Surfing a web of trust:

Reputation and Reciprocity on CouchSurfing.com

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***Abstract*—Reputation mechanisms are essential for online transactions, where the parties have little prior experience with one another. This is especially true when transactions result in offline interactions. There are few situations requiring more trust than letting a stranger sleep in your home, or conversely, staying on someone else's couch. Couchsurfing.com allows individuals to do just this. The global CouchSurfing network displays a high degree of reciprocal interaction and a large strongly connected component of individuals surfing the globe. This high degree of interaction and reciprocity among participants is enabled by a reputation system that allows individuals to vouch for one another. We find that the strength of a friendship tie is most predictive of whether an individual will vouch for another. However, vouches based on weak ties outnumber those between close friends. We discuss these and other factors that could inform a more robust reputation system.**

Keywords: CouchSurfing, social network, reputation system, trust

I. INTRODUCTION

The spread of online communities on the Web has allowed groups to form and personal connections to be made around a wide variety of shared interests and activities. These communities allow participants to interact across the globe and across time and organizational boundaries. Though these communities enable the exchange of goods and services between parties who do not know each other, these transactions often carry greater risk than those based on long-term offline relationships. This makes trust and reputation a crucial factor for users who are deciding whom to interact with. Reputation systems address this issue by collecting information about a user's history of interaction on a site and making it visible to other users. This has dual benefits: it allows users to judge others' trustworthiness based on their past behavior and feedback from others, and also provides incentives for users to be honest, as having a poor reputation will likely prevent others from interacting positively with them in the future [24].

Hospitality services are one specific type of online community in which reputation systems are particularly essential, as they are used by members to arrange offline experiences with others they have never met. In particular, the goal of hospitality services is to connect travelers looking for a place to stay with those in the local area willing to serve as temporary hosts. These stays are conducted without any monetary exchange, but rather with the broad goal of promoting cultural experiences and understanding between people of different backgrounds. Several active online hospitality services currently exist, including Servas International, Global Freeloaders, Hospitality Club, and CouchSurfing. CouchSurfing.com, the community which we study in this paper, is the by far the largest and most popular online hospitality service, with more than one million members representing 230 countries [10].

CouchSurfing relies on the reciprocity of members to support a lively exchange of visits. If all users wish to surf but not enough are willing or able to host, the service could support far fewer visits. We therefore study the nature of reciprocity on CouchSurfing, including how frequently direct reciprocity between a surfer and host occurs, as well as whether users "reciprocate" in general by taking the roles of both surfers and hosts.

After showing that the activity on CouchSurfing shows a great deal of direct and generalized reciprocity, we turn our attention to the reputation systems that enables such activities. CouchSurfing offers a multi-faceted reputation system that includes three components: physical verification, personal references, and vouching. The vouching system, which is the component we focus on, is a way for users to declare certain friends as trustworthy. Users can only vouch for others if they have at least three vouches themselves. Thus, vouching forms a circle of trust, and a somewhat-exclusive club of which only a small number of users (6.8%) are members. The purpose of the vouching system is to give members additional information to aid in judging whether another member is trustworthy for "hosting" a visitor or "surfing" on a host's couch. We aim to study the current efficacy of the vouching system, to see whether members are using it as the community designers intended and whether it is capable of effectively signaling which members are trustworthy.

In this paper, we examine the online activity of CouchSurfing.com to answer these questions about reciprocity and vouching. We start by detailing related work, then describe CouchSurfing and our data set in more depth. This is followed by analysis of network properties and patterns of user behavior for reciprocity as well as vouching. We conclude with discussion and avenues for future work.

II. Related Work

To our knowledge, the only other research related to trust on CouchSurfing was conducted by Bialski and Batorksi [4]. Their study focused on analyzing factors relating to higher trust between friends, and was conducted in 2006 before the vouching system on CouchSurfing had been implemented. They used the private trust ratings that friends can assign to their connections to determine trust; these same trust ratings are still being collected by CouchSurfing but were unavailable to us. Bialski and Batorski found that higher trust is most correlated with the origin and context of the relationship; friends who knew each other from offline trusted each other more than friends who met through the site, while the trustworthiness of friendships formed from hosting or surfing was less than that of offline relationships, but increased for stays of longer duration. They also found that in general, friendships that had been maintained for longer durations were more trusted than more recent friendships. While this prior work discusses members' private trust ratings, it is not able to tell us about how the public reputation system itself is functioning. In contrast, our work examines the different factors that may influence whether one vouches for a friend's trustworthiness when this act is visible to the entire community.

Previous work on trust and reputation in the context of online communities has touched on topics such as trust transitivity [20], propagation [15], and inference [13]. CouchSurfing's reputation system, however, includes unique features that distinguish it from other online communities and reflect the strong need to build trust among its users. An example is the explicit rating of friendship type for each friend connection. By requiring users to choose a friendship type for each connection, CouchSurfing is able to overcome the issues other social networks have in eliciting this information when it is made optional [17]. Additionally, while other online communities will often encourage users to indicate a large number of transient, weakly connected friendships, CouchSurfing does the opposite. Adding many weak friendships may in fact harm how trustworthy others deem one to be, and vouching for those whom one does not know well enough to trust is also taboo.

Other avenues of research have included developing robust trust models for online communities. Caverlee, Liu & Webb note that trust models on online communities often fall short when they only count quantity of recommendations, but not the source or relationship to the source of the recommendation [5]. SocialTrust, a proposed framework that does incorporate these additional factors, was shown to be more resilient to malicious activities of users than PageRank [23] and TrustRank [16]. In this paper, we similarly explore both local and global network trust metrics for CouchSurfing's vouch and social networks.

As for reciprocity, this concept has been studied in many forms. Molz has examined the meaning of reciprocity in the context of hospitality exchanges [21]. She found that though reciprocity is not strictly enforced on hospitality services, it is certainly encouraged as a community norm through statements on the sites as well as displays on member profiles that show how often a member travels versus hosts. From this feedback of users' activities, those who are obvious freeloaders and are using the service simply to find a free place to stay can be recognized as such.

Other researchers have studied what motivates users to help others on online communities. For example, Constant, Sproull & Kiesler found that people can be motivated to help others, even in the absence of direct acquaintance, similarity, or likelihood of direct reciprocation [7]. Instead, the motivation can come about because of personal benefits such as self-esteem, or because of a desire to help the organization. This latter motivation can cause *generalized reciprocity* to come about, in which people offer help because others have helped them in the past and they expect others will help them again in the future. Baker [2], who studied generalized reciprocity from an organizational perspective, found that it can cause such benefits as elevated trust and greater connectivity and cohesion within a group.

III. CouchSurfing

CouchSurfing.com is a "worldwide network for making connections between travelers and the local communities they visit" [9]. This mission is carried out every day by the hundreds of thousands of users who participate in the site, whether it be through advertising their own couch so travelers can stay with them, looking for a couch themselves when traveling in a foreign city, or finding and participating in local CouchSurfing meetups in their area. Established in 2004, CouchSurfing has grown steadily since then to cross the million-member mark early in 2009. As a nonprofit organization, CouchSurfing's mission is to "internationally network people and places, create educational exchanges, raise collective consciousness, spread tolerance, and facilitate cultural understanding" [8].

Besides vouching, the two other components of the reputation system on CouchSurfing are verification and references. Verification happens when members pay a small fee to have their name and physical address confirmed; this step is optional but can help users gain others' trust. References, however, are ratings and feedback left by members on others' profiles. After a couchsurfing experience takes place, it is the norm for the two members involved to rate the experience as positive, neutral, or negative. As seen by statistics available on the site, only a very small percentage of experiences are rated negatively (0.17% in the last week), showing a strong pressure against negative feedback [10]. This is consistent with findings from other reputation systems, such as eBay [24].

IV. The Data

The data set provided to us by CouchSurfing consisted of anonymized information for 666,541 users with 1,541,398 edges (connections) between them; this was the entire network, as it existed in early 2008. Attributes of the nodes and edges are listed below. Figure 1 shows the way the edge attributes are made visible on the profile of one user.

User attributes include:

- City
- Country

- Date the user joined CouchSurfing
- Number of profile views

For each friendship connection, there exist two directed edges. Associated with each directed edge is the data that one of the users provided about their friendship connection with the other. The attributes for each pair of edges do not necessarily align. For example, one friend may have a different opinion than the other on how strong the friendship is.

Edge attributes include:

- Whether they have met in person (yes/no)
- How they met (Not on CS, Chat, Meeting, etc.)
- Friendship type (1=Haven't met yet, 2=Acquaintance, 3=CouchSurfing friend, 4=Friend, 5=Good friend, 6=Close friend, 7=Best friend)
- Number of days traveled together
- Number of days hosted
- Number of days surfed
- Whether the user has vouched for the other (yes/no)
- The rating of the reference (-2=extremely negative, 1=negative, 0=no reference or neutral, 1=positive, 2=extremely positive)
- The date the friendship connection was made

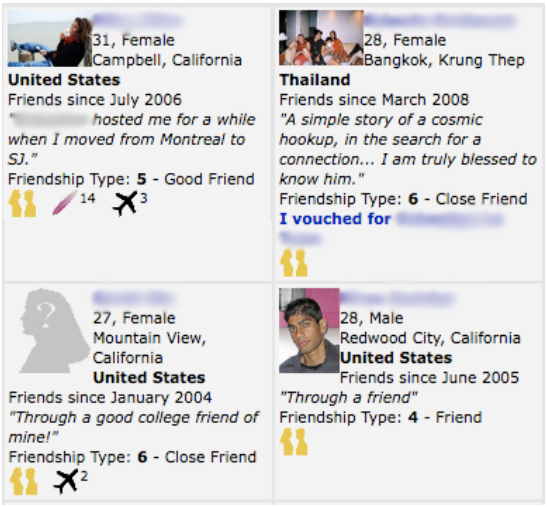

Figure 1. Example of friendship connection data from a user's profile

V. Network Characteristics

A. Uneven participation

As is common on online communities, users' participation on CouchSurfing is unevenly distributed. Figure 2 shows the frequency distribution of number of surfing and hosting events per user. It can be seen that many users have surfed or hosted very few times, while only a few have surfed or hosted many times. This is similar to the uneven participation distributions found in other types of online communities such as question and answer forums [1], collaborative tagging systems [16], newsgroups [12], and wikis [18].

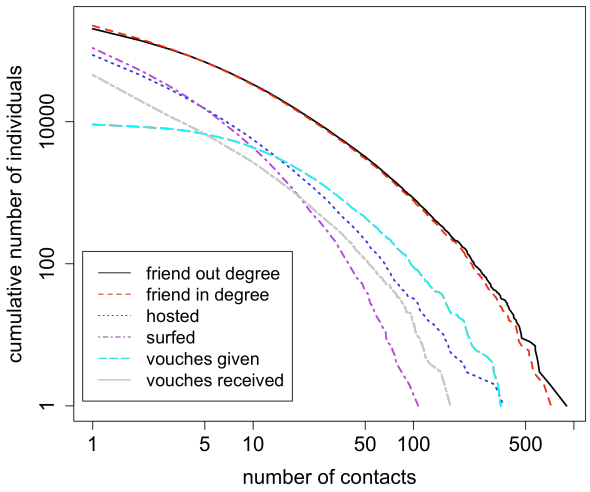

Figure 2. Frequency distributions of various kinds of connections users make on the site.

B. Skewed distribution of friendship connections

Figure 2 shows that the number of friendship connections and vouched friendships that users have on CouchSurfing is also highly skewed. A large number of members have a very small number of friends (in fact, 62% of users do not have any friendship connections at all) and a few members have a disproportionately large number of friends (the highest is 902). This skewed distribution is expected, as it is similar to those found on other online social networks [22]. This distribution can occur due to preferential attachment – individuals with many friends on the site are more easily discovered by browsing friend lists and so tend to accrue even more friends over time [3].

VI. Reciprocity in Surfing and Hosting

One of the key functions of online communities such as CouchSurfing is to enable a form of generalized reciprocity [2]. Individual A may host B, but B need not reciprocate directly by hosting A. Rather B may host another member of the CouchSurfing community. Or, if B is not motivated to reciprocate, they may opt to not host anyone at all and instead only surf. It is therefore of interest both whether users reciprocate in a general sense by being both hosts and surfers, as well as whether they practice direct reciprocity by hosting a person who hosted them.

We observe that between 12 and 18% of the visits are directly reciprocated. The number is only approximate because reports of stays are not always updated on the site by both users (A may report hosting B, but B might not report having surfed A's couch). Still, this number is significant, and shows that meaningful personal connections are being made through Couchsurfing such that the people involved sometimes stay in contact and eventually reciprocate the exchange. Indeed, many anecdotes on the CouchSurfing website from users talk about how lifelong connections have been made because of positive couchsurfing experiences [11].

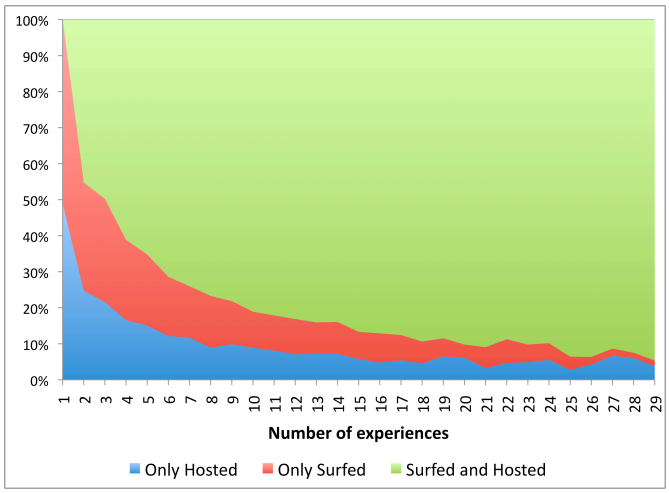

Figure 3. Percentage of users who only surf, only host, or do both, as a function of number of surfing and hosting experiences

To address the question of generalized reciprocity, we began by looking at the number of users who only surfed, only hosted, or did both, as a function of the total number of hosting and/or surfing activities they reported. Figure 3 shows that users may start by only surfing or only hosting, but then rapidly become engaged in both activities. Interestingly, a user is equally likely to surf or host initially, indicating a balanced preference for either activity from the start. The majority of users with more than 10 experiences have fulfilled both surfing and hosting roles, and indeed, the number of times a member has surfed and hosted are highly correlated ($\rho = 0.779$).

One can also extend the idea of reciprocity to the level of entire countries. Some countries may do more hosting, while residents of others may be hosted more often. Figure 5 shows a visualization of the exchange of surfers between countries. Some countries are internally more active than others, and some regions of the world are more actively trading with one another than others. For example, North America, Europe, and Australia/New Zealand have frequent exchanges, although other parts of the globe are active as well. Interestingly, although we expected desirable destinations such as New Zealand or France to host more than they surf, it was countries such as the United States, Australia, and Germany that were doing more hosting than were being hosted, perhaps because of the large number of members from these countries.

Finally, we looked at the "surfing" network of the 150,000 users who either surfed or hosted, with 500,000 edges between them. Fully 55,185 or roughly a third of the users who surfed are in the giant strongly connected component. This means that one could hop from couch to couch and eventually reach any of these users from any other by following previous surfs. Such a broad, global, and active network must be supported by an underlying network of trust. We next turn to our attention to the vouch system, which enables this network of trust to form.

VII. VOUCH NETWORK

CouchSurfing is very adamant on its website about how the vouching system is to be used. Their instructions state, "The vouching system on CouchSurfing.com is a security measure. We take it VERY SERIOUSLY. Respecting the significance of vouching is essential to the integrity of the network. Once vouched for three times, you can vouch for any of your good friends. It is very important that you ONLY vouch for people that you have met in person and know well enough to believe that he or she is trustworthy" [25].

Figure 4. CouchSurfing activity across the globe. Nodes are sized according to the amount of country-internal surfing. Only edges with more than 20 days of surfing between two countries are shown.

CouchSurfing certainly hopes that its members will consider this information seriously when they decide to vouch for someone. To verify this, we examined the vouch network, which is the subset of the network made up of only nodes that are vouched and the vouched edges between them. In particular, we were interested in determining the characteristics of those who are doing the vouching and those who are being vouched.

Of the 666,541 users, 45,543 (6.8%) are vouched at least once. Although this number may seem low, it is in part a reflection of the skew in activity on the part of the users. The more active the user, the more likely he or she is to be vouched: 82% of 'active' members (those with 5 or more friends) have been vouched; this number increases to 95% for those with 10 friends or more. A further 11,961 (1.8% of all users) are vouched at least three times, meaning that they can now vouch for others. A majority (9,133) of these members have exercised their ability to vouch. Figure 2 shows the skewed distribution of the number of vouches given out by the members who are able to vouch, with an average of 15.07 vouches given.

Similarly, although only a small portion of all edges (8.9%) are vouched, roughly a quarter of the edges that can be vouched are. More specifically, among the 530,494 friendship connections (34.4% of all edges) where the individual has the ability to vouch, 25.9% are vouched. Reciprocity is also high. When A vouches for B, and B has the ability to vouch, the vouch is reciprocated in 74.6% of the cases.

There are multiple ways of interpreting the high rate of vouches on edges. One is that the site has successfully established a tight web of trust. But another is that users vouch too freely. Similarly, a high degree of reciprocity may reflect mutual trust, or it may simply reflect pressure or expectation to reciprocate. We therefore further examine the characteristics of vouched edges.

1) Relationship between vouching and friendship degree

Consistent with previous work on private trust networks [4], our analysis finds vouching to be related to friendship degree. For example, best friends (friendship degree 7) are much more likely to vouch for each other compared to acquaintances (friendship degree 2); 60.7% of best friends vouch each other but only 0.38% of acquaintances do.

At first, it may appear that the system is functioning as intended, and that those users who know each other very well are the ones vouching for one another. However, best friendships constitute a minority of all edges in the network, such that other types of friendships, despite a lower rate of vouching may constitute most of the vouch network.

Many of the connections in the network are between members whose friendship connection is degree 3, or "CouchSurfing friend". CouchSurfing friend is a designation created but not fully explained on the site – it is intended to mean that the users became friends because of their activities on the site, such as chatting in the chat room, posting in the groups, going to local meetings, or couchsurfing with each other. Of all the connections that are CouchSurfing friends,

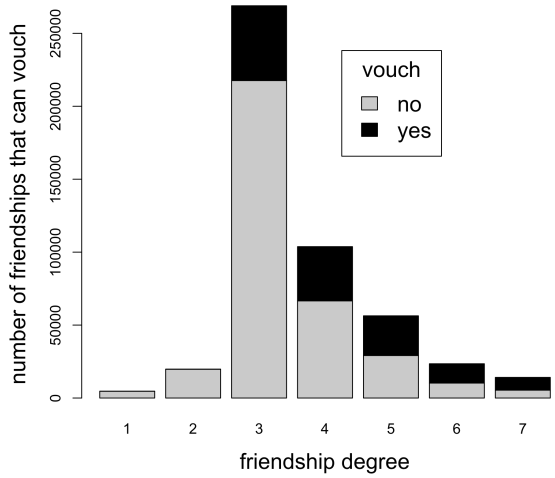

Figure 5. All friendships from a person who is able to vouch for others, by friendship degree and whether the edge is vouched.

19% have vouched for each other. This is just a third the rate of vouching for best friends, but over 50 times the rate of vouching for acquaintances. The consequence of this high vouch rate becomes clear in Figure 5, which shows the breakdown of vouching based on the friendship degree. Note that CouchSurfing friendships constitute many of the vouched edges.

2) Relationship between vouching and 'how they met'

CouchSurfing allows its users to note not just the degree or strength of the tie, but its origin as well. As Figure 8 shows, the two are related. Those who met outside of CS tend to be closer than those who met through various online CS activities. The latter group are most likely to be "CouchSurfing friends" (level 3).

Next we analyzed whether vouching also depended on how the members first met (see Figure 7). The percentages of

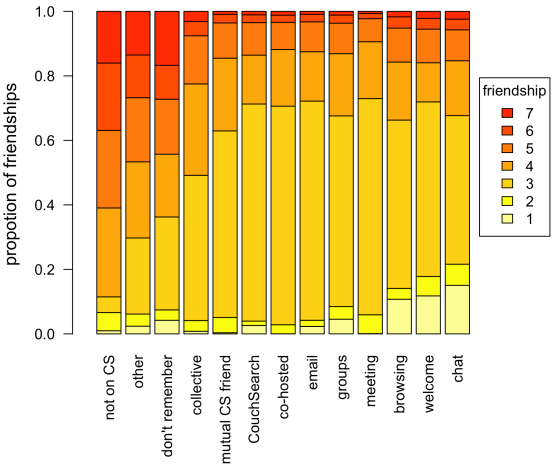

Figure 6. The strength of the friendship tie is related to how the users met.

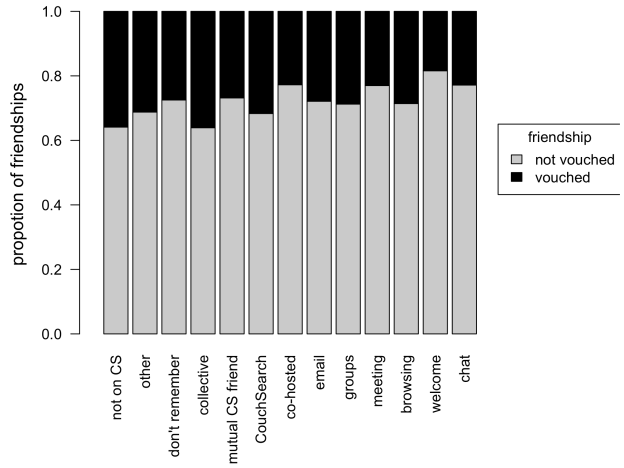

Figure 7. Percentage of vouches as a function of how users initially met.

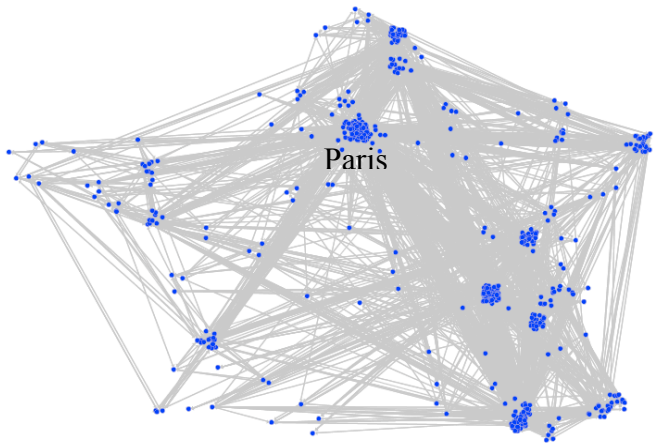

Figure 8. Geographic layout of nodes and edges for users in France

members vouching each other in each of the 13 different meeting options were fairly similar and ranged from 18% for those who met through new member welcomes on the site, to 36% for those who met outside of CouchSurfing. Surprisingly, vouching has relatively little to do with how two individuals met, but instead is more strongly dependent on the friendship type.

We note that those users who met through CouchSurfing collectives are just as likely to vouch for each other as those who met outside of CouchSurfing. This suggests, although the differences are slight, that CouchSurfing activities that allow friendships to transition and grow offline are more likely to result in vouches. CouchSurfing collectives are gatherings of volunteers that are intended to foster close ties between members as they work together on improving the site. Collectives may help members transition from being CouchSurfing friends to being friends by a broader definition of the word.

3) Vouches between CouchSurfing friends

Because CouchSurfing friendships account for so many of the vouches, we further examine their origin. Many of them (27.2%), originate at CouchSurfing meetings, which are social events organized by members in a local area, frequently held in pubs or bars. This figure is most pronounced, however, in large cities such as Paris, which has more members than any other city and thus has frequent local meetings. Of the members in Paris, 52% of the friendship connections between 'active' users (those with 5 or more friends) were between members who met at local meetings. Figure 8 shows the friendship connections between members in France, as well as the clusters of members in cities such as Paris.

We find evidence that living in a big city where many meetings take place can affect vouching activity. Overall for the entire CS network, 17.5% of vouches were between members in the same city. Of these vouches in the same city, 28.7% were between members who had met at meetings. These figures are much larger in cities with many meetings such as Paris, where 80% of vouches were between those who had met at meetings. Whether vouching for someone whom one potentially doesn't know very well (a CS friend) or was met in only one social context (meetings) is helpful or detrimental is an interesting question for further study.

4) Factors that contribute to vouching

Finally, we sought to quantify the factors that contribute in one person vouching for one another. We took all connections that were vouched, along with any connections that had the potential to be vouched (where the user from whom the connection originated had at least 3 vouches). There were 137,631 vouched edges and 392,863 edges that potentially could have had vouches but did not.

We built a balanced set of 100,000 randomly sampled vouched edges and the same number of unvouched edges. We then ran a logistic regression model using 10-fold cross validation in order to discern which variables would most accurately predict a vouched edge. Our overall accuracy as to whether an edge would be vouched or not was 71%, compared to a 50% accuracy one would have with a random guess. Table 1 lists the variables in order from most to least significant. All coefficients are significant at the ($p < 0.001$) level.

TABLE I. PREDICTING WHETHER AN EDGE WILL BE VOUCHED.

Variable	Coefficient (standard error)
friendship degree	0.162 (0.005)
overall experience	0.127 (0.001)
how met	separate coefficients
Jaccard coefficient	0.975 (0.020)
degree from/1000	0.520 (0.013)
degree to/1000	0.496 (0.016)
met in person	0.525 (0.005)
views from/million	3.007 (0.1639)
surfed/1000 days	1.925 (0.247)
same country	0.015 (0.002)
views to/million	1.219 (0.1876)

The most predictive variable was the friendship degree, followed by how positive the couchsurfing experience was, and how the two friends met. Other significant variables in the regression were the Jaccard similarity coefficient of the two users' friends and whether the friends met in person.

The correlation between friendship strength and vouch makes sense, as a vouch is basically an indicator that the person is trustworthy as a very close friend would be. Of course there are certainly exceptions, as on occasion one has a dear friend whom one would rather not have sleeping on one's couch. Positivity of couchsurfing experience also makes sense as this would imply there was a couchsurfing experience between the users to begin with, and the better the experience, the more likely a vouch would occur. The Jaccard coefficient, representing the number of friends two individuals have in common, is a measure of embeddedness of the tie. Two individuals who share many friends are part of the same clique or community, and this correlates positively with trust.

We also see a positive correlation in the level of CS activity of both the voucher and the vouchee, as reflected in how many friends they have and how often their profiles are viewed. It is expected that more trustworthy individuals would be more popular within the context of CouchSurfing. But it also raises the question of whether one can become vouched by strategically amassing friends online.

As mentioned above, 74.6% of vouched edges are reciprocated. Unsurprisingly, when one includes a factor corresponding to whether the edge is vouched in the opposite direction, the accuracy of the vouch prediction model increases by 5%, to 76%.

Finally, we examine whether indirect or global measures of trust can be predictive of vouching between individuals. Our two-step indirect measure propagates vouches as follows. If A vouches for B and C, both of whom vouch for D, then the indirect vouch score for the edge A->D is [1/n(B)+1/n(C)], where n(B) and n(C) are the number of vouches made by B and C respectively. We divide by the number of vouches each person makes to correct for individuals who may be too liberal in handing them out.

As a global measure we apply PageRank to the vouch network, with 10% of the edges removed. It is these 10% of the edges that we then aim to predict. To create a balanced set, we include additional unvouched friendship edges. Using a logistic regression for each variable alone we find that friendship type is most predictive (67.7%), followed by the Jaccard coefficient (55.8%) and 2-step vouch propagation (54.2%). Finally, the global PageRank measure is least predictive, yielding little advantage past a random guess (50.6%).

The above results indicate that whether a person will vouch for another is strongly localized on the network – depending primarily on the closeness of the relationship, followed by indirect yet still local ties, and finally by a global trust metric. Reputation systems that rank individuals without locality or context may well miss this important facet. In fact, the CouchSurfing search interface already adds context by ranking individuals returned in a search result according to their proximity in the network and the strength of the intermediate ties.

VIII. Conclusions and Future Work

In this paper we explored CouchSurfing, a large and active online community, which due to the nature of the hospitality activities it supports, depends on reciprocity and trust among its users. Our study of both the surfing activities, and the social and vouch networks, yielded several findings that we hope will help CouchSurfing and other online communities improve the quality of their reputation systems.

First, we find CouchSurfing to be a community rife with generalized reciprocity: active participants take on the role of both hosts and surfers, in roughly equal proportion. About a third of those who hosted or surfed are in the giant strongly connected component, such that one couch can be reached from any other by following previous surfs across the globe. This is in contrast to other online communities, such as question & answer communities, where the core may comprise only a few percent of all users, with the majority either exclusively asking or answering [1].

The high degree of activity and reciprocity is enabled by a reputation system wherein users vouch for one another. We found that connections that are vouched, or declared trustworthy, on CouchSurfing can best be predicted based on the direct interaction between the two individuals: their friendship degree, followed by the overall experience from surfing or hosting with the other person, and also how the two friends met. The correspondence between friendship degree and trust shows that other online communities could benefit from adding friendship degree to their friendship connections, as this information can aid members in determining how much trust may lie behind a friendship. On the other hand, global measures that aim to propagate trust, such as PageRank, are poor predictors of whether an edge is vouched. This suggests that although such metrics may be useful in assigning overall reputation scores to individuals, they are too diffuse to predict specifically whether one individual will vouch for another.

Finally, our analysis revealed a high rate of vouching: about a quarter of all edges that can be vouched are, as are a majority of highly active users. While this could be reflection of a healthy web of trust, there are indications that vouches may be given too freely. For example, many of the vouches were exchanged between individuals who had met through CS meetings, and were "CouchSurfing friends". Anecdotally, many members complain on the site's message boards about this issue, saying that these vouches artificially inflate the trustworthiness of those who have the benefit of living in cities with many CS meetings. It is certainly possible that members who meet at the gatherings may eventually become very good friends, however it is unlikely that so many people do. In future work, we would like to conduct surveys to elicit whether these vouches are in fact of lower quality, and if so, how this issue can be addressed.

Another reason behind the high rate of vouching may be its public nature. It can be awkward for friends to not give or reciprocate a vouch, even if privately they have reservations about the trustworthiness of the other person. In future work we would like to directly compare the public vouch network with the private trust ratings individuals assign to others, to compare which reputation mechanism produces more reliable trust ratings.

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