Lookie - A Case Study of a Location Based Collaborative Application

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***Abstract*—In the age of smartphones, increased online social connectivity, and advanced technological capabilities, collaborative applications often take advantage of crowd resources in an effort to enhance the welfare of the community. Lookie is a collaborative application where users can ask other users to share up to date footage regarding their whereabouts. This paper presents the results of a field trial performed with Lookie, focusing on aspects of user experience, privacy, and participation. Analysis of system logs and questionnaires answered by the field trial participants produced the following key results: (1) users' perceived participation is biased toward their own active deeds, (2) appropriate timing of requests and personalized meaningful request messages improve user experience, (3) most users do not mind helping strangers by taking pictures or answering requests but many refrain from disclosing their location, and finally, (4) users that indicate privacy concerns and feel reluctant to reply to requests, have the same average response ratio as the rest of the community, although, they initiate less interactions.**

Keywords–sharing; location based services; mobile application.

I. INTRODUCTION

Collaborative systems enlist the cooperation of their users to share knowledge and information. Some well known examples of such systems (or applications) include Wikipedia, Yahoo! Answers, Amazon Mechanical Turk, peer-to-peer file sharing platforms and Facebook. Despite the fact that these platforms have their own unique characteristics, they hold a common goal of utilizing the knowledge of their participants and sharing it among community members.

Such applications were thoroughly studied and classified according to nine major dimensions by Doan et al. [1]. The three most important dimensions are:

The contributions of users can manifest in different ways according to the nature of different collaborative applications. For example, in Wikipedia, a contributing user is one who creates and edits Wikipedia pages. On Facebook, a contributing user is one who shares their own information such as photographs, videos and text (i.e. status).

Effort can be distributed among users and owners of the collaborative systems. A recommender system requires some participation of its users (a rank, an opinion), while most of the effort is imposed on the system owner itself (providing recommendations). Wikipedia users are responsible for writing, reviewing and merging all pages, and no effort is required from the system owners.

Roles refer to the type of contribution and how can it be achieved. A contribution can be a thought or perspective, self-generated content or a part of a collaborative artifact. A single user can play multiple roles in each collaborative system.

There are various reasons for users to cooperate. In some cases, cooperation might be beneficial for a user in the future. For example, a user sharing a file fragment in a peer-to-peer system relies on other users to share files with one another, based on their previous sharing history [2]. This consideration of benefit (also, referred to as *utility*) is the foundation behind incentive mechanisms that consider their users to behave rationally, i.e., motivated by maximizing their benefit [3]–[6]. However, human participants rarely act rationally. One Nobel Prize winning paper [7] introduced a behavior different from the expected (when considering utility) behavior in decision making under risk and uncertainty.

Incentives, social ties, and privacy are only a few of the factors that affect user cooperation in collaborative systems. Privacy is known to be a major concern of users, especially in services that include location tracking [8]. Incentives often have contradictory effects when presented to different types of participants. In some cases, monetary reward were found effective for recommender systems [9] and crowd sourcing websites [10]. In other cases, extrinsic rewards, were shown to decrease motivation when performing tasks based on good will [11]–[13]. Intrinsic rewards, such as social ties, within the cooperation community or environment increased workers' performance [14]–[17]. In general, people with a pro-self value orientation tend to respond better to extrinsic incentives, while people with pro-social value orientation tend to better respond to trust and social ties [18]. In order to devise an appropriate incentive scheme for a collaborative application, one must study the user population and apply incentives that facilitate cooperation and discourage free-riding.

In this paper, we study user collaboration through data collected from a two week field trial of a real time collaborative mobile application called Lookie [19]. Analysis of system logs and questionnaires, answered by the field trial participants, indicates that participants recall their own active deeds within the application and tend to disregard requests that they had no opportunity to answer. We can see that personalized meaningful request messages can be regarded as intrinsic incentives improving the experience of responders, while blank or meaningless requests, as well as inappropriate timing, greatly annoy the users. Finally, the study results indicate that users are more sensitive regarding sharing their location than answering queries received from strangers. However, users that feel reluctant to reply to requests have the same average response ratio as the rest of the community, although they initiate fewer interactions. The last result is consistent with other studies that show that privacy concerns have little influence on activity in social networking services [20].

The remainder of the paper is structures as follows: The Lookie application is described in Section II. Section III includes the field trial settings, description of questionnaires, the collected data, and analysis of the results. Findings are discussed in Section IV as well as conclusions and future work.

II. THE LOOKIE PLATFORM

Lookie [19] is a location based Android application. It enables its users to share images from their location upon demand of other users. The application can be easily downloaded and installed through Google Play. Lookie users can request

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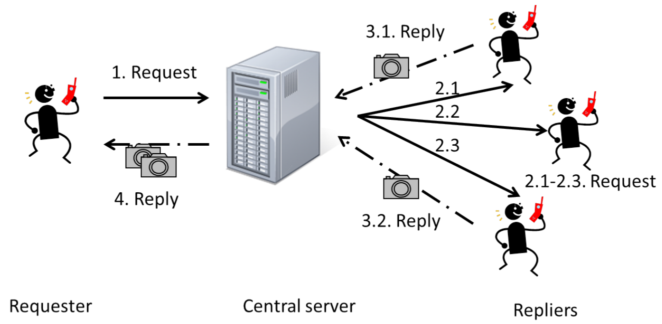

Figure 1. Users' interactions in Lookie

images from other Lookie users. We denote requesting users as *requesters* and responding users as *repliers*, even though each user can play both roles. In this section, we will describe Lookie usage scenarios and the architecture of the application.

A. Interactions

An interaction begins when a requester wishes to see a real time image from a location of interest (e.g., a crowded restaurant). Opening the Lookie application brings the requester to a screen that contains a map showing other online users in their respective (different) locations. For convenience, users that appear on the map are arranged in groups according to their location and zoom level.

Tapping on a group near the location of interest will display a list of users in the group. These users are close enough to the location to serve as potential repliers. The requester can choose one or more user and send a personal text message, ideally mentioning the intention of the desired photo (e.g., "Show me how crowded the restaurant is."). If the request is answered, the user will receive a pop-up message with the photo taken by the replier.

The request that was sent to the potential repliers pops up on each of the replier's phone screens containing the text message. The pop-up contains three options: to accept the message and send an image back to the requester; to decline the request; or to postpone it to another time.

Accepting the request triggers the mobile device's camera. The replier may take a few pictures until she is satisfied with the result. Afterwards, the replier can choose to add personal design details that are supported by the application. She may also add a personal message and set a mood barometer to better represent the atmosphere of the photographed location.

The interactions between application users do not entitle them to any extrinsic reward or compensation. The application is socially oriented in the form of location sharing, community building, and personal touch both in terms of requests and replies. Since requests are sent in real time, and replies are relevant for only a short time period, there is an expectation that users cooperate and serve as repliers in order to ensure that the majority of requests are responded. Without the cooperation of repliers, the Lookie application cannot exist.

B. Architecture

The Lookie application is composed of two main components: the client application installed on the mobile phone of the users and a server mediating all interaction between clients. The client has two main responsibilities: to report and display the geolocation of users and to handle requests and replies.

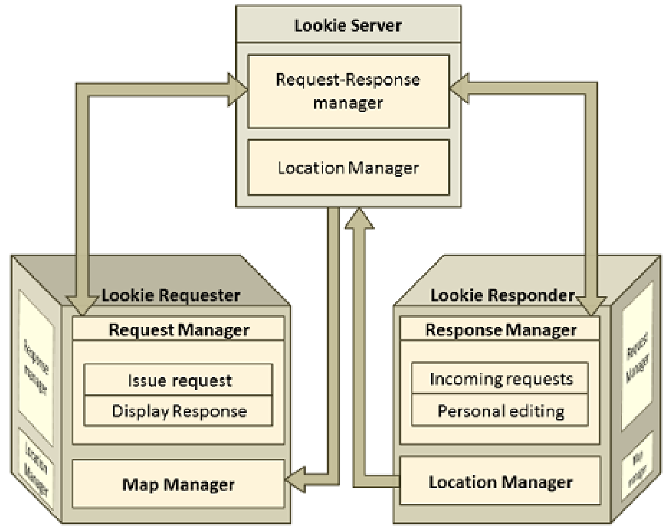

Figure 2. Lookie architectural design

To support the first, the client uses the smartphone's GPS and WiFi connection to determine its location, and sends its own location reports to the server. In parallel, the client is able to poll the server for the updated location of other users in a specific area on the map, which enables the application user to select a potential responder in a location of interest. Second, the client handles incoming and outgoing requests and replies. All outgoing requests and replies generated by the client are forwarded to the server which navigates them to the recipients. Incoming requests and replies generated by other users are transferred from the server.

The server application is the mediator between all Lookie clients. It accepts location reports from clients and updates them on the whereabouts of other users upon demand. In addition, the server manages the navigation of requests and replies between the client applications. This results in all communication being transferred through one main machine which allows us to record all inter-client communication (requests and replies), as well as client-server communication (location updates). The system logs are maintained in a database and are used to analyze users behavior in the performed trials.

A graphic description of these components is available in Figure 2. In addition, Figure 1 illustrates an interaction between a requesting user and potential repliers. The illustration presents a user sending a request (1) to three users in a desired location. The request is forwarded to the central server from which it is distributed to the users (2.1-2.3). Two of the users who received the request take a photo and send it back to the central server (3.1-3.2), which returns the photos to the original requester (4).

III. User Study

A. Lookie Field Trial

The field trial was conducted from March 13, 2011 through March 26, 2011 with 26 participants. The participants were recruited via advertisements around the university campus and on designated student web forums. In parallel, the Lookie application was published on Google Play.

Recruited participants were students at Ben-Gurion University of the Negev, Israel. Field trial held no preconditions for

TABLE I. PARTICIPANTS IN FIELD TRIAL

Demographic	Description
Gender	23 male, 3 female
Age	21 – 29
Occupation	All students, 8 with jobs
Marital status	20 single, 3 married
Total	26 participants

TABLE II. SERVER RECORDED MEASUREMENTS

Name	Description
q_out	total number of queries a user sent.
r_out	total number of replies a user sent.
time_online	total number of location reports a user reported.
q_in	total number of incoming queries a user received.
r_in	total number of incoming replies a user received.
r_out_neg	total number of requests a user did not reply to.
r_out_percent	percentage of replies a user sent.

participation because Android phones were not very popular among students at the time of the trial, and Android users were difficult to find. Table I describes the demographic information of participants. We see an imbalance in gender and in marital status. The limited pool of Android users is reflected in the small number of participants, as well as the lack of participation by females (the lack of female participants is attributed to the lack of females who owned Android smartphones at the time of the trial).

The experiment was scheduled as follows: on December 13, 2011, participants were asked to attend the laboratories, where they received guidance on application installation and basic usage scenarios. At that time, participants completed an initial questionnaire. No requirements were made during the trial regarding the desired number of requests or responses in order to minimize bias in communication resulting from the field trial setup. However, participants were instructed to keep the application online for at least 50% of the field trial period in order to receive the participation fee of 15 EUR. At the end of the trial period, participants were asked to fill out a second questionnaire regarding their experience with the application, and, at that time, they received the payment. Further discussion regarding the questionnaires can be found in Section III-B.

B. Measured Parameters

Because all communication went through a central server, the Lookie server had the ability to save logs accurately representing an anonymized history of past location traces and user interactions, in the form of request-response pairs with time stamps, for analysis purposes. We list the measurements extracted from the server logs and aliases in Table II. All server side measurements are calculated on a per-user basis an are accumulated throughout the field trial period.

Outgoing queries (*q_out*) represents the total number of queries (i.e., requests) a specific user sent during the field trial period. We count a request as a single query sent to the system even if it specifies several potential recipients. We define a request as answered if it received at least one positive reply. Incoming replies (*r_in*) represents the total number of replies a user received to distinct requests, i.e., the number of answered requests. *R_in* accounts only for positive replies and does not account for replies that were declined. *R_in* is always less than or equal to *q_out*.

Incoming queries (*q_in*) represents the total number of queries (i.e., requests) a user received during the field trial. Outgoing replies (*r_out*) represents the total number of replies a user sent an image to. *R_out* does not include declined or ignored requests. Negative outgoing replies (*r_out_neg*) represents the total number of requests a user *did not* positively reply to (i.e., did not send an image). In this measurement we count all declined requests as well as requests the user ignored. The sum of *r_out* and *r_out_neg* is always equal to *q_in*.

R_out_percent represents the percentage of requests a user replied to from the ones she received. We calculate this parameter by dividing the number of replies a user sent by the number of requests she received: $r\_out\_percent = \frac{r\_out}{q\_in}$. *Time_online* represents the total time a user was connected to the Lookie server. We estimate this time using the total number of location reports the client application sent to the server while it was online. Location reports are sent with a constant frequency while the client application is used or runs in background.

1) Questionnaires:

During the Lookie field trial participants were requested fill out two questionnaires. The first questionnaire was handed out on the first day of the trial, and the second one was distributed when the trial ended.

The first questionnaire primarily addressed demographic information. This paper does not contain an analysis of the different segments of the population within the field trial but rather presents a general description of the relevant population (see Section III-A). In the first questionnaire the participants were also asked to state their acquaintance with other field trial participants. The specific question is presented in Table III. We will refer to the number of acquaintances a participant had within the test group as *friends*. Lastly, participants were asked to state their preferred hours to receive requests. Users could check one or more of the following blocks of time: 08:00-12:00, 12:00-16:00, 16:00-20:00, 20:00-24:00. The late night and early morning hours (00:00-08:00) were assumed to be a resting period. The specific question is presented in Table III and is referred to as *good_q_time*.

We distinguish between four sets of questions in Table III. First are the number of friends (*friends*) and the desired hours to receive requests (*good_q_time*) which are part of the first questionnaire. The remainder of the questions were part of the second questionnaire which was distributed after the field trial. The second group of questions (*no_res_strangers*, *res_acq*, and *loc_share*) is related to users' privacy concerns. Participants were asked to rank their agreement with the presented statements on a scale from 1 to 5, where 1 corresponds to "strongly agree" and 5 corresponds to "strongly disagree". The third set of questions relates to the user's experience. The participants were asked to rank their agreement with the statements: *filter_req*, *keep_use*, *use_as_requester*, *req_meaningless*, *tnk_snd*, and *tnk_rcv* on the 1–5 scale. The participants were also asked to rank their experience while taking pictures and editing them before sending the responses (fourth group, question *edit_experience*). In this question, a ranking of 1 indicated that a user had a bad experience, and a ranking of 5 indicated a good experience. We omit other questions that are not relevant to current analysis.

Some measurements can be extracted from the system logs (objective source) and from the questioners (subjective user responses). We consider both objective and subjective data in order to distinguish between actual usage and the perception of users about their usage. We extend the discussion about the two in the following sections. The following sections present the field trial analysis and refer to users' activities, characteristics, and experience.

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TABLE III. QUESTIONNAIRES

	Label	Question
1	friends	How many of the other participants are you familiar with?
	good_q_time	During which blocks of time would you prefer to receive requests?
2	no_res_strangers	In the future I would not like to reply to people I'm not familiar with.
	res_acq	In the future I would like to send requests only to people I'm familiar with.
	loc_share	I don't mind sharing my location.
3	filter_req	I didn't feel like responding to some requests.
	keep_use	I would like to keep using the application.
	use_as_requester	I would be happy to use the application only to send requests.
	req_meaningless	Most of the requests I received were meaningless.
	tnk_snd	I received many requests.
	tnk_rcv	I sent many requests.
4	edit_experience	How would you rank the editing photo experience?

C. User Participation

As common sense suggests, the number of replies one sends or receives should be strongly correlated to the number of requests she receives or sends respectively. Indeed, we observe a significant correlation between *q_in* and *r_out*, as well as between *q_out* and *r_in*, both at the level of 0.01. No significant correlation was found between *r_out* and *q_out* measurements or between *r_in* and *q_in*.

1) Users' perceptions of their own activities: We asked the participants to estimate the number of requests they sent and the number of requests they received using the *tnk_snd* and the *tnk_rcv* questions. Checking whether the reports of users correspond to the actual application usage produced asymmetric results. We found a significant correlation at the level of 0.01 between the *q_out* and the *tnk_snd* measurements, suggesting that participants have rather similar perspectives on the number of requests they sent. However, we found no significant correlation between *q_in* and *tnk_rcv*.

Surprisingly, a correlation between the *tnk_rcv* and the two measurements *r_out* and *r_out_percent* was found to be significant at the levels of 0.05 and 0.01 respectively. This correlation implies that users do not perceive the actual number of incoming requests as the overall number of requests they received, but rather the overall number of requests they have received and replied to. The more requests the users replied to (out of the requests they received), the more requests they believe to have received.

2) Social ties: Next, we examine the effect of the number of acquaintances a participant had within the test group on the actual usage. We expect that users of pseudonymous applications such as Lookie, would refrain from denying a request that comes from a friend. Therefore, we expect a higher response ratio for users that reported a higher number of acquaintances. In contrast to *r_in* vs. *r_out*, here causality is apparent as prior acquaintances precede the field trial.

The setup of the trial did not allow us to compare the actual response ratio of participants to requests sent by friends and requests sent by strangers. Instead, we compare the responses sent by participants with at least one acquaintance within the test group to responses sent by participants with no reported acquaintances within the test group. We conducted a t-test (independent sample, $\alpha = 0.05$) to determine whether the means of *r_out* significantly differ for two groups of users, one having $friends = 0$ and the other having $friends > 0$. We found significant differences in the means of *r_out*. Users who have at least one acquaintance in the application community, reply more than users who have none.

TABLE IV. FREE RIDERS IN THE LOOKIE FIELD TRIAL

	1	2	3	4	5
use_as_requester	14	6	6	0	0

3) Free riders: Users who do not contribute to the application community, and use its resources are commonly referred to as a *free riders* (as opposed to *good Samaritans* who enjoy mainly serving as contributors). For most applications it is important to quantify the expected (or existing) number of free riders and good Samaritans in order to design appropriate incentives. The Lookie field trial community included six free-riders out of 26 participants (23%) as will be explained shortly.

We employ *use_as_requester*, *r_out*, and *r_out_percent* to quantify the number of free riders and good Samaritans in the trial population. Table IV summarizes the answers participants gave to the *use_as_requester* question. Is it easy to see that non of the participants reported a number higher than 3. Next we will take a closer look at the three groups of replies (participants who answered 1, 2 and 3 to the question). Out of the six participants who answered 3 to that question,five have a reply ratio below 0.15, and on average, the reply ratio is 0.14. If we omit the only participating user (with $r\_out\_percent = 0.7$), the average reply ratio drops to 0.03. Moreover, four of those six participants did not reply to any request they received.

Out of the six participants who answered 2, two did not reply to a single request they received. The mean of *r_out_percent* in this group stands at 0.23 (s.d. 0.18).

It appears as though we found our free riders. However, they do not seem to be aware of it, or more likely did not admit it in the questionnaire. Finally, the last group of users who answered 1, contains no free-riders, and the mean of *r_out_percent* for this group is 0.48 (s.d. 0.19).

We compared the means of *r_out_percent* and *r_out* between the group of users who answered 1 and the groups of users to answered 2 or 3. T-test (independent sample, $\alpha = 0.05$) results show a significant difference between the groups in both measurements. In addition, *use_as_requester* negatively correlates to both r_out and $r\_out\_percent$ with the significance level of 0.05 and 0.01 correspondingly.

T-test (independent sample, $\alpha = 0.05$) results on the means of the *q_out* measurement between the group of free riders (who answered 2 or 3 to *use_as_requester* question) and the group of all other users (who answered 1) show no significant difference between the means of the two groups. This demonstrates that free riders' expected participation patterns of sending requests are no different than the patterns of sending request measured in non-free riders. However, free riders reply significantly less.

D. User Experience

1) Timing of requests: 27% of participants indicated that they didn't feel like answering some questions ($filter\_req \geq 4$). Next we try to find a possible explanation for this negative experience. Accurate understanding of the reasons for a negative experience can help developers of request-response based collaborative applications design systems in a way that will limit negative experience as much as possible. For example, this could be done by implementing a heuristic responder selection mechanism that forwards requests to participants that would not mind or might enjoy answering it.

We found a correlation at the significance level of 0.05

between the *time_online* measurement and the *filter_req* values reported by the participants. This correlation could be attributed to the number of received requests: the more time users spend online, the more requests they receive. Similarly, abundant requests reduce the desire to respond with the required effort and may increase the likelihood of a user receiving an annoying request. We expected that the more requests a user receives, the more requests she would report as unwanted. However, we did not observe a significant correlation between *filter_req* and *q_in*, suggesting that there should be a different explanation to the correlation between the time spent online and the likelihood of receiving an unwanted request.

We hypothesize that the desire to ignore some requests is caused by an inappropriate timing of the requests. Since participants aimed to achieve the 50% online time, this would link the correlation to the *time_online* measurement: Participants turned on the application even if the time was not suitable for replying, thus receiving requests they would rather ignore.

In order to determine what time is considered "inappropriate" we looked into users' reports on desired time for requests, referenced as *good_q_time* in Table III. Once we knew desirable times, we checked the number of requests each user received during a "bad time". We will refer to the total number of requests at an inappropriate time as *bad_q*. The ratio of unwanted requests (*bad_q_ratio*) is defined by $bad\_q\_ratio = \frac{bad\_q}{q\_in}$.

Next we calculated the PCC between *filter_req* and *bad_q* as well as between *filter_req* and *bad_q_ratio*. Both correlations were significant at the level of 0.01. According to these results, the timing of requests is an important user experience factor in applications such as Lookie. We will further discuss the consequences of this observation in Section IV.

2) Responders' user experiences: Keeping the users satisfied with the tasks they are requested to perform is important for the sustainability of collaborative systems. Our results show that unwanted requests reduce the willingness of users to keep using the Lookie application. We found a negative correlation (at the significance level of 0.05) between the *filter_req* and the *keep_use* measurements. However, it appears that unwanted requests do not necessarily translate into reduced response ratio. We found no significant correlation between the *filter_req* measurement and the *r_out_neg* measurement; nor did we find a correlation between *filter_req* and *r_out_percent*.These results suggest that even though a system should refrain from forwarding unwanted requests to potential responders, it may still do, provided there is appropriate compensation (in our case, compensation was likely the field trial payment).

Another interesting result involves the user experience during photo capturing and editing. The personal editing experience was a major user interface design consideration targeted at increasing the fun of replying to requests. We found a negative correlation between the *req_meaningless* and the *edit_experience* measurements at the significance level of 0.01. This implies that users enjoyed the personal editing experience as long as the requests were meaningful. No other correlations were found between those two measurements and other measurements collected. Aside from the well known fact that personalized requests get answered more often, we observe here that they also improve the responder experience.

TABLE V. PARTICIPANTS REPLIES TO PRIVACY RELATED QUESTIONS

	1	2	3	4	5
no_res_strangers	15	3	2	5	1
res_acq	14	5	5	1	1
loc_share	6	5	4	7	4

TABLE VI. PCC BETWEEN PRIVACY MEASUREMENTS

	no_res_stranger	res_acq	loc_share
no_res_strangers	–	.921**	-.471*
res_acq	.921**	–	-.379
loc_share	-.471*	-.379	–

* significance level of 0.05
** significance level of 0.01

E. Privacy Concerns

One of our goals was to understand how privacy concerns affect the participation and user experience within the Lookie application. Table V summarizes the distribution of participants' replies to the privacy related questions (Explained in Section III-B1).

The first two questions relate to communication within the Lookie application. Due to the nature of Lookie, it is important to understand whether users are fond of the idea of sending photos to strangers within the community. The table shows that $\approx 69\%$ of participants in the trial were willing to reply to strangers and not limit their replies only to acquaintances.

The third question relates to user's location sharing. While we have a majority of participants not concerned with replying to strangers, here the population divides to $\approx 42\%$ of users who do not mind sharing their location and $\approx 42\%$ who do. It is therefore important to design location based services in such a way that users could be contacted based on their location, but locations of specific users could not be determined by strangers.

Table VI presents the PCC between privacy measurements. Most correlations were statistically significant. The only exception is the correlation between res_acq and loc_share with a significance of 0.56. This significance of the correlation is almost at the 0.05 level. The cause of this might lay in an unexplored factor that is affected by environmental sources.

Next, we examine the effect of privacy related concerns on participation. We expect users who are more concerned with their privacy to participate less. Three t-tests (independent sample, $\alpha = 0.05$) were conducted to determine whether privacy concerned users issue less requests (*q_out*) on average than users who are not concerned with privacy. The first two groups include participants that responded $1-2$ and $3-5$ to the *loc_share* question. T-test results showed significant difference between the means of the two groups, implying that users who don't mind sharing their location send on average more requests than users who do not like sharing their location.

Similar groups were created according to the *no_res_strangers* and *res_acq* questions. Note the scale of these two questions is opposite to the scale of *loc_share*. Here, users that replied $4 - 5$ were in one group and users who replied $1 - 3$ were in the other. Both t-tests showed significant differences between the mean values of *q_out* of the respective groups. Our results support the hypothesis that privacy concerned participants send less requests on average than participants who are less concerned with privacy.

The two measurements, *no_res_strangers* and *res_acq*, negatively correlate with *q_out* at the significance of 0.05 and 0.01 levels respectively. This negative correlation implies, that the more users are concerned with privacy, the fewer requests they send. We believe that these users would abandon the application outside of a field trial. Correspondingly, there is a significant correlation at the 0.05 level between the *loc_share* and the *q_out* measurements. This strengthens our claim that the more privacy preserving a user is, the less requests she will initiate.

Next, we examine the relationship between privacy concerns and replying to requests. We found a significant correlation at the 0.05 level between the *filter_req* measurement and the *no_res_strangers* and *res_acq* measurements. We deduce that the more participants wish to avoid interactions with strangers, the more likely they are to be annoyed by requests. However, previously we noted that higher values of *filter_req* do not necessarily translate into lower *r_out*.

We check the effect of privacy concerns by conducting two t-tests. Again, we divide our population into two groups for every test. The first group consists of users that replied $4-5$ to *no_res_strangers* and the second group consists of users that replied $1-3$. Similarly, two groups were created for the *res_acq* measurement. Two t-tests (independent sample, $\alpha = 0.05$) on the two sets of groups show no significant difference in group means of *r_out* values. We infer that the actual replying pattern of privacy concerned users is not significantly different from the replying pattern of users that are less concerned about their privacy. Though their satisfaction from replying may be lower, their response rates are still high enough on average. For system developers this result would imply that if a low cost incentive exists that may keep these users in the community they can still be a valuable resource.

IV. Discussion and Conclusions

In order to understand the forces driving user participation in collaborative location based applications similar to Lookie, we conducted a two week field trial whose results are presented in this paper. In Section III-C, we presented the analysis of user interactions and perception thereof. Our results confirm that previous acquaintance increases the level of participation in collaborative applications such as Lookie. The implication of these results is twofold. First, in applications such as Lookie, existing social ties should be supported via integration to social networking services. Second, initial deployment of these applications should closely cover socially and geographically contained communities such as schools, colleges, etc.

It is important to determine the intended usage of the application by the members of the target community before deployment, for example, via bus-study questioners. However, asking users about their intended usage may also bring up controversial results as indicated in Section III-C3. None of the free-riders in the Lookie field trial admitted intended usage solely as a requester.

Furthermore, our results indicate that users' perceptions of their interactions de facto within the application is biased as well. Users have rather similar perspectives on the number of requests they sent. However, they perceive the number of incoming requests as a fraction of the requests they actively replied to.

From the perspective of user privacy concerns we see that the vast majority of the field trial participants do not mind responding to requests from strangers. On the one hand, system logs indicate that users who do not like responding to strangers send fewer requests. On the other hand, these users have the same reply ratio as the rest of the community. There are a few possible explanations for this bias. For example, these users could feel obligated to answer an incoming request, similar to other users. Alternatively, their attitude toward requests from strangers may depend on the context. Unkind or even distasteful requests, for example, can easily damage user experience. However, we did not observe a significant difference in the attitude toward Lookie between users with privacy concerns and those without.

While only a small fraction of users feel reluctant to communicate with strangers, a larger number of field trial participants expressed concerns about constant location sharing. A design emphasizing on anonymity could contribute to crowding in those types of users.

In order to mitigate inappropriate timing of requests, we propose an automatic *do not disturb* status should be available for potential responders.

Finally, the results of the field trial indicate that including a meaningful personal message in the request improves the responder user experience. It is easy to understand why helping others, by replying to a request, would be favorable if the requester truly needs help. Therefore, applications such as Lookie should encourage requesters to send more personal requests and avoid using a default request form.

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