

# Everything Has Its Price: Privacy Concerns and Rewards for Using Mobile Location Services

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## ABSTRACT

Mobile location information is strongly desired by application developers and marketers but fiercely protected by users. Developers and marketers want location information in order to deliver tailored information, but consumers are not willing to share their location without compelling rewards. Our goal is to determine what makes people relinquish location and other personal information knowing that their information may be sold for marketing purposes. We looked at users' willingness to share location information when given rewards such as coupons and free applications. Since the usage of smartphones and user's privacy concerns may vary by age, gender, and level of education, we also analyzed how demographics impact people's decisions to share their location. We surveyed 51 people across a variety of demographic groups to determine specific rewards they would need to share their location information with an application. Application developers and advertisers will find that though users are willing to share this location information for a price, that price may be too high.

**Keywords: mobile devices, privacy, location sharing, location services**

## INTRODUCTION

As smartphone sales rapidly increase, application developers have strived to build mobile applications which are powerful, intuitive, and profitable. One of the newest and fastest growing areas in mobile application development is location-based applications. Through the use of global positioning systems (GPS), Wi-Fi, and cellular tower information, smartphones are able to share their location with applications. Location-based applications can provide driving directions (Google Maps), find nearby restaurants (Yelp), or “check in” at businesses (Foursquare). Location-based services are at the heart of the strongest trends in software – mobile, local, and social applications. Though software developers, investors, and advertisers are rushing to build location-based applications, consumers may not want to use them. Multiple studies have found the majority of smartphone users do not want to share their location. A 2012 survey by TrustE found only 9% of users want to share their precise location (TrustE, 2012) and a 2011 survey by Microsoft found 52% of users had location-based information privacy concerns (Microsoft, 2011). Location-based services raise unique privacy concerns, such as giving your physical location to someone potentially dangerous, such as a stalker, so users are hesitant to share their location (Tsai et. al., 2010). Because of this hesitation, application developers need to provide clear and compelling rewards for users to share their location.

Most studies on location information focus on user adoption, privacy, and policy. An application developer, marketing manager, or product developer looking for research on location-based applications can find information on privacy and policy hurdles, but not how to overcome them. A location-based application without a clear and compelling reward for users could find that 90% of users will not use their application (TrustE, 2012). Businesses developing mobile applications which require location information will need to determine what unique feature or reward is necessary to overcome the user’s strong privacy concerns. Our research provides clear examples of what consumers require for sharing their location with an application. Smartphone users value their privacy, but they also value functionality, convenience, and discounts on goods and services (Larose and Rifon, 2007). For an application to gain a critical mass of users sharing their location, and the large profits that application could generate, location-based applications must provide significant rewards.

In this paper, we first review relevant literature on mobile location privacy and the tradeoffs people make between application functionality and privacy. Second, we discuss our research design, and third we discuss our results. Finally, we draw conclusions and provide future directions for research.

## LITERATURE REVIEW

Though mobile location-based services are a new technology, there is extensive research on the topic. Two heavily researched areas are location information privacy and rewards for location sharing. Location-based applications can attract users with rewards in return for users sharing their data, but users may feel uncomfortable disclosing this information if it will not be kept anonymous and will be sold to marketers.

### *Consumers Mobile Location Privacy Concerns*

A 2012 survey by TrustE discovered users are more concerned about mobile location privacy than most other types of private information. They found that 49% of users will share their gender with an application and 36% of users will share their email, but only 9% will share their precise location. In a survey from ISACA (2012), the top location-based privacy concerns were: strangers knowing too much about their activities (24%), information being shared for marketing purposes (24%), and personal safety (21%).

With the growing use of mobile devices, two prominent fears have arisen around mobile location privacy.

1. Companies are able to determine other information associated with an individual such as where a person has traveled, where they live, socioeconomic status, and religious affiliation;
2. Users are afraid that the government and other organizations are able to track their location via GPS on mobile devices.

Data gathered from location tracking can be analyzed for a deeper understanding of a person than typical demographic information. For instance, by gathering data on the location of one's home, companies can deduce information about their neighborhood, average mortgage prices, socioeconomic status, and other demographic information (Wicker, 2012). If companies are not careful with location-based information, consumers will not use their application out of concern for information leakage and sale of their private location data. Users that do not trust a company with their location information will almost certainly not utilize their location-based application (Zhou, 2012).

In the United States, because of growing concerns over location-based information privacy, two senators proposed the Geolocation Privacy and Surveillance (GPS) Act to protect location data. The act mandates that police must obtain a warrant before acquiring the location data of a United States citizen, except in cases of emergency, national security, theft, or fraud (Gowdy and Chaffetz, 2012). Tracking location data could reveal religious or political organization affiliation; therefore, GPS surveillance without a warrant would violate the First Amendment right of "freedom to associate and privacy in one's associations." (Wainscott, 2009)

In contrast, the European Union (EU) implemented location data privacy controls in 2002. The EU Directive on Privacy and Electronic Communications requires companies in all EU states to obtain consent before collecting or using customer location data (Mumford, 2010). The directive also requires stored data to be kept anonymous or kept only for the duration necessary for the provision of a value added service.

### *Rewards for Sharing Private Information*

When a consumer makes an online purchase, visits a social network site, or uses a GPS, they relinquish some personal information. Though consumers are concerned about their privacy, they will share personal information for a variety of reasons. Three reasons individuals share their private information are:

1. They want to join an online community;
2. They are unaware how their private information will be used;
3. They will receive discounts or rewards.

Users divulge personal information to join online communities. The term “community” relates to a group of people that value the importance of their members’ feeling of belonging, the affective ties and mutual support among the members, and the common culture they share (Cărtărescu, 2010). Cărtărescu states that online communities are in fact actual communities, because their members share a sense of belonging, have a specific culture, a specific set of norms, affective ties that bind them together, and a sense of shared history. Therefore, by surrendering personal information when visiting websites or using mobile applications, users earn the feeling of belonging to a community.

Some users share private information because they are unaware of how their information will be used. Larose and Rifon (2007) found 80% of Internet users rarely read privacy policies and fewer than 5% always read them. Even if users do read privacy policies, consumers lack knowledge of how their personal information will be used. Sovern (2000) discovered that the complexity of privacy policies makes it difficult for users to decide if they should continue using certain websites and applications. Sovern also found that a third of Internet users have difficulty understanding websites privacy statements and two-fifths refuse to read them. For example, Netflix’s (2013) privacy policy is over 2,900 words and has a Flesh-Kincaid reading grade level score of 17. With a Flesh-Kincaid score of 17, only a college graduate is likely to understand Netflix’s privacy policy.

While a few users may accidentally share personal information, the vast majority exchange private information to receive something in return. According to Larose and Rifon (2007), Internet users willingly divulge personal information to obtain “free” information, personalized content, prizes, or some other form of “fair exchange.” For example, a user may create an account on a website and opt-in to

receive a company's newsletter to get coupons. Loyalty cards have also been used by consumers for many years to exchange their demographics and purchasing data for modest rewards. Rowley (2004) found 85% of households in the United Kingdom have at least one loyalty card, and with these cards consumers give "implicit permission to use data to enhance business success and profitability".

Mobile phone users take into account these three reasons for sharing private information when utilizing location based applications. Many mobile phone users do not know how their location information will be used because they do not read the terms and conditions, as stated above. However, the other two reasons, to be a part of a community or to receive a reward, are thoughtfully considered when users utilize location based applications.

Navigation applications are a popular type location based application that supplies a fair exchange for a user's location information. Networks in Motion, a mobile navigation location based service, surpassed two million users of its navigation and local search services in 2007. The benefit to consumers is the voice-prompted turn-by-turn directions that will give an alternate route if a turn is missed. The local search option offers 14 million points of interest. The benefit of using the navigation application is so strong for consumers, that they are willing to exchange even more than just their location information to utilize it. The cost of this application ranges from \$2.99 a day to \$9.99 a month for usage (Anonymous, 2007).

Location based services that allow users to "check-in" at various places on social media sites are another popular type of service. The number of check-ins on Foursquare grew 3400% in 2010 alone and surpassed six million users (Shields, 2011). The benefits of utilizing this type of location based service can include "accessing deals, discovering new places that [friends] are visiting, and checking out reviews and recommendations" at locations such as restaurants (Mulvihill, 2012).

When users choose to share information, they "explicitly consider the trade-off between the merits of interaction and potential consequences" (Hann et. al., 2007). Hann et al. found that for American users, a website offering a \$20 reward had an 18% greater likelihood of having users share their personal information than a site offering a \$5 reward. Their study found that small monetary rewards caused a large increase in information sharing, but as the reward was significantly increased there was a significant decrease in additional sharing. Danezis et. al. (2005) had students enter a "compensation auction" to determine the amount of money required for their phone's location to be tracked twenty-four hours a day for four weeks. They found if the information was to be used for academic reasons the mean required compensation was £27 (51 USD) and if it was used for commercial reasons the mean was £33 (61 USD). Cvrcek et. al. (2006) expanded the previous study to over one thousand students throughout Europe. They found for non-commercial uses the majority of students would share their location every 5 minutes for €30 (36 USD).

### *Demographics and Online Privacy*

Gender, age, and education could all play a role in determining whether a consumer will share their location with an application.

Multiple studies on gender and online privacy have found women are more concerned about privacy than men. Youn and Hall (2007), Chai et. al. (2011), and Kuo et. al. (2007) found women were less likely than men to share private information online. In a study of European students, Cvrcek et. al. (2006) found women required a 40% higher reward than men to use their mobile location for commercial reasons. Because women value their online privacy more than men, they should be less likely to share their mobile location. However women are also more likely than men to be interested in free gifts and discounts. “56 percent of female respondents to a 2013 survey said they would pay more attention to ... brands with coupons or gift vouchers [over brands without such rewards], but only 45 percent male respondents would do this.” (Anonymous, 2013) Aharoni (2007) also found that women preferred discounts more than men. Aharoni found that 52% of women were pleased when their credit card reward program switched from points-based to discounts at various stores versus only 39% of men despite points being able to be spent on any item or to get cash back versus a store discount that would require the consumer to spend their own money on items in order to redeem the reward.

Joinson et. al. (2010) and the Lares Institute (2010) found a positive correlation between age and a concern with online privacy. In the study, age had the strongest demographic correlation with privacy sensitivity. Older users were consistently found to be more concerned with online privacy than younger users. Zukowski and Brown (2007) studied Internet users' privacy concerns and found a correlation between age and an increasing awareness of privacy practices, a desire for more control over their private data, and a higher degree of concern about how individual data is used.

Studies have found education is inversely related to privacy protection. O'Neil (2001) found a small decrease in privacy concerns as education level increased. Turow et. al. (2008) found a correlation between a higher level of education and a better understanding of privacy rules. They wrote that education provided consumers with tools and skills to develop and understand sophisticated knowledge frameworks. As a person obtains more education, they have a better understanding of how information will be used and are more comfortable with how sites will use it. Zukowski and Brown (2007) found education was correlated with a decrease in concern about how data is collected and analyzed. In their study, more educated users saw a decreased risk in how data is gathered and an increased benefit from how that data is used. Another study done by Albrecht (2006) found that higher levels of education corresponded to higher levels of knowledge about data collection. In a study on shopping loyalty cards

and data collection, Albrecht found that of shoppers that had not completed high school, none knew that the cards were being used to collect shopping data which reinforces that more education provides a deeper understanding of how private information will be used by those collecting data.

### **Research Questions**

We have addressed the following research questions throughout this paper.

*With what types of applications are users most likely to share location?*

Applications that are resourceful for the user should yield more users and thus yield more location information. What is considered resourceful will vary depending on the individual consumer's needs. Resourceful applications could involve maps, directions, social network sites, music or games. We feel that the applications involving maps and directions will be considered more resourceful for the consumer and thus it is more likely that they will divulge their location information with these applications.

*Do demographics affect a user's willingness to share his/her location?*

We hypothesize that a person's age, gender and level of education will impact how he/she responds to our survey questions. For instance, we believe that those that are younger and/or have a lower level of education will be the most likely to share their location information regardless of the reward. Previous studies have shown that younger people are less concerned with privacy. Those that are more highly educated were found to better understand privacy policies. As a result, they are more aware of how their information will be used. We feel that even though the previous research suggests that those that are more highly educated will be more likely to share their private information, the opposite will be true since they better understand privacy policies and the ways their information may be used or sold. We also feel that women will be less likely to share their location than men, but women will be more easily influenced by the rewards offered as shown by the previous research done in this area.

*How do rewards affect a person's willingness to share their location?*

Smartphone and mobile phone users will likely give up their location for rewards, where a reward can be defined as ranging from a free application to discounts at a retailer. We believe that people will surrender location information to mobile application developers and web site owners who offer rewards that best fit their individual needs.

### **Experimental Design**

To determine rewards required to access location information, we constructed a survey instrument. To understand a smartphone user's previous experiences, we asked about the types of applications they use, how often they read the application's terms and conditions, and about their concern about their location information. Background information is important to determine a baseline level of how likely a user is to share his or her information with a mobile application. After gathering background information, the remaining questions asked the types of rewards the respondent would need to disclose their location information. The rewards range from application functionality, to discounts from a retailer, to free clothing. This will determine what rewards application developers will need to provide in order for smartphone users to share their locations with an application.

The survey was completed by a random sampling of participants with a response rate of fifty-one respondents from the region of central Connecticut. We feel that the sampling of participants represents a broad cross-section of mobile users and can be generalized to the population of mobile phone users in the United States. Out of our participants, nineteen were women, thirty-one were men, and one did not choose a gender. For highest level of completed education, sixteen responded with high school, eight with associate's degree, twenty-three with bachelor's degree, and two with master's degree or higher. For age, twenty-four were between eighteen and twenty-eight, twelve between twenty-nine and thirty-nine, four between forty and fifty, seven between fifty-one and sixty-one, and two respondents were over sixty-two. Every type of individual was recruited to join the study, even if they did not own a mobile phone with location services. Because the rewards were hypothetical, they were asked to consider if they would share their location for the specified reward had they owned a smartphone.

Questions on gender, age, and level of education were assessed with Pearson's correlation to determine whether demographics had an effect on reward behavior. For fifty-one respondents in a two-tailed test, the 90% significance value for Pearson's  $r$  is 0.231. Ten multiple choice questions were evaluated based on the percentage of responses given for each choice offered. Four questions used a Likert scale and were evaluated by calculating the mean of all of responses. All final results were also analyzed by demographic.

## EXPERIMENTAL RESULTS AND DISCUSSION

### *What types of applications are users most likely to share their location with?*

In our survey, 68% of respondents indicated they have shared their location with a mobile application. Though only 68% had shared their location, 75% of respondents indicated that they have allowed their phone to access their current location for directions. This shows a gap in understanding of how location-based applications function. Users may not know they are sharing their location with an application, when in reality their location is being shared by their usage of the application.

Besides navigation, other location-based uses of smartphones were as follows: 45% of respondents have used their phones to tag photos with their location, 37% have accessed coupons from a retailer using their location, and 32% have checked in at a location.

On a Likert scale of one (very unlikely) to five (very likely), respondents rated their average willingness to share their location with an application a 2.8. In general, users were neutral about sharing their location with an application, but were more likely to share their location than allowing access to contacts (1.5), access to the camera (1.9), and access to text messages (2.1). Overall, 42% of people claimed they were “somewhat concerned” about location privacy, while 18% were “very concerned” and 18% were not concerned at all. These results show that our respondents were not as hesitant to share their location as those in the TrustE (2011) survey, where 91% of users did not want to share their location. Our respondents were similar to the 2010 Microsoft survey which found 52% of people had mobile location privacy concerns. Without the context of the application and the usage of the data users were not automatically dismissive of location sharing.

Respondents were by far more likely to share their location with a navigation application (4.3). A news application was second (2.7) and least likely was a game application (1.7), see Figure 1. The reason why the application needed a user’s information was often seen as a major determining factor in a user sharing their location. When asked why they would not share their location with a news application, users commonly stated “I don’t want this information known” and it “seems unnecessary”. When asked why they would not share their location with a retail application, users said location was “not information [the retailer] needed to know” and “I don’t feel that a clothing store would need my location.” Respondents claimed that they were not interested in additional game content in exchange for sharing location information, but this result could be affected by the excitement of an actual game and the perceived need for extra content or features.

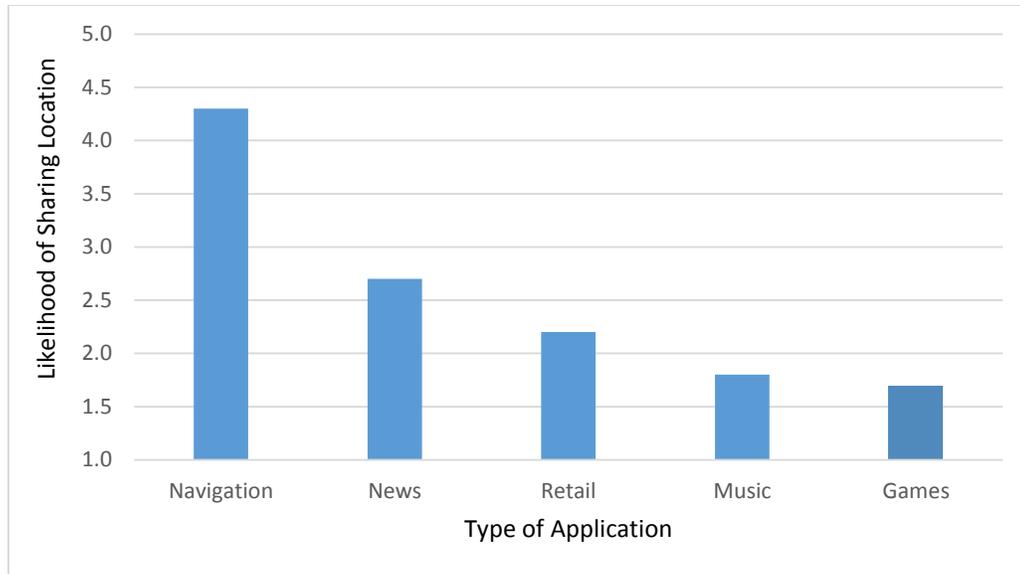


Figure 1. Likelihood of Sharing Location with a Specific Type of Application

Because users carefully consider the reasons necessary for sharing their locations, mobile developers should not add location features to every application they create. For example, gaming and news application developers would use up resources to develop a feature that users are unlikely to use. If the user cannot see a compelling reason for the application to use their location, most respondents indicated that they would be unlikely to choose to share their location. Conversely, if a compelling reason can be found, such as turn-by-turn directions for a navigation application, users are very likely to share their location. When choosing to devote time and money in developing a location-based feature, companies should carefully consider how users will interpret the request for their location.

*Do demographics affect a user's willingness to share their location?*

Overall, demographics played only a small role in determining whether a person would share their location. Age was found to negatively correlate with one's willingness to share location data. The younger the respondent was, the more likely they were to share their location with an application. Age was negatively correlated with both sharing data anonymously and with marketers. On every location sharing question, the older the user, the less likely they were to share their location ( $p$ -value < 0.0005), see Figure 2. Because many of our respondents are college students, individual questions for those older than 40 do not always follow a linear path downwards. We had only 4 respondents between the ages of 40 and 50, 7 between 51 and 61, and 2 older than 61. But, the overall trend of age negatively correlating with age was clear when using data for those over 40.

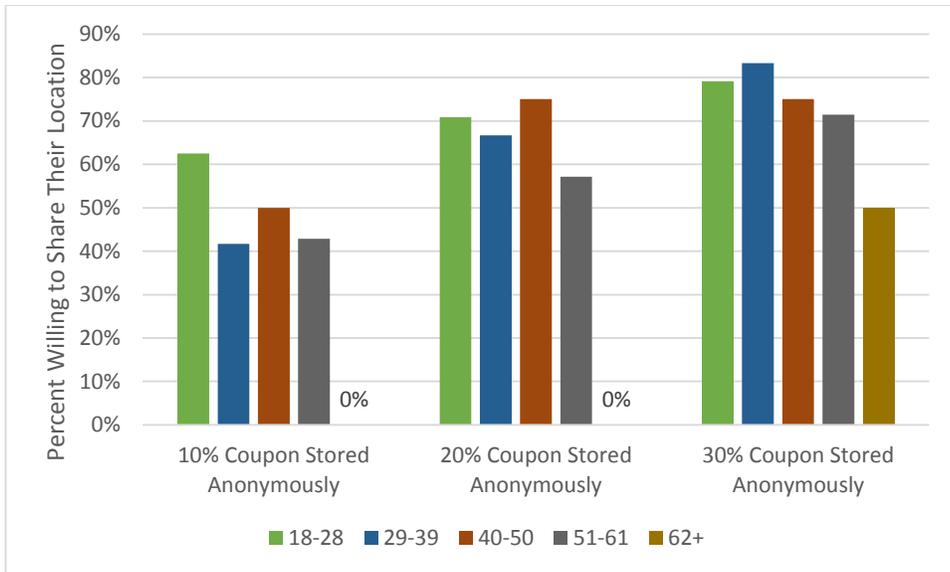


Figure 2. Percent Willing to Share Location Anonymously with a Restaurant by Age

Gender was found to have a complex effect on location sharing. Across all applications and for all levels of rewards, men were more likely to share their location with an application than women (72% versus 53%,  $p$ -value  $< 0.0005$ ). Women, however, were more likely to be swayed by coupons and discounts than men. For example, 84% of women would share their location for a 30% off restaurant coupon, even if it would be shared to marketers, while only 79% of men would do the same ( $p$ -value  $< 0.0005$ ), see Figure 3. If presented with a coupon or free item, women were slightly more likely to share their location. When not presented with a coupon and instead given game content or localized news, men were more likely than women to share their location.

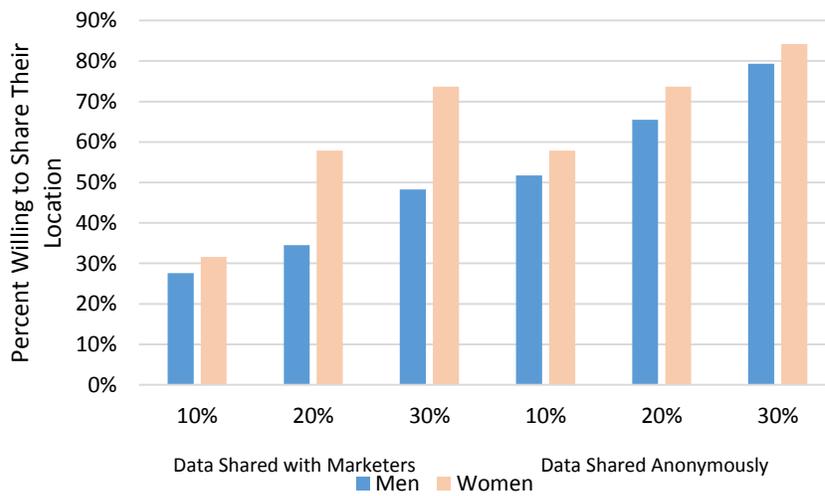


Figure 3. Percent Willing to Share Location Anonymously and with Marketers to a Restaurant by Gender

Level of education was not found to be correlated with willingness to share location information. Users with more education were not found to any more likely to share their location for a reward. Turow et. al. (2008) and Zukowski and Brown (2007) found increased education decreased privacy concerns, but their survey questions involved prior sophisticated knowledge. Our survey questions were intentionally written to require no prior knowledge and had simple language, so no sophisticated knowledge was required. When asked simple questions with yes and no answers, the price to access the location of highly educated users was the same as less educated users.

For a mobile application developer, demographics can play a role in determining whether a user will share their location. Older users are less likely to share their location, education had no impact, and women were less likely overall to share their location but more strongly swayed by rewards. The demographic correlations were slight, so application developers should not conclude that it will be either easier or harder to gather location information from any age, gender, or education group versus any other.

*How do rewards affect a person's willingness to share their location?*

Unsurprisingly, rewards have a significant effect in determining whether a person will share his or her location with an application. When an application offered the user a small reward, the vast majority of respondents did not want to share their location. Only 20% would share their location for extra game content and only 27% would share their location for personalized news. For information that would be shared with other users and marketers, 23% would share their location for a 10% off retail store coupon, 27% for a 10% off restaurant coupon, and 35% for 10% off a significant car repair bill.

As the reward was increased, more respondents would share their location. If a restaurant would share their information with marketers, 27% would share their location for a 10% off coupon, 41% for a 20% off coupon, 55% for a 30% off coupon, and 63% for a 50% off coupon. If that same information is shared anonymously, 51% would share for a 10% off coupon, 65% for a 20% coupon, and 76% for a 30% off coupon. If respondents chose not to share their location, they were asked if they would share their location anonymously for any restaurant coupon. Only two additional users said they would share their data anonymously even if they could name their own discount amount.

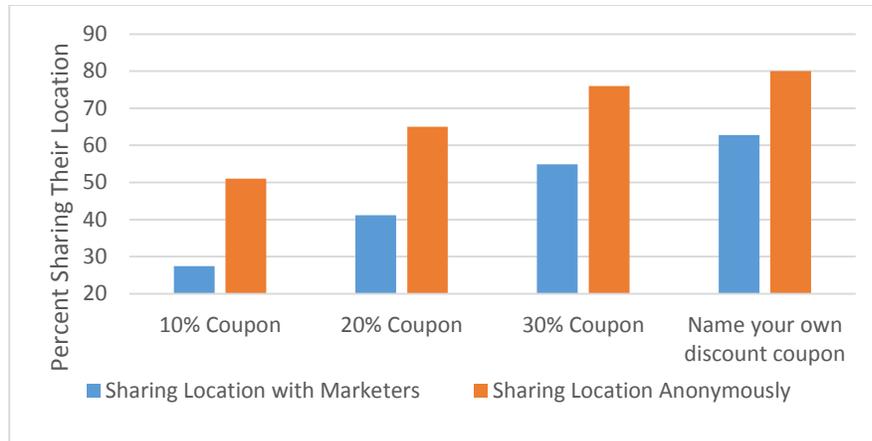


Figure 4. Percent of Users Sharing Their Location Anonymously and with Marketers for a restaurant coupon

The tangible benefit a user receives from sharing their location plays a significant factor in determining if they will share their location. For an application looking to gather a user's location and sell that information to marketers, the application needs to offer at least a 30% discount at a store. When users were told they would need a \$200 car repair and were offered a \$60 coupon to use an application to share their location, only 63% of users would share their location. Our findings showed a small percentage of the population that thought "[their] location is private," this data was "too personal," and it was "not worth it." Therefore, marketers looking to gather and analyze location data will have to determine whether or not it is necessary to attempt to attract this portion of the population by increasing the reward even though the majority of the population will share their location for a lesser reward.

How the information would be used strongly impacted whether a respondent would share their information or not. In our hypothetical restaurant example, 76% of respondents ultimately indicated they would share their information for a coupon as long as the data remained anonymous, see Figure 4. However, for the same example, if the data were to be shared with marketers, only 63% of respondents would share their data (Chart 3). For a retail store, 71% would anonymously share their location for a coupon versus only 45% that would share if the data would be given to marketers. For a restaurant and retail store, when data was guaranteed to be anonymous, an average of 24% more users agreed to share their location.

Respondents strongly considered how information would be used by the application. Because most users are hesitant to share their location, applications looking to use a person's location must include strong privacy protection. If data will not be shared or will remain anonymous, developers should clearly display that information to easily increase their user base. Anonymity and privacy protection are as valuable as doubling the reward to the user.

## CONCLUSION

Our survey found that applications that want users to share their location must have a clear and compelling reward for that information. Without any reward and no guarantee of privacy, at least 70% of users will not share their location with an application. Our respondents were strongly motivated to share their location for monetary rewards, but they also shared their location for unique features and privacy guarantees. An average of 24% more respondents would share their location when guaranteed that their data was private and anonymous. Many of our respondents had “checked-in” at a location or used a GPS, so they had previously freely shared their location with an application for a unique service. Our free response questions found users chose not to share their location because they did not find it necessary for the application.

Also, we found that though location data was highly protected, everything does have its price. If an application developer wanted to make an application that has no end-user benefit for gathering location data other than to sell it to marketers, most users would sell their location for \$45. This result compares similarly to Danezis et. al. (2005) who found the cost for commercial use for location information was \$61 and Cvrcek et. al (2006) who found it to be \$36. Because users place such a high price on their location information, application developers should find new and innovative ways to attract users into sharing their locations. The desirable solution would be for an application to attract as many young users as possible, as our findings showed that they are the most likely to share their locations. The benefit to the end users would be an application that enhances their mobile user experiences while offering the greatest reward. In return, the application developers will have vast amounts of location data to analyze. “Mobile, social, and local” applications are attracting a significant amount of interest from investors, but we found that almost all users do not want to automatically and always share their location. For gaming, music, retail, and news applications, our respondents indicated that they were “very unlikely” or “unlikely” to share their location. Users only had a strong desire to share their location with navigation applications. The challenge to developers is to design applications within these genres that will entice the end users into sharing their locations with a reward that is equally as beneficial to the end user as that of a navigation application.

However, application developers generally do not include location-based services primarily for the benefit of the end-user. Their purpose for including these services is to collect as much data about the user as possible for marketing purposes in order to learn what types of users most use their application. Through analyzing this information, they can better market their application towards the target demographics as well as invest in research on how to market their application towards non-target demographic users. Since our study showed that this data can be bought for a price, application

developers that wish to collect such information should determine how much of a reward they can afford to distribute that would still attract users to share their location information.

Our study showed that there is a direct correlation between rewards for the end-user of an application and their willingness to share their location data. Therefore, further research on the topic of rewards for location data could include a larger scale study, an experiment instead of a survey, or a study on consumer understanding of location-based privacy. Our study was small and localized, so a broader study could be done to see if our results translate on a larger and multi-national scale. In order to learn how rewards truly affect someone's decision to share their location with an application, researchers could conduct a study using actual rewards. By offering a reward to half of the users that download a particular application and utilize location-based services and no reward to the other half of users that download the same application, developers would be able to determine with certainty whether or not the reward makes any significant difference. Since our study showed a lack of consumer understanding about how applications can gather location data and how application developers and marketers can utilize this data, a study could be done to learn exactly how much the average consumer understands about this issue.

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