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Privacy preserving actions of older adults on social media: Exploring the behavior of opting out of information sharing

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ABSTRACT

Social media are being fast adopted by older adults for extending their social relationships. However along with the adoption, there have been concerns about risky issues regarding privacy leakages and information sharing hazards. Such risks are partially due to the fact that seniors (knowingly or unknowingly) share private information that may be misused by others. In this paper we explore the privacy-preserving actions regarding information sharing for this demography on one social media platform — Facebook. Facebook is the largest social networking platform today and many of its privacy related practices have been in the news recently. More specifically, we study the information sharing behavior of the elderly by observing the extent to which they opt out of sharing information publicly about themselves on their profile pages. In addition, we also observe how much overlap exists between these older Facebook users and their respective friends in terms of their public information sharing habits and explore the differences across gender. Finally for comparative purposes we also collect data on a sample of younger Facebook users and conduct an analysis.

1. Introduction

One of the fastest growing demographics to utilize the Web as part of their everyday life is the group of older adults who are aged 55 and above. While conventional wisdom has usually pointed to a lower rate of adoption of information and communication technologies (ICTs) within this community, several studies [43] have shown that this story is far more nuanced. For example [48], have shown that ICTs enhance the knowledge, business transactions, and social connections of older adults. Since a high number of baby boomers, a term commonly used to refer to people born in the post world war II era of 40s and 50s, are expected to retire in the next few years, they will become more active users of the Web who will increasingly use online services to complement their retired lifestyle [29]. Older adults have not only become a valuable target audience for commercial Web properties but also those that offer social networking opportunities (e.g. Facebook) [35]. A strong indicator of the adoption of social media within this age group is the proliferation of several chapters of the AARP (formerly the American Association of Retired Persons) on Facebook which seek to bring together older adults. As of 2011, there are approximately 16 million people 55 and older, who are Facebook users [9,16] who have set up profiles on Facebook.

In spite of this increased adoption of the Web and online social media, people aged 55 and above remain the most vulnerable in terms of online information security and privacy. Most older adults do not spend as much time on the Internet as younger consumers ("grey digital divide") and are not as knowledgeable about Internet fraud [38]. According to the U.S. Senate Special Committee on Aging (http://ageing.senate.gov/issues/elderfraud/index.cfm) while seniors 60 and older make up 15% of the U.S. population, they account for roughly 30% of fraud victims, making them a select group for our study. A recent report [47] based on complaints received at FTC shows that "scam artists are targeting older Americans more than ever before". Wall Street Journal [27] reported that 2011 was the record year for investment scams for people aged over 50. Frauds targeting older adults have become even easier to commit through online channels [13].

In addition to fraud, privacy breaches and leaks have been a major issue for social media websites. This has been exacerbated by the complexity that most users face about managing privacy on these websites [6,34,52]. Studies have shown that while people might express high privacy concerns about social platforms like Facebook, their information sharing habits tend to defy those concerns [1]. One of the unintended consequences of platforms like Facebook have been the embarrassment caused by over-sharing resulting in countless regrets [55]. Researchers have found that people of different age demographics have different attitudes towards computers [44] and more specifically privacy concerns on the Web [49] — it is therefore important to explore the phenomenon of information sharing on social media websites in terms of demographic factors like age groups. These differences are even more pronounced when it comes

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to actions in the context of online shopping that involve revealing sensitive information [40]. The growing use of social media like Facebook among older adults along with the existing threats of fraud targeting them, makes it important to investigate behaviors of information sharing of older adults on social media.

In this paper we investigate older adults' privacy-preserving decisions about personal information sharing on Facebook. We argue that social influence effects of social capital, in terms of building relationships and sharing interests and the actions of peers, have an impact on the privacy-preserving and sharing behavior of elders [52]. Relational social capital is built up on a social media platform and involves greater trust and reciprocity among its relational embedded members [6]. Such reciprocity may play a critical role in making them vulnerable or protecting them in the social media. Further, in line with several studies that have shown that men and women behave differently on the Internet; we draw theoretical inspiration from social role theory, which explains that women and men show different social behaviors [55]. We incorporate the gender parameter to explore the phenomenon of older adults sharing personal information in the social media. Henceforth, the term "gender" will be used to refer to the biological sex of the Facebook users.

While social media websites are part of everyday life, some actions in them are more common and frequent than others. We thus carefully chose the observable actions on a social media website such as sharing of personal and background information. It is through these actions or habits we investigate the information sharing characteristics of elders and the difference between the genders in the older adult population about privacy attitude in social media. Since social support has long been established as important criteria towards influencing decisions with technology, we argue that adopters of social media websites are influenced by the practices of relational peers particularly for making privacy-preserving decisions about sharing information.

In this paper, we address the following two broad research questions: (a) Do sharing (or non sharing) habits of friends on a social media platform influence an older adult's sharing habits? (b) Is this influence different between male and female older adults? Our research questions will help explore the phenomenon of privacy-preserving and information sharing on a platform that actually encourages public sharing by default, and understand how existing friends' privacy related behaviors on that same platform influence their respective opt-out decisions. To the best of our knowledge, this is one of the first studies to investigate privacy and information sharing in social media in the context of the older generation. Furthermore, this study uniquely approaches the concept of privacy-preserving action through actual observations of publicly shared information on a social media platform. While the objective of this study is to explore older adults' online privacy behavior, we do include a brief analysis of younger adults for comparative purposes. This can be expanded in future research.

The rest of the paper is organized as follows: Section 2 focuses on the theoretical foundation where we discuss selected works from the intersection of aging, privacy, social network, social capital and gender. Section 3 develops propositions to define the research model. The measurements of the variables are discussed in Section 4, followed by the elaboration of the data collection as well as the statistical methods used. The next section presents the results. The paper then concludes with practical implications about the findings in the context of the broad research questions posed above.

2. Theoretical foundation

The phenomenon being examined has several theoretical surfaces that allow us to articulate the fundamental motivation for this study. Social capital theory explains the outcome of maintaining relationships with other human beings in terms of goodwill, knowledge, influence and much. The basic assumption of social capital theory [15,39] is that the set of social resources embedded within a relationship can improve people's collective action. The networks of relationships give rise to the social capital. Such networks represent the perspective of social networks from every individual. Every relationship in a network of a person is qualified, according to this theory, as strong or weak and it has been established by several researchers that people have the strongest ties with those with whom they share similar interests, gender, age group, political views, etc. [26]. Such ties would have a social influence on peers and we argue that that the sharing habits of an individual can be considerably influenced by behavioral patterns of friends. Previous research has shown, for example, that within virtual communities, social influence which is part of social capital generated has a strong effect on the attitude towards products discussed within those communities [54]. Other studies [51] have established that social influence is an outcome of the social capital generated in an interactive environment and this influence can be predicted by prior relationships as well as ties to others within that environment.

Further, in order to understand sharing behavior that can help in devising protection mechanisms against such vulnerabilities on social networks, it is important to understand why older adults are increasingly using social networks today. One perspective to explain this adoption comes from the activity theory of aging [19], which explains that as people grow older, they tend to feel isolated from the younger portion of society and thus take up new activities that they might not have been exposed to in the past in order to get more satisfaction in life. Many have also argued that adoption of new things is not enough. Through the exchange theory of aging [46], it has been demonstrated that new artifacts and technologies that enable more social exchange with like-minded people lead to more substantial coping with the aging process. Finally, the theory of the subculture of aging [23], suggests that not only are older adults naturally adopting these social sharing technologies, but also their sharing habits can also be influenced by each other. The reason behind this influence comes from the fact that aging drives these individuals towards a shared community.

While strong friendships and relationships tend to generate positive influence in social media, the extent or the nature of that social capital can vary based on gender as found in the case of blogging [11]. Social role theory suggests that social norms are the main cause of gender differences that emerge during social interactions. According to [22], women and men show different social behaviors because of different societal and cultural expectations for the two genders. Social role theory proposes that all types of women's and men's social behavior can be framed within the two extremes of a continuum: men are agentic and women are communal [2]. As a consequence of these characteristics, the behaviors of men tend to focus heavily on outcome, whereas those of women are greatly dependent on interpersonal relationships.

In addition to the lack of attention to the older generation on Facebook as mentioned above, this age-demography also elicits interesting characteristics when it comes to technology adoption and attitude towards technology in general. Several studies have shown that cognitive ability is one of the key aspects of aging [25] and one that directly influences their usage of Web and email. However this usage has been shown to improve with the availability of social support [14]. We can reasonably argue that a social media platform like Facebook where the prime objective is to connect with friends and acquaintances, social support should be easier to receive which can perhaps help older adults overcome their general fear of anxiety [14], fear of unknown solicitors [32] and aversion to any kind of technology-related risk [45]. The social support on Facebook is available partially through the visibility of information one's friends are sharing on their respective profile. Such information leads to a peer influence, which we investigate by measuring the similarity of information sharing habits between the older adults and their friends. Social support is often a source for influence in actions and attitude [28,50]. Influence through friends on social

media websites have been shown to be significant in different ways (i.e. both positive and negative) based on the personality of the social media participant [30].

3. Research model

Facebook is a social media platform that actually encourages sharing. It is a platform that supports the so called "Social by Default Trust" [10]. Such a platform encourages information sharing — a trust related behavior, because it fosters reciprocal altruism [42]. It allows the circulation and sharing of information among the circle of friends and could become a knowledge generation and dissemination mechanism. Unfortunately it also makes the Facebook user vulnerable to the actions of others who are privy to that information.

However, with the increasing incidents of fraud, identity theft and the constant fear of malware, distrust has also started becoming more prevalent in cyberspace [24,36]. Distrust is important because it causes people to avoid negative consequences by encouraging them to take actions on the social media platforms that enable them to preserve privacy. Since the default action on Facebook is to share, a decision choice by a user would be to follow a path that has less risk in terms of negative consequences (than the positive consequences that the user could envisage by sharing information) and actively opt out of sharing information. This would help in preserving individual privacy information and thus buffer oneself from potentially harmful situations. In this paper we focus on only the distrust mitigating behavior of opting out from information sharing on the social media platform. Following Lewicki [33], we opine that such level of distrust may indeed be functional in that it may prevent a user from falling prey to some untrustworthy user on Facebook. It would allow the setting of certain boundaries around one's social behavior and yet permit functional interaction with other Facebook users (by contrast too much distrust would be dysfunctional).

The phenomenon being investigated in this paper is the influence of the privacy-preserving and social media sharing behavior of friends on the behavior of older adults, seen through the prism of the related concept of social influence. To understand the differences between genders, we draw on social role theory. Clearly it is important to study this phenomenon because of the potential threats of such sharing behavior. In this section, we focus on one social media platform – Facebook – to develop the research model and propositions. We do wish to note that while the objective of this study is to explore older adult online privacy behavior, we include a brief analysis of younger adults for comparative purposes. This can be expanded in future research.

An elderly Facebook user may share several pieces of information in terms of the attributes of his/her Facebook profile that are visible to the public. Upon the creation of a Facebook profile, some information is shared publicly by default. Some of this information includes photos, education and work related information.

The default sharing mode is "public" on Facebook. Therefore the privacy-preserving action decision made by the older adults would involve actually opting out of the information sharing default. In this paper, we focus on exploring the opting-out habits of older adults as far as information sharing on Facebook is concerned. More specifically though, we want to understand how this opting out decision is influenced by or at least correlated to the same privacy-preserving opting out actions by one's Facebook friends. We thus argue, in the subsequent part of this section, that if most of the friends opt out of the default public sharing settings for certain attributes, then the older adult tends to demonstrate a similar sharing attitude. The commonality or similarity in the corresponding privacy-preserving action habits between the elderly individuals and their friends can be observed from the missing attributes on corresponding Facebook profiles.

3.1. Similarity in photo sharing

Though concerns have been raised about the disclosure of personal information, studies show that an overwhelming number of Facebook users report posting photos of themselves or friends on their Facebook pages [56]. Photos have been an integral part of Facebook since its use became mainstream [31]. In fact, many family members join Facebook for the ease of sharing photos with each other [24]. As seen in Fig. 1, the default privacy mode of any new Facebook user is "public" [8]. When a Facebook user leaves this privacy mode unchanged, the default visibility option for any photo uploaded is "public" as well. On the other hand, the message shown in Fig. 2 is an example where a user consciously changes the overall privacy mode to "Friends". In such a scenario, the photos that are uploaded are by default only shared with the Facebook user's friends (see Fig. 3). Thus older adults on Facebook who consciously change the default settings to "Friends" and thus make all their albums invisible from the general public are presumed to have a higher degree of privacy preserving attitude.

We posit that people, (we focus here on older adults), are more likely to demonstrate the utilization of a technology that is similar in a way their friends do. In our paper, this similarity is observed through the lack of the default level of visibility of certain uploaded information, like photos. The social capital thus produced on a social media platform constitutes among other things an influence that one person has on another in terms of adjusting to and adopting the same platform. Therefore, we propose the following:

Proposition 1. *An older adult will be more likely to take a privacy-preserving action about his/her photos on Facebook if more of his/her friends do the same.*

3.2. Similarity in sharing education/work information

Several social networking and social media websites have been built and most of them require a minimal set of information to join the network and get started. This was, however, not the case with the earliest versions of Facebook, which were restricted mostly to college students. At that time it was required to enter the college name for verification purposes at the profile creation stage. However, since Facebook was opened up to the general public [31], this became an opt-in attribute for Facebook profiles. In other words, education (including high school and college) history are only entered by those older adults who actually choose to share this information as part of identifying themselves as well as to help connect with old friends. Since older adults [35] adopt social media like Facebook primarily for meaningful contact purposes, they are likely to highlight their education history with the public much more if there are similar minded people in their friends' list. Recent research has confirmed that social identity is one of the motivators for using online social networks like Facebook [12] and education history is certainly a part of social identity for many individuals. Further, most older adults would have built up their friends' circles through their years of prior work and professional contacts. Thus sharing employment history with the public would be a mechanism for reinstating old contacts and expanding the friends' circles based on the social ties that were developed in the past. Therefore making the employment history visible to the public on Facebook would also contribute to increasing social capital.

Since Facebook allows changing the visibility of background information like employer(s) and higher education while adding them on the profile, it is reasonable to assume that every Facebook user by virtue of being offered the same option at the information entry tends to select the option that matches his/her overall personal preference about sharing information. Since most Facebook users become friends with whom they share some similarity (especially prior to "friending" them on Facebook) – a concept commonly referred to as "homophily"

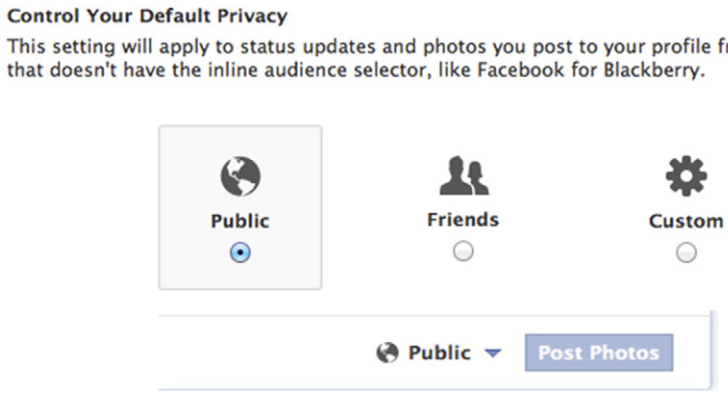

Fig. 1. Photo sharing is public by default.

[4,37] – it can be argued that such a similarity will often extend to information sharing preferences. Similar folks can, in other words, share a common method of defining their identities and part of such method can be revealing to the public one's education and work background [18], although the latter is considered more sensitive in general [41]. Unlike photos, however, regardless of a Facebook user's overall privacy mode, education and work information are always set to "public" visibility at the point of entry by default. Therefore, if one wishes to keep education and work related information private, they would have to specifically opt out of sharing. We propose the following:

Proposition 2. *An older adult will be more likely to take a privacy-preserving action about his/her college information on Facebook if more of his/her friends do the same.*

Proposition 3. *An older adult will be more likely to take a privacy-preserving action about his/her employer information on Facebook if more of his/her friends do the same.*

3.3. Differences between genders

According to social role theory [53], society and cultures have evolved with a certain set of expectations on two genders — male and female. These expectations elicit different kinds of responses from women and men that result in different social behavior. Such behavior stems from the habit or the predisposition to sharing information about self to strangers. One of the barriers to sharing information with strangers is the fear of that information being misused, i.e. essentially the lack of trust in strangers who may have access to such information. In this paper we argue that such sharing of fears or a lack thereof extends to a social media based environment as well. And since gender-based expectations are inherent to any society and culture, we argue that such expectations are also present among the users who use Facebook. It is thus logical to expect gender-based differences in behavior like public information sharing in Facebook. We posit that this behavior is relevant not only in the context of social norms but also in social interactions that are mediated by social media platforms. Prior research [1] has shown that men tend to share more than women do on Facebook. We argue here that the influence of the friend-based similarities and friends' list sizes is different between the two genders. This leads to the following:

Proposition 4. *There are differences between male and female older adults in the sharing decisions about the corresponding attributes on their Facebook profiles.*

4. Measurement

The research question addressed by this paper is the following — does the opting out decision of certain information by Facebook friends affect an elderly individual's similar decision about publicly sharing personal information? In order to understand this effect clearly, we also include the effect of friends' opt-out decisions about other attributes that are not necessarily related to a chosen attribute of the older adult. To investigate each proposition described earlier, we selected a set of attributes that were shared by older adults (See Table 1).

The privacy-preserving action of each profile attribute by friends is measured by the total number of friends not exposing that attribute to the public and we call this measure the *similarity index* for that particular attribute. This index is a ratio of the aforementioned count divided by the total number of friends an older adult has on Facebook.

For the data collection, we collected up to 50 friends of each older adult. We used 50 as the cut off number for counting the number of friends based on Dunbar' small group number. Dunbar's number suggests that for maintaining stable social reciprocal relationships, there is a cognitive limit to the number of people in one's circle of friends and Dunbar suggests that for small groups, the number varies between thirty and fifty [20].

The dependent variable for each proposition captures the individual older adult's privacy-preserving action of the corresponding profile attribute — i.e. photos, college and employer. The DVs are binary indicator variables where 0 indicates privacy-preserving opt-out and 1 indicates default public sharing. In other words, if a person kept his/her photos public, we marked the indicator as 1 for photos. We thus have three dependent variables: (a) *Individual Sharing of Photos* (ISP), (b) *Individual Sharing of College* (ISC) and (b) *Individual Sharing of Employer* (ISE). It should be noted that the independent variables – the similarity

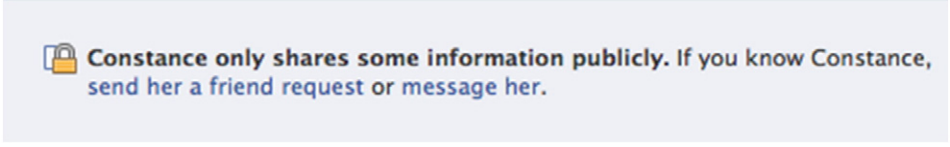

Fig. 2. This user has changed the overall privacy mode from "Public".

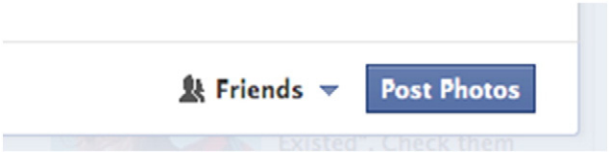

Fig. 3. Default visibility of uploaded photos under a "Friends" setting.

indices – are essentially counts of the friends' individual sharing of each profile attribute being 1. We can present these relationships as follows:

Let us describe the profile of each individual i in terms of 6 attributes as shown in Table 1 above:

The profile of Person i can be represented by $\{H_i,C_i,E_i,L_i,P_i\}=PR_i$.
The set of Facebook friends of Person $i=F_i$.
The number of Facebook friends of Person $i=N(F_i)$.
The similarity index for profile attribute x for Person i:

$$S_{x_i}=\sum_{\substack{j\in F_i\\ i\notin F_i}} X_{ji}/N(F_i)$$

where X_i is a generic binary indicator for one of those presented in Table 1 above.
E.g., if $P_i=0$ (i.e. Person i chooses to not share his/her photos publicly by default), then:

$$S_{P_i}=\sum_{\substack{j\in F_i\\ i\notin F_i}} P_{ji}/N(F_i).$$

There exists a set of similarity indices based on friends for each older adult i: $\{S_{H_i},S_{C_i},S_{E_i},S_{L_i},S_{P_i}\}$.

5. Data collection and method

IS researchers have usually studied information sharing intentions through self-reported surveys where intentions are captured [1,7,21,41]. Many studies use university and college students as their samples to understand online and social network privacy issues but very few are dedicated towards the generation of older adults (aged 55 and above) [7,21].

In this paper we contribute to the literature by focusing on actual privacy-preserving action behavior by using an unobtrusive observation mechanism. This mechanism entails recording, from a public perspective, what people post on their profile pages on Facebook. This mechanism was applied to older Facebook users and their friends to investigate the peer influence or similarity on information sharing on Facebook.

For our study, we collected 134 profiles of older adults (aged 55 and above) from Facebook. In addition we also collected the profiles of 50 friends on their respective Friends pages. From here onwards we will refer to these elders as Root Users. (The average number of friends of Root Users was 44.5 — we analyzed the information sharing behavior of 5965 friends.) 66 of these root users were females while the remaining 68 were males. The profiles of the older adult Facebook users were collected manually from the Facebook pages of the different chapters of the American Association of Retired Persons (AARP). The same method was used to collect the profiles of the friends of these older adults. We used this data to compare the effect of similarity in sharing with friends, on the extent of individual sharing. Each profile page was programmatically searched for keywords related to our chosen predictors of sharing. For example, "High school" was the keyword searched in these profile pages to see if a user had listed his/her high school on the profile. The profile pages were saved as HTML files and the search for the keyword was a simple text search for the text with the format: "*>keyword<*". This was necessary because our keyword would appear on a page loaded by any browser only if it was placed between certain HTML formatting tags. This method also helped us in keeping the search simple in the HTML files that were for the most part machine-generated. Our algorithm would store the value 1 once it came across the attribute in the aforementioned format and 0 if it did not. The value 1 for each attribute in our dataset thus indicates that the corresponding user has shared it on the profile for public viewing and 0 indicates otherwise. It must be mentioned that since Facebook moved to the Timeline format [17] for its profiles, we had to search not only the profile page but also the "About" page since the latter would store most of the personal information (e.g. gender). Similar binary coding was assigned for photo sharing. We were interested in distinguishing between those who did not share any pictures with the public (see screenshot of private message below) and those who did (even if it was just one photo of someone else). The search method for identifying photo-sharing was a little different from that for the other attributes as explained above. In this case, we investigated the landing page of each user's photos and then launched two type of searches: (a) for older versions of Facebook profiles, we searched for a piece of text that explicitly mentioned that the user has not shared any photo with the public, and (b) for Timeline profiles, we searched for HTML tags with appropriate strings indicating Facebook's server that stores images. The latter helped us since Facebook stopped printing the aforementioned piece of text about privacy for photos since they started converting users to the Timeline format.

In addition to the older adults, we also collected 61 profiles of younger adults whose ages were less than 55. These profiles, along with those of 50 friends of each (total of 3050 data points), were processed through the same analysis in order to get a comparative picture of where older adults and younger adults differ in terms of their privacy-preserving action habits on Facebook.

When a person starts using Facebook, he/she has to create a profile on Facebook using some basic information as gender and birthday. In addition, when a profile is created, certain elements of that profile become public by default. However there are nuggets of profile information that a person has to enter after creating the default profile page and username for the very first time. As shown in the screenshots below (Figs. 4 and 5), all these information input forms are accompanied by a drop-down preference selector for the extent of people who would be able to view that particular piece of information. E.g., if you don't want friends of your friends to see your birthday, you have the complete authority inside the Privacy Settings page to change that visibility of your birthday to "friends-only".

Table 1
Attribute sharing indicators.

Profile Attribute	Description
H_i	If a person hides/doesn't share *high school* with public
C_i	If a person hides/doesn't share *college* with public
E_i	If a person hides/doesn't share *employer(s)* with public
L_i	If a person hides/doesn't share *current location* with public
P_i	If a person hides/doesn't share *photos* with public
PR_i	The set of all the above profile attributes of an older adult

6. Analysis and results

In this paper, we used binary logistic regression to measure the impact of each similarity index normalized by size of Friends' list on the privacy-preserving decision for each of the selected profile attributes (i.e. photos, college and employer). Logistic regression is very well suited for studies where the dependent variable is a categorical variable. In our study, we are interested in studying the impact of the similarity index on an older adult's decision to share and such a

decision has two options ("default public" and "privacy-preserving") thus making our categorical dependent variable binary. In our binary logistic regression model, p is defined to be the probability that an older adult will opt for a privacy-preserving action of a particular profile attribute and the expression $p/(p-1)$ represents the *odds ratio* for that action. The dependent variable in this regression equation is the *logit function* of p which is defined as the natural logarithm (base e) of the odds ratio as shown below:

$$\text{logit}(p) = \log_e[p/(p-1)] = \ln[p/(p-1)]$$

Our propositions are targeted at studying the impact of the privacy-preserving actions of friends on that of an older adult for a select number of profile attributes, in our regression model. We have included other profile attributes as independent variables as well to make sure that the equations were not underspecified. Finally, in order to test the gender-based differences (Proposition 4), we have added the gender of the older adult as a categorical independent variable in the binary logistic regression model as well. The following is the complete model:

$$\begin{aligned}\ln[p/(p-1)] = \alpha &+ \beta_1 \text{Similarity} - \text{Index}_{\text{High-School}} \\ &+ \beta_2 \text{Similarity} - \text{Index}_{\text{College}} + \beta_3 \text{Similarity} - \text{Index}_{\text{Employer}} \\ &+ \beta_4 \text{Similarity} - \text{Index}_{\text{Location}} + \beta_5 \text{Gender}_{\text{OlderAdult}} + e\end{aligned}$$

where p is the probability of a privacy-preserving action decision for each of the dependent variables: (a) *Individual Sharing of Photos* (ISP), (b) *Individual Sharing of College* (ISC) and (b) *Individual Sharing of Employer* (ISE). Thus we tested 3 different binary logistic models, each with different odds ratios and the same set of predictor variables. The same regression model has been applied to the dataset of younger adults and their friends on Facebook.

The following statistics from the SPSS output of the binary logistic regression model for the older adults are reported below in Table 3 and for the younger adults in Table 4: *Exp*(B) (also known as the *odds ratio* — in this case for the independent variables), Wald statistic, 95% confidence interval of *Exp*(B), −2 log-likelihood statistic, and Hosmer–Lemeshow (H-L) goodness-of-fit statistic. *Exp*(B), indicates the change in the odds due to one unit change in the predictor variable. In our analysis, the dependent variable is the decision of a Facebook user about sharing a particular profile attribute. This variable is coded as 1 if the individual sticks with the default public sharing option and 0 if the individual takes a conscious privacy-preserving decision (i.e. to not enter it on Facebook at all or not share it with public). If both limits of the 95% confidence interval of the odds ratio for each independent/predictor variable are greater than 1, then we can claim that one unit increase in that predictor variable will lead to a statistically significant increase in the likelihood of the older adult's decision to stay with the default sharing option. On the other hand, if both limits of the 95% confidence interval are smaller than 1, then there will be a significant increase in the likelihood of that Facebook user (older or younger) to take a privacy-preserving action decision.

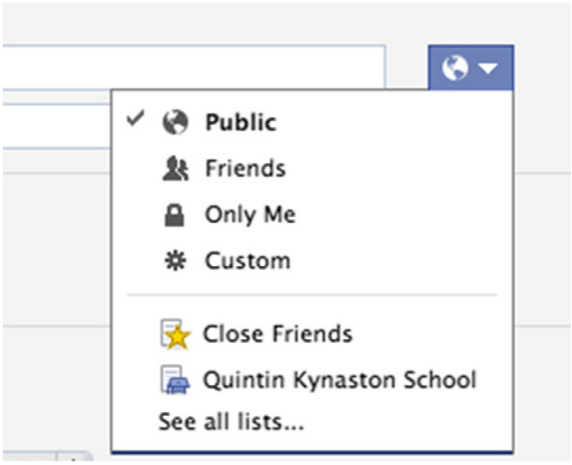

Fig. 5. Options of visibility for every piece of information.

Wald statistic was used in order to test whether the predictor variable makes a significant contribution to the prediction of the dependent variable. The significance level of the Wald statistic is reported below as well. We reported the −2 log-likelihood ratio (−2LL), which tests whether the predictors of the model make a difference in predicting the dependent variable. Larger values of −2LL ratio indicate a poorly fitting model. Finally, Hosmer–Lemeshow (H-L) statistic was reported as well to ensure the goodness-of-fit. A p-value that is greater than 0.05 indicates that the logistic model's estimate for the data is at an acceptable level.

The results from binary logistic regression model for the older adults can be summarized as follows (see Table 2):

1. Similarity index of photos influences privacy-preserving actions regarding photos, by older adults.
2. Similarity index of college influences privacy-preserving actions regarding college, by older adults.
3. Older male adults opt out of sharing employer information publicly more than older female adults do.

Tables 3 and 4 below give the odds-ratios for predictors in all the 3 logistic regression models pertaining to Propositions 1 through 3 in the presence of Gender (G) as a dummy variable. Each cell in this table has two values — the first one is the *Exp*(B) (odds-ratio) and the second one is the 95% confidence interval (CI) limits. The 2 bottom rows of the table contain the −2LL and H-L test statistics for each of the models tested. The H-L values are presented with the corresponding significance values in parentheses.

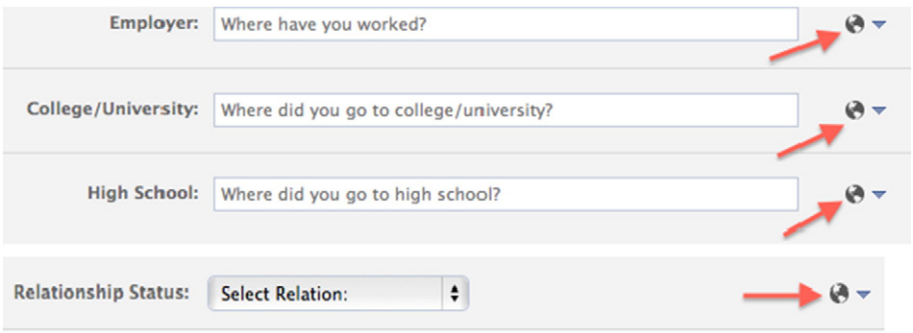

Fig. 4. Information that can be added after profile creation and for which visibility can be altered (drop-down lists pointed by the arrows).

7. Discussion

Our results show that all our attributes of interest have a role of similarity in terms of decision to expose them to the public on one's Facebook profile. This is true among those who are aged 55 and above but not so much among those who are below 55. This comparison tells us that there is something different about the older adults who perhaps look at similar sharing patterns among friends to make their own decisions. The same cannot be concluded from our results for the population below 55. We found that if a young adult's friends share their high-school information, then the young adult herself will tend to share her photos publicly, although the prediction power for this is marginal. This is possibly due to the fact that several young adults use Facebook to re-establish contact with their friends from their high school. Also sharing photos publicly helps in being discovered by such friends as well. We also found marginal support for influence of friends' sharing of employer information on their own privacy-preserving action regarding the same. A possible reason is that those friends' act of divulging such information makes the young adults feel comfortable about publicly associating themselves with their own employers.

We could argue that this might be a reflection of the equal level of awareness of privacy and security issues on the Internet among young male and female adults. An interesting observation, however, is that there seems to be no effect of our chosen influencing profile attributes on the sharing decision about college information among these young adults, regardless of their genders.

On the other hand, older adults seem to be influenced not only by their friends' sharing decision of the same attribute (i.e. photos of friends on photos of self, college of friends on college of self, etc.) but there seem to be other additional factors in play. It appears from our findings that the more an older adult's friends share their location, the more they themselves share their photos. Since location could be considered one of those personal information nuggets that a person would be least likely to share with the public, it could be argued here that seeing one's friends reveal them could make a person feel more comfortable about sharing precious personal moments captured in photographs. The Hosmer–Lemeshow value for the model predicting opt-out of photo-sharing turned out to be not significant. We posit this as an indication that the attributes chosen as IVs might not be sufficient to make such a prediction. This is a limitation that we would like to address in the future, primarily by incorporating more profile attributes where friends of older adults exercise their privacy-preserving actions.

In this study we have chosen to focus on the privacy-preserving action of photos and information of college attended as well as past and present employers. Analyzing the data collected from the older adults' profiles as well as the profiles of their 50 friends we found that the decision to opt out of the default sharing of those chosen attributes on their profile is positively impacted by similar decisions for the same attributes by their respective Facebook friends. The positive and significant odds ratios in the binary regression models support this. We also used the similarity of other attributes as possible indicators or predictors of such sharing habits. It turns out that most of them have no significant impact on the privacy-preserving action of the attributes of our choice. This tells us that elders opt out of the default public sharing mode for certain information on their profiles based on the influence of their friends

While we found significant influence of friends in information sharing from the pooled data, there was partial support for gender-based differences. Our fourth proposition was aimed at testing the differences in the impact of friends on individual-level sharing between older male and female adults. This difference, however, was found only when it came to predicting the sharing decision about employers. More specifically, the coefficient for the gender dummy variable was found to be significant and negative. In other words, we found that a Facebook older adult is a male, then there's a higher likelihood for that person to opt out of publicly sharing information regarding his present or past employer(s). The coefficient for gender in the case of predicting ISC (College) was also found to be negative but not significant. We feel that this will require further examination with a larger sample size.

The findings in Table 4 however also highlight a limitation of this study whereby we should not be treating the under-55 Facebook users as a monolithic group and that there might be nuances within them. Further, rather than using survey instruments which would help us capture intention and perceptions, we have used the method of "unobtrusive observations" where actual behavior is captured. However it is more difficult to capture a person's characteristics in contrast to the survey method. We also attempted to address the issue of endogeneity of our predictor variables. During the data collection for the younger adult population, we made sure that the younger adult users did not go to the same college or have the same employer. Unfortunately, we were not able to collect any additional data from the older adult population. Since we collected only profile pages (along with their "photo" and "about" pages), we did not get a chance to uncover any communication between older or younger

Table 2
Means of the independent variables.

S_H	S_C	S_E	S_L	S_P
0.3960	0.3037	0.3667	0.5010	0.6436

Table 3
Binary logistic regression results for older adults.

Predictor variables	Test statistics	Sharing of photos	Sharing of college	Sharing of employer
High school	*Exp*(B)	7.593	36.518	68.787
	95% CI	0.049–1165.404	0.315–4236.295	0.529–8944.982
College	*Exp*(B)	0.507	**0.000*****	1.731
	95% CI	0.003–74.055	**0.000–0.031**	0.011–265.034
Employer	*Exp*(B)	0.240	1.555	0.008
	95% CI	0.001–53.624	0.009–272.148	0.000–1.998
Location	*Exp*(B)	**0.001****	11.458*	0.656
	95% CI	**0.000–0.224**	0.055–2392.651	0.005–83.883
Photos	*Exp*(B)	**0.002****	1.298	0.129
	95% CI	**0.000–0.332**	0.006–281.365	0.001–18.501
Gender	*Exp*(B)	1.237	0.541	**0.363*****
	95% CI	0.515–2.970	0.227–1.288	**0.149–0.884**
−2LL		137.175	137.245	137.928
H-L		23.408 (0.003)	5.408 (0.713)	7.961 (0.437)

* p<0.10.
** p<0.05.
*** p<0.005.

Table 4
Binary logistic regression results for younger adults.

Predictor variables	Test statistics	Sharing of photos	Sharing of college	Sharing of employer
High School	*Exp*(B)	**0.000****	5.344*	119.631
	95% CI	**0.000–0.104**	0.004–6869.304	0.028–512690.457
College	*Exp*(B)	119294.459	0.152***	15780.221
	95% CI	0.037–3.866E+11	0.000–300.504	0.763–326315924
Employer	*Exp*(B)	840.891	0.197	**0.000****
	95% CI	0.002–417341033	0.000–641.746	**0.000–0.004**
Location	*Exp*(B)	25497.975	1.284	0.437
	95% CI	0.271–2.402E+9	0.003–655.223	0.000–468.881
Photos	*Exp*(B)	0.001	0.002	0.052
	95% CI	0.000–85.294	0.000–2.957	0.000–158.890
Gender	*Exp*(B)	0.571	1.416	1.448
	95% CI	0.108–3.027	0.461–4.355	0.391–5.373
−2LL		37.108	77.251	60.135
H−L		5.488 (0.709)	4.409 (0.818)	5.361 (0.718)

* p<0.10.
** p<0.05.
*** p<0.005.

adults and their respective friends and thus we could not uncover any peer influence. This is a limitation that needs to be taken care of in future research.

8. Conclusions

In this paper, we have investigated the information sharing habits of particular age demography on social networking websites like Facebook. We have focused on the group of Facebook users that are aged 55 and above. We investigated how older adults tend to opt out of sharing information with the public on a social platform like Facebook. The core research question asked in this paper is whether those practices are influenced by their friends in their Facebook networks. The similarity in opting out habits is measured first by picking a set of interesting and potentially sensitive classes of information that a person can share on a Facebook profile. These classes of information are attributes of Facebook profiles that are used to measure similarity in sharing habits. The similarity is measured using a similarity index for each such attribute. To answer the research question, in this paper we have focused on the privacy-preserving action decisions regarding three kinds of information — sharing uploaded photos, college information and past and present employers. Through binary logistic regression we show the effect of hiding or not sharing Facebook profile attributes by friends on the older adults' own decision to do the same with the same set of attributes. In addition to information sharing, we have also aimed for the gender difference aspect in this paper and our results show that male older adults are more likely than their female counterparts to be influenced by their Facebook friends in sharing employer information.

It is important to highlight the type of sharing activity we are looking at in this paper. In a social network like Facebook, a person sets up his/her profile providing personal information. These profiles are visible to different people with differing degrees depending on the nature of the relationship. A Facebook user exposes his/her daily activities on Facebook with differing degrees. In this paper, we classify the latter kind of sharing as information sharing over time while the former is regarded as static information sharing. It is of course highly possible that a user may be prone to changing his/her profile page very frequently [57]. This brings up a limitation of our study where we are examining a snapshot of a profile as opposed to a periodic observation to understand richer aspects of information sharing by older adults. Another limitation of this study is the reliance on the third party observation mechanism used to collect data to support our hypotheses. As mentioned earlier, this method (a) highlights the differences between users in sharing only at a public-level and does not account for the friends and friends-of-friends levels, and (b) does not distinguish between the hiding of information from public and the decision to not share information at any level. In other words, for our future studies we will need to conduct a survey to augment that data with information about intentions about sharing. In addition to the limitation about the data collected directly through Facebook, it is also important to factor in the level of feeling of trust or distrust an older adult may harbor towards different friends on Facebook as well as towards Facebook as a platform. These feelings should play a significant moderating role in helping older adults make privacy-preserving decisions about sharing personal information on Facebook. However, this also means we should deploy a self-reported data collection method to measure perception-based constructs like trust. While research has shown that trust is an important role in online auctions [3] as well as in people's reluctance towards sharing personal health information on the Internet [5], it is important to understand the parallel concept of distrust as well in this context. The role of distrust in the older adults' decision to opt out of default information sharing behavior on online social networks shall be studied in future research.

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