Who Wants to Know What When? Privacy Preference Determinants in Ubiquitous Computing

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ABSTRACT

We conducted a questionnaire-based study of the relative importance of two factors, *inquirer* and *situation*, in determining the preferred accuracy of personal information disclosed through a ubiquitous computing system. We found that privacy preferences varied by inquirer more than by situation. That is, individuals were more likely to apply the same privacy preferences to the *same inquirer* in *different situations* than to apply the same privacy preferences to *different inquirers* in the *same situation*. We are applying these results to the design of a user interface for managing everyday privacy in ubiquitous computing.

Keywords

Ubiquitous Computing, Privacy, Social and Legal Issues

INTRODUCTION

As part of our efforts to develop a user interface for managing personal privacy in ubiquitous computing, we conducted a questionnaire-based study to determine the relative importance of two factors – the *inquirer*'s identity, and the user's *situation* at the time of inquiry – in determining the preferred *accuracy* of personal information disclosed to an inquirer through a ubiquitous computing system. Adjustable accuracy is an important element of privacy management in ubiquitous computing, allowing for nuanced disclosure approximating that of traditional social life. For example, by disclosing one's location as "New York City" but not "the corner of 6th Ave. and West 13th St.," one reveals just enough information to satisfy certain inquirers without breaching one's desired level of privacy. We developed a study to help identify the stronger determinant of a user's preferred accuracy of information disclosure in ubiquitous computing – the identity of the inquirer, or the user's situation at the time of inquiry.

PRIVACY ABSTRACTIONS AND METAPHORS

We have previously identified three user-level abstractions for a ubiquitous computing privacy management system: inquirer, situation, and accuracy preferences [4]. Their

essential relation is that the *inquirer*'s identity and the user's *situation* at the time of inquiry together determine which of the user's *preferences* will moderate the *accuracy* of disclosed information. In this study, we sought to determine which factor is the stronger preference determinant: inquirer or situation.

Our three abstractions map partially to Anne Adams's findings [1], which show that perception of privacy in an audio/video-captured environment is shaped by the interrelation of (1) the perceived identity of the information *receiver* (comparable to our *inquirer*), (2) the perceived *usage* of the information (which we do not address in this paper), (3) the subjective *sensitivity* of the disclosed information (made adjustable by our *accuracy preferences*), and (4) the *context* in which the information is disclosed (comparable to our *situation*). In this paper we report on the relative importance of two of these abstractions, inquirer and situation, in determining users' privacy preferences in ubiquitous computing.

In the study design, we represented sets of accuracy preferences as metaphorical "faces". That is, moderating the accuracy of personal information with a given set of preferences is akin to wearing a given "face" in a social situation. This approach is rooted in the work of social psychologist Erving Goffman, who furthered the theory that an individual actively yet intuitively monitors and adjusts his behavior in the presence of others in an attempt to control their conceptions of his identity [3]. The notion of fragmented identity pervades user interfaces in the forms of pseudonyms and profiles and has been used in research on privacy user interfaces on the desktop [*e.g.*, 2].

STUDY DESIGN

Our scenario-based web questionnaire was designed to measure the relative importance of inquirer and situation in determining an individual's privacy preferences in ubiquitous computing environments.

The website asked each subject to imagine she had a cell phone containing her name (true name and a set of pseudonyms) and profile (primary and secondary email addresses, occupation, and interests) and capable of automatically determining her location and activity. Interested parties could collect some or all of this

Face	Personal Information Accuracy			
	Identity	Profile	Activity	Location
True	Actual	Primary email, Occupation, Interests	Actual	Actual
Vague	Pseudonym	Secondary email, Interests	Vague	Vague
Blank	Anonymous	Undisclosed	Undisclosed	Undisclosed

Table 1. For each disclosure event, subjects could assign any of these three faces or create a custom face.

information in real-time through various services (*e.g.*, a remote friend could determine the subject's location through a website, or a nearby merchant could directly query the phone for the subject's contact information and interests). The phone contains a set of three "faces", each of which specifies the accuracy of the personal information an inquirer can collect about the subject while she wears that face (see Table 1).

Subjects were asked to assign a face to each of the eight personal information disclosure events representing the cross-product of two situations:

- *Working Lunch*: Downtown with a colleague,
- *Social Evening*: Live music club with two friends;

and four inquirers:

- *Spouse/Significant Other* (remotely located),
- *Employer* (remotely located),
- *Stranger* (proximately located),
- *Merchant* (proximately located).

For each event, subjects chose from the 3 faces to blur the information disclosed to that inquirer in that situation, or created a custom face by specifying the accuracy levels of personal information to disclose.

RESULTS

We posted the questionnaire to community websites across the U.S. and to engineering students at UC Berkeley, resulting in a sample size of 130. Note these results are self-reported and based on imaginary scenarios; future work should emphasize the analysis of empirical data.

Our primary concern was not which face a subject chose for a given event, but rather which factor had a greater influence over that choice. We wanted to know whether users would be more likely to (1) assign a given face to handle a given inquirer in all situations, or (2) assign a given face to handle all inquirers in a given situation.

We found that the inquirer's identity is a stronger determinant of privacy preferences than is the user's situation. The mean number of different faces used across the four inquirers in the *working lunch* situation was 2.72 (SD: 0.84); the mean in the *social evening* situation was 2.58

Inquirer	Same face	Different face
Spouse / S.O.	**109 (83.8%)**	21 (16.2%)
Employer	71 (54.6%)	59 (45.4%)
Stranger	**101 (77.7%)**	29 (22.3%)
Merchant	**112 (86.2%)**	18 (13.8%)

Table 2. Number of subjects who assigned the same face or different faces to each inquirer in the two situations.

(SD: 0.89). This shows that within a given situation, subjects *did* vary faces across inquirers. In contrast, for a given inquirer, subjects generally *did not* vary faces across situations. Table 2 shows that when the inquirer is a significant other, stranger, or merchant, the situation (or, at least, the two situations covered in the study) is a weak determinant of the choice of face. One subject wrote, "The recipient is more important than the context, because the information will likely outlive the circumstances." Another wrote, "For me, 'who' is all that matters. If I don't trust the person with personal information, I wouldn't want to give them any information at any time. If I do trust the person, I'm willing to give out information freely."

When the inquirer is the subject's employer, situation becomes a stronger determinant of face. 45.4% of subjects assigned a different face to employers in different situations, more than twice as many as for any other inquirer. One subject wrote, "[D]uring the work day, or after-hours during crunch time, I'd want my boss/coworkers to find [me] - after hours I'd rather be more anonymous."

CONCLUSIONS AND FUTURE WORK

Study results show that (1) identity of the information inquirer is a stronger determinant of privacy preferences than is the situation in which the information is collected, and (2) situation is nonetheless an important determinant, especially when the inquirer is the user's employer. These results imply that designers of privacy user interfaces for ubiquitous computing should strongly consider emphasizing the inquirer as the primary index and the situation as a secondary index into the user's privacy preferences.

REFERENCES

1. Adams, A. Multimedia information changes the whole privacy ballgame. *Proc. of Computers, Freedom and Privacy 2000*, 25-32.

2. boyd, d. Faceted Id/entity: Managing representation in a digital world. M.S. Thesis, Mass. Inst. of Tech., (2002).

3. Goffman, E. *The Presentation of Self in Everyday Life*. Anchor, Doubleday, New York, (1959).

4. Lederer, S., Dey, A.K., & Mankoff, J. A Conceptual Model and a Metaphor of Everyday Privacy in Ubiquitous Computing Environments. Technical Report CSD-02-1188, Univ. of California, Berkeley, (2002).