Open Transaction Network: Connecting Communities of Experience through Mobile Transactions

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Abstract. In order to understand the value of social information in the context of mobile commerce, we created the Open Transaction Network (OTN), a collaborative, social transaction system. OTN uses voluntarily contributed transactions to index personal and social experiences in the physical world and to form dynamic communities around purchases. We use mobile phones and Open Spaces as portals to facilitate sharing of transactions. Through real world deployment we investigate the design elements and analyze users' tolerance to sharing such experiences. The sociability threshold, introduced as a measure of user's willingness to share for different categories of products, is found to correlate with price. The system was deployed to over 20 users over a 5 month period to allow the participants to share their in-store purchases. The analysis of empirical data shows that second degree connections are valuable for obtaining recommendations.

Keywords: open information, social networks, transactions, mobile, commerce, advertising.

1 Introduction

As mobile phones become Internet- and transaction-enabled, how we consume (search, find, buy and use) products and services are changing in many dimensions. *Presale* behavior is changing as people begin to research products and services on demand, instead of waiting for an Internet connection. As we traverse through different locations, information on relevant products and services will be broadcast to us. Near *point of sale*, consumers will be able to compare the products in real time and contact their social network for opinions on their choices prior to their purchase. Cash registers may become obsolete as consumers pay immediately with their phones bypassing long lines at the register. After a purchase (*post sale*), people will be able to connect with communities of people who can be real-time resources to provide quality assessments to those considering a similar purchase; to seek out guidance and aid in troubleshooting; and to ask warranty related questions.

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We expect the same changes that have occured with the web to occur at a more rapid pace on mobile devices as the existing Internet infrastructure and services extend to the mobile space. The web has gone through three distinct periods of growth; as an information service (initial world wide web), a global transaction platform (electronic commerce), and now in large measure, a social space for sharing dynamic, real-time information and relationships with other people. Such combination of social space and transaction platform has naturally evolved into the mobile environment as smart phones and Internet-enabled devices become the hub of personal communications. Although there are anecdotal evidence accumulated from mobile advertising and SMS flash mobs regarding social-mobile purchase influence, we lack a quantitative system understanding of the effects of social networking in mobile commerce [13].

In this paper we present the Open Transaction Network as a system that provides a better understanding of people's purchase behaviors and the flow of information through mobile transactions. We investigate the design of a mobile, user contributory, social networked financial environment, that allows individuals to share their purchase behaviors with a community of consumers to collaboratively sense the activities and opinions of the market. The system can reveal the potential of passive information diffusion due to its socially networked nature and openness. We discuss its implications on mobile commerce as it may enable more informed financial decisions in geo-local contexts through friends and communities of similar people. We investigate people's willingness to share and the potential benefits and issues related to open transactions. We developed the system and deployed it for almost 5 months to over 20 users (14 female, 8 male) at a corporation where some of the users are known collegues.

The paper is organized as follows. The following section describes related work and the context for understanding financial data in a social milieu. The third section introduces the OTN design principles, system architecture, and user interface considerations. In the fourth section, we present the findings from field deployment and analysis of the collected data. The fifth section discusses the limitations of OTN in the current environment and its potential impacts on mobile advertising. In the final section, we conclude with design guidelines for social mobile commerce and future research directions.

2 Related Work

In the general area of mobile commerce, OTN touches several aspects of related research. OTN principles build upon many previous works on participatory sensing and mobile applications to commerce. Discussions on information revelation are insightful, since the data collected through OTN are through voluntary contributions. Mobile marketing as an application is also considered as well as the impacts of open transactions and social networks.

2.1 Participatory Sensing

Nowadays, data is constantly collected about our lives and activities as we traverse through this world. When we register for a driver's license, open a bank account, eat at a restaurant, fly on a plane and access web sites, we generate data about our activities. [12] describes the information asymmetry problem that creates externalities to data owners, as services that own the data make the data available to third parties while users themselves though possible, do not utilize much of their own data.

Recent literature on participatory sensing and in-situ sensing through mobile devices demonstrate how users can contribute content and data from mobile devices to allow other users and services to understand the environment and the users' behavioral patterns[8]. For example, digital footprinting through mobile phones can be used to track tourist traffic and their activities in different areas in Rome[9]. Mobile digital footprinting allows the city to know which areas are popular on what days of the week and what months of the year. It also allows the city to view where people from different nationalities visit. Such information enables local merchants to tailor their offerings to people of certain nationalities and manage their inventories accordingly.

2.2 Information Revelation

With digital mediation, we can capture the extent and the willingness of people to reveal themselves. Information revelation and self disclosure through computer mediation[15] describe how reciprocity is a key factor in users' revelation. Development of online social networks has led to emergent styles of openly sharing one's personal information for various social motivations: ease of connecting to new communities, exhibitionism through open content, and lightweight maintenance of social relationships. Ease of connecting with people online is shown through Facebook where 30% of people are willing to accept strangers as friends permitting their profiles to become open and visible[10].

People are willing to share their identity and preferences with online merchants when sites are able to provide personal incentives such as discounts for products and services[1]. Especially when there are needs and willingness to help others, people reveal themselves in online communities to provide a network of exchanges, self expression and answers[20] to questions. By diffusing such information through the devices we carry, we can facilitate opportunistic communications in-situ.

[17] indicates that one of the ways to build trust in a mobile transaction environment is to help build a community which allows members to exchange experiences and develop relationships. Contribution from all participants engaged in reciprocal communication forms the foundation of trusting relationship in the new social digital era.

2.3 Communities and Commerce Decisions

The theory of embedded markets[7] describes how purchase behavior is influenced by the social relations that are embedded in those transactions. The total return from the transactions increase or decrease the relationship strength between sellers and buyers depending on the satiation of the transaction. Data on these transactions can provide insights to these social relationships. Unfortunately, usually the seller maintains the history of these transactions with very fragile records (paper receipts or personal memory) maintained by the buyer. Amazon.com and Netflix has been successful in opening up transactions of people with similar purchase behaviors for collaborative filtering and provide users with recommendations during shopping online. More importantly, the lack of information on social relationships and people who made similar purchases make it difficult to understand the possible influences and social causes for the purchase. In the case of OTN like architecture, the open transactions and the social network of consumers can be used to investigate the horizontal embeddedness due to diffusion, gift exchanges or auctions that may bind consumers to each other.

In mobile commerce, numerous work has been done on providing people with just-in-time information for price comparisons, planning people's shopping routes and managing digital payments and coupons. [3] focuses on navigation and availability of products in shopping malls and delivering offers in proximity. Project Aura shows how tagging of the physical world items from the mobile can help acquire just-in-time information in mobile commerce settings[5]. The system had features to publicly share reviews and annotations with the public, but the effectiveness of such social information was not evaluated. [18] is an object annotation system that links physical objects in the retail environment with online content. It discusses the potential utility of extending it to social networks, but has not implemented it to investigate its implications of sharing. We extend these efforts to understand the design elements of incorporating social networks in mobile commerce contexts.

3 Open Transaction Network

Open Transaction Network (OTN) is a system built to investigate the design elements for incorporating social information into mobile commerce. In this section, we delineate the system architecture of OTN, its design principles, and user interface considerations.

3.1 Scenario

One Sunday morning, Jane, a flute instructor, and her friend John, a computer scientist, are driving to Jane's flute class and they notice that Jane's "check engine" light came on. John indicates that he has experienced the same phenomenon in one of his cars many times before and that it usually is not a serious

problem but something that she should get checked sooner than later just to be safe. He leaves a voice mail for his brother Mike, who used to work for a car manufacturer, to see if he has any suggestions. In the meantime, they find a local mechanic open. However, when they speak to the mechanic, he tells Jane she will need to leave the car overnight to perform the computerized diagnostic and that it will cost $91. Since Jane is unable to leave her car overnight and is concerned about the warning indicator, the mechanic suggests going to the nearby CarZone that can usually run the diagnostic in a few minutes and perform it for free. Jane and John thank the mechanic and head to CarZone. The CarZone associate performs the computerized diagnostic and the code provides two possible causes, either the water pump or the engine coolant temperature sensor. As the CarZone associate is explaining the causes, John gets a call from Mike. Based on the results of the test, Mike informs John that as long as the engine temperature is stable, it can wait a few days. With this information Jane is comforted and decides to take her car back to the mechanic on Monday.

Throughout this interchange, a large amount of distributed embedded knowledge is shared and discovered by the actors, both friends and experts, to objectively assess the problem. OTN is an attempt to alleviate such situations by allowing users to search their social network for purchase experiences. In this case, Jane would search "check engine light on" in OTN and get a list of friends and people that can help her. She would be able to call them directly and talk to them. In the case when she does not find anybody, she would log her "free" experience at CarZone in OTN for others to consume. These transactions would be automatically logged and accessible as transactions become more real time through digital receipts at the point of sale and card transactions get processed in real time with services like Yodlee providing standard APIs to retrieve these card transactions. In addition, as mobile devices become capable of handling payments, one could pay with the phone and also use it to decide to share it with friends and public at the point of sale.

3.2 System Architecture

In this section, we present the potential of OTN constructed through people's participation. This approach can have numerous benefits to the consumer. It provides easy sensing of the market by utilizing the experiences and knowledge of other shoppers. When Jane goes shopping for shoes and finds several sales events at different stores, she publishes this information on OTN. This information is easily shared with others who might be interested in shopping for shoes and she becomes a reference for recommendations and information. Such information reduces the opportunity cost for searching while providing background awareness to ongoing sales events.

OTN was deployed to a group of real users to understand people's willingness to contribute and share purchase information with others in their social network. [18] mentions about the potential for communities forming around products and we develop the concept further to understand the system design issues to support such communities.

The system is a mobile application with a web backend. The mobile application provides data entry and easy access to the information collected from the participants. The web backend is linked to various external backends to facilitate recording of transactions (Figure 1).

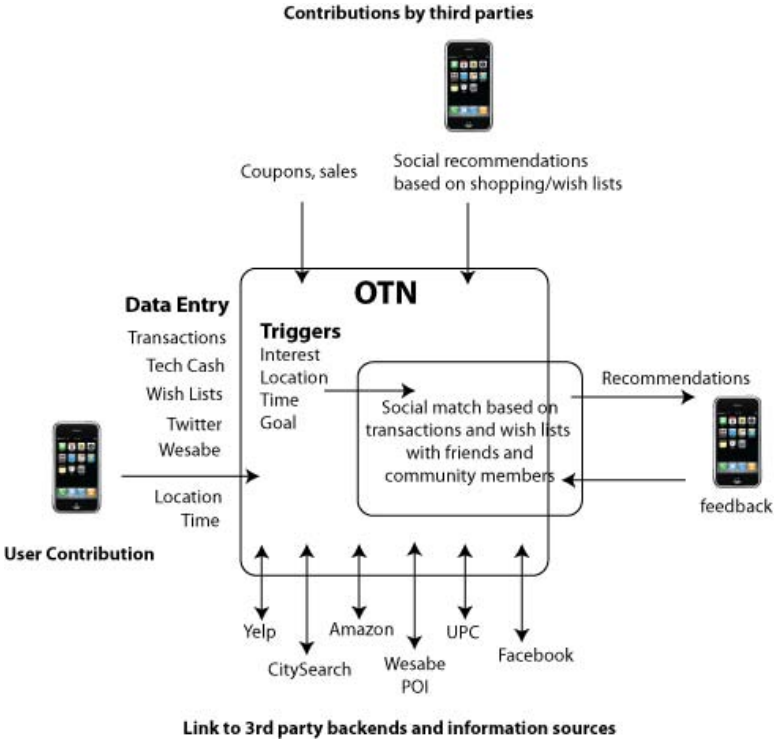

Fig. 1. OTN Architecture

OTN has the potential to convey recommendations in-situ. Moreover, it could track and influence people's decisions in-situ, but at the time of the trial we did not have the mechanisms to track causality of such influences. We will consider this in our future work on digital receipts and digital menus.

3.3 Mobile Application

The mobile application allows one to log one's shopping list and itemized list of purchases to form a social network around these items. Individuals can share this data to inform and guide others in a timely, personal and contextual manner when they are shopping for a product or seeking a service. It can also help people connect opportunistically in a local area to make group purchases, to pick up an item for a friend, and to perform reverse auctions. Beyond consumption, it

allows one to be more aware of spending as transactions may be shared with friends or family.

The mobile application has the following core features: a purchase log, a wish list, and friends. The purchase log records any purchases that the participant wishes to capture in OTN. The purchase log records the 1) item name, 2) category, 3) the store name, 4) price, 5) rating and 6) sharing option (friends or OTN). Ideally if there was a digital receipt system or an advanced mobile payment system, the first four items would be entered automatically. However, in the current world, it is rare to find merchants like BestBuy that make itemized level data available through an API. As a result, manual entry was used due to the lack of a standardization for obtaining required information. The wish list is used to record items people are intending to purchase in the future. The friend's view allows one to view friends' open transactions and wishlist items(Figure 2).

The purchase list and the wish list automatically becomes input to the system to filter what users may potentially purchase regularly or what they might want in the future. The data, in return, allows personalizations for fulfilling wish lists that merchants could use for reverse auctions. Not only does it provide control to the consumer, but it also allows vendors to sense the market and control their inventory and prices based on the requirements of users[2].

(a) Search Results (b) Profile

Fig. 2. OTN iPhone mobile application

3.4 Product Entry and Auto Completion

One of the important features to facilitate user interaction with the system is for the application to recognize what the user is trying to enter, search and auto complete this data based on the location. The key to such an approach is to do a geospatial query for relevance. In order to accomplish this, we used the following architecture.

In order to expedite the product entry, UPC codes are used. One can enter the UPC code in the search bar. The UPC code maps to the name of the item and the manufacturer. This allows a standard way of identifying a product so that all users' information can be correlated. Other information such as price, rating and settings for sharing still must be manually entered.

A shortcoming of UPC codes is that they only exist for manufactured goods. In the case of OTN where many transactions were in categories of food, services, and entertainment, UPC codes are not particularly beneficial. As a result, the utilization of the UPC database was limited for this trial.

As the user types in a query, it is posted to the server. The server looks up the existing cache of search results to see if any similar search has been made. If so, the result candidates are sent as JSON objects back to the client. If there are no cached results, the search query is made against Yelp and City Search (scraped and downloaded on our server). The results returned are parsed to obtain the names and cached in our local database. The results are again returned as JSON objects to the client.

3.5 Extending to Open Spaces

We extended OTN and created a prototype system named "Open Spaces", which allow us to demonstrate the opportunity of using just-in-time information in retail spaces. [14] describes potential uses for having large shared screens in retail shops to track traffic, locate items, and provide feedback to store owners and customers. Open Spaces specifically allows OTN information to be integrated with existing shared spaces that would be available in such pervasive computing environments. Open Spaces is an extension of OTN, where people can browse through and share their shopping lists on a large shared public display.

The large shared public displays present the ability for merchants to engage in sales offers to specific people. The phone broadcasts the wish list to the merchant as the customer opens the OTN mobile app, the store can accordingly provide location information where the items could be found, and also present a just-in-time discount offer to influence the customer's purchase decision.

If another customer who shares interests in the same product approaches, both customers' wished item can be displayed on the screen. The customers can share information with each other and help each other decide on the purchase. The system also allows access to a friend's or a family member's wish list and to potentially purchase the item on his/her behalf since the user is located at

the store and has visibility to their friend's needs. The merchant can also provide a group offer to motivate people to coordinate their purchases when two people have same wish item (Figure 3).

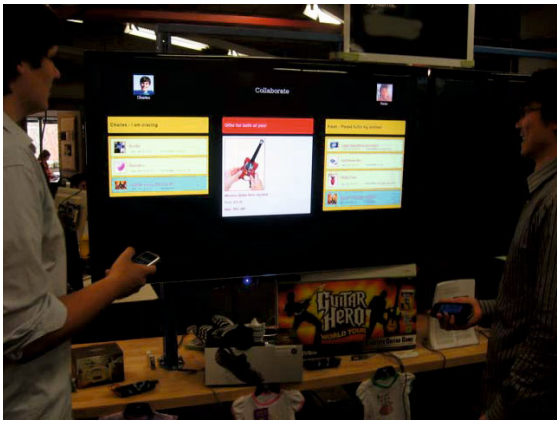

Fig. 3. Open Spaces: Wish list viewing and collaborative shopping

3.6 Wish List Sharing Protocol

OTN's wish list sharing protocol allows people to openly share their wish lists with others. It operates by using the Bonjour protocol to share with any entities that are willing to accept the wish list sharing protocol. There are two ways to have it implemented: infrastructure and ad-hoc. The infrastructure mode only publishes a URL, which returns a JSON-formatted wish list. Each wish list item contains information about the item including its name, its brand, the price range, and a description. The ad-hoc mode publishes a JSON-formatted wish list only to neighboring devices that accept the wish list sharing protocol. Applications like Open Spaces could utilize this ad-hoc feature when an Internet connection is not available.

Such wish list functionality enables filtering of the marketing content and advertisements if the user selects it as a filter. Attention needs to be focused around the relevance of the content and the timeliness and frequency of the delivery of marketing messages[6]. The history of transactions and the wish list can increase the "relevance" of the content.

OTN additionally provides the social information around the wish list, beyond just its content. These are context sensitive alerts that will be raised to the user depending on their location. If a user is entering a wish list item, it will query the server to see if there are any users with the same item on their wish list or have recently bought the same item. It does not pop up, but it is visible to the users after they immediately save a wish/shopping list item.

4 Evaluation

The system was used for approximately five months to collect over 600 trasactions from over 20 people. This represents on average about 15% of transactions of the participants. Volunteers were recruited to participate by providing them an iPhone and a data plan for the length of the study. About 50% were married and other details are described in Table 1. In this section we summarize the findings from the deployment and share the insights we gained from the collected data.

Table 1. Participant demographics

Parameter	**Min**	**Max**	**Median**
Age	23	55	38
No. of children	0	3	1
Total transactions made during the trial period	50	over 400	250

4.1 User Interface

The original goal was to collect itemized level data that is usually not available in credit card statements or online banking. However, the data we collected did not have desired details due to people's difficulty with manual keying on the mobile phone. For example, for Italian food, users simply recorded 'spaghetti' instead of the full dish name. For groceries, many people entered 'groceries' instead of specific items that they bought.

The application would have been more effective if data entry was minimal. A more user friendly design would be for a user to take a photo of their receipts with details filled in through a connection with the merchant or via crowd sourcing. We are attempting this design for our current version.

The collected data contained geo-information for location based filtering. As shown in Figure 4, the purchases were geo-coded so that they would naturally be useful information for those specific locations. Our initial design did not proactively make other people's purchases visible at pre-sale. One could see the list of people who had purchased the same item or had the same item on their wish list after they have logged the item. People found it most helpful to know this information when they were buying gifts for others, or when they had to choose wine at a restaurant. The main advantage beyond a Yelp like service was that a recommendation was available from *known* people and the system could be generalized beyond just restaurants.

At the time of the trial, 3G was not universally available and many indoor locations did not have adequate cell phone coverage or WiFi reception. Therefore, it was necessary to implement persistence on the device so that items logged were stored and uploaded the next time the application acquired a network

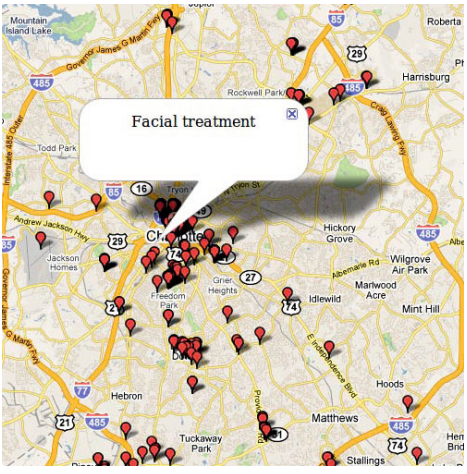

Fig. 4. Geo-coded purchases

connection. Since locations were not tagged due to lack of GPS coordinates when there were no GPS, WiFi or cell signals, it was necessary to estimate coordinates from the location name or previous entries. This constraint is a limitation with using the iPhone, since on Google G1 (Android phone), GPS coordinates using background process can be regularly tracked and used to estimate locations.

4.2 Individual and Group Behaviors

The primary benefit of OTN is that it networks people with similar transactions and also informs of the social distance. Individual profiling can be performed from participants' open transactions. Each individual in the study was represented as a vector of 16 values representing normalized fraction of purchases in each category. The basic use of this information is to create a signature of financial behavior. The transactions recorded in OTN are shared with friends and the public depending on the user's sharing preferences at the transaction level. Not only does this approach allow for comparisons with friends but also with other individuals in different dimensions. Participants in second degree and third degree friends are readily viewable through OTN.

Participants indicated it would be most useful to compare their information with people of similar income, similar family size, or lifestyle since these people would have useful information about stores of similar interest or sales of interest. In contrast to anonymous recommendations on the web, by adding social distance information, it has the added advantage of judging the reputation of the recommenders.

In order to understand how purchase behaviors relate to social relationships, we calculated the mean squared distance between the transaction vectors. We found that the behaviors of individuals compared to their social network of

different distance was divergent on average (Figure 5). By comparing the vector distances, we found that the social network relationship does not provide any information about how similar friend's purchase behaviors are. One could explain this from the fact that they are coworkers and each have very different life styles. However, this also means that new product/service related information could be easily obtained from the social network due to the social network having knowledge about products and services that one might not be familiar with.

We refer to the "second degree social network" of an individual user as the collection of users who are either friends of friends. This second degree friends are particularly special since they can potentially provide significantly more recommendations. Compared to a randomly generated social network, the empirical data shows that the second degree friends can supplement the most amount of information (Figure 5). By comparing the empirical data with randomly generated social networks, we find that the purchase behavior of second degree friends in the OTN trial are statistically different ($p < 0.01$) from random social networks. Therefore being able to reach the second degree network more easily may provide more valuable information for the consumers. This is due to the real world social networks having hubs that bridge different groups in contrast to random networks.

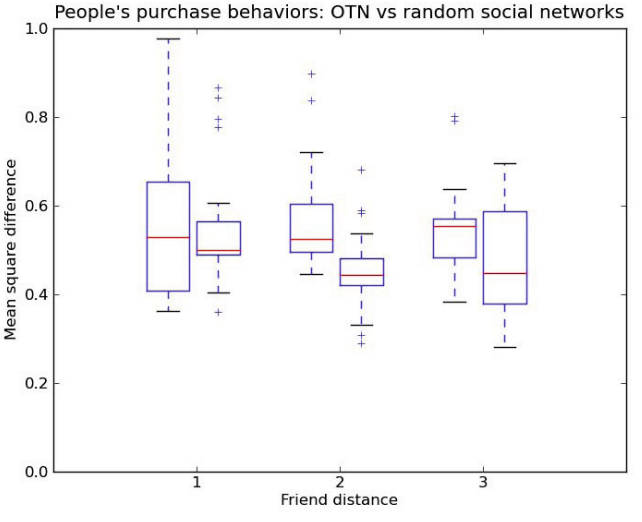

Fig. 5. 2nd degree friends can provide most information. Transaction behaviors related to social distance (0 very similar, 1 very different). First set of box plots are empirical data from real world social network of OTN participants. Second set of box plots are from participants connected through random networks. Second degree friends are different from random friends ($p < 0.01$).

The Open Transaction Network can also be used to analyze group behavior and identify the shared experiences from people's consumption data. The sequence of events also form a behavioral story of individuals and of the community. The transaction timeline (Figure 6) shows much more activity as the December holiday season was approaching. The 2 week cycle of large spending spikes aligned with the bi-weekly pay cycle of the company in which the participants were employed, illustrating temporal group pattern in consumption.

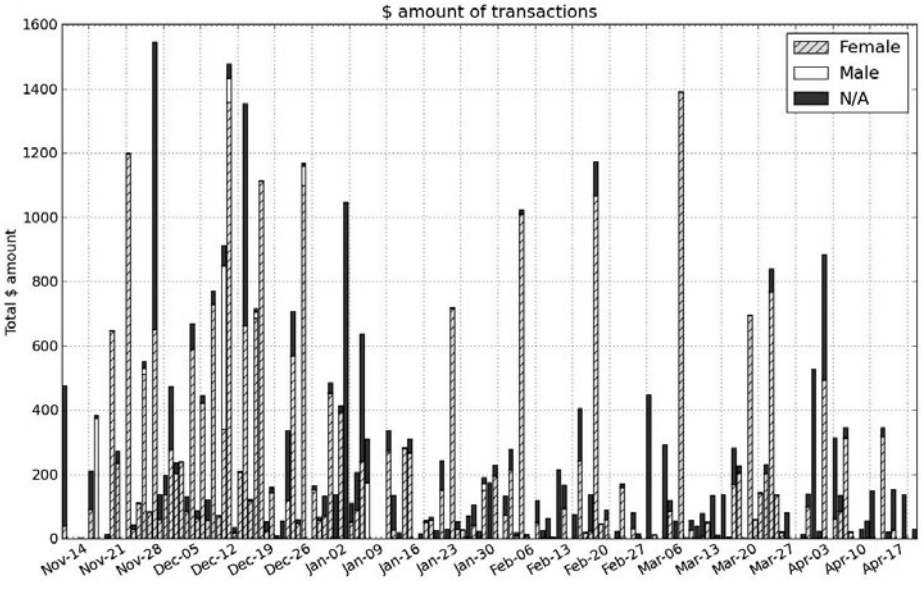

Fig. 6. Transaction time line from November 2007 to April 2008

4.3 Social Network of Recommenders

Figure 7 illustrates the social network of participants in the OTN. These were identified by participants adding people they knew through the OTN website. The color gradient shows the different number of friends with darker circles having larger number of friends. Subjects 15 and 19 form the hub of the social network.

The OTN community shows the benefits of open (shared) transactions versus closed (not shared or shared only with direct friends) transactions. Normally we are only connected by 1st degree friends in the real world or with a lot of random reviewers on the Internet and somewhat through word of mouth to 2nd and 3rd degree friends. By connecting people via transactions, we can see larger community (friends of friends) of people that can share their experiences for common category of purchases. Through OTN, people have trusted visibility to other participants' transactions in the social network and the OTN community.

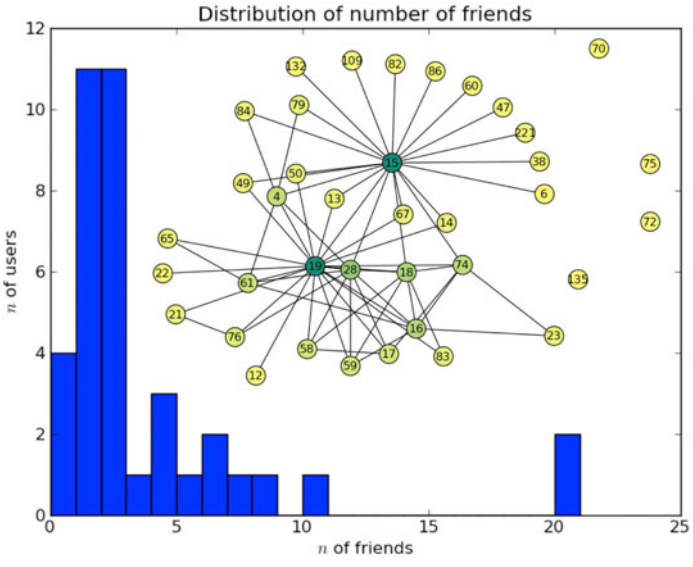

Fig. 7. Social network of participants and degrees of friends in OTN

In the small community of participants in current study, a range of 4 to 14 people purchased items in common categories (Figure 8). We define the *potential recommenders* for an individual to be the people in OTN who have a purchase experience in the same category before the individual's purchase date. The greater potential recommendations from 2nd degree relationships is especially noteworthy. If one were to seek information in a typical social network, one would have to ask a friend to refer a friend for information. However in OTN, the openness of the platform provides a direct link to a community of known, trusted recommenders and reviewers through similar transactions, making information equally accessible even to those who are socially disadvantaged.

The actual utility of these potential recommenders may vary depending on the product category. Those product categories that have greatest uncertainty about the quality would benefit the most from these recommenders who have past purchase experiences. Categories of products and services that require experience, denoted as experience goods[11], such as food, auto mechanics, medical services, plumbers and clothing would benefit from greater number of trusted second opinions. The benefit of OTN is that these are people who have actually purchased these goods or services and are potential friends or acquaintances. Also, if one has a high degree of friendship, each individual's opinion might not carry the same weight. As a result, those that have lower number of friends might actually benefit more from OTN by being able to filter information through first and second degree friendships.

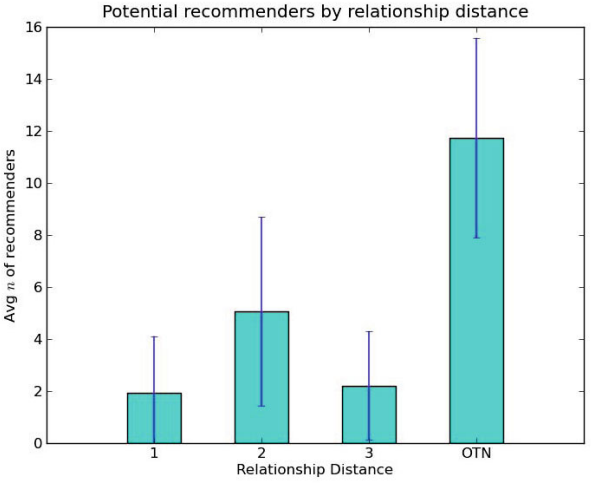

Fig. 8. Mean potential recommendations from different social network distances (1st, 2nd, 3rd degree) compared with OTN (when connected through common transaction categories). Whiskers indicate standard deviation.

4.4 Sociability Threshold

A key research question that results from OTN is about dimensions of people's willingness to share: if users are willing to contribute their data, then for which categories and under what conditions are they willing to reveal to others? Though the experimental trial was done with a reduced group of people in an organization, it revealed some insights to these questions.

OTN has four categories of sociability: private, friends, community and public. In the case of the mobile scenario OTN attempts to allow users to control sharing of their transactions in different contexts since, unlike the online context, offline context is dynamic. Users decide whether certain purchases were shared between friends, community (people who purchase in similar categories) or the public.

OTN users had an increased willingness to share with friends (20% increase) and public (30% increase) about their purchase information after the OTN trial as compared to the start of the trial (Figure 9). Through online surveys we investigated the general public's willingness to share purchases on 10 items between friends and the general public. The survey also questioned people's willingness to share the name, brand, location and price. Consistently price came up as the least willing to share attribute. The same survey was completed by OTN participants. We cannot directly compare the results since the total population that was surveyed without experience of OTN was much larger (∼250 people) while the OTN participants were only 20 people. However, there was a consistent trend that the OTN participants were more willing to share with both friends and the public. The least difference between the survey groups was observed in pizza and the most difference was observed in expensive items such as "Ralph Lauren trench coat on sale" and a MacBook.

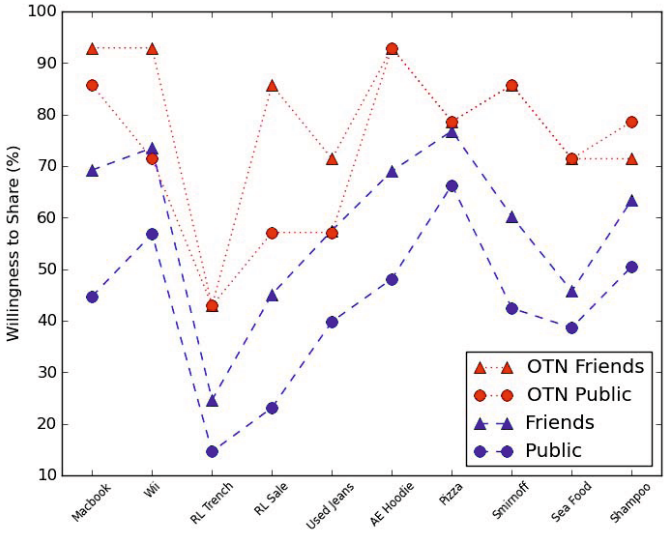

Fig. 9. Online Survey: public's willingness to share (dashed) compared with OTN participants (dotted)

The sociability threshold is a measure that indicates that there is a price threshold for each category of products that users are open to reveal and accept recommendations from friends. Dining, coffee, groceries, entertainment, fashion were the top categories that were openly shared by people (Figure 10). Categories purchased less frequent, for example electronics, were less likely to be open shared. From interviews we found that people were not willing to share their

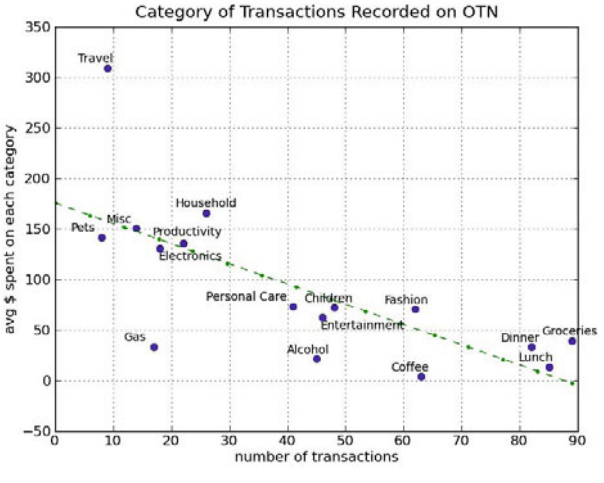

Fig. 10. Sociability threshold of categories correlation to price (Pearson r=-0.75)

pharmacy purchases since these purchases may reveal person health issues. Post interviews revealed that people would like to be able to find other friends and community participants that are actively purchasing specialized items such as electronics, pet accessories or wine. Another subject mentioned that she wanted to purchase a gift for her 12 year old niece and it would have been extremely helpful to obtain recommendations from their friends who have experience with gifts for that age group. Finally, one participant commented about her avid wine consumption which she did not publish on OTN due to potential misinterpretation by her colleagues.

5 Discussion

5.1 Applications to Advertising

There is no variable in current advertising models to capture a user's appetite to particular advertisements. OTN provides a social metric for products that can be used as a proxy for relevant advertising in those product categories. The frequency of transaction categories could be used to limit the frequency, timing, and amount of advertisements that a user receives.

A user's behavioral propensity to save or spend should be the basis of advertisements. We believe the new measure of success for advertising will be the ability to enhance closing rates instead of click-through rates and impressions. By presenting transactions socially, advertisements can become socially aware (i.e. your friend Mark likes/has purchased these items). We believe this targeted social information can make users more informed and more comfortable with their product purchases.

5.2 Limitations on Collecting Data

Sites like Amazon, BestBuy and others are collecting information about people's wish lists so people can share and manage them while the merchants may use it to make recommendations to increase purchase behavior. Purchase data have always been collected by offline retail, but only sold to third parties and rarely shared with the customers. The mobile phone allows such data to be accessible to customers and provide contextual recommendations when needed. In the case of OTN, one can search at the location whether others that they know may have purchased a similar item. By making this data more available for application developers and community, a more consumer centric data gathering and application environment can be fostered while increasing the number of applications that can benefit consumers.

Transaction information from credit and debit cards are readily available through sites like Buxfer that provide APIs to access transactions from multiple banks. However, the data provided through payment networks and card transactions are difficult to decipher due to the truncated text and numeric strings that do not provide much meaning. For example, if there are multiple

CVS locations in Cambridge area, it is not a trivial task to identify from the transaction string (CVS 1002 01002 Cambridge) which specific store was used. For smaller stores, the merchant names do not match the actual business names, making it difficult to identify the actual location of purchase. Categorization is also not readily available through these APIs. The time of the day of the transaction can provide a lot of information about the daily behavior of users, but this information is not available in current transaction information.

OTN overcomes these problems through user participation. However, similar to many user contribution based systems, it will require a much larger number of participants to contribute to cover the tremendous number of products. Participation by merchants and a more open system beyond existing point of sale systems could be a great way to seed the system.

5.3 Privacy Concerns

Stalking is the behavior of following someone incessantly by utilizing information that can be obtained publicly. When purchase behavior transactions are made widely available in the public domain especially in timely manner through mobile devices, stalking problems could arise. A person may not want a boyfriend or girlfriend to know where they shop or when and where they met another person for coffee. Similarly, college students may not want their parents to know that they are spending a majority of their available funds on alcoholic beverages. OTN provides the opportunity for resolution of disputes over certain events and/or the time of their occurrence.

However, with the prevalence of social network services (i.e. people following on Twitter), it is imperative to understand how we can manage such open information rather than continue the existing tradition of keeping the information vaulted by the banks and merchants. There is greater benefit to be gained for the greater community as we understand how socialization of transactions affects people's commerce behavior. The community may know the best price; the community may know the pitfalls for certain services; the community may know when new products are available and selling in what quantities they are selling.

OTN is currently an experimental platform to understand control given to users to manage their privacy. Making the purchases shareable to a community of people that have similar purchases is one way of limiting the information diffusion. For example, people who actually buy flowers will only be notified about others who bought flowers. The friendship degrees can be used as a way to control diffusion. Initially people will only see their first degree neighbors, but as they contribute more they will be able to access second degree friends that might contain more valuable information.

6 Conclusion

This paper presented the OTN, an extensible platform for mobile social transactions that is built on the principle of encouraging greater access to your financial

data and community awareness of information. Despite privacy problems that were created by Beacon for publishing Amazon purchases on Facebook, startups like Blippy[19] and tweetwhatyouspend.com have reformulated the idea to allow people to share transaction data for online purchases in more practical ways. Companies like Square are also pioneering digital receipts that make it easier for sharing purchases. As the industry is moving towards providing the tools and APIs to access the transaction information, it will become important to consider what it means for transactions to be open and the possibilities of new applications and systems that can be built in such an environment[16].

An open transaction is not about just making the information public, but it's also about creating an environment where people feel safe to share their purchases and inform each other. When it is open, it is also open for verifying, annotating, and disputing for refunds[4]. Accounting is made open for users and comparisons can be made about each other. This trend has become prevalent in Wesabe and Mint like services where they aggregate many people's transaction data. This approach presents opportunities to socially influence people for behavioral change in-situ. However, we believe viewing this information on a website is less persuasive than viewing it during the purchase decision or at the point of sale. Mobile phones are the natural means for such interventions. The effectiveness of these interventions is currently being tested through a digital menu and a digital receipt applications.

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