

# Don't Disturb My Circles! Boundary Preservation Is at the Center of Location-Sharing Concerns

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## Abstract

Past research on location-sharing technologies and social media has uncovered many types of privacy concerns such as informational privacy, impression management and interactional privacy. We interviewed 21 users and nonusers of location-sharing technology and found that many of these privacy concerns are actually just symptoms of a higher-level motivation: the desire to preserve one's existing offline relationship boundaries. We confirmed and generalized this finding through a nation-wide survey (N=1532) and path analysis. These results imply that designers of location-sharing systems should focus on preserving users' relationship boundaries to address this cause of privacy concerns.

## Introduction

Location-sharing systems (e.g. Gowalla, Foursquare, Google Latitude, Facebook Places) have permeated the social media landscape in recent years (Tsai et al. 2010). Some are dedicated services for sharing your location and knowing where your friends are, while others are a feature of other social media (such as sending GPS-coordinates in Twitter tweets). Despite the quick proliferation of smartphones and the prevalence of GPS-enabled cell phones in developed countries such as the United States (35% of U.S. adults own smartphones; Smith 2011), researchers note that people have been slow to adopt location-sharing technologies (Zickuhr and Smith 2010). Many authors attribute this fact to a myriad of concerns that location sharing systems seem to engender, such as informational privacy (e.g. withholding or disclosing personal information), impression management (e.g. self-presentation concerns about how one appears on a map), and interactional privacy (e.g. being found when you do not want to interact) (Xu et al. 2009, Tang et al. 2010, Tsai et al. 2010).

We conducted a two-part study to understand real-world concerns about using location-sharing technology. In the first phase (reported in Page and Kobsa 2009, 2010), we interviewed users, non-adopters, and those who had abandoned location-sharing technology. Taking a grounded theory approach, we identified many of the same privacy concerns currently discussed in the literature.

In this paper, we report on further analysis of qualitative data from the first phase that sheds light on the *source* of these concerns. We found indications that privacy concerns are actually symptoms of a desire for *boundary preservation*: An online social interaction manifests as a privacy issue if it renegotiates relationship boundaries with the other person. For example, one interviewee signed up for Latitude in the presence of someone she was dating. She did not add him since it "would be weird...[It] could potentially turn into kind of a stalking situation with someone you're dating." He seemed similarly cautious about changing their current dating relationship boundaries: "I think there was a mutual understanding that we didn't want to know where each other were all the time. Like we weren't in that phase of our relationship." Location-sharing would have made it difficult to preserve their offline relationship boundaries. They thus opted out of sharing with each other at this point in their relationship.

In the second phase of our study, we confirm and generalize this finding through a nation-wide online survey of concerns with location-sharing technology. We uncovered a hierarchical relation between lower-level privacy concerns and the high-level desire for boundary preservation.

By identifying and verifying that boundary preservation is one of the driving forces behind privacy concerns, we lay the foundation for future research to diagnose and alleviate this cause of user concerns about location-sharing applications. We also suggest how our findings may extend to other social media (e.g. Facebook, Twitter), as people's location-sharing use/non-use is intertwined with how they use other social media (Page and Kobsa 2009).

## Related Work

Research on location-sharing technologies has identified a range of privacy concerns that users of such systems harbor. Many studies focus on information disclosure and analyze with *whom* and *why* people share their location, and how they avoid sharing with the wrong people (Wiese et al. 2011, Consolvo et al. 2005). Some studies uncover user anxieties around not having control over how they are presented (Tang et al. 2010). Researchers have also found that people may be more concerned about disturbing others and being disturbed by others than about the private nature of disclosure (Iachello et al. 2005). Other work focused on perceived risks and found that fear of potential stalkers is one of the biggest barriers to adopting location-sharing services (Tsai et al. 2010).

Social media researchers have noted similar concerns. As social networks have grown in popularity, so has users' concern around what others will post about them (Tufekci 2008). The many different social spheres (e.g. family, friends, work) that intersect on one's Facebook page lead to worries about who can see what (Binder et al. 2009). People are annoyed and sometimes overwhelmed by too much, sometimes useless, information from others (Ehrlich and Shami 2010). Researchers also point out how people can be overwhelmed by having to interact with others online (Smith and Rogers 2003) and at how they limit who can see their profiles so that disclosure does not go beyond a defined audience (Stutzman and Kramer-Duffield 2010, Li and Chen 2010, Meeder et al. 2010).

On the other hand, researchers have also identified many counterexamples where privacy seems no concern. Trials of location-sharing systems in small, close-knit peer groups or families seem to promote connection rather than privacy fears (Barkhuus et al. 2008, Raento and Oulivirta 2008, Brown et al. 2007). Even within larger social networks, people continue to share tremendous amounts of personal information despite potential drawbacks including embarrassment, loss of employment, identity theft, and threats to personal safety (Neuburger 2008, Acquisti and Gross 2009, Acquisti and Gross 2006). Nardi et al. (2004) observed how some people leave diary-like blogs open to the world. In fact, some share intimate details with complete strangers when they will not even share those details with their closest relationships (Hasler and Ruthven 2011). Moreover, people increasingly use location-based services such as OkCupid to connect with strangers nearby (Rao 2011).

Other research shows that most social networking ties are with existing, offline relationships (Boyd and Ellison 2007, Lampe et al. 2006). Online privacy regulation also mirrors offline behavior. Drawing from Altman's theories of privacy in the offline world, Palen and Dourish (2003) describe how, just like in the real world, online privacy is a boundary regulation along the dimensions of identity,

disclosure, and temporality. Using this conception, privacy not only consists in withholding information or withdrawing from others, but it can also involve sharing information or being more accessible. People regulate their disclosure or accessibility to the desired level, and thus, seemingly overt online behavior may not be a privacy violation at all.

To support these privacy boundary regulation activities, researchers investigated multiple approaches to setting privacy policies, with varying degrees of success (Kelley et al. 2011, Jones and O'Neill 2010, Tsai et al. 2009). The focus of our study is to understand the motivations behind boundary regulation, which can help us in the design and evaluation of location-sharing and other social media.

## Constructing the Theory

The first phase of our study consisted of 21 interviews exploring the real-world factors affecting people's adoption or explicit non-adoption of Google Latitude. In earlier analysis (Page and Kobsa 2010), we identified many of the same privacy concerns found across the location-sharing and social media literature, such as information overload (Iachello et al. 2005), impression management (Tang et al. 2010), and disclosing location to the wrong people (Wiese et al. 2011, Tsai et al. 2010). Many researchers have focused on *who* can see one's location as the origin of a number of these concerns (e.g. Consolvo et al. 2005). However, in our analysis we noticed several examples where *who* sees one's location was not the main determinant of privacy concerns. For instance, in relating his location-sharing experiences to Facebook, one interviewee explained how he turned off his Facebook wall to keep his coworkers from seeing unprofessional communications. This preserved his professional relationship boundaries. At a later point in time though, he "got over it" and turned the wall back on: "It's fine now. I don't really care [if they see it]...I'm not there anymore, I quit the job." In this example, his ex-coworkers are still on Facebook with him, but his relationship with them has changed. In other words, the *who* is constant, but the *relationship* has changed from coworker to ex-coworker. This transition dispelled privacy concerns since he no longer had a professional relationship boundary to maintain.

Examples like this had us wondering whether the *relationship* is more important than *who* sees one's location. Thus, in the next section we return to the qualitative data and perform a new analysis to answer that question.

## Qualitative study

We interviewed 17 males and 4 females (average age 28, range 21-40's) who had either adopted or explicitly chosen not to use Google Latitude, a comparatively popular location-sharing service. See (Page and Kobsa 2010) for

detailed study procedures and demographics. Our previous grounded theory analysis used open coding to produce a catalog of privacy concerns (expressed by both location-sharing users and non users). In the current closed-coding analysis, we introduced a code for each concern (C1-C8), as well as an opposite code to represent *non-concern*. In order to investigate the influence of relationship management through boundary preservation, we also coded the *relationship* type (R), acts of boundary preservation (BP), and indications of privacy concerns arising when boundary preservation fails (BPC). Below, we use these codes to annotate our findings.

## Findings

What consistently predicted the absence or presence of privacy concerns turned out not to be the relationship type itself. Rather, it was whether or not the situation would change existing offline relationship boundaries. However, boundaries (and thus the ensuing activities) change when the associated relationships change, even when the ‘who’ stays the same: when acquaintances become good friends sharing may increase, while sharing may slowly decrease when relationships dry up. In turn, what was once a privacy concern may no longer be, and new concerns may appear where they were absent. This was even the case for potentially negative relationships such as stalkers and strangers: people were not necessarily concerned about their privacy unless they anticipated a change in relationship with the stalker or stranger.

In other words, people preserved their offline relationships and boundaries in the online environment by engaging in a specific type of online boundary regulation, namely *boundary preservation*. In this section, we illustrate how the concern of boundary preservation manifests in the most commonly discussed privacy issues. Many examples are drawn from other social media, since interviewees often expressed location-sharing concerns by using examples from their ecology of social technologies.

### C1. Bothered by Information

Many interviewees complained about information filtering and information overload problems. This ranged from status updates or tweets about “the most inane things about their life” to Latitude location updates that “clutter up my phone.” On the other hand, many found it useful to keep in touch with friends or family about everyday activities such as knowing when a spouse was on their way home.

What made the difference between information being an annoyance versus being helpful was the relationship between sender and receiver. An interviewee illustrates this by explaining his disinclination to use Twitter: “Somehow my older sister calls my mom 18 thousand times a day... seemingly every 5 minutes (R).” They “would enjoy [Twitter], cause I think that's the level of communication

they might have... That's their relationship (R).” Twitter would bother him since he has a different relationship with them (BPC). Several interviewees also pointed to how they wanted less detailed status (BP) from friends as they moved away and grew apart (R). They often asserted that online communications should reflect existing offline practices (BP).

### C2. Bothering Others with Information

For some relationships, interviewees were also sensitive to bombarding others with information:

I work so hard to maintain my relationships with my colleagues (R) ... I don't want to encumber them by spending too much time with them (BP). [Also] I don't want to encumber them with the extra data about me (BPC).

Nonetheless, many of these same interviewees emphasized sharing in their family relationships: “More information is always important to the other person (R)...I would love them to know where I am right now (BP)” in order to feel “connected to my family always even if I'm not able to talk to them.” Others had a different family relationship where sharing would be superfluous: “I don't tell them what I do every day, and I never have (BP). We just don't have that type of relationship, even though it's very close (R). That's how I'd want it online as well (BP).”

### C3. Sharing with More People than Intended

Quite a few interviewees had bad experiences disclosing to more people than they had intended. Even when the information was not private, when they intended to share it with people of a certain relationship type, it could invite too much attention from other relationship types:

I even have this problem with my status. I used to just put my status to say *In <lab name>* and that on its own would often just lead to random people, well not random, but my buddies (R) IM-ing me and saying, ‘Hey, what's <lab name>?’ out of curiosity. And it would just be this, not pointless, I'm glad to explain what I'm doing, but at some points it would be just irritating (BPC) ...”

There is no clear boundary (BP) telling his IM contacts that this status is meant for work relationships (R). Similarly, the interviewee who turned off his Facebook wall (see earlier example) had unprofessionally “abusive language” between him and his good friend “that started coming onto Facebook” from their offline relationship (R). He turned off the wall (BP) to keep his professional contacts from witnessing it (BPC). However, when he left his job, they no longer had a professional relationship (R) and so it didn't matter anymore to him whether they saw it (BP).

### C4. Compelled to Interact Online

A common concern was feeling compelled to interact with others on social media, ranging from having to respond to

too many instant messages, texts, or Facebook wall posts, to having to interact in person because of location sharing:

[If] I'm in the neighborhood [and] enough of them calls me at once, 'Drop by', it doesn't seem nice to say 'Ok, I can't' to everyone (BPC). I'm kind of an old fashioned guy. I'll probably get in touch with [friends] (R) I need to on a cell phone. And I expect them to do the same (BP)... I like to be pretty much in control of my own life rather than people directing me how to go about it (BPC).

In contrast, this same interviewee did not have the same concerns about being compelled to meet his extended family (R): "You have your own schedule and if it's on the way and you have some spare time, why not. But if you are kind of busy, you just say, 'I'll try, but maybe sometime later (BP).'" Saying no upsets the relationship boundary with his friends but not with his family.

Similar privacy concerns can arise with old acquaintances (R) with whom one used to interact regularly (BP). One interviewee worried about acquaintances who, years after they've lost contact (R), reengage and try to advance their relationship online: If "I felt like I had to respond and keep this thing up... that would be annoying (BPC)."

#### **C5. Others' Actions Reflecting Badly on Me**

Others' online activity was also a source of anxiety, especially when this activity could hurt the image that interviewees maintained towards people with whom they had a different kind of relationship. Even a profile picture could trigger concerns:

I just don't need my neighbor's mom (R) knowing who I hung out with last night... or even just my list of friends (BP). Like if I have a friend whose profile picture is a little more scandalous, I feel like that would reflect upon me somehow (BPC).

This interviewee kept the "older generation" (R) out of her friend list in order to maintain the relationship boundaries that she has spent her "whole entire life" upholding (BP). Other interviewees would delete or untag (BP) problematic posts or photos of them uploaded by others (BPC).

#### **C6. Unknown Social Etiquette**

Social etiquette includes knowing "which level friends" are appropriate to add, and expectations around how others would use one's disclosed information and vice versa. Not knowing the etiquette makes it difficult to anticipate which relationships will be affected and how.

Some interviewees explained how this concern is mitigated in intimate relationships: "Only with my partner (R) could I have those conversations where I'm like, 'you will never do this because it upsets me.' (BP)" However, unless a relationship reaches that point of intimacy, "it's too private having that conversation (BPC) with a friend (R)" or to say to a supervisor (R), "I don't like that you use

Google Latitude and used it to say... 'You're in the lab. Cool, you're available for me to ask to do some task.' I can't say to my advisor (R), 'Don't do that!' (BPC)." This illustrates how negotiating social etiquette is within the boundaries of intimate relationships, but crosses the line for other relationships and leads to privacy concerns.

#### **C7. Controlling Who Sees My Location**

Interviewees were often concerned about controlling who can see their location. Sometimes they wanted to manage the impression they made on others. Other times they focused on being caught in a lie. One interviewee complained that he would be "in trouble" if his girlfriend (R) saw him hanging out with his best friends who were a "bad influence" (BPC). Once their relationship ended, his concerns disappeared because he was no longer accountable to her for his actions (R).

Surprisingly, only a handful of interviewees expressed safety concerns about making their location public. Most interviewees explained that strangers would not be interested in their location:

I would treat [it] as anyone not online in real life (R). You won't just go and talk to anyone. You'll say hi, or whatever, but that's just it, right? (BP) Even if you broadcast your location, your name, ... that doesn't mean everyone will come and talk to you (BPC).

One interviewee even asserted Latitude would not change his relationship with a girl who had been stalking him (R) since she would know how to find him anyway (BP). Even when it comes to strangers and stalkers, location-sharing does not necessarily violate relationship boundaries.

#### **C8. Others Joining Me Unexpectedly**

Sometimes interviewees worried that others would join them at an inopportune time. This too seemed to be influenced by the type of relationship they had with the other. Several people also worried about how to deal with relationships (R) where just showing up was not a problem initially (BP), but as the relationship changed (R), it became a problem (BPC). This included acquaintances who seemed interesting at first (R), but less so over time (R). One example was a student who did not have concerns about sharing his location yet:

Because right now I'm just a student (R), but next quarter I'm going to be a TA [Teaching Assistant]. Cause I know if I'm going to TA in a class where a lot of people want to grab me (R)... I can say bother me in these hours (BP)... but I'd feel really guilty and probably help them (BPC)... I've had friends that have their students (R) try to pull all their attention and try to get their help a lot... to do all the work for them (BPC).

Right now there is no reason for the students to want to find him, so he is not concerned about them dropping in on

him. As a TA, his relationship will change so that he expects to be accessible during office hours. However, the interviewee is concerned that students will violate the boundaries of that new relationship.

### Generalizing and Validating the Theory

The examples in the previous section illustrate how people defend existing relationship boundaries. They are concerned if they suspect others may cross that boundary, changing the nature of their relationships. In several examples, the *who* stayed constant while the *relationship* changed. To validate these results, we administered a nation-wide survey to find out whether these privacy concerns are widespread and in fact motivated by the desire for preserving relationship boundaries.

In our previous qualitative analysis (Page and Kobsa 2009), we noticed that people’s attitudes towards location-sharing do not necessarily align with actual usage: Reluctant users dreaded an inevitable wave of friends and acquaintances joining the service, and enthusiastic non-users wished they owned a supported smart phone, or that their friends were on it. Thus, we focus the quantitative analysis on privacy concerns and do not require survey respondents to use location-sharing technology. This allows us to also address the concerns of non-adopters and not just of people who are already users.

### Quantitative Study

Table 1 lists the items used in our survey for boundary preservation concerns (BPC) and eight other frequent concerns (C1-C8) uncovered in our qualitative study. Participants evaluated the items on 7-point scales whose values are -3 (Disagree Strongly), -2 (Disagree Moderately), -1 (Disagree Slightly), 0 (Neutral), +1 (Agree Slightly), +2 (Agree Moderately) and +3 (Agree Strongly).

Additionally, we asked participants how frequently they used five popular types of social media commonly mentioned in the qualitative interviews (Facebook, MySpace, Twitter, Instant Messaging, Social Media Games) using 6-point scales: 0=Not Applicable, 1=Less than once a week, 2=Once a week, 3=Several times a week, 4=Once a day, 5=More than once a day. For analysis, we employed a composite of the individual social media items (including an “other” category) to represent the total amount of social media use. Finally, we collected demographics (age, gender, education, geographical location) and controls (smart phone ownership, data plan).

Because many location-sharing concerns are so intertwined with people’s attitudes and concerns towards social media in general, items C1-C5 probed on the respondent’s current social media behavior or attitudes. Those items were only shown to the 75.8% of respondents who indi-

cated that they use some sort of social media beyond instant messaging at least once a week.

BPC	I’m worried LSS will change my relationship with others
C1	I am bothered that others share so much information with me
C2	I am concerned that if I share too much information, I would bother others
C3	I worry that I might share information with more people than I intend to
C4	I worry about feeling compelled to interact with others online
C5	I worry that what my friends share will reflect badly on me
C6	I’m worried about knowing the social etiquette of using LSS (e.g. who to friend, what to share, etc.)
C7	I’m concerned about being able to control who sees my location
C8	I’m worried others would join me at an inappropriate time if I share my location

**Table 1** Questionnaire items considered in our current analyses

We piloted the survey to test for clarity and understandability and to get an estimate of the time needed for completion. The pilot also included two of the original interviewees (a non user and a user) to probe for discriminant validity of items. We subsequently advertised our survey using Craigslist, a popular online site for jobs, services, and selling or buying goods. Craigslist sites are regional and so we chose the most active sites in each sub-region of each major geographic region (West, Mid West, South, North East), as defined by the U.S. census. To obtain a more representative sample, we chose additional sites for the least active regions (located in the Mid West and the South). In all, we posted on 13 Craigslist sites (Los Angeles, San Francisco Bay Area, Seattle, Denver, New York City, Boston, Chicago, Minneapolis, Omaha, Atlanta, Miami, Louisville and Fort Worth) and collected 2039 responses over the course of a week in the spring of 2011. To make our sample more representative of the U.S. population, we normalized the answers from each of the four regions by their respective metropolitan population sizes.

As an incentive to participate, we offered the first 50 respondents a \$10 Amazon gift certificate. We also entered the first one thousand respondents into a drawing for one of two \$100 gift cards. To ascertain the validity of responses, we included 7 reverse-coded items, trick questions (e.g. asking how frequently they used made-up social media), and quality checks (e.g., unrealistic completion times and/or surveys coming from the same IP address). We eliminated submissions that failed on two or more of the seven controls. We removed 1.7% who had lived in the

U.S. for less than 5 years, to control for cultural background. The resulting 1532 valid responses were randomly divided into an exploratory sample (N=510) and two confirmatory samples (N=511, N=511), one of which is used for this paper while the other is reserved for cross-validation of future theories.

Of these responses, 24.0% of respondents had used a location-sharing service, 79.0% used some form of social media at least weekly, 54.0% owned smart phones, 59.7% were on an unlimited data plan, 66.6% were female, the education level was in line with the U.S. Internet population and the average age was 35.5 years (range 18-73).

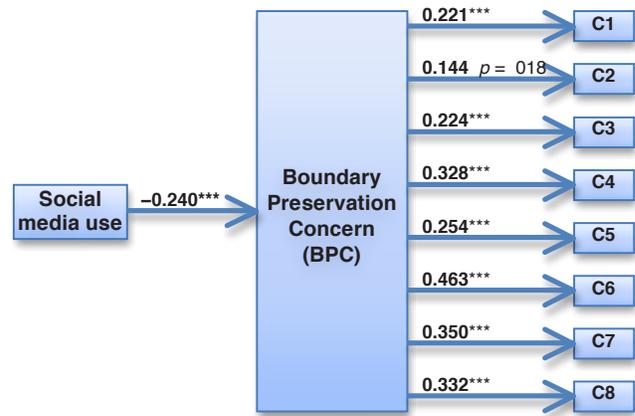
## Findings

We used the exploratory sample to model several possible relationships between boundary preservation and the other concerns, controlling for social media use. We explored the possibility that the other concerns are hierarchically at the same level as boundary preservation, or that concerns are unrelated to social media use, or even that the concerns affect social media use. However, the model that had the best fit (lowest AIC and BIC)<sup>1</sup> and the most explanatory power was the hypothesized model, in which boundary preservation causes all other measured privacy concerns.

This final path model was estimated using Weighted Least Squares estimation with categorical indicators for the concerns (Figure 1). The model had excellent fit indices ( $\chi^2(8) = 9.428, p = .3075; CFI = 0.999; RMSEA = 0.019 [0.000, 0.057]; WRMSR = 0.291$ )<sup>2</sup>. More importantly, all modeled effects are highly significant.

Figure 1 shows that social media use decreases concerns about boundary preservation. As hypothesized, boundary preservation concern has a reasonably large, significant, positive direct effect on all other location-sharing privacy concerns (see Figure 1 for the standardized effect sizes). Moreover, the effect of social media use on the lower-level concerns is fully mediated by boundary preservation concerns.

We validated this model on our confirmatory sample, and found that the effects from boundary preservation concerns to the lower-level concerns were consistent in size and significance. Most prominently, the effect on C2 was even larger in the confirmatory model (0.231,  $p < .001$ ). This model also indicated that aside from social media use, other demographic variables (i.e. age, gender, education, smart phone, data plan, and geographic region) did not have a consistent influence on either boundary preservation or the lower-level concerns.



**Figure 1:** The path model, in which boundary preservation concern (BPC) serves as a cause of the other privacy concerns (C1-C8). The numbers on the arrows represent the standardized effect sizes; \*\*\* indicates a significance level of  $p < .001$ .

## Discussion

Our findings support the hypothesis that boundary preservation is a main source of location-sharing privacy concerns. This insight allows us to causally explain the various concerns of location-sharing system users that prior research has identified: When people are concerned about boundary preservation (i.e. they are concerned that location-sharing services will change their relationships with others), this will increase their various other concerns, such as worrying about being compelled to interact with others, or being overloaded by information from others. Conversely, when people are *not* concerned about boundary preservation, they are also less likely to have these other privacy concerns.

In our analysis, the only consistent causal influence on boundary preservation concerns was social media use: frequent social media users are less concerned about boundary preservation. Other influences may exist, but using our confirmatory sample we were able to rule out consistent influences of age, gender, education, smart phone ownership, data plan, and geographic region.

## Conclusion and Future Work

Now that we recognize that boundary preservation is a main source of many common privacy concerns, we can offer design suggestions for more effective privacy management. Google+ takes a step in the right direction by grouping contacts into circles and allowing users to interact within a circle. Google+ also supports the concept of *relationship* rather than just *who* by permitting a contact to be in multiple circles. The next step for system designers is providing users with a way to defend the boundaries of these circles by focusing on how their technology alters or

<sup>1</sup> The Akaike information criterion (AIC) and Bayesian information criterion (BIC) are statistics for comparing the fit of non-nested models.

<sup>2</sup> The “non-significant” Chi-square indicates that the model has no significant misfit. Accepted cut-off values for the other fit statistics are:  $CFI > 0.96, RMSEA < 0.05$  (within (0.00, 0.10)),  $WRMSR < 0.95$ .

maintains the relationship boundaries observed in the real world. One direction would be to help people see and perhaps even shape the etiquette around location-sharing use. Since social privacy revolves around social norms (Solove 2008), establishing shared expectations around how these technologies will mediate social interactions allows people to use the service in a way harmonious with their offline relationships. For example, LinkedIn realizes that professional connections usually emerge out of a pre-existing relationship: the other person is a friend, colleague, business partner, etc. By requiring this information when adding someone to your professional network, LinkedIn effectively mirrors the social etiquette present in creating offline professional networks (i.e. requiring a certain relationship before being able to connect). In the future, we plan to study location-sharing etiquette in more depth.

Another area for designers to investigate is lowering the odds that someone will join at an inopportune time. This concern had a rather high correlation with the concern about controlling who can see my location ( $r = 0.647$ ). This also came across in interviews when several people were worried that, just by virtue of sharing their location, they had invited others to join them. System designers should consider how various online actions are interpreted by users, and should find ways to avoid misunderstandings. For instance, Google+ allows the user to choose with whom to share her location, making it easier to share with only certain circles. However, there can still be ambiguity about whether the user is open to others stopping by and to what extent. In real life, a party host may tell his closest friend to stop by and to spread the word to others from their shared circle of friends. Online, the host may broadcast to that same circle of friends, but the other friends may show up to hang out regardless of whether the close friend goes—something the host may not intend (see also Kelley et al. 2011). The offline relationship reflects an implicit structure of the one close friend bridging the relationship between the host and the others. Either the close friend comes alone, the close friend brings others along if she is inclined, or nobody goes at all. With circles, the relationship structure is flattened and the explicit action of broadcasting makes it an equal invitation to everyone. This may be why many users in our and other studies refrain from participating or disclosing anything at all.

Further, we echo recommendations of prior work to support plausible deniability and other social mechanisms that people use in offline relationships to support smooth social interactions (Hancock et al. 2009, Nardi et al. 2000).

Our model showed that social media use counteracts concerns about boundary protection, and has no direct effect on the symptoms. This suggests that as people use social media more, they learn to navigate them in ways that do not impact their relationships negatively. Understanding how existing boundaries are preserved in online social

media may provide insights into how to support boundary preservation processes for location sharing.

The questionnaire items considered in the quantitative study were part of a bigger survey that was limited in length in order to evoke a large response. Future research can expand on the boundary preservation concept and produce a multi-item scale to measure people's boundary preservation concern.

Our research focused on the U.S. population, and more specifically, urban users of Craigslist. Because privacy is culturally influenced, research should expand beyond the United States. Future research should also study if and how concerns evolve with technology use over time, and with a more ubiquitous adoption of location-sharing technology.

Although our work focuses on location-sharing technology, we think it is likely that our findings extend to other social media. Our qualitative data suggests that the location-sharing concerns are intertwined with and similar to those found in other social media (Page and Kobsa 2009). Future research should investigate whether boundary preservation applies to social media in general and what regulation mechanisms can maintain these boundaries.

This study lays the groundwork for further exploring the relationship between privacy concerns, social media use, intention to adopt location-sharing services, and actual adoption and usage behavior. Understanding that boundary preservation is a major source of concern in location-sharing enables us to test whether and how much privacy concerns impact adoption. We are actively investigating this matter.

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