
Reducing Communication Uncertainty with Social Intelligibility: Challenges and Opportunities

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Abstract

Uncertainty is an inherent part of any social interaction, and is amplified when using computers to communicate. Social intelligibility mechanisms are becoming prevalent in social media and online communications, used to reduce uncertainty by

transmitting information about the activities of peer users. For example, message delivery notifications in chat systems let the users know whether the other party had had seen a sent message. However, designing these mechanisms is a difficult task due to the complexities of computer-mediated social interaction. This paper presents some of the tradeoffs associated with providing intelligibility to social contacts with regard to privacy, the impact on social dynamics and the impact on trust between users. We present some initial insights from a scenario-based, structured interview study of an intelligible context-aware social application, and discuss some of the open questions and challenges of reducing social uncertainty.

Author Keywords

Intelligibility; explanations; social; uncertainty; privacy.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction

Uncertainty is an inherent part of social interaction. Understanding the behaviors of others and interpreting the inherent uncertainty in the communications with

We provide intelligibility of context inference by generating explanations for the following questions:

1. **What** is the current outcome value of the context?
E.g., the user is unavailable.
2. **Why** is this outcome the current value?
E.g., the user is unavailable because she is in a meeting.
3. **Inputs**: what factors affect this context?
E.g., the user has a scheduled meeting, is standing, is located in her office, and speech can be heard.
4. **What if** the factors are different, what will be the outcome?
E.g., if the user were not in a meeting, she would be available.
5. **How To**: what are the rules for inferring the outcome?
E.g., the user has a rule in which she is unavailable if there is an event on her calendar.

others are two of the most difficult and fundamental tasks in the human experience. Digital communication raises additional uncertainty to communications, as it lacks situational and geographical contexts that can help people to infer the social context of the communication. Several studies suggest ways to increase the certainty of the communications through various context awareness mechanisms (*e.g.*, [1, 2, 5]), in which higher-level social context (such as availability to receive a call) is conveyed to the user's social relations based on lower-level contexts. These ideas are also reflected in contemporary technologies. For example, instant messaging systems such as WhatsApp have read receipts (double blue ticks), which show whether the user had opened sent message.

We propose **social intelligibility** to explain of the user's current inferred state (*e.g.*, availability, activity), in various levels of detail and logic, based on different types of sensors. However, this may have unexpected social consequences. Intelligibility seeks to illuminate deeper levels of context information and system reasoning. While this additional information can help users to better understand their counterparts, it also has the potential of compromising their privacy and autonomy. We have previously found that showing uncertainty may help or hurt trust in single-user applications [4]. In this position paper, we seek to explore research questions about the potential impact of intelligibility on social dynamics. As a first step, we analyze the results of interviews conducted with 10 users to understand the complexities of using social intelligibility to reduce communication uncertainty.

Primarily, we investigate the tradeoff between intelligibility and privacy, we focus on three factors that

influence the use of intelligibility in social applications: the social contacts with whom to share contextual information sensed and inferred, and explanations of these inferences.

Social Contacts

We studied attitudes towards sharing with five types of contacts (Contact Types) in descending order of closeness: *Significant Other, Immediate Family, Close Friends, Coworkers, Others*.

Context Inference Factors

We designed CallMeLater, a context-aware, social mobile application, which infers the user's availability for being called by inferring over six contextual factors: Contact Type, Schedule (Personal, Work Task, Unscheduled), Time, Location (Office, Home, Library, etc.), Sound Activity (Talking, Listening to Music, Ambient Noise), and Motion (Sitting, Walking, Driving, etc.). The contextual factors have uncertainty due to error and noise in the machine learning models used.

Intelligibility of Context Inference

CallMeLater is *intelligible* [4] (see side bar) to explain its inference of a user's Availability to be contacted. These explanations can be shared with the contactor to improve social awareness and reduce uncertainty.

Structured Interview Study

We conducted an interview study in the lab where we presented interviewees with a survey with two scenarios (**S1**: taking a workday off to go shopping for birthday presents; **S2**: being in a meeting in a conference room at work with coworkers). We recruited 10 interviewees: 8 college students, 2 staff; ages 21-29 (Median=23.5); 6 females. Each interviewee filled out a



You are in the restroom at the office.

CallMeLater has inferred your availability as **Somewhat Available**.

Your **Immediate Family** may call you or decide to call you depending on whether you share the following automatically generated information:

I am currently **Somewhat Available**.

I am currently **Somewhat Available**. This is because:
In the Restroom
Contacter is Immediate Family

I am currently **Somewhat Available**. The following is sensed about me:
Time: Workday - Before 6pm
Schedule: Nothing Scheduled
Location: Restroom within Workplace
Sound: Ambient Noise
Motion: Sitting
Contacter: Close Friends

I am currently **Somewhat Available**. You can explore my availability at other times by selecting the values of the possible sensed factors you wish, and click What If to see how my Availability will be inferred:
Time: 5:00pm
Schedule: Nothing Scheduled
Location: Home
Sound: Ambient Noise
Motion: Sitting
Contacter: Significant Other / Spouse
[What If](#)
This display is not functional, but demonstrates of how the interface could work.

I am currently **Somewhat Available**. My availability is inferred based on several rules, such as:
I would be *Somewhat* in the Restroom, Contacter is Significant Other / Spouse
I would be Available when: Before 6pm on a Workday, Contacter is Immediate Family
I would be Available when: Before 6pm on a Workday, Contacter is Close Friends
I would be *Somewhat* in a Conversation Available when: Scheduled a Meeting, Contacter is Coworkers
I would be Unavailable Scheduled Family Time, Contacter is when: Other
[See More...](#)
This display is only a demonstration of some of the rules which your Immediate Family may see.

Figure 1. Example survey scenario with different explanation types (What, Why, Inputs, What If, and How To, respectively) explaining with 5 contextual cues. Each participant only sees one explanation in a yellow box.

brief survey where interviewees rated their willingness to share each Explanation Type with each Contact Type (within-subjects). Figure 1 shows some explanations that interviewees saw.

Social Impact of Sharing Intelligibility

We briefly present qualitative findings from our results. Iteratively applying open coding from grounded theory, we categorized interviewees' reactions to the scenarios in terms of the potential utility of sharing intelligibility, its influence on their interactions and relationships with social contacts.

Social Interaction Agency

Interviewees felt the explanations given by the intelligible systems could help them automate some aspects of their interactions with their social relations, by streamlining interaction while reducing embarrassment and uncertainty. Seven interviewees cited *coordination* as an important reason for using the technology. They gave examples in which the technology would help them defer calls when it was dangerous or uncomfortable to answer, and how explanations could be used by contacts to optimize interaction, e.g., *"The application can really be helpful. With my boyfriend, it can help me plan things. He also studies in this university, so if I need anything, I don't have to call him, I can just go to where he is and wait for him. [CallMeLater] can really help."* (I2). Another reason for using the technology was *curiosity*, specifically in social, rather than professional, circumstances. Six interviewees expressed curiosity about their contacts, e.g., *"I want to know everything about friends and family! Exactly where they bought their clothes. With coworkers, I just want to know the things that are relevant to me."* (I10).

Contact Behavior Dynamics

The interviews shed some light on the potential impact of intelligibility on the interaction dynamics between users and their social contacts. I1, I2 and I8 noted that they would alter their behavior if they knew their social contacts were receiving explanations. For example, I1 mentioned: *"In a meeting without the [CallMeLater] technology, I would not answer a call. But if my mother would call, and the technology is on, then surely there is a good reason, and I would answer."* Hence, the expectations from social contacts can be altered by intelligibility, leading the user to change his behavior due to the assumed, increased awareness of the viewer. Interviewees had specifically referred to the value of explanations to provide the contact with a context to their unavailability. For example, I6 referring to the work scenario reflected that: *"If someone is trying to call several times and you are unavailable, and they can see that you are unavailable because there is a lot of noise around, that's useful."*

Privacy Sensitivity

Interviewees cited privacy concerns as the main reason for withholding certain Explanation Types, some information items or for completely avoiding the application. While most interviewees indicated relatively high willingness to release availability information (What), they were concerned about sharing detailed information. Interviewees disliked sharing Inputs explanations due to concerns of being tracked, e.g., *"I don't want the 'big brother' to know where I am"* (I8). On the other hand, interviewees were fine with sharing a limited view of their state through Why explanations, e.g., *"the reason is really important, because my family calls all the time and if they know why [I am busy] they would call less."* (I9). The Contact Type, with whom the

information is shared, plays an important role in the interviewees' sharing decisions.

Uncertainty in sensor data can also affect how users' can manage their identity and image. 5 interviewees mentioned that sharing intelligibility limits plausible deniability as an explanation for lower sharing preferences, e.g., *"If I said that I am in a meeting, but they see I am going [to a different place], then its contradicting the information I gave"* (19). This illustrates a distinction between explanations that can reveal one's current context and those that can reveal one's social preferences.

Trust Signals

Some interviewees wanted to use intelligibility as a tool to convey trust and intimacy with significant others. The properties of intelligibility, the fact that it is created automatically, allow the potential of using it as a trust signal. Due to its objectivity as a context-reporting tool, sharing this sensitive information was perceived by some interviewees as reflecting trust, e.g., *"I have a boyfriend, for many years, and there is a lot of openness and everything, I don't have anything to hide from him, and he does not have anything to hide from me. That's why everything is ten [the highest willingness to share]. In an important meeting, I would filter [intelligible explanations] for my friends, but not my boyfriend."* (12)

Challenges and Opportunities

We have discussed Social Intelligibility as a means to reduce uncertainty in social interactions. However, the use and existence of this feature can lead to privacy concerns and impact social behavior and expectations. The existence of intelligible mechanisms drives users to

manipulate and adjust their expectations around them, which paradoxically, may lead to more uncertainty. This work extends the discussion of uncertainty in interactive intelligent systems to beyond just single-user, personal applications to systems where information is about the system and another user. This raises some open questions, such as how to manage the sharing of uncertainty and intelligible explanations, how to present a richer and diverse range of information to express one's social and physical state, how to limit this sharing, and how to justify one's choice for limited sharing.

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