

To Befriend Or Not? A Model of Friend Request Acceptance on Facebook

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ABSTRACT

Accepting friend requests from strangers in Facebook-like online social networks is known to be a risky behavior. Still, empirical evidence suggests that Facebook users often accept such requests with high rate. As a first step towards technology support of users in their decisions about friend requests, we investigate why users accept such requests. We conducted two studies of users' befriending behavior on Facebook. Based on 20 interviews with active Facebook users, we developed a friend request acceptance model that explains how various factors influence user acceptance behavior. To test and refine our model, we also conducted a confirmatory study with 397 participants using Amazon Mechanical Turk. We found that four factors significantly impact the receiver's decision, namely, knowing the requester's in real world, having common hobbies or interests, having mutual friends, and the closeness of mutual friends. Based on our findings, we offer design guidelines for improving the usability of the corresponding user interfaces.

1. INTRODUCTION

Users of Facebook-like online social networks (FOSN) are not careful when accepting friend requests from strangers, i.e., those who they do not know in real life or online communities [3, 20]. This behavior can be exploited by an attacker to run an infiltration campaign in a target FOSN [6]. Such malicious campaigns are a growing cyber-security threat [9], where an attacker controls a set of user accounts and exploits them to befriend a large number of benign users.

Large-scale infiltration has three alarming security implications [6]: First, the social graph of the target FOSN is compromised and polluted with a large number of non-genuine social relationships. This means that third-party services and websites have to perform appropriate "cleaning" to mask out fake accounts and their relationships before integrating with or using such a FOSN. Second, and other than online surveillance, the attacker can breach the privacy of users and collect large amounts of personally identifying information (PII), such as email addresses, phone numbers and birthdates, which have considerable monetary value in the Internet underground markets [5]. In addition, this information can be used to

run follow up, highly personalized e-mail spam and phishing campaigns [16]. Third, the attacker can exploit the infiltrated FOSN to spread misinformation as a form of political astroturfing [23], or even influence algorithmic trading that uses opinions extracted from FOSNs to predict stock markets [2, 4].

Preventing large-scale infiltration, or at least limiting its scale and impact, is important not only to users but also to FOSN operators and social media-based businesses. Improved technology support for FOSN users in helping them to make better decisions in regards to friend requests is expected to reduce the associated risk. This, however, requires a better understanding of user's befriending behavior in FOSNs, particularly what makes them to accept or decline friendship requests.

Our research bridges this knowledge gap. In particular, we aim to answer the following general research question: *Why do FOSN users accept friend requests from strangers?* In our studies, we focused on the scenario where a FOSN user receives a friend request from another, a stranger in particular, and investigated the factors that influence the user's decision on whether to accept this request. Moreover, we also studied the process that users go through, when accepting friend requests, including identity verification, new friend management, and privacy settings updates.

In order to understand users' behavior in FOSNs, we designed two studies: a qualitative, exploratory study and a quantitative, confirmatory study. We received an approval for both studies from our university's research ethics board.

First, we conducted a set of semi-structured interviews with 20 active Facebook users (Section 2). The goal of conducting this exploratory study was to understand users' behavior in FOSNs in response to friend requests, and explore the factors that influence their decisions. To the best of our knowledge, there is no related qualitative work to support our research questions. Therefore, we used Grounded Theory [8] in our exploration to develop a model that captures such a behavior.

In the confirmatory study (Section 3), we refined and partially tested the developed model, by conducting an online survey among 397 Mechanical Turk (M-Turk) workers. The goal was to identify prominent factors that highly impacted users' decisions in practice.

Based on our findings, we offer guidelines on designing FOSN interfaces for reviewing and responding to friend requests (Section 4). While defending against large-scale infiltration is challenging [7], we hope that progress in this research direction will lead to the improvement of existing security defences and make them less vulnerable to both human exploits (i.e., automated social engineering [15]) and technical exploits (i.e., platform hacks [26]).

To summarize, this paper has the following contributions:

1. We developed a model for online lifecycle of Facebook friendship acceptance, which explains the factors that influence

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Symposium on Usable Privacy and Security (SOUPS) 2014, July 9–11, 2014, Menlo Park, CA.

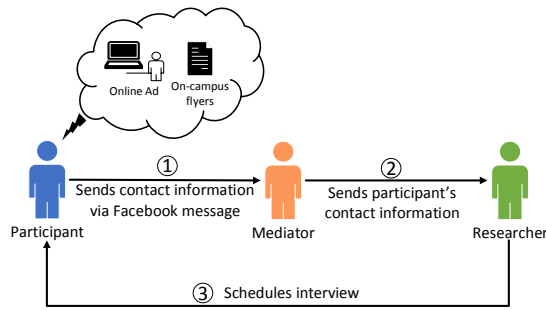


Figure 1: Mediator role

users' behavior in response to friend requests.

2. We characterized such factors and analyzed their impact on users' decision with regards to friend requests. We also identified four factors that significantly impact users' befriending decisions.
3. Based on both qualitative and quantitative results, we suggest design guidelines for FOSN interfaces that we expect can help users make informed decisions about friend requests.

2. EXPLORATORY STUDY

The study was in the form of semi-structured interviews. In what follows, we give more details about the study, including research questions, recruitment procedure, data collection and analysis.

2.1 Grounded Theory

We chose Grounded Theory as the approach of this study as it is an appropriate method for research in areas that have not been previously explored, especially when a new perspective might be beneficial [24]. Among different ways to apply Grounded Theory [13, 10, 8], we chose to follow the definition proposed by Charmaz [8] because it provides a more flexible format for data analysis.

2.2 Research Questions

In the exploratory study, we aimed to understand users' befriending behavior in response to friend requests, and to explore the factors that impact their decision. By applying the procedures of Grounded Theory coding, we were able to find new information, concepts, themes, and categories to develop a theoretical model, which helped in answering the following research questions:

- **RQ1:** What are the factors that influence users' decisions when responding to friend requests in general, and to friend requests sent by strangers in particular?

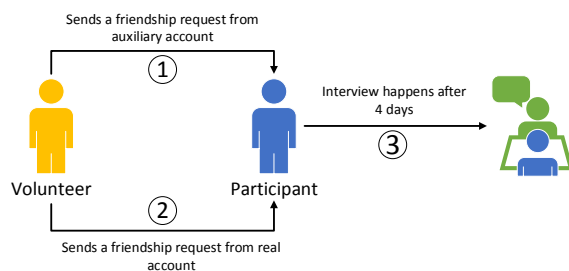


Figure 2: Volunteer role

- **RQ2:** What are the actions the users take before making a decision about a friend request?
- **RQ3:** What are the actions the users take after making a decision about a friend request?

2.3 Participant Recruitment

We posted the recruitment notices on local Craigslist and Kijiji websites. We also distributed flyers across our university's campus. In the recruitment notice, we included a brief description of the study and a hyper-link to an existing Facebook profile, and asked potential participants to send a personal message to that profile describing their interest, along with their email addresses.

We asked potential participants for their email addresses so that we have a reliable way to communicate urgent messages without depending on Facebook (e.g., unplanned changes in the interview schedule).

The owner of the profile was a graduate student in our department who was not affiliated with our research lab and was recruited to mediate the initial communication with potential participants. The purpose of recruiting a third party (i.e., the mediator) was to avoid any potential linkage between the user profile used for recruitment and our study. The mediator signed a non-disclosure agreement stating that all data collected through mediation would be immediately erased after relaying them to us, and that all information about the study would not be shared externally.

Overall, the mediator, denoted by M , operated under the following protocol, as illustrated in Figure 1:

1. A potential participant P uses Facebook to send a personal message to the mediator M , which contains P 's email address and interest in the study.
2. M sends to the dedicated researcher an email including P 's Facebook user identifier along with P 's email address.
3. Once the researcher receives the email from M , he asks M to permanently delete the message that was sent by P and not to respond to any interactions initiated by P .

Using the email addresses of potential participants, we used email to schedule interviews with them. We used the mediator to avoid inaccuracies due to self-reporting, when it came to identifying which of our participants tend to accept friend requests from strangers. This is why we had another volunteer who sent prospective participants friend requests from two other dedicated Facebook user profiles. The first user profile was a real account managed by another volunteer, while the second one was an auxiliary account that we created for the purpose of this study.¹ We aimed at reducing the chances that the participants knew the real account. To this end, we excluded students in our department from participating in the study.

As illustrated in Figure 2, the volunteer controlled both accounts and sent friend requests to potential participants according to our instructions. The volunteer, who was a graduate student from our department but not affiliated with our research lab, signed a non-disclosure agreement that prohibited him from both interacting with potential participants and sharing any collected information.

To avoid any suspicion among the participants in regards to the volunteer's account, we asked the volunteer to remove Facebook friends made for the purpose of the study after the interviews were finished, rather than before the interviews. While there was a risk

¹The auxiliary account represented a male graduate student attending our university. The profile included a publicly available, generic picture of a man in his mid 20's.

of two participants having a pre-existing social connection (either online or offline) and seeing that the one is a friend with the volunteers, which could have influenced the other participant, none of the interviewed participants indicated that this was the case.

After each interview, we sent a debriefing message via Facebook to thank the participants for their interest in our study and provided them with more details about our research.

2.4 Data Collection

Our interviews were semi-structured, which gave us the flexibility to adjust and add new questions. We performed data analysis concurrently with the interviews in order to inform each new interview with the results obtained from the previous ones.

Each interview followed roughly the interview guide reproduced in Appendix A and had the following 6 parts:

1. Overview of the project.
2. Participants' demographics (e.g., age, gender, education, occupation, language) and Facebook usage-related questions (e.g., membership time, frequency of usage).
3. Participants' befriending behavior in general, and their responses to friend requests in particular. For instance, we asked questions about participant's friends, factors or criteria they employ to make a decisions about friend requests.
4. Participants' attitude towards their privacy and security.
5. Participants' attitude towards befriending strangers, and whether they had befriended strangers before.
6. Debriefing participants and concluding the interview. During this part of the interview, we also informed them about the friend requests that our volunteer sent. We observed each participant's reaction and asked each participant who accepted any of the two requests why they did so. We also asked participants if they had any suggestions regarding the interface design that might help them make more informed decisions.

As an iterative process, we analyzed the data by searching for patterns and forming concepts that were gathered into categories. We also wrote memos during the process of analysis to capture our understanding about the emerging categories and relationships among them.

Thanks to the iterative data analysis performed between interviews, we were able to detect "theoretical saturation" [14]. After 15 interviews, as Figure 3 shows, we reached the plateau where further data collection did not add new categories. This is why we stopped data collection after interviewing 20 participants. Their demographics are summarized in Table 1. All interviews were conducted in person at our university's campus. Each interview took about 50 minutes on average.

2.5 Data Analysis

As specified earlier, we employed Grounded Theory for the exploratory study. In Grounded Theory, data analysis involves searching for the concepts behind the answers. We transcribed, anonymized, and analyzed the collected data after each interview with an average turn-around time of 4 days. We used a web application tool called Dedoose for the analysis [1]. In what follows, we describe each part of the analysis in detail.

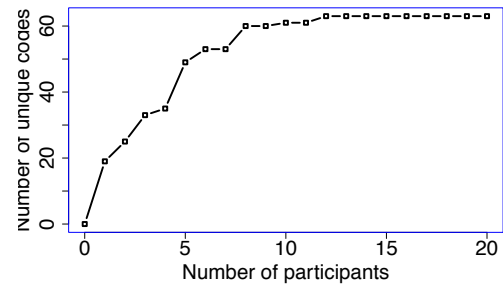


Figure 3: Theoretical saturation of interview data

2.5.1 Open coding

As the first step of coding, we identified, named, described, and categorized phenomena found in the collected data. Open coding resulted in a set of 63 unique codes, including both abstract (e.g., befriending behavior) and concrete labels (e.g., Facebook frequency of use). The intuition behind having abstract labels was to help develop a model. At the end, we had in total 2,620 coded excerpts, with an average of 131 per interview. We performed triangulation by having two other coders on four of the interview transcripts (interviews numbers 2, 6, 8, 11). The codes generated by the other two coders turned out to be subsets of codes generated by the main coder.

2.5.2 Axial coding

After open coding, we started to relate the generated codes to each other and ended up with 7 categories grounded in the collected data. The categories are *friendship factors*, *privacy and security awareness or concerns*, *investigation actions*, *decision execution*, *maintenance actions*, *environmental factors*, and *interface capabilities*.

2.5.3 Selective coding

The aim of selective coding was twofold: (1) to identify the main category, which ended up being **decision making process for friend requests**; and (2) discarded all categories that were not related to the core category, e.g., *fancy interface features*. Finally, we read the transcripts again and selectively coded any data related to the core category.

| Demographics Type | Range | # of Participants |
|-----------------------------|----------|-------------------|
| Age | 19-29 | 11 |
| | 30-39 | 6 |
| | 40-49 | 2 |
| | 50-59 | 0 |
| | 60-69 | 1 |
| Gender | Female | 12 |
| | Male | 8 |
| Facebook Membership (years) | 0-2 | 7 |
| | 2-4 | 9 |
| | 4-6 | 3 |
| | 6-8 | 1 |
| Facebook Friends | 0-100 | 6 |
| | 100-500 | 9 |
| | 500-1000 | 5 |

Table 1: Demographics of interview participants

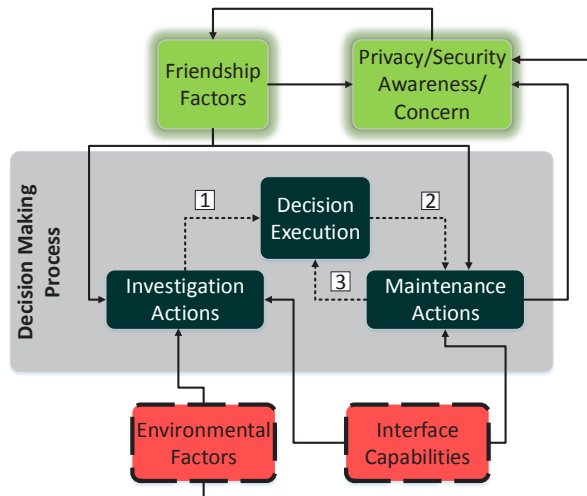


Figure 4: Online Lifecycle of Facebook Friend Acceptance (OLFFA) model. Shaded components on the top are the internal factors and components with hyphenated borders are the external factors. The middle box, which includes 3 components, represents the decision making process. The dashed arrows represent decision making flow. The solid arrows represent the impact of components on each other.

2.5.4 Theoretical coding

During this stage of analysis, we applied to the data the developed theoretical model. We integrated the model into related data in order to explain the core category. The outcome was a grounded model, or theory, about the lifecycle of Facebook friend acceptance, which we discuss in the following section.

2.6 Results

We now present the results of our exploratory study. First, we start by discussing the overall model, and then continue with detailed descriptions of the model components and the relationships among them.

2.6.1 The Overall Model

We refer to the developed model as the **Online Lifecycle of Facebook Friend Acceptance (OLFFA)**. It includes 7 components, as shown in Figure 4. Each component is derived through the coding steps that were described earlier and is representative of a set of users' behaviors.

The factors that we found to have influence on the process of users' decision making can be categorized into four groups, to which we refer as components: Friendship Factors, Privacy and Security Awareness and Concerns, Environmental Factors, and Interface Capabilities. Since the first two components (green shaded rectangles in Figure 4) are user-specific and subjective, we considered them as *internal* (to the user). On the other hand, since a user does not have any direct control over the last two components (red rectangles with hyphenated borders), we call them *external* factors. The components inside the large grey box in the middle of the figure represent the decision making process, and the numeric labels indicate the flow of actions associated with decisions. The rest of this section discusses each of the components and the relationships among them.

2.6.2 Friendship Factors

This is the component that was brought up and discussed by all of the participants. Friendship Factors impacts Privacy and Security Awareness and Concerns of users in the sense that when users employ more restricted friendship factors, they become more sensitive about their profiles' privacy and security.

On the other hand, Friendship Factors could be impacted by Privacy and Security Awareness and Concerns. This happens when the Friendship Factors that the users employ change due to an adjustment of their view on their profiles' privacy and security:

“Well, from the time my brother’s account on LinkedIn was hacked, I have always concern to have my info available on the internet. So I started to accept people that I feel comfortable to share my info with them. Not like before that I was accepting almost everyone.” (P9)

As the result, a user could become more conservative in making new friendships. A reverse change could happen as well.

This component also impacts Investigation Actions and Maintenance Actions. For instance, if a user relies on the similarity of backgrounds for making friendships on Facebook, an investigative action could be to check out the requester’s profile in order to see her background. Similarly, finding and removing passive friends is another example of maintenance actions driven by friendship factors.

Here is the list of Friendship Factors we have discovered:

- **Knowing the person in the real world (KRL):** It was reported by participants that they care about knowing people in real world or at least in online communities (e.g., forums), when they consider accepting friend requests on Facebook. For instance, P5 said:

“If I do not know them, I do not accept them. I mean I should have seen a person at least once to accept them as Facebook friend.”

- **Profile picture (PRP):** The profile picture is one of the most important factors for users. We encountered users who usually spend only a few seconds to decide about friendship requests. Those users pay attention to only the profile picture, as the fastest way to make their decision. As P4 puts it:

“I can really know from pictures. If you do not have a picture then I do not know you!”

- **Profile name (PRN):** Similar to profile pictures, the profile name is used by users especially for the case when they want to instantly decide about friendship requests. They prefer to receive requests from recognizable names, to facilitate the process of decision making.

- **Common background (CBG):** During the interviews, many participants mentioned common backgrounds and interests as friendship factors. Users tend to accept friend request from people who have common background with them. These commonalities include city and country of birth or residence, schools and universities attended, personal interests, and hobbies, etc. When we asked for the reason, the users pointed out that these commonalities work like a trigger that helps them remember the people they have on Facebook and to know them better. For example, P17 said:

“Although it is fine for me to have new friends based on my interests, I would prefer to be in the same city to make closer friendships.”

- **Being active on Facebook (BAF):** According to our data, the fact that the friend requester is an active Facebook user is sometimes the most important factor, even more than knowing the requester. P5 expressed this by saying:

“If they send me a request, okay, I know you. I am going to accept your request but it has been five months and you are not posting anything. You never come to Facebook. You never post anything. Okay, I am sorry. I have to delete you because you are not adding anything.”

- **Gender (GEN):** The gender was another factor for participants. P5 said:

“I think gender is effective in terms of friend requests. You know, I am sorry to say it but put a picture of a pretty girl would get hundreds of friendship requests or even messages. I have a male friend who was building a ‘stable’ of Facebook women. He had about 600 friends and they were all women. There is not a single male friend on the list!”

- **Number of mutual friends (NMF):** The majority of participants confirmed that the number of mutual friends is important, as it helps users to remember whether they know each other. Although it is known as a way of verification by many users, it might fail them. P2 raised an interesting point about it:

“I used number of mutual friends as a fast approach to accept friends but later it turned out it is not necessarily good enough because I removed many friends who had large number of mutual connections with me. Maybe because I had a lot of friends, around 800, so I had many friends in common with people and it did not work all the time.”

- **Closeness of mutual friends (CMF):** Some participants highlighted that, in addition to the number of mutual friends, it is also important to know the closeness of those friends. That is, even if there are a couple of mutual friends between the receiver and the requester, it is not necessarily enough for users to make a decision. As P5 expressed it:

“You either have to be someone I know or you have to be mutual friends with someone I really know. Anyone else I do not take requests anymore because I ran into some pretty weird people.”

- **User’s activity pattern (UAP):** Another friendship factor was user’s activity pattern, including what kind of information is shared (i.e., either relevant or irrelevant) and how often the content is shared. For instance, P1 said:

“I do care about what they post. If they post, like, things that I would find disturbing for me, ding!! I would delete them.”

Furthermore, our participants disliked being friends with those who just monitor others’ posts, and possibly report to mutual contacts:

“My aunt turned out was watching my page and then reported my activities to my mom. And that did not go over well and I just blocked them. I would never befriend anybody who just monitors others.” (P6)

Given this dislike for passive users, it was interesting to discover that some of our participants had changed their activity on Facebook over the years. They undergone a shift from active to passive users, who just read others’ posts, without regularly adding any content. According to our participants, an active user is the one who is willing to have a lot of Facebook friends and performs a variety of activities, such as sharing photos, notes, and videos, as well as posting their status, etc.

- **Closeness and quality of friendship in real life (CFR):** We found in the interview data that it is important for users to make sure how good of a friend they might become with the requester and if they might get along. For instance, P6 reported:

“If I know them then, it takes a little bit longer because then I have to decide because my half-brothers and their daughters have requested to be my friends. And yes, I know them but, no I do not want them on my page. Because the girls I do not get along with when they come for Christmas dinner. We only see them at Christmas time and I do not get along with those girls. My half-brothers, the one I do not – I have only met this past summer for the first time, so I do not know him and I am not interested!”

Another participant, P5, expressed similar concerns:

“I found this quite upsetting but there is a woman on my site who I worked with. We were quite close at work but I did not like a number of things that she did, and you know I did not accept her request.”

- **Application-based friendship (APF):** There was another factor raised by our participants where users tend to make friendships with others for the sake of receiving bonuses from some applications such as games. As a result, such users would send and accept more friendship requests.

2.6.3 Privacy and Security Concerns and Awareness

As described earlier, this component is influenced by and impacts Friendship Factors. Maintenance Actions also impacts this component. This might happen as a maintenance activity, for example, when a user monitors a friend’s profile and she ends up facing surprisingly irrelevant content posted by this friend. This observation would cause them to be aware of fake or hijacked accounts posing as close friends:

“I remember that I found that there were two accounts for a friend of mine and I thought he had created another one. When I asked, it turned out that the first one was a fake account and he had already deactivated his previous account. So, somebody had created an account similar to his first account. I did not know that. I even checked my name to see if there is any fake account for me as well as other friends.” (P17).

Another source of influence on this component is Environmental Factors in general and media in particular. Some participants noted that their awareness of privacy and security on Facebook were affected by media reports. For example, P7 shared:

“Previously, I would just add like a lot of random people and accept requests. Later, I became more conservative, as I heard from media about leakage of users’ information.”

P1 also believed that there were security incidents reported by media that influenced her behavior:

“Because there are a lot of issues with Facebook, like pictures, as there was the recent one about the girl who committed suicide and how her photo was used for some porn website so things like that. So for the pictures that I post on Facebook, they are never of my face.”

P3 had similar concern describing his experience:

“I used to post a lot of photos on Facebook but then there are issues with security. The more you post, the more you cannot take back because I read in a blog that even if you post a photo on Facebook and get rid of it from your account, just delete an album, you are still going to be on Facebook. So because of that I stopped posting photos on my account.”

We also found an interesting point about the effect of security and privacy incidents in other online services, which results in change of behavior on Facebook. P10 said:

“I had profiles on LinkedIn and Evernote but then I removed it because of some security leak in passwords. I got sensitive in terms of disclosing information on my accounts.”

2.6.4 Interface Capabilities

Our participants reported a set of issues related to capabilities of the interface—e.g., lack of required information, device-specific design, and frequent changes of privacy settings—that would impact Investigation Actions and Maintenance Actions.

Some of the participants could not easily find desired information in order to make decisions about friendship requests. As a result, they preferred sometimes to think about requests, rather than looking for additional information on Facebook about the requesters. This raises the issue of information visibility in the interface. For instance, P3 provided the following suggestions:

“Definitely need to have what/where they are from, what they have, if it is in academic backgrounds, then what they studied and where. And if it is just maybe a few interests that they have, [it] could never hurt, I think. Just because you look at a person and you think they are interested in photography I do not think it could actually hurt anyone. So just something along those lines that can give you more information.”

Regarding the issues related to device-specific design, P8 shared her experience as follows:

“In terms of an interface, maybe a bigger button, I think just because sometimes all those buttons look very similar and you tend to click one. If you are using your phone and looking at someone who you are not a

friend of, but you want to (this has happened to me before), you want to message that person instead before you add as a friend and then by mistake because the buttons are right next to each other I would press add a friend, send a friend request, or add a friend instead of message. So when that goes out that is it. They receive it and then you cannot really retract that.”

P13 mentioned another issue in this regard:

“It really depends if I use my phone or my desktop when I accept or reject a request. Using the desktop, I spend way more time while this is not the case with my iPhone. So you would be lucky to have me on desktop when receiving your request. On iPhone, I would make my decision very quickly. If I do not remember, I would just reject.”

This issue shows the gap between usability of device-specific designs of interfaces for accepting/rejecting requests.

The last issue about the interface was frequent changes made to the interface, the privacy settings in particular. Participants found it difficult to catch up with these changes.

2.6.5 Investigation Actions

Before making their mind in regards to friendship requests, some of our participants took one or more of the following actions:

- **Sending personal message:** Specified by many participants, sending personal message is a common technique for obtaining additional information about the requesting user, especially when he is not known to the receiver. As P7 explains:

“I would personally ask them on private messaging and say that I do not know you or asking some questions like ‘have I met you?’ ”

- **Checking out photos:** It was also common among the participants to go to the profile and, if possible, check out photos of the requester. They reported to be helpful to recognize the requester, to either make decide about the request or start communicating with the requester via messaging.
- **Looking for commonalities:** Another action taken by our participants was to explore for commonalities in terms of background, friends, interests, etc., as P5 illustrated:

“Do we have common interests? Do you know some friends of mine? We have something in common maybe?”

This action seemed to be done by those participants who had new friends, in order to help them know people better, as well as those who wanted to have limited list of friends, in order to help them verify requesters, in case the profile picture or name were not recognized.

- **Checking mutual friends profiles:** Some of our participants reported that, although it was important to know if there were any mutual friends, it also took time to check out the mutual friends’ profiles for evaluating the closeness of the relationship. Although it was important to some of our participants, some other participants said that they would skip this step because it was too time-consuming and required somewhat high cognitive load:

“I really want to know more than just number of our mutual friends and see if those are close friends but I check that when it does not take me a long time. Like less than 5 minutes otherwise I won’t do that.” (P13).

2.6.6 Decision Execution

We found three types of behavior for decision execution. (1) Some participants would make their decisions immediately after they received requests. If they could find information they needed to make the decision, then they would easily make it right away. There were other participants who would accept friend requests right away, although for different purpose. They would do so in order to find out more about the requester (after becoming friends) and then decide if they wanted to unfriend her or not.

(2) Otherwise, they would reduce their set of decision criteria, in order to expedite the process. In such cases, participants with less concerns about privacy and security would most likely accept friend requests:

“If I get a friend request that we share mutual friends but I do not know them, I am always hoping that I can check their profile. Sometimes it is restricted so you cannot. So I accept the friend request.” (P5)

(3) On the other hand, some users would leave requests as they are, and postpone further investigations.

2.6.7 Maintenance Actions

The interview data revealed three types of Maintenance Actions that our participants took after accepting friend requests.

One of the common maintenance actions was to remove friends after a while, due to a number of different reasons. For examples, those friends that had been added in order to play face boo games, would be removed when there was no need to be friends with them. Another common reason was finding content shared by to-be-removed users irrelevant. As a result of these actions, users may adjust their Privacy and Security Awareness and Concerns, which would eventually impact their Friendship Factors.

One other type of maintenance actions was to define different levels of access for friends. This usually happened in two ways. One was to define separate groups of friends and then specify visibility of the posts using these groups. The other way was to deny specific users the ability to see a post or any desired content on-the-fly. This means that participants sometimes set the access level manually to avoid a group of friends accessing the post. As an example, P7 said:

“If it is for family pictures, I would just change the privacy setting to relatives. Then, I do not have to remember every one of those friends. Sometimes I do not even have to create a group for relatives though. I can remember who are my relatives.”

The third type of actions was for our participants to update the privacy settings of their profiles. However, some of our participants, who were sensitive about their privacy, complained about frequent changes that Facebook privacy settings undergo:

“It changes a lot, but from time to time I try to go back and look at it, but that could be like once a year or so.” (P3)

On the other hand, we found that some participants were not even aware of privacy settings in the interface. When we asked about the possibility of access to information of their profiles, some of them did not even know if it were possible. P2 said:

“I guess so, because I have not seen that at all. But, now that you have talked about that, to me that means there are thousands of people that can check who I am. Some groups are pretty big. I have not thought of it.”

This issue with frequent changes in Facebook privacy settings illustrates the relationship between Maintenance Actions and Interface Capabilities, in which the latter impacts the former.

2.6.8 Environmental Factors

Analysis of interview data revealed that there are three environmental factors that influence Investigation Actions and Privacy and Security Awareness and Concerns, as discussed before.

First, the participants referred to the lack of time, as a factor that influenced their decisions about friend requests. For instance, P17 said

“I have always problem with the lack of time during break times. I have to check updates, requests, messages, etc. in just 15 minutes. I once accepted a friend by mistake, as the requester had just same name as a friend of mine and I had not checked his profile to get more info about him.”

The second factor is the lack of concentration, while checking out Facebook:

“On the way to university, I usually check out my profile on the bus. I once accepted a request when I was on the bus and that was a wrong decision. I guess I was distracted by stops and also other passengers so that I forgot to send a message to the requester.” (P20)

The third environmental factor was the effect of media. As described earlier, the Privacy and Security Awareness and Concerns of our participants were impacted by media reports about security and privacy incidents.

2.7 Discussion

In order to answer the research questions, we decided to go one step back and envision the problem as part of a bigger context. Therefore, we managed to come up with a model which discusses users’ behavior when they want to accept/reject a friend request. This idea was supported with the fact that there is no previous study focused on this aspect of users behavior. Armed with such a model, we would be able to uncover behavior of users towards strangers since this scenario would be a specific case of the model. We define stranger as a person who is not familiar in real life or online communities. In this regard, we indirectly asked participants about their interaction with strangers so that we can reveal more details about this scenario.

2.7.1 Befriending Strangers

As described in Section 2.3, before each participant was interviewed, the participant received two friend requests, one from a Facebook profile of a real user, and the other from an auxiliary profile made up for the purpose of the study. Five participants accepted at least one request from one of these accounts, and one of them accepted requests from both accounts. When we reached in our interviews the debriefing part, in which we informed the participants that these requests were from our research team, their reactions varied.

The participant who had accepted both requests said that it was okay with him and he did not care about strangers among his Facebook friends, since he did not have any idea that anybody could

make any use of his profile data. The other four participants who had accepted requests from either real or auxiliary accounts of the researchers had different attitudes. After hearing the scenario, they got nervous and one of them said:

“I would not have accepted the request if I knew more. I saw the guy is from UBC and is a graduate student. I thought that it should not hurt.”

Another participant, most of whose profile was accessible publicly, had similarly nervous reaction, especially when we explained the possibility of any user accessing his profile information. He commented that in the future, he would pay more attention regarding friend requests.

In addition, we found evidence in interview data suggesting that some OSN users don't pay attention to possible threats, when it comes to making friendship connections:

“I seem to be a million times more strict than most people. I know some friends who accept anybody that requests. Well, I mean a lot of people do. They do take it too easy. How can you have 2,000 friends?” (P5)

Another participant had a set of “friends” from accessory shops (she did not know them) while they had access to the profile information e.g., other friends in her profile. Some participants seemed to have no criterion for making friendship. They would just add anybody, as P11 explained:

“I am always nice to requests on Facebook, as I cannot remember that I have rejected a request.”

Attitudes Towards Strangers: These observations made us more curious about users' perception of Facebook users they do not know in real life. Our analysis suggests that, when it comes to one's attitude towards strangers on Facebook, our participants can be roughly divided into three groups.

We found that one group of participants had a “take it easy” attitude towards accepting friend requests from strangers. As P1 justified:

“I have spent some time with them on Facebook and they do not seem somebody who would cause me pain!”

As P1 mentioned, it is enough to have a feeling that a person is not going to make any trouble for them. The other reason for accepting their requests is that having less commonality might be even an advantage, as P16 illustrated:

“I know some people in real life who have common things with me like our neighbor's kids that we lived in the same neighborhood, we went to the same school. But I do not want him to be on my Facebook profile. I prefer to have more of these unknown guys instead of our neighbor's son, as some of them post cool stuff and I don't need to be worried about my posts, because none of them would tell my dad what I am doing!”

On the other hand, for some other participants, only knowing a requester in real life did not necessarily mean that this was a right person to be friends with on Facebook. P2 illustrated this point with the following example:

“I have like friends from primary school who ask me to be [Facebook] friends. But, in primary school you are friends with all your classroom so then it will be like your real friends. And that has not been done for 15 years. So now I do not accept them anymore if I see that we are in really different world and everything. It is my private life and I am a new person now.”

P1 explains this attitude further:

“If you have not kept in contact or you have not actually tried to stay in contact, I feel like there is no point. Long ago in the past, I do not go back there.”

Users who have this attitude are less vulnerable to the threat of accepting a stranger's request.

The third group's attitude was not as clear cut as for the first two groups. As a result, participants from this group were influenced by the various factors specified in our model. This group would be also vulnerable to the threat of accepting strangers' requests, as participants from this group reported issues in recognizing people in real life or online communities.

These groups are not necessarily mutually exclusive, i.e., the same user can exhibit in the majority of cases the behaviour of one group, and yet handle some of the requests following the pattern of another group.

Accepting While Not Intending: Our analysis revealed that some of our participants would make inconsistent decisions. For instance, they would accept friend requests although they didn't have intention to be Facebook friends with the requesters, as an example of P11 illustrates:

“Some requests are from people that I had a quick chat with them or somehow I remember them but honestly I don't want to be friends with them. However, I will accept if they send me request.”

These participants seem to find it socially awkward to reject friend requests. P18 made it explicit.

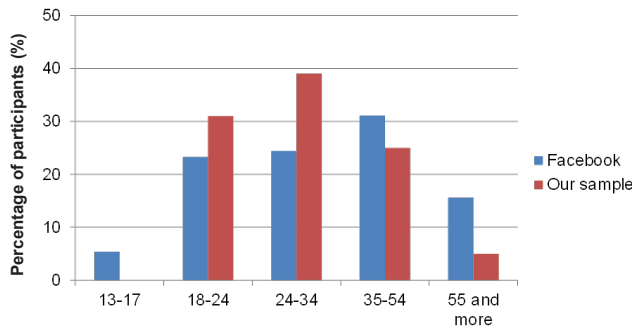
“I always have this problem with some of people I know but I don't have a really good relationship with them that I cannot say no to their request. I don't know why but I think it's better to accept rather than reject them.” (P18)

Usage Differences: We discovered differences in the way our participants used Facebook, and these differences seem to correlate with the way they treated friend requests. Although it has been previously shown that users tend to use OSNs (including Facebook) to make connections and share different kinds of data, we found three “flavours” of users:

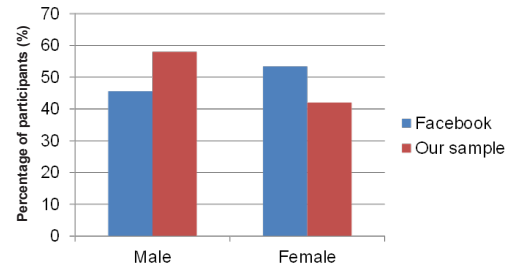
- **Contributors:** These are traditional users who both consume and contribute new content. They make friendships, share photos, share personal information, post updates, and interact with others by commenting and favoring their shared content. From the point of view of this group, the aim of FOSNs is to make an environment in which people feel free to share information with others and receive feedback. While they are willing to have more friends, they are also conscious about their profile privacy and friendship management, as P16 illustrated.

“I really enjoy using Facebook when I share posts or comment on a post and receive likes. But this is because I know my friends and feel comfortable with them”

- **Observers:** On the other end of the spectrum, there are users that avoid having social interaction and prefer to passively observe others. They have different reasons for this behavior including lack of time, security concerns, difficulty to use the interface. As the result, they do not share any information and they are willing to make connection with as many users as possible.



(a) Age



(b) Gender

Figure 5: Age and gender comparison of our sample to Facebook population.

“I like Facebook as it gives me the chance to read my friends’ posts and watch their photos, read news and many other things. Of course I don’t share anything as I use my phone and it’s really difficult to type a lot. Moreover it takes a lot of time.” (P13)

- **Conscious Contributors:** In addition to these two extremes of the spectrum, there are advanced contributors who are more sensitive about the audience of their posts and other shared content. This third group of people reports more issues regarding friendship management, as P15 illustrates:

“What I am looking for on Facebook is to interact with others and share my info as well as see their posts. I am spending a lot of time to manage my profile and I have this difficulty to put my friends in different groups as I want to have them but I don’t like to share my personal photos or posts with all of them.”

To summarize, our observation indicates that we can categorize users of FOSNs into three groups, with Contributors and Conscious Contributors being more likely to have issues in terms of privacy and security of their profiles. This sheds light on the point that privacy and security would have different meanings for users according to the type of their FOSN usage. Consequently, this may impact user’s attitude towards friend requests.

Our Online Lifecycle of Accepting Friends model could be helpful for FOSN designers, when it comes to supporting users in deciding about friend requests. The model could aid in considering various factors that impact user decisions.

3. CONFIRMATORY STUDY

While the exploratory study allowed us to identify possible factors that have a role in users’ decisions about friendship requests, we wanted to test these factors on a representative sample and measure the fraction of users who are employed by those factors. Therefore, we decided to conduct an online survey that would allow us to collect quantitative data from a representative sample.

For each of the eleven friendship factors identified from the interviews, the survey had at least one statement (e.g., “If I recognize someone’s picture, I would accept his/her friendship request on Facebook.”) and asked participants to indicate their agreement on Likert scale of 1-5. For those factors that had more than one statement, we used the mean score. For testing data quality, we have

included contradicting statements. For example, “I would accept a friendship request from a Facebook application.” and “I don’t tend to accept friendship requests sent by Facebook applications.” All questions from the survey can be found in Appendix B.

We recruited 425 M-Turk participants from USA and Canada. Each USA participant received \$0.50 and Canadian \$0.75. It took 16 minutes on average for our participants to finish the survey. We removed 28 participants because of contradictions in their answers, which left us with responses from 397 participants.

3.1 Results

First, we provide statistics related to sample representativeness and participants demographics, then descriptive statistics regarding employment of the friendship factors, finally we discuss the impact of the friendship factors on accepting a stranger’s request.

3.1.1 Participants Demographics

We compare demographics of our sample with the demographics of Facebook users.

As Figure 5a shows, our sample is younger than Facebook users. We got more younger participants (18-24: 31% vs 23.2% and 24-34: 39% vs 24.4%) and fewer participants in higher age ranges (35-54: 25% vs 31.1% and 55 and above: 5% vs 15.6%). We did not have any preference to recruit participants from younger age range and as mentioned earlier, we recruited participants from Amazon M-Turk. However, previous work shows that the turkers are relatively young with about 80% in 18 to 40 years old age range (Average = 31, Minimum = 18, Maximum = 71, Median = 27) [22], which could be the reason for having a younger sample rather than Facebook demographics. It is also worth mentioning that we did not have any participants in the age range of 13 to 18, as we chose to recruit participants who were at least 19 years old.

In terms of gender, as Figure 5b shows, our sample was biased towards male participants (58% vs 42%), while 53.3% of Facebook users are female and 45.7% are male.

Demographics of our participants show diversity of the sample. In terms of age, we had participants from 19 years old to 65 and more. Gender-wise our participants were fairly evenly distributed. Participants also had diverse education levels (26% with high school or lower degree, 59% with undergraduate degree, 10% with graduate degree). The employment status of our participants varied, too: 56% employed, 22% students, 16% unemployed, 2% unemployed and 4% had other employment status.

We also asked our participants general questions about their Facebook usage and experience. The majority (94%) were Facebook

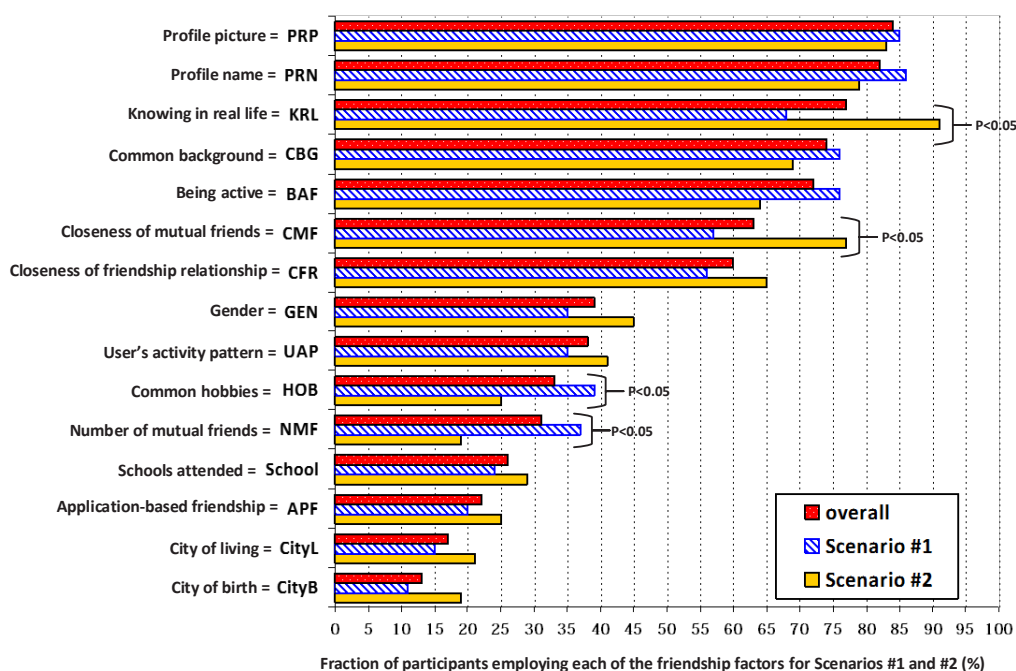


Figure 6: Distribution of friendship factors employment among all participants, scenario 1 (S1), and scenario 2 (S2). Significant differences between participants of S1 and S2 are shown in terms of employing KRL, CMF, NMF, HOB ($p < 0.05$).

users for more than 2 years. In terms of usage frequency, 92% reported that they login into Facebook at least once a month, while 80% login several times a week. They were also asked to go to their Facebook profile and enter the exact number of their friends. Our participants had wide range of friendship circles, with minimum of 10 and maximum 3,000 (mean 328, median 203). This shows that collected data came from users with different befriending patterns. Majority (64%) of participants receive at least one friend request in a month and only 7% receive friend requests less than once a year.

3.1.2 Friendship Factors

Figure 6 summarizes results of the survey on the friendship factors. The red bars show the percentage of all participants who reported employing each of the factors, i.e., they agreed or strongly agreed with the corresponding statement(s).

Starting from the most popular factors, requester's profile picture (84%) and name (82%), participants accept friendship requests if they recognize the requesters. Seventy seven percent agreed with statement "I tend to accept friendship requests from people I know in real life or online communities."

Another factor was "common background" (CBG). While 74% of participants agreed that it is important to know requester's background, the survey results show that the participants were not specifically interested in a single type of background information. And the importance varied among participants. For instance, only 15% would accept friend requests from users who were born in the same city as they were. Similarly, only 18% would accept friendship requests from users who live in the same city as they do. On the other hand, 27% would be interested in having Facebook friends from the same school/university. The most popular type was "common interests/hobbies," with 35% relying on this background information in their decisions about friend requests. This particular result was corroborated in the interviews, with participants reporting interest

in new FOSN friendships with those who share interests or hobbies.

Another factor that we tested was activeness of friends, with 72% reporting interest in accepting friend requests from active users. In terms of gender (GEN), 39% of participants confirmed they consider it during decision making for friendship requests. The "number of mutual friends" (NMF), which is currently shown in the Facebook's friendship request dialog, was only used by 31% of participants for making their decisions. On the other hand, the majority of participants (63%) do care about "closeness of mutual friends" (CMF) to them. Regarding the impact of "user activity pattern" (UAP), we found that 38% of participants were reluctant to accept a friend request if they saw irrelevant posts shared by the requester. This was expected, as our interviews showed that although people like to have access to the posts of requester, they usually do not have this level of access. The results also show that "closeness and quality of friendship in real life" (CFR) was important for 60% of participants. We also measured the number of participants who would accept "requests from Facebook applications". Results show that 22% of participants took APF into consideration, as a factor in deciding about friend requests.

3.1.3 Accepting Friend Requests from Strangers

We wanted to understand if there is a difference between those participants who accept friend requests from strangers and those who don't. We were specifically looking at the difference in the way they would be influenced by the Friendship Factors.

To investigate this difference, we considered two types of user behaviour, which we describe as two scenarios: (1) (S1): users could accept friend requests from strangers, and (2) (S2): users would reject friend request from strangers. In these scenarios, friendship factors are dependent variables (DVs) and a decision of either accepting or rejecting friend requests is the independent variable (IV).

We divided our dataset into two groups (scenario 1 and 2). This was done by analyzing the answers to one of the survey questions, which explicitly asked participants if they have any strangers among their Facebook friends. 62% of the participants confirmed that they did. Then, we compared these two groups in how much they used each of the friendship factors. In what follows, we describe the results of our comparison.

We found that while only 68% of participants in S1 consider the knowledge of the requester in real life (KRL) in their decision process, this number jumps to 91% for S2, with the difference being statistically significant (Mann-Whitney's test: $p = 0.0003 < 0.05$). We interpret this result as an indicator for the level of awareness in these two groups.

For profile name (PRN), although we did not see much difference between the groups, participants in S1 reported more interest than those in S2 (80% vs 87%) for using profile name as a factor.

For common background, we looked at four types of background information, including city of birth (CityB), city of Living (CityL), schools/universities attended (School), and common hobbies/interest (HOB). For the first three factors, we could not find statistically significant difference between participants in S1 and S2. However, S2 participants were slightly more interested in them (CityB: 19% vs 12%, CityL: 21% vs 15%, School: 29% vs 25%). The difference was significant when it came to "common hobbies/interests" (HOB). While 40% of participants from S1 employed this as a friendship factor, there were only 25% in S2 who did so (Mann-Whitney's test: $p = 0.03 < 0.05$). This result could be leveraged as a cue by socialbots to customize profile information in order to increase the chance of getting their friend requests accepted. "Being active" (BAF) was also more popular among S1 (76%) members rather than S2 members (64%), although the difference was not statistically significant.

Regarding the "number of mutual friends" (NMF), we saw significantly more members in S1 (37%) than S2 (19%) employing it as a factor in their decisions (Mann-Whitney's test: $p = 0.01 < 0.05$). Also, comparison of S1 and S2 in terms of "closeness of mutual friends" (CMF) indicated that more participants in S2 (77%) cared about it than in S1 (57%) (Mann-Whitney's test: $p = 0.03 < 0.05$). The results of comparison for NMF and CMF suggest that informing users about the closeness of the requester with the mutual friends would be more effective than only showing the number of such friends (available in current interface).

For user's activity pattern, we found that participants from S2 were slightly more interested in UAP than from S1. We suspect that the absence of statistically significant results in regards to UAP is due to the difficulty of finding a pattern, as we had this feedback in exploratory study. Regarding closeness of friendship relationship, we did not find statistically significant difference between S1 and S2. This result is expected, as it more relates to scenarios in which friendship requests are sent from known users, according to our interview data. Finally, we could not find statistically significant difference between participants in S1 (20%) and S2 (25%) regarding application-based friendship (APF), although we expected to observe significantly more participants in S1 who rely on this factor. This might be because of the shortage in the number of participants who have received this type of friendship requests.

4. DISCUSSION

Considering the first goal defined for the survey, we analyzed the data related to each of the factors to investigate how much they are used. As the result, except for UAP and APF, all other friendship factors were employed by at least more than 50% of participants, which shows the validity of friendship factors inferred from the ex-

ploratory study. In addition, we asked survey participants to share with us other friendship factors if they have any. Analysis of answers to this question did not add to the factors themselves. The participants who answered this question, mostly suggested features that could be added to the friend request decision dialogues. As mentioned earlier, since having access to user's wall is usually not possible, people may not consider UAP as a factor. However, according to the exploratory study, participants prefer to have information about the activity patterns of requesters. For APF, a low percentage was expected from the interview study, in which only few participants reported receiving friendship requests from applications.

For the second goal, the idea of focusing on the results of groups who have strangers in their Facebook friends, and comparing it to those who do not have, helped us to investigate and uncover the impact of the friendship factors. As the results show, we found four friendship factors (KRL, HOB, NMF, CMF) could play a notable role and influence users' decisions. This result could be leveraged for improving the interface design so that users make more informed decisions.

4.1 Interface Design Recommendations

As discussed before, the results from the analysis of our survey data revealed interesting points about friendship factors that could be used for improving the Facebook interface. Therefore, we offer the following suggestions for designing user interfaces for accepting friendship requests:

- The interface should convey the importance of making accurate decisions about friendship requests and encourage users to make informed decisions. For instance, users could be notified by a pop-up window (similar to current design) asking users to go to another page in order to make an informed decision, using useful information or a check list. Having such a feature in the interface is supported by the OLFFA model since it helps users to appreciate the importance of these decisions.
- The interface could contain a message box so that requesters can briefly specify how they know the user. Another suggestion is to give access to photos selected by each user to better recognize the requester. We had reports from participants of both studies complaining about unclear small photos. This kind of improvement would facilitate the investigation/maintenance actions (in the decision making process of OLFFA model) for users.
- It could be helpful if user had access to statistics (number of likes, number of comments, number of personal messages, number of common photos) about interaction with his/her friends. In this case, it is easier to investigate closeness of mutual friends, which was shown to be more useful than only the number of mutual friends. In other words, this feature would facilitate the Investigation Actions in the OLFFA model for finding out closeness of mutual friends.
- The interface could encourage the user to specify the access level for new friends at the time the user accepts a friend request. We suggest this because our analysis showed that 31% of participants in S1 did not define any access level for their friends while 9% in S2 reported similar behavior. Therefore, this could be helpful (at least for users who accept stranger's requests) as a facilitator for performing maintenance actions and help users to be more cautious about the level of access they grant to their Facebook friends.

It is worth mentioning that although we believe these recommendations could be helpful for the Facebook interface improvement, they are currently hypotheses to be tested.

5. LIMITATIONS

Our work has several limitations. In the exploratory part, it would be better to have more diversity in terms of age so that the model could be representative of a wider range of Facebook users. On the other hand, although we reach saturation in data collection, we had five participants who accepted friendship requests from the volunteer. Having more participants from this group could result in more interesting observations and a more accurate model.

In the survey, we asked participants to report their activities, which might not be accurate due to somewhat abstract nature of the questions. As an alternative, it could be done by providing them with different scenarios and then asking them questions. We refrained from doing this due to the time limits of our survey. Finally, our sample is not representative of all Facebook users, as we recruited participants only from USA and Canada. Having participants from other countries could reveal more interesting points about users befriending behavior.

6. RELATED WORK

Previous work shows that changes in friendship network has been observed due to internet use. For instance, friendships continue to be abundant among a wide range of adult Americans from (25 to 74 years old) from 2002 to 2007 [27]. Emergence of online social networks was one of the main reasons for this phenomenon. While the number of OSN users is still growing, there are concerns about privacy of users. There is work on definition of privacy, and digital privacy in particular, to clarify what should be expected by users in terms of privacy [21]. On the other hand, it has been shown that this is not always a fault of systems that results in privacy and security issues and humans are a major cause of these failures [25]. Therefore, it is necessary to consider humans in designing systems. Cranor proposed a framework to reason about the human in the process of designing secure systems [11]. This framework was insightful during the process of qualitative data analysis to form our model. There is also work related to privacy of users on Facebook. It was shown that users' intention does not match with their privacy settings [18, 19]. Another study showed that users have difficulty in understanding the privacy settings and cannot configure them correctly [12]. As the most related work to ours, Johnson et al. showed that the main concern is insider's threat rather than the outsider's [17]. We believe that the focus of our work is different, as our concern is to understand user's behavior towards friendship requests rather than how they manage their privacy settings. Moreover, we believe that stranger's threat still exists as 62% of our sample reported to have at least one stranger in their friend list.

7. CONCLUSIONS AND FUTURE WORK

Our work contributes to providing socio-technical solutions to help users be aware of their decisions towards friendship requests from strangers. First, we aimed to better understand their behavior. We identified three groups of factors that impact users' decisions, including internal factors (Friendship Factors, Privacy/Security Awareness and Concern), external factors (Environmental Factors, Interface Capabilities) as well as a 3-step process of decision making (investigation, decision execution, maintenance). We believe that this model is helpful for improving the part of interface related to receiving friendship requests. We also showed that accepting stranger's requests is still a threat, as having at least one stranger

in friend list was reported by 62% of our participants. We also introduced 4 friendship factors (knowing in the real world, common hobbies/interests, number of mutual friends, closeness of mutual friends) that can significantly impact users' decisions in regards to friend requests. Then, we offered suggestions for improving the interface.

There are several directions for future work. One direction is to perform structural model testing on the proposed model Structural Equation Modeling (SEM). Another direction is to conduct a user study and investigate impact of modifying the interface using the proposed guidelines. Another one is to focus on each component of the model and investigate their potential impact on friend request decisions.

8. ACKNOWLEDGMENTS

This work was supported by NSERC. We would like to thank LERSSE members for their constructive feedback on this work.

9. REFERENCES

- [1] <http://www.dedoose.com/>.
- [2] J. Bates. Sniffing out socialbots: The combustive potential of social media-based algorithms. http://www.huffingtonpost.com/john-bates/financial-trading-algorithms_b_1125334.html, December 2011.
- [3] L. Bilge, T. Strufe, D. Balzarotti, and E. Kirda. All your contacts are belong to us: automated identity theft attacks on social networks. In *Proceedings of the 18th international conference on World wide web*, pages 551–560. ACM, 2009.
- [4] J. Bollen, H. Mao, and X. Zeng. Twitter mood predicts the stock market. *Journal of Computational Science*, 2(1):1–8, 2011.
- [5] Y. Boshmaf, I. Muslukhov, K. Beznosov, and M. Ripeanu. The socialbot network: when bots socialize for fame and money. In *Proceedings of the 27th Annual Computer Security Applications Conference, ACSAC '11*, pages 93–102, New York, NY, USA, 2011. ACM.
- [6] Y. Boshmaf, I. Muslukhov, K. Beznosov, and M. Ripeanu. Design and analysis of a social botnet. *Computer Networks*, pages 1–22, 2012.
- [7] Y. Boshmaf, I. Muslukhov, K. Beznosov, and M. Ripeanu. Key challenges in defending against malicious socialbots. In *Proceedings of the 5th USENIX conference on Large-scale exploits and emergent threats, LEET'12*, Berkeley, CA, USA, 2012. USENIX Association.
- [8] K. Charmaz. *Constructing Grounded Theory*. SAGE publications, 2006.
- [9] E. Chung. Facebook easily infiltrated, mined for personal info. <http://www.cbc.ca/news/technology/story/2011/11/07/technology-facebook-socialbots.html>, November 2011.
- [10] J. Corbin and A. Strauss. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Sage, Newbury Park, CA, 1990.
- [11] L. F. Cranor. A framework for reasoning about the human in the loop. In *UPSEC'08: Proceedings of the 1st Conference on Usability, Psychology, and Security*, pages 1–15, Berkeley, CA, USA, 2008. USENIX Association.
- [12] S. Egelman, A. Oates, and S. Krishnamurthi. Oops, i did it again: mitigating repeated access control errors on facebook. In *CHI*, pages 2295–2304. ACM, 2011.

- [13] B. Glaser and A. L. Strauss. *The Discovery of Grounded Theory, Strategies for Qualitative Research*. Aldine Publishing Company, Chicago, Illinois, 1967.
- [14] B. G. Glaser. *Theoretical sensitivity : advances in the methodology of grounded theory*. Sociology Press, Mill Valley, CA, 1978.
- [15] M. Huber, S. Kowalski, M. Nohlberg, and S. Tjoa. Towards automating social engineering using social networking sites. *Computational Science and Engineering, IEEE International Conference on*, 3:117–124, 2009.
- [16] T. N. Jagatic, N. A. Johnson, M. Jakobsson, and F. Menczer. Social phishing. *Commun. ACM*, 50(10):94–100, 2007.
- [17] M. Johnson, S. Egelman, and S. M. Bellovin. Facebook and privacy: it’s complicated. In *Proceedings of the Eighth Symposium on Usable Privacy and Security*, page 9. ACM, 2012.
- [18] Y. Liu, K. P. Gummadi, B. Krishnamurthy, and A. Mislove. Analyzing facebook privacy settings: user expectations vs. reality. In *Proceedings of the 2011 ACM SIGCOMM conference on Internet measurement conference, IMC ’11*, pages 61–70, New York, NY, USA, 2011. ACM.
- [19] M. Madejski, M. Johnson, and S. Bellovin. A study of privacy settings errors in an online social network. In *Pervasive Computing and Communications Workshops (PERCOM Workshops), 2012 IEEE International Conference on*, pages 340–345, March 2012.
- [20] F. Nagle and L. Singh. Can friends be trusted? exploring privacy in online social networks. In *Proceedings of the 2009 International Conference on Advances in Social Network Analysis and Mining*, pages 312–315, Washington, DC, USA, 2009. IEEE Computer Society.
- [21] L. Palen and P. Dourish. Unpacking “privacy” for a networked world. In *CHI ’03: Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 129–136, New York, NY, USA, 2003. ACM.
- [22] G. Paolacci, J. Chandler, and P. G. Ipeirotis. Running experiments on amazon mechanical turk. *Judgment and Decision making*, 5(5):411–419, 2010.
- [23] J. Ratkiewicz, M. Conover, M. Meiss, B. Gonçalves, S. Patil, A. Flammini, and F. Menczer. Truthy: mapping the spread of astroturf in microblog streams. In *Proceedings of the 20th international conference companion on World wide web, WWW ’11*, pages 249–252, New York, NY, USA, 2011. ACM.
- [24] P. N. S. Rita Sara Schreiber. *Using Grounded Theory In Nursing*. Springer Publishing Company, ISBN 0826116221, 2001.
- [25] B. Schneier. *Secrets & Lies: Digital Security in a Networked World*. John Wiley & Sons, Inc., New York, NY, USA, 1st edition, 2000.
- [26] T. Stein, E. Chen, and K. Mangla. Facebook immune system. In *Proceedings of the 4th Workshop on Social Network Systems, SNS ’11*, pages 8:1–8:8, New York, NY, USA, 2011. ACM.
- [27] H. Wang and B. Wellman. Social connectivity in america: Changes in adult friendship network size from 2002 to 2007. *American Behavioral Scientist*, 53(8):1148–1169, 2010.

APPENDIX

A. INTERVIEW GUIDE AND QUESTIONS

At the beginning of the interview, we will not inform the interviewees the potential threats of accepting a strangers’ friendship requests in Facebook. Our objectives is to collect interviewees’ responses to investigate users’ behaviors towards friendship requests sent from users and strangers in particular. Our sample includes active users on Facebook who logged in at least once a week.

Agenda:

1. Give an overview of the project: “The purpose of the study is to investigate the factors users employ when making a decision to befriend other users.”
2. Introduce second interviewer and specify his role.

Part1:

1. General Questions:
 - (a) What is your age?
 - (b) What is your gender?
 - (c) What is your highest level of education?
 - (d) What is your major or occupation?
 - (e) How long have you own a Facebook account?
 - (f) How often do you use Facebook?
 - (g) What is your first language?
2. The befriending behavior of users with strangers:
 - (a) How many friends do you have on Facebook?
 - (b) How often do you receive friend requests?
 - (c) Have you ever accepted a friendship request from a stranger you do not know in real-life or have not met before online or offline?
 - (d) What kind of factors do you rely on when you decide to accept a friendship request from a stranger? (For any factor users ask, we need to dig into more details by asking questions) (Gender, Friends, Mutual Friends, Profile, Picture, Wall show the activity in Facebook)
 - (The interviewee mentioned gender.) Will you accept a friendship request from a homosexual stranger or a heterosexual one?
 - (The interviewee mentioned friends.) How many friends does the stranger have that you will accept his/her friendship request?
 - (The interviewee mentioned mutual friends.) How many mutual friends does the stranger have that you will accept his/her friendship request?
 - (The interviewee mentioned profile.)
 - i. Same/different hometown
 - ii. Same/different schools
 - iii. Same/different age
 - (The interviewee mentioned wall.)
 - Active/quiet person
3. Users’ attitudes towards their privacy security:
 - (a) Have you ever set your privacy setting? (If yes) How did you modify your privacy setting?
 - (b) Have you assigned different privacy setting to your friends? (If yes) How did you modify your privacy setting for different friends?

- (c) Have you had reported any security incident before in your online activities on Facebook, email, etc.?
 - (d) Have you realized that if you accept a friendship request from a stranger, he/she will have the access to your personal information? (If yes) What kind of information do you think will be exposed to the strangers?
 - (e) Do you mind your private data being exposed to the strangers? (If yes) What kind of information do you mind being accessed to the strangers?
4. Users' appeal of strangers:
- (a) How do you describe your connection with the stranger that you have accepted his/her friendship request?
 - (b) Are you emotionally attached with the strangers?
 - (c) At the very end, do mention that the request will be removed.

Debriefing happens here!

Part 2:

1. What would be your suggestion if you want to design the window for friendship requests?
2. Will you change your behavior towards friendship requests? (If participant had accepted the request)
3. Do you have anything else related to this study that you want to share with us?

B. SURVEY QUESTIONS

Thanks a lot for participating in this survey. In this survey, there are questions about your activities on Facebook. It will take you about 15 to 20 minutes to answer the questions. For the likert-scale questions, please choose one number from 1 to 5, where 1 means "strongly disagree" and 5 means "strongly agree".

1. What is your age?
 - 19 to 25
 - 26 to 30
 - 31 to 35
 - 36 to 40
 - 41 to 45
 - 46 to 50
 - 50 to 55
 - 56 to 60
 - 61 to 65
 - 61 and more
2. What is your gender?
 - Female
 - Male
3. What is your highest level of education completed?
 - High school
 - Undergraduate
 - M.Sc
 - PhD
 - Other:
4. What is your employment status?
 - Employed
 - Student
 - Retired
 - Unemployed
 - Other:
5. How long have you owned a Facebook account?
 - Less than a year
 - 1 to 2 years
 - 2 to 3 years
 - 3 to 4 years
 - 4 to 5 years
 - More than 6 years
6. How often do you login into Facebook?
 - Every hour
 - Several times a day
 - Once a day
 - Several times a week
 - Once a week
 - Several times a month
 - Once a month
 - I have my account de-activated
 - Other:
7. Please go to your Facebook profile. How many friends do you have on your Facebook profile?
 - Answer:
8. How often do you receive friendship request?

- Everyday
 - At least once in 2-3 days
 - At least once a week
 - At least once a month
 - At least once every 6 months
 - At least once a year
 - At least once in every two week
 - Other:
9. Have you ever accepted a friendship request from somebody who you do not know in real life or online communities?
- Yes
 - No
10. Check all groups that you would likely befriend on Facebook:
- Parents
 - Siblings
 - Relatives
 - Close friends
 - Friends
 - Acquaintance
 - Colleagues
 - Other:
11. If I distinguish the person from the picture, I would accept the friendship request.
- 1
 - 2
 - 3
 - 4
 - 5
12. I usually become friends with:
- Only females
 - Only males
 - I do not care about the gender
13. Knowing the number of mutual friends is enough for me to accept a friendship request.
- 1
 - 2
 - 3
 - 4
 - 5
14. If I have mutual friends with the person who sent me a friendship request, I would look at the closeness of those mutual friends to me in addition to just the number of mutual friends.
- 1
 - 2
 - 3
 - 4
 - 5
15. If I know somebody in real world or online communities, I would accept her/his friendship request on Facebook.
- 1
 - 2
 - 3
 - 4
- 5
16. If I recognize someone's name, I would accept her/his friendship requests on Facebook.
- 1
 - 2
 - 3
 - 4
 - 5
17. () of my friends actively share content on Facebook (1: a few, 5: almost all)
- 1 (a few)
 - 2
 - 3
 - 4
 - 5 (almost all)
18. I tend to accept friendship request from everybody, who was born in the s lame city as I.
- 1
 - 2
 - 3
 - 4
 - 5
19. I tend to accept friendship request from everybody, who lives in the same city as I do.
- 1
 - 2
 - 3
 - 4
 - 5
20. I tend to accept friendship request from everybody, who have attended the same school/university as I do.
- 1
 - 2
 - 3
 - 4
 - 5
21. Similarity in personal interests or hobbies is sufficient for me to accept friendship requests.
- 1
 - 2
 - 3
 - 4
 - 5
22. I mostly accept friendship requests from people who share a lot of content on Facebook.
- 1
 - 2
 - 3
 - 4
 - 5
23. Users who passively monitor others' posts on Facebook does'nt motivate me to post less content on Facebook.
- 1

- 2
 - 3
 - 4
 - 5
24. I limit my activities on Facebook because I know my friends are not interested in the content that I post.
- 1
 - 2
 - 3
 - 4
 - 5
25. I don't tend to accept friendship requests sent from Facebook applications.
- 1
 - 2
 - 3
 - 4
 - 5
26. I used to share more content since I felt more comfortable to share content with my Facebook friends.
- 1
 - 2
 - 3
 - 4
 - 5
27. If my friends shared content irrelevant to me, I would remove them from my friends list.
- 1
 - 2
 - 3
 - 4
 - 5
28. I don't accept a friendship request if I have just common interests or hobbies with the person who sent me friendship request.
- 1
 - 2
 - 3
 - 4
 - 5
29. I would accept friendship requests sent from a Facebook application (for example a game) on behalf of others.
- 1
 - 2
 - 3
 - 4
 - 5
30. Who is a Facebook user that you do not want to have a friendship connection with on Facebook?
- Anybody who seems to be annoying (sending weird message, irrelevant post, etc.) regardless of being known in real life or not. 308
 - Anybody except people that are known to some extent
31. How would you define different levels of access for Facebook friends?
- Anybody except for those that have strong connections in real life
 - Creating separate lists with different access levels
 - Using manual exemption feature for each shared content
 - I do not define different levels of access