
Audience Visualization Influences Disclosures in Online Social Networks

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Abstract

One of the major concerns about online social networks (OSNs) is privacy. OSN users want to share, but they sometimes disclose more information to more people than they would like. We introduce visualization and numeric audience information as potential interface solutions to the problem of privacy behaviors that are misaligned with privacy preferences. Findings from a large experiment with participants of all ages and from a broad range of backgrounds suggest that for both current and potential users, augmenting an interface with a visualization or numeric display of the audience helps people disclose in a way that is more in line with their own preferences. We conclude by proposing that audience visualization and quantification tools have the potential to assist users in achieving their privacy goals while using OSNs and have the potential to enhance privacy in other information systems as well.

Keywords

Privacy, social network, visualization, disclosure, information sharing.

ACM Classification Keywords

H1.2 User/Machine Systems, *human factors*; H.5.2 User Interfaces, *User-centered design*. K.4.1 Public policy issues, *Privacy*.

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CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

ACM 978-1-4503-0268-5/11/05.

Introduction

With the continuing growth of social network technologies, connecting in online social space has rapidly become a part of mainstream American life. Yet current and potential users face an ongoing challenge—wanting to connect and participate in the growing landscape of online social media spaces [8] while protecting their privacy in unfamiliar spaces where social norms for participation and disclosure are still emerging. It is not surprising, then, that adults in the U.S. continue to express concerns about privacy in digital social spaces [11]. Specifically, balancing one's concerns with behaviors that are consistent with disclosure goals has proven to be a challenge. Previous research has indicated differences (both perceived and observed) between privacy preferences of individuals and disclosure behaviors, particularly in online spaces. These differences create disruptions [10] or expectancy violations [4] that may result in concerns and account for a reluctance to fully participate in social spaces.

We argue that helping people to achieve consistency between their privacy goals and disclosure behavior can reduce privacy concerns associated with OSNs. Specifically, because OSNs contain few visual cues about who is present, and few boundaries defining private and public space, we believe that online social space visualization, or design that enhances *Audience Awareness*, may help individuals to maintain consistency between disclosures goals and actual disclosure.

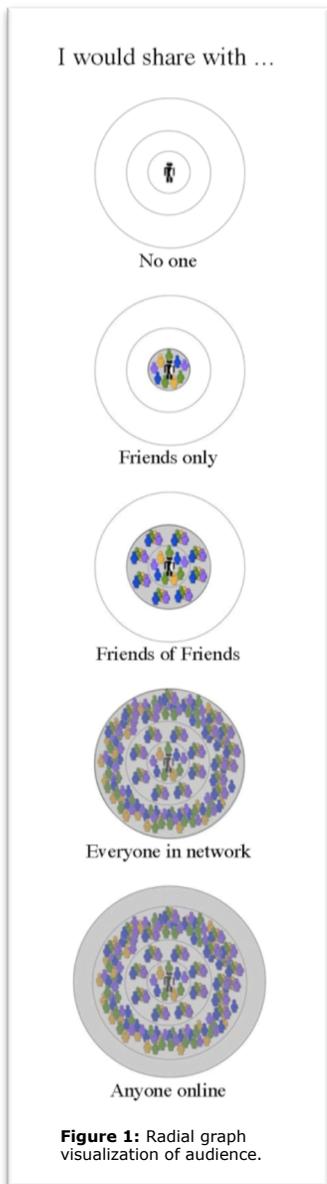
Audience Awareness

One of the challenges presented in managing privacy online is the realization that the audience with which one interacts and discloses to is often “invisible” [3] or

“imagined” [1]; the boundaries that help to define norms within a particular space (such as a private room, an office space, or a public auditorium) are not present online to assist individuals in framing their social and disclosure behaviors.

It has been suggested that the *architecture of virtual space* [3] can influence self-disclosure. A few researchers have explored this concept of architecture in virtual space embodied in “virtual walls” [2, 6]. For example, Kapadia and colleagues [6] identified three types of metaphorical walls that can inform the behaviors of individuals in virtual social spaces. Other research suggests that visualization tools can be used to enhance privacy protection in online community venues. For example, Anwar and colleagues suggest that privacy-enhanced visualization tools will help OSN users to understand who is in their “extended neighborhood” online [5]. In a well-received visualization, McKeon [9] illustrated the change in default facebook privacy settings over five years. In his visualization, the extent to which information was disclosed to audience members was visualized in the form of a radial graph, with each successive radial representing a larger audience gradient, or social circle.

However, until now there has been no systematic HCI research extending the physical space analogy of privacy to test whether providing social network information analogous to the physical world (i.e., a visualization of an audience) will affect disclosure preferences. In this study we manipulated an OSN information disclosure interface to include a visualization of the audience, and tested whether intended disclosure behaviors are influenced by this visualization.



Methods

We experimentally varied audience presentation using either Text, Numbers, or Visualization, and measured individual responses to disclosing five kinds of information to determine the effect of audience awareness. Participants (N=1322) were recruited from attendees of the Indiana State Fair on six weekend days over a period of three weeks in August 2010. Participants ranged in age from 18 to over 65, were generally well educated and overwhelmingly White.

To assess users' willingness to disclose information using OSNs, participants responded to a 5-item survey scale asking them to indicate to whom they intended to share their: a) phone number and address; b) date of birth; c) hometown; d) photos from their birthday party; and e) a status update message stating "I'm going to the State Fair tonight." The disclosure target was one of five recipient choices: a) no one, b) friends only, c) friends of friends, d) anyone in network, and e) anyone online. Participants were randomly assigned to one of three information presentation conditions that varied the presentation of audience information alongside each survey item. The *Text* condition presented recipient categories as nominal text (e.g., friends). This condition is similar to many current OSN privacy setting interfaces (e.g., Facebook); the *Number* condition presented recipients as a combination of text and numerical information about the number of recipients in each target group (we controlled this variable and presented the numbers as: no one = 0, friends = 50, friends of friends = 2500, all network users = 500 million, and anyone online = 1.6 billion); the *Visualization* condition presented a radial graph visualization representing a gradient of social circles or audiences (see Figure 1).

Results

The goal of this study was to assess the effects of audience visualization on OSN disclosure, thus we focus only on the results directly related to this effect.

EFFECT OF AUDIENCE INFORMATION ON NON-USERS

A one-way between subjects ANOVA testing whether there was an effect of visualization on number of items disclosed for non-users (Figure 2) was significant $F(2, 419) = 3.20, p = .042$. Follow-up Bonferroni-adjusted contrasts indicated that participants in the Text condition ($M = 3.46, SD = 1.72$) reported they would disclose significantly more items than participants in the Visualization condition ($M = 2.91, SD = 1.92; p = .038$). There was no significant difference between the Numbers condition and either the Text or the Visualization conditions ($ps = .277$ and $.999$).

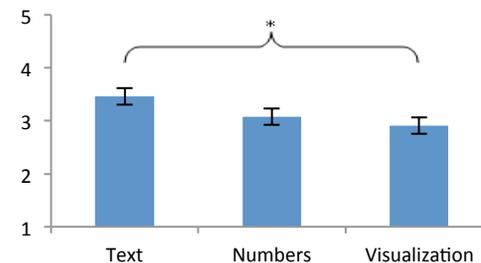


Figure 2: Mean number of items disclosed by non-users across audience display conditions.

EFFECT OF AUDIENCE INFORMATION ON USERS DISCLOSURES

A one-way between subjects ANOVA testing the effect of visualization on number of items disclosed for OSN users (Figure 3) was significant $F(2, 898) = 4.14, p = .016$. Follow-up Bonferroni-adjusted contrasts indicated that participants in the Number condition ($M = 3.97,$

SD = 1.27) reported they would disclose significantly fewer items than participants in the Visualization condition (M = 4.24, SD = .92; $p = .016$). There was no significant difference between the Text condition and either the numbers or the Visualization conditions (p s = .999 and .121 respectively).

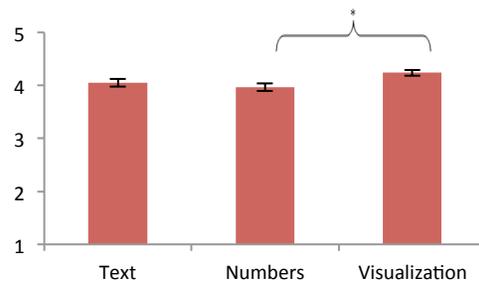


Figure 3: Mean number of items disclosed by OSN-users across audience display conditions.

Discussion

In this study we tested the association between audience information and how much information people are willing to disclose. Overall, we found that willingness to disclose was influenced by an interface enhanced with audience information. Specifically, we found that non-users were less likely to disclose when they received visual-based audience information, and OSN users were less likely to disclose when they received numeric-based audience information. In the following sections we discuss these findings and their implications for design.

EFFECT OF AUDIENCE INFORMATION ON NON-USERS

Information about the intended audience at the time of disclosure influenced how many items non-users would

disclose using an OSN. Specifically, participants who saw a visualization of recipients were willing to disclose fewer items than participants who did not. For non-users who lack experience using social networks the visualizations may act as scaffolding upon which they can build a representation of social space. This scaffolding may help participants translate schemas and norms about disclosure behavior from other contexts to the context of the OSN. Thus, for non-users who have yet to develop behavioral norms about online social spaces, the visualization of the social space may reduce the disruption between stated privacy preferences and intended behavior.

EFFECT OF AUDIENCE INFORMATION ON OSN USERS

Information about the intended audience at the time of disclosure also influenced how many items experienced OSN users were willing to disclose. Specifically, participants who saw numeric-based information disclosed the fewest items. Individuals who are already OSN users likely already have a conceptual model of how information is shared in online social space. However, based on previous research, we know that even experienced users prefer to disclose less than they actually disclose in OSNs [1]. Our results suggest that providing numeric information about the potential audience size (e.g., all network users = 500 million) allows OSN users to develop a more realistic conceptual model of sharing behavior and thus align disclosure behaviors more closely with disclosure preferences.

Design Implications

Information provided in the form of visualization has been used successfully as an aid for understanding complex material for hundreds of years [5]. However, despite the complexity of managing privacy online, little

support has been available to users. Specifically, visualizations have not been available to help individuals make sense of complex privacy settings.

PROVIDE AN AUDIENCE VISUALIZATION

In this study, we found that providing participants who were not already OSN users with a visualization of their potential audience allowed them to make disclosure decisions that were more closely aligned with disclosure preferences. Thus, a significant design implication is that providing a visualization of possible audiences to new OSN users may help individuals understand the offline to online analogy of sharing. Consequently, augmenting an interface with visualization of potential audiences may help people align their privacy behaviors with their privacy preferences.

PROVIDE NUMERIC AUDIENCE INFORMATION

Whereas providing visualization was helpful for individuals who are not currently OSN users, we found that numeric audience information was more helpful to those who are already users. For current OSN users providing specific, detailed information about the number of potential recipients resulted in less willingness to disclose. Consequently, if the goal of a designer is to encourage users to disclose information using an OSN in a way that is consistent with disclosure preferences, including information about the number of potential audience members in an OSN disclosure interface may be helpful. For example, when a user enters new information, such as a photo, he or she is usually also asked to choose the recipients who can access that photo. In this case a redesigned interface could include additional information about the number of recipients at each disclosure level. Based on the findings in this paper, this additional information could

assist the user in disclosing photos to their intended audience. In addition, designers who are interested in helping users to understand disclosure decisions and align their disclosure behaviors with preferences, may design privacy tools that assist users in disclosure decisions, even if those tools are not embedded within an OSN. For example, a privacy advocacy group may use these findings and design a facebook application that helps users better understand their audience by including visualizations and enhanced information.

Future Work

The audience visualizations we have used in this study are rudimentary, and drawn for empirical purposes only. Future work can focus on the usefulness of particular design choices for effective audience visualization. For example, the visualization of each gradient level could be scaled to be consistent with typical numbers of potential recipients. Alternatively, the visualization of disclosure targets could be scaled to directly reflect the size of one's personal social network. Similarly, for the audience number interface, numbers could be personalized such that they reflect the actual number of people in each recipient group. Also, for this study we separated the visualization from the numeric information to be able to ascertain which type of information was most useful in assisting users with disclosure decisions. However, in terms of design, a combination of both a visualization *and* numeric information about audience may be more useful. Future work should assess the effects of these types of information combinations. Finally, the categories of audience used in this study, while based on literature and existing categories used in OSNs, could be refined and potentially expanded. For example, we found participants were most likely to share with friends.

However, we know that there are distinctions among friends within an OSN [7]. Thus, it is likely that participants may want more or fewer pieces of information with different sub-groups of friends, such as a family or workgroup. Having the scaffolding of a visualization or providing numeric audience information may be even more useful when people need to make such fine-grained disclosure decisions.

Conclusions

This work breaks new ground in understanding how OSN design features may allow users to share information in a privacy-sensitive way. Most notably, we found that willingness to disclose could be encouraged or discouraged by augmenting an OSN interface with additional information about the audience. Based on this finding we conclude that designing (or augmenting) online social spaces that include audience visualization helps to reduce the discrepancy between reported privacy attitudes and actual disclosure behaviors. These findings suggest that providing enhanced audience awareness can users achieve privacy goals across a variety of systems. These findings should be useful for designers who wish to assist users with achieving online privacy goals.

Acknowledgments

We thank the Purdue Extension Office for allowing us to collect data at the Indiana State Fair, and P. Rao, J. Bernat, D. Dutta, J. Fyke, V. Hawes, L. Herbers, C. Janssen, R. Rao, P. Rajan, C. Scherr, and S. Shorter for assistance in data collection and preparation.

References

[1] Acquisti, A. & Gross, R. (2006, June). Imagined communities: Awareness, information sharing, and

privacy on the Facebook. *Lecture Notes in Computer Science*, 4258, 36-58.

[2] Adu-Oppong, F., Gardiner, C. K., Kapadia, A., & Tsang, P. P. (2008, July). Social Circles: Tackling Privacy in Social Networks. In *SOUPS '08: Proc. of the Fourth Symposium on Usable Privacy and Security*.

[3] boyd, d. (2007). Social network sites: Public, private, or what? *Knowledge Tree*, 13.

[4] Burgoon, J. K. (1978). A communication model of personal space violation: Explication and an initial test. *Human Communication Research*, 4, 129-142.

[5] Friendly, M., & Denis, D. J. (2009). *Milestones in the history of thematic cartography, statistical graphs and data visualization*. Available online: <http://www.datavis.ca/milestones/>

[6] Kapadia, A., Henderson, T., Fielding, J. J., & Kotz, D. (2007, May). Virtual Walls: Protecting Digital Privacy in Pervasive Environments. In *PERVASIVE '07: Proc. of The Fifth International Conference on Pervasive computing* (pp. 162-179). Berlin: Springer-Verlag.

[7] Kisselburgh, L.G. (2008). *The social structure and construction of privacy in sociotechnical realms*. Unpublished dissertation, Purdue University, West Lafayette, IN.

[8] Lampe, C., Walsh, R., Velasquez, A., & Ozkaya, E. (2010). Motivations to participate in online communities. In *Proc. of the SIGCHI Conference On Human Factors in Computing Systems* (pp. 1927-1936). New York: ACM.

[9] McKeon, M. (2010). *The evolution of privacy on Facebook*. Retrieved from: <http://mattmckeeon.com/fac ebook-privacy/>

[10] Petronio, S. (2002). *Boundaries of privacy: Dialectics of disclosure*. Albany, NY: State University of New York Press.

[11] Pew Internet & American Life Project (2010). Raw data from a survey conducted in May 2010. Available online: <http://pewinternet.org/>