. Other results that were found in the study included three main observations:

1. Location Sharing Service (LSS) users follow simply reproducible patterns
2. Social status along with geographic and economic factors is coupled with mobility
3. Content and sentiment-based analysis of posts can reveal unobserved context between people and locations

Additional implications for future research are to possibly look at the social structure inherent in LSS's to study group based human mobility patterns. The researchers would also be interested in personalized location recommendations based on checkin history (Cheng, Caverlee, Lee, & Sui, 2011).

3.1.6 Sports Tracker

In a study conducted by Ahtinen et al. in 2008 involving the Sports Tracker application, it looks at a user study of 28 people utilizing the application to study their usage habits and experiences involved. The 28 users were divided in three groups: Novice users (reflecting the initial use of the application), Experienced Users (reflecting a relatively short term use of the application) and Veteran users (reflecting long term use of the application). The user experiences were asked from a series of interview questions over the phone and a text messaged based questionnaire collecting user data over a period of two weeks.

Results concluded that the app was used the most with biking (80% of participants) followed by running (60%), walking (40%), and hiking and skiing (both 15%). The average weekly use out of the three groups was 3.3 times per week. In regards to sharing with others, the most important factor for all three groups for this application was to follow up on their own workout. However, for the Novice group, viewing other workouts was the 2nd most important and sharing their own workouts was the least important. As for Experienced and Veteran users, it was the other way around. The results also showed that automatic tracking and logging was the main motivation to use the application. In regards to sharing to others using the Live Share feature, most of them have tried it but were not using it frequently. This was because many were suspicious as to why others would see this information as valuable. This study also finds that using such applications can enhance exercising practices since it provides a large amount of data the user can keep track of in the application and through their web service (Ahtinen et al., 2008).

Section 3.1 summarized 12 different LBSN user studies involving the Foursquare application, Instagram, Facebook Places, Sports Tracker, Gowalla, and utilizing Twitter. The studies showed their activity patterns, privacy issues,

reasons for using these types of applications, and other general check-in habits. The next section will delve deeper in to the studies with a comparative analysis.

3.2 User Study Comparisons

This section comprises of a detailed comparison of the studies that were summarized above. It includes three tables (table 6, table 7, and table 8) of the reviewed studies which compares the research methods, sample sizes, areas, and main results found to give a general overview of the studies. The other sub-sections in this section will discuss these in more detail. It includes differences and similarities in activity patterns, motivations for sharing location and issues with privacy.

TABLE 6 Study's Research Methods, Sample Sizes, and Area

	RESEARCH METHODS	SAMPLE	AREA
FOURSQUARE			
1. Noulas et al 2011	Twitter shares and check-ins	12 000 000 checkins, 679 000 users	Global
2. Lindqvist et al 2011	Interviews + 2 surveys	Three phases: 6 (interviews) + 25 + 219 (surveys)	US, Canada
3. Cramer et al 2011	Interviews + surveys	20 (interviews) +47 (survey)	US, Sweden, The Netherlands
4. Pontes et al 2012	Foursquare dataset API	13,6 million users	Global
5. Vanconcelos et al 2012	Foursquare venue analysis API	Data from 1,6 million venues	Global
6. Qu & Zhang, 2013	User generated mobile data involving check-ins	31.5 millions check-ins, 1 million users	US
7. Long et al 2013	Check-ins analysis	104 887 check-ins from 8746 respondents	Pittsburgh
FOURSQUARE + INSTAGRAM 8. Silva et al, 2013	Twitter shares	9,1 million check-ins, 3 million photos	New York, Sao Paolo, Tokyo
FACEBOOK PLACES 9. Chang & Sun 2011	Check-in and POI data	N/A	San Francisco
LOCACCINO 10. Wagner, 2010	Training + questionnaire + semistructured discussion	15 participants	University of Madeira
MULTIPLE 11. Cheng et al, 2011	Check-ins/ Twitter	22 million check-ins, 225 098 users	Global
SPORTS TRACKER 12. Ahtinen et al 2008	Interview and questionnaire	28 users	Finland

TABLE 7 Study's Activity Patterns, Motivations for Sharing Location & Privacy Concerns Part 1

FOURSQUARE	**ACTIVITY PATTERNS**	**MOTIVATIONS FOR SHARING LOCATION**	**PRIVACY CONCERNS**
1. Noulas et al 2011	Check-ins highest on weekdays in the morning, lunchtime, and evening; 20% checkins occur within 1km, 60% between 1km and 10km and 5% at over 100km since motion between longer distances takes more time	N/A	N/A
2. Lindqvist et al 2011	Most users are checking in to bars, restaurants, and work. Home and school aren't checked in to so many times	Sharing location with friends, getting discounts and discovering new places; Earning badges and competing with friends on points; meeting new people	Some users had self-representation issues making them not want to check in; spamming issues, and safety concerns; most do not post their check-ins to Facecbook to avoid spamming
3. Cramer et al 2011	N/A	Sharing information with friends such as events and presenting one's self; Also used for coordinating for meeting friends	Most users don't add people they don't know in real life on Foursquare; Some users have made check-ins private only as a means for a personal achievement or a bookmark for themselves
4. Pontes et al 2012	More activity is shown in larger cities than in smaller ones	N/A	Based on user's activity of checking-in, tips, and completing lists of places of where to go, figuring out the user's home location has a high probability.
5. Vanconcelos et al 2012	Venues which have lots of tips and reviews attend to attract more visibility; Venues in Food, Arts and Entertainment and Travel and Transport categories tend to get the most amount of tips; Users who add more tips for venues tend to spread them across different places	N/A	Spamming
6. Qu & Zhang, 2013	Grocery/Supermarkets, Restaurants, Coffee Shops are popular check-in venues, and places such as a Hospital, Gastropub or Ramen Noodle House (niche venues) are less common	Coordinating with friends or presenting one's self	N/A

TABLE 8 Study's Activity Patterns, Motivations for Sharing Location & Privacy Concerns Part 2

	ACTIVITY PATTERNS	MOTIVATIONS FOR SHARING LOCATION	PRIVACY CONCERNS
FOURSQUARE 7. Long et al, 2013	Food, Shop & Services categories along with professional & other places, shop & service, and travel & transport are the most common types of venues to check-in; When visiting as a traveler to a foreign city, sports, higher education, and hotel and transportation venues have the highest amount of check-ins	N/A	N/A
FOURSQUARE + INSTAGRAM 8. Silva et al, 2013	Check-ins within cities tend to be higher than outside cities; Foursquare datasets varied more than Instagram ones which could have to do with cultural traditions; Foursquare is found to better express typical routes of people inside cities than Instagram; Instagram is shown to capture particular signatures of cultural behaviors moreso than Foursquare	N/A	N/A
FACEBOOK PLACES 9. Chang & Sun 2011	Most users check in to the same venue repeatedly over time; Age plays a major factor in checking in; Time of day or day of the week have no significance on checking in; Users who check in to the same place are more likely to be friends with each other	N/A	N/A
LOCACCINO 10. Wagner, 2010	N/A	Sharing locations are associated with actions	Most users have no problems sharing their location with family, friends or co-workers, but sharing their location with strangers; When sharing others' locations, users are much more cautious
MULTIPLE 11. Cheng et al, 2011	Most popular check-in venues are restaurants, coffee shops, airports, stores, and places that reflect the user's daily activities; Major check-in times were at 9am, 12pm, and 6pm; Cities can differ on when users check-in, possibly due to cultural differences	N/A	N/A
12. SPORTS TRACKER Ahtinen et al 2008	The app was used mostly with biking, running, walking, and hiking and skiing.	Following up on their own workout and sharing it with others to gain motivation	N/A

3.2.1 Activity Patterns – Similarities and Differences

It is shown through these studies that there are three main themes regarding activity patterns when using LBSNs. One of the activity pattern's main themes found throughout these studies is the types of venues that are most popular among users. These include restaurants, bars, various shops, and arts and entertainment venues (Lindqvist et al., 2011; Vasconcelos et al., 2012; Long, Jin & Joshi, 2013; Cheng et al., 2011). This could be explained as a result of users going to places where they could meet their friends and this would be a good way to let them know where they are. Additionally, these types of venues are places that are specifically chosen by the user, so it can also be a good way to see like-minded people who are there as well and possibly form new friendships. It should be noted that these types of venues are frequently checked-in by people living in these cities or towns where it is located. When a visitor is involved, the categories vary a bit as travel and transport destinations along with hotels are more frequently checked in to. Sports venues and higher educational venues are also places most commonly visited when a user is a visitor to a city or town. Regarding where users check in the least, it shows that places such as the user's home, a doctor's office or hospital, or niche venues such as a ramen noodle house are common places. This is a result of not only user's concerned about their privacy (i.e. home), but also embarassment (doctor's office or hospital).

The second main theme found in these studies is the time of day when users are checking-in. When discussed in the studies, the times of day that showed the highest peaks of activity when checking-in were morning (anywhere from 7am-9am), noon (12pm), and evening (6pm-8pm)(Cheng et al., 2011; Noulas et al., 2011). These times of day are highest as it is when people are commuting to work in the morning, eating lunch, and going shopping, eating, or home in the evenings. It should be noted that these findings were with the Foursquare application. When this was studied in the Facebook Places research, it showed that time of day played little to no significance in activity peaks of check-ins (Chang & Sun, 2011). One reason this could be the case is because Foursquare is a stand-alone app used purely for checking-in (at the times of the studies), while Facebook Places is part of the Facebook app and website, where there are more uses than just sharing location.

The third main theme found is that higher peaks of activity are found to be in large cities rather than smaller towns and rural areas, as shown by the studies of Pontes et al. (2012) and Silva et al. (2013). This can infer there are more people in cities and as a result will be more likely to be utilizing these types of apps since there are more venues to check in for the user. It should be noted however that some cities around the world differ on when users check-in, which can be attributed to cultural differences.

Regarding differences in activity patterns throughout these studies, they mostly have to do with the type of app itself. For example, in Silva et al.'s (2013) study with Foursquare and Instagram, it was shown that Foursquare tends to track routes of users better than Instagram because the main point of Foursquare is to check-in to venues whereas Instagram uses location as a more

secondary feature. This statement can also be attributed to the Sports Tracker study, since that uses location to track movements of exercise, and not so much a typical route of the user's daily activities (Ahtinen et al., 2008). This can also hold true to motivations for sharing location, which will be discussed in the next section.

3.2.2 Motivations for Sharing Location

As with the activity patterns, there are also some common main themes regarding users' motivation for sharing location when using LBSN applications as demonstrated by the studies of Lindqvist et al. (2011), Cramer, Rost and Holmquist (2011), Qu and Zhang (2013), and Chang and Sun (2011). One of the main motivations for a user to share their location is to showcase it to their friends. Delving deeper into this, it is a way for friends to coordinate with each other while trying to meet. It makes it convenient for them to find each other since it offers a map of where that particular venue is located.

Another common main theme is that using LBSN applications can be used to present one's self (Qu & Zhang, 2013; Cramer, Rost & Holmquist, 2011). For example, if a user shares their location at a fancy restaurant or club on the Foursquare app and posts that on Facebook or Twitter, this can highlight what they are doing and what kinds of places that user goes in a positive light.

Just like the activity patterns however, there are more specific motivations because of the type of app. With the Foursquare study from Lindqvist et. al (2011), not only did users want to coordinate with friends, but they also used the app to meet new people, compete against each other with points, and discover new places. It's also interesting to note that in the study by Cramer et al. (2011), they found with Foursquare that motivations for checking in went beyond the purpose-driven and social-driven sharing to performative aspects and audience management. They also found that checking in could be intended as a personal support to the venue or as a personal bookmark not intended for the audience. Also playful, expressive factors were found like playful naming of the venues or fantasy venues. Many of these factors can co-exist in the motivations, norms and conflicts behind whether to check in or not. Location sharing seems to be also a social negotiation with whom you are sharing with (Cramer, Rost, & Holmquist, 2011).

Lastly, the Sports Tracker app is used to share not so much their location with others, but their workouts and to look at other users' workouts to help gain motivation for themselves (Ahtinen et al., 2008).

3.2.3 Privacy Concerns

The studies from Lindqvist et. al (2011), Cramer, Rost and Holmquist (2011), Pontes et al. (2012), Vasconcelos et al. (2012), and Wagner et al. (2010) that delved into privacy issues looked at different aspects of privacy when sharing one's location. However, the one common main theme found was that users do not like to share their location with strangers. This infers that even though users

enjoy sharing with family, friends, and even co-workers and other acquaintances, privacy and safety are something that a majority of users still want to have when using LBSN applications.

These studies found some other interesting results as well. The Pontes et al. (2012) study which looked the user's activity of checking in and leaving tips on the Foursquare app and trying to infer the user's home location from those activities had a high probability of doing so. This can be a cause of concern for the minority of users who use LBSN applications to meet new people as they could be able to locate that user's home. That's why it is important to be cautious of strangers met through these types of applications.

Spamming is also seen as a cause of concern for users when using LBSN applications, as demonstrated by the Lindqvist et al. (2011) and Vasconcelos et al. (2012) studies. Users are generally concerned over annoying their friends via social media websites by posting their check-ins and tend to avoid it. For users of social media who don't use LBSN applications, it would be best suited for users who do to avoid posting their location via these platforms and to stick to the application where their friends are also using it. Additionally, posting ones location via social media websites can also be a cause of concern for safety as users generally have more acquaintances or strangers as friends on these websites and sharing location may compromise that user's safety as a result.

Lastly, a study from Page, Kobsa, and Knijnenburg (2012) which was not formally analyzed in section 3.1 includes interesting information regarding privacy concerns. It discusses that concerns about sharing location are symptoms of desire for boundary preservation. They found a hierarchial relation between lower-level privacy concerns and the high-level desire for bounday preservation. In the first phase of the study they had interviewed 21 users and nonusers of location sharing technology (Google Latitude in this case) on the source of their concerns. It is not explained in the study how the users were proportioned. In the second phase of the study, a nation-wide online survey was conducted, which confirmed the results of the earlier study. They collected 2039 responses to the survey. They explain that boundary preservation as people being concerned if location-sharing technologies will change their off-line relationship boundaries with others (Page, Kobsa & Kniijnburg, 2012). It is quite possible that location sharing technologies and applications can change the user's relationship with other people. For example, one may not want even their friends to know where they are at all times, and applications such as Swarm are allowing users to see what neighborhood their friends are in even if they are not checked in somewhere. It should be noted that this feature can be turned off (only for all users, not selectively), but one may not always remember to do so.

This chapter looked in to an overview of 12 different studies on LBSN applications and an analyses concerning activity patterns similarities and differences, motivations for sharing location, and privacy concerns. It is found that there are common main themes found in each of the studies on, with some differentiations which was a result of the context of the study or the different nature of the application. The next chapter will discuss the limitations of these studies along with implications for possible future research.

4 DISCUSSION

This chapter is a discussion which comprises of a section on the limitations of the studies which were obtained for this thesis along with implications for possible future research as well as a section discussing the future trends for LBSN applications.

4.1 Discussion of Research – Limitations and Future Research

When comparing the studies, it is good to acknowledge the differences between the research methodology. It can be noted that the research methods summarised here vary from interviews and surveys to studies dealing with analyzing user databases (i.e. Foursquare API) and posts on Foursquare check-ins via Twitter. Both quantitative and qualitative research methods have been applied in some studies comprising of different phases (i.e. Lindqvist et al., 2011). It also needs to be noted that eight of the user studies reviewed involved Foursquare, one involved Facebook Places, one involved Locaccino, and one involved multiple applications. Additionally, only one user study was found on Sports Tracker. Therefore the results of this study are more biased to Foursquare and other Social apps, rather than Sports apps. Research methods on eight of the reviewed studies were studies on the database of the check-ins or utilizing Twitter posts in their analysis, whereas only four of the reviewed studies were user studies involving interviews and surveys. Regarding the sample sizes, the sample sizes of qualitative data (such as interviews) are quite small, ranging from six to 28 users (Lindqvist et al., 2011; Cramer et al., 2011; Wagner et al., 2010; Ahtinen et al., 2008). Regarding analyzing the user databases, it should be noted that not all data is publicly available, so some researchers have studied the Twitter shares associated with the check-ins (i.e. Noulas et al., 2011, Silva et al., 2013, Cheng et al., 2011). Not all users use the Twitter though, so this could be the limitation to the generalizability of the findings in those studies. The user studies analysing the databases are big in sample size which have up to 31.5 million checkins and one million users over the course three to ten months. Regarding the area of the summarized studies,

the user studies with interviews and surveys were made in the USA and Europe, where as most of the studies analyzing the whole database were globally oriented. It can also noted that the results of the studies with interviews and surveys could therefore be more biased to Western culture, and the generalizability to the global user behaviour is limited. It would be interesting to study in the future if the user behaviour varies in different cultures.

It is also interesting to see that the user studies with interviews and surveys were cross-sectional in their study design, providing a snapshot of user behaviour at a specific point in time. It would be interesting to apply longitudinal design over the years to study if people continue using location-based applications and what the factors are behind this. The motivations for stopping to use the applications would be also beneficial to study in more detail to design a better user experience. In a study by Lindqvist et al. (2011) users were classified to new-comers and long-term users. It was shown that most usage was shown during the first 200-300 days of downloading Foursquare and then the usage declines (Lindqvist et al., 2011). Also opinions of non-users could be studied to understand more the phenomenon of location-based social media usage and non-usage. Finally, in sports applications, the motivations for checking in can be suggested to be more related to keeping a log of one´s own performance, than sharing it with others. According to the study of Sports Tracker, sharing data was not perceived as valuable (Ahtinen et al., 2008).

It would be interesting to study to see if gender plays more of a role in who uses LBSN applications. The studies presented with this information didn't really look in to this matter. It could however be possible that it plays no role at all, or then depends on the type of application being used. In the case of Foursquare, which were a majority of the studies looked at in this research, it would seem that at least for that app it doesn't play much of a role. Another interesting thing to look for developing this research at would be how social media usage comes in to play. As of January 2014, nearly 74% of all Internet users are on social media and it would be fascinating to see how many use LBSN applications (Pew Research Center's Internet & American Life Project, 2014).

Another matter that could be looked into for future research could be to compare different age groups and see what kind of affect it has on LBSN application usage. It could be inferred that younger age groups (18-25) would be most likely inclined to use them, however older crowds can also find uses for these applications depending on the type. For example, a health related LBSN application like Sports Tracker could easily be used for all ages. Also, future research could also include looking at how different personality traits correlate with the use of LBSN applications. Lastly, it would also be interesting to see how iPhone and Android users differ in behavior with the use of these types of apps.

4.2 Current and Future Trends for LBSN Applications

With the discussion of the research's limitations and possibilities for further developing the research, it is also interesting to see how the current trends are evolving to what LBSN applications could become in the future. One example is the health and fitness location-based applications. As sensors such as heart rate monitors and activity bracelets are being paired with these types of applications currently to keep track of heart rate and movement respectively, more types of sensors could be getting developed to further track and monitor one's health. It will be interesting to see how these will cooperate with apps developed in this sector.

Another example are location-based applications that work based on the vicinity of the user, such as Tinder and Groupon. Since these use location to find a potential mate closeby or a great deal, it would be fascinating to see how this develops. Perhaps more services which use one's vicinity could be developed such as alerting a user when their favorite type of food is on special nearby or if a particular bar closeby has that user's favorite song playing in order to go in and grab a quick pint. As a result, this has much potential for businesses being able to market themselves on a much more personal level.

Although Google Latitude shut down in 2013 (Epstein, 2013), when it was active it automatically tracked the user's movements and tied them to premade locations in their database, often getting the place wrong. As location-based technology improves, this could be something to bring back to more LBSN applications as it would eliminate the need to check-in manually. Of course, this brings privacy concerns in to account as the user may not want to share each place they are at.

This chapter looks at a discussion of the research studied and discusses its limitations as well as implications for future research. It is found that the limitations include the sample size of some of the user studies, as well as the bias of where the studies took place as they are quite similar. Additionally, a bias can also be seen as half of the user studies involve the Foursquare application alone. Implications for future research could include looking at if gender plays a role in the use of LBSN applications, as well as different age groups and how much of a correlation between the amount of people who use social media and how many use LBSN applications exist, and how usage could correlate with different users' personality traits. Finally, the chapter looks at some of the current trends for LBSN applications and where they could possibly go in the future. The next chapter will have the main points of the thesis summarized.

5 CONCLUSIONS

The popularity of location-based social networking applications can be suggested to be rising with the virtualization of everyday life. Therefore, it is crucial to study the many aspects of user behavior of LBSNs to develop better user experiences, versatile services and to acknowledge the privacy issues associated with the use of these applications. User research on LBSNs could also look in to the perspective of businesses and how they can utilize their marketing or segmentation strategies and practices. Also, the data of user mobility can be utilized in urban design.

As a conclusion this thesis provided an overview of a selection of recent user studies in the growing field of LBSN applications and how they are used. It looked to answer the main research question of how LBSN applications are being used along with five subquestions which were to answer the types of activity patterns that occur, motivations for sharing location, what privacy concerns can occur, current trends from showing some of the main applications, and future trends of these types of applications. The main findings found a number of common themes in which LBSN applications are used in regards to activity patterns, motivations for sharing location, and privacy concerns. For activity patterns, these common themes include the types of venues that users check-in to are quite similar. These include restaurants, bars, various shops, and arts and entertainment venues. Additionally, the times of day that users check-in are shown to happen in the early morning, lunchtime, and early evening. Check-ins also happen to occur more in large, urban areas as opposed to rural areas. Motivations for sharing location also share common themes which include wanting to showcase their location to their friends in addition to wanting to present one's self. Lastly, with the privacy concerns the common main theme found is that users don't like sharing their location with strangers.

However, there were found to be some limitations of the research. The user studies were very Foursquare biased as eight of the 12 user studies involved the application as there were not many user studies on other types of applications. Additionally, not all data was publicly available for a majority of the studies so other methods such as Twitter shares had to be used instead of the API itself. The studies also had a very Western culture bias which may have impacted the findings. Regarding implications for future research, looking in to

gender roles, comparing different age groups, correlating between social media usage and LBSN application usage, and also correlating between LBSN application usage and users of iPhone and Android all could be interesting to study.

Lastly, looking at current trends such as the check-in of a venue manually from the user could evolve in to automatic check-ins, although privacy concerns will stem from that. And with looking at the future, more services that use one's vicinity could be utilized further for businesses to market themselves. The health sector can also benefit from these types of apps further in to the future as more sensors are developed to interact with an application to monitor one's health and overall fitness.

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