Social Affordances: Understanding Technology Mediated Social Networks at Work

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ABSTRACT
Computer-mediated communication (CMC) technology includes messaging systems, such as e-mail, and conferencing technologies designed to facilitate group work. CMC adoption fails when it interferes with subtle and complex social dynamics of groups. Yet empirical studies of CMC use *which explicitly associate social behavior with design features* are largely absent from the literature. So too are conceptual tools for detecting and describing such behavior. This research addresses this absence by closely examining how CMC design supports social interaction among distributed work groups and thus stimulates or suppress adoption.

Keywords
Groupware, adoption, social affordance, computer-mediated communication.

MOTIVATION
The primary motivation for my research is what I see as a compelling likeness between the problem of social factors surrounding groupware adoption and the problem of perceptual factors surrounding software usability. Groupware experts contend CMC is resisted when it interferes with subtle and complex social dynamics of groups. Similarly, for over 15 years, perceptual psychologists have contended software interfaces are misinterpreted when design interferes with the complex dynamics of human perception (Gaver, 1991; Norman, 1988). They offer the concept of object affordances to describe the relationship between human perception and usability. I believe a principled understanding of groupware adoption – *which accounts for social factors* – can be modeled after theories of perceptual psychology. Specifically, I think the concept of affordances can be appropriated to account for social factors in CMC adoption. To my knowledge, this idea has not been articulated or empirically tested elsewhere.

Furthermore, designing for adoption requires relating patterns of social behavior in groups to CMC design. Yet empirical studies of CMC use *which explicitly associate social behavior with design features* are largely absent from the literature. So too are conceptual tools for detecting and describing such behavior. This research addresses this absence by closely examining how CMC design supports social interaction among distributed work groups and thus stimulates or suppress adoption.

RESEARCH PROBLEM
The CHI and related literatures are well populated with empirical studies of CMC. In particular, social factors impacting the adoption and use of computer-mediated communication (CMC) technologies in the workplace have been studied for over a decade. Authors of these studies suggest that behavior and social conventions affect adoption. A common conclusion being that understanding adoption requires careful examination of the interactions between technological features and the social context of use (Bradner et al, 1999). My research focuses on the social aspects of adoption. Specifically, my *research problem* is: Social factors in adoption of CMC among small groups in the workplace. In an effort to conceptually disentangle the social and technical factors in adoption I examine the following ***research question*: What are examples of social affordances of CMC and how can the notion of social affordances inform our understanding of CMC adoption among distributed work groups?** By identifying social affordances impacting adoption, I begin to build a generalizable description of social factors in adoption. My goal is to describe, in a principled manner, the notion that social affordances impact adoption.

Hypothesis and Plan
My approach to understanding social and technical factors in adoption is inspired by Norman's work in object perception (Norman, 1988). I appropriate the term 'object affordance,' which is a theory human perception vis-à-vis object interaction, and apply it to social interaction. I use the term 'social affordance' to describe the social dimensions of groupware use. I propose two hypotheses concerning social affordances and adoption:

Hypothesis 1: The concept of social affordances can be used to describe a bidirectional relationship between technology design and the social context of use.

Hypothesis 2: The social affordances of computer-mediated communication technology (CMC) affect adoption outcome in small groups.

My research is organized into three complementary studies. Study 1 and 2 are qualitative studies of two different computer-mediated communication technologies, chat and instant messaging. Study 3 is a quantitative study of computer-mediated small group interaction. Studies 1 and 2 can be construed as my effort to understand the technical and social dimensions of groupware use. It is here that I formulate and apply the concept of social affordances. Study 3 is a quantitative study designed to validate findings in Study 1 and 2.

My working definition of a social affordance is *the relationship between the properties of an object and the social characteristics of a given group that enable particular kinds of interaction among members of that group*. I use this conceptualization of affordances as a theoretical framework with witch to interpret data collected from both qualitative and quantitative studies of CMC use.

Study 1 examines the social affordances and adoption patterns of a novel, chat-like system called BABBLE. Drawing on interviews and conversation logs from a 6-month field study of six different groups at IBM Corporation (USA), I examine the ways in which the affordances of the system enable particular types of communicative practices such as waylaying and unobtrusive broadcast. I then consider how these practices influence (positively or negatively) the adoption trajectories of the six deployments.

Study 2 examines how instant messaging supports multiple types of informal communication in the workplace. I document the affordances of IM that support flexible and expressive communication. Some unexpected affordances of IM highlight important of aspects of communication that impact adoption and are not part of current media theorizing.

Study 3 is composed of two complementary quantitative studies that examine the effects of videoconferencing and application sharing on task performance. Results show that when people are performing a cognitive reasoning task during a video conference or with application sharing, their performance is impaired. I interpret these findings to suggest that although application sharing and one-way video both lack visual cues of conversational partners, both media afford a sense of social presence which affect task performance. Background on the term 'affordance' and a closer look at Study 1 and 3 will help illustrate the role of social affordances in technology use and adoption.

Background: Object Affordances

Affordance: n. *aufforderungscharakter*; literally translated is 'invitation character', also valence.

Social affordance is an appropriation of the term 'technology affordance' which itself is an appropriation of the term 'object affordances.' Gibson defines an object affordance as "properties taken with reference to the observer… neither physical or phenomenal". Object affordance refers to properties of an artifact that determine how an artifact could possibly be used by an agent with particular interactive and perceptual capabilities. An example of an affordance is a door handle. A vertical door handle is perceived to permit pulling by an agent capable of grasping. As a concept, the notion of affordances illuminates the perceptual dimensions of human-computer interaction and provides a conceptual tool for analyzing the relationship between technology design and usability. Because the concept of affordances is useful for understanding how design and perception impact technology use, I suspected it might help explain the social side of the usability equation. Motivated by my desire to understand groupware adoption, I borrow from perceptual psychology to construct the concept of "social affordances."

Affordance Theory

The theory of object affordances is rooted in the critical realist tradition of perceptual psychology (Gibson, 1979). The concept was applied to the study of user-centered design of every day objects by Norman (1988) and to the study of human-computer interaction. Gaver defines an affordance as "properties of the world that are compatible with and relevant for people's interaction" and was the first to suggest that researchers might characterize different electronic media by the affordances they make available. Gaver demonstrated the power of the 'technology affordances' concept by using it to identify properties of the audio-video medium which shape the possibilities media spaces offer for collaboration (Gaver, 1991).

Since Gaver's study of media spaces, the concept of affordances has explicitly informed analysis of software use in only a few theoretical studies but has become a familiar concept in the field of Human-Computer Interaction (HCI). I am interested here in the related term "social affordance" that has recently appeared in the Computer-Supported Cooperative Work (CSCW) literature. My conjecture is that researchers investigating the social dimensions of CSCW have appropriated the term, because fundamentally, technology affordances are emergent properties of the interaction between users and technology. When interaction with technology mediates social interaction, as is the case with groupware technologies, it becomes useful to think about properties of technology affording social behavior.

BABBLE Design and Use

BABBLE is a chat-like communication tool in which typed messages are transmitted across a TCP/IP network, stored on a server and displayed to each client. BABBLE allows its users to engage in synchronous or asynchronous textual conversations, and provides visual feedback of who has recently participated in a conversation (Erickson., 1999).

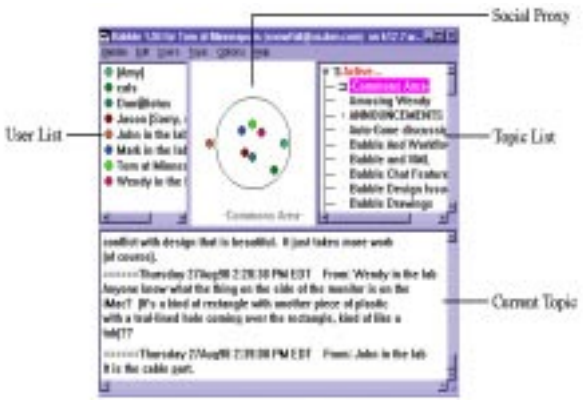

Figure 1: The BABBLE Interface

The panes of the BABBLE window (Figure 1) display the following information: a list of all connected users; the social proxy (a minimalist graphical representation of user activity); a list of topics (user-defined conversation areas); the current topic (i.e., text of the conversation). Messages appear in the order posted.

Three features of BABBLE distinguish it from other chat systems. First, BABBLE conversations are persistent: the conversations stay on the server permanently, thus permitting asynchronous conversations and activities. A user who is not on-line when a comment is made can see it later, and can scroll back through the entire history of a conversation. Second, a minimalist graphical representation called a social proxy is used to provide information about who is currently present in the conversation. The proxy uses a large circle to represent the conversation, and colored dots (a.k.a. "marbles") to represent individuals. A marble inside the circle represents a user who is 'in' the displayed conversation; a marble outside the circle is in some other conversation. When a user interacts with BABBLE — either by posting a message, or simply by scrolling or clicking on the interface — her marble rapidly moves towards the center of the circle; with inactivity the marble will slowly drift out to the inner edge of the circle. In Figure 1, five participants have recently 'spoken' or 'listened,' two have been idle, and one is in a different conversation. The third distinguishing feature of BABBLE is that it lacks technical mechanisms for enforcing behavior. Originally intended for small workgroups, it provides no technical means for 'kicking' people off, creating private topics, etc. With the exception of private, one-to-one chats, all BABBLE conversations are visible to everyone in a deployment group. Although various usage conventions have arisen, all negotiation and enforcement of such conventions is social.

Babble Use Analyzed

Although one might expect groups using the same software within the same organization to exhibit somewhat similar behavior during the first month of use, Figure 2 shows varied usage patterns among the six groups. Interactive social discussion dominates in three groups, whereas use of dedicated topics dominates

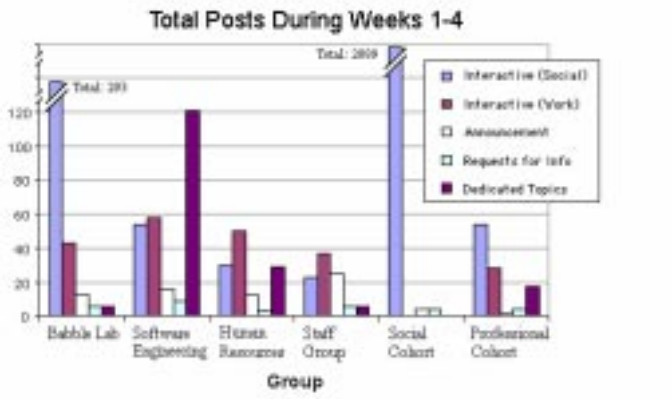

Figure 2: Total posts in the first 30 days of use.

the Software Engineering group. The Human Resources and Staff groups show a slight dominance of interactive work discussion with relatively little social discussion. In short, although participation is relatively high for all groups during the first month (Figures 4, 5), the content varies considerably during this time (Figure 6), indicating that differences among groups in social dynamics and work practices affect the earliest stages of use. This suggests that groups appropriate new technology differently; understanding the relationship between group dynamics and adoption is the topic of the next section.

Social Practices

How might we understand an initial burst of usage followed by failure (or not) of adoption? Our data suggest that one answer lies in looking closely at the social interaction that BABBLE supports. If BABBLE enables a practice that is not desired by some group members, or that produces consequences some members dislike, adoption may fail.

Waylay is a good illustration of the relationship between communicative practices and adoption. Electronic waylay for the purposes of soliciting technical assistance appears to reinforce ongoing use of chat as a distributed help environment. Our data bear this out: high levels of work-related interaction (Figure 2) can be associated with successful adoption in the Software Engineering group (Figure 1).

However, when waylay is or can potentially be used to assign work, it inhibits use. Interview data strongly indicate that the fear of waylay was a strong deterrent to use among the members of one group. After an initial period of several weeks during which most of the group was using BABBLE, the group failed to adopt. One member of this group reported that he and his colleagues were hesitant to log in to BABBLE because it made them too accessible. He explained that he and his coworkers feared that their increased accessibility might enable their manager to rope them into additional projects. In effect, the increased accessibility created by participation in BABBLE threatened their

autonomy. Our informant described the fear of waylay below:

> "I'm [near] Mike [the manager] and Susan isn't that far away. When random [unassigned] work comes in, it sticks to us. Babble means that everyone is immediately accessible, so people who aren't geographically near Mike [the manager] are thinking that this accessibility is a down side [to BABBLE]." – Human Resources

Although the use of chat to waylay subordinates for the purposes of assigning work is a blessing for managers, it may be considered a curse by workers. The accountability afforded by Babble, while it enables managers to easily offload tasks it creates undesired accountability for workers.

Similarly, the use of BABBLE to maintain a closed discussion sanctuary encouraged use in the case of the BABBLE Lab and Software Engineering group (Figure 6). BABBLE encouraged free exchange of ideas, uninhibited brainstorming and casual chit-chat in these open information sharing cultures. In more closed cultures, like the Market Research group, the accountability afforded by Babble discouraged use. Furthermore, even when a system is adopted, it is important to ask by whom it is adopted and to what ends: the social affordances of a CMC can spur adoption in one social context and suppress adoption in another.

Measuring Social Affordances

The BABBLE study reveals that in a conversational exchange involving requesting information or assigning tasks, the conversational initiator wants to maximize accountability to maximize the chance that he/she will receive a response. At the same time, the recipient wants to minimize accountability. By minimizing accountability, the recipient buys time to negotiate his availability. Different CMCs, in different contexts, afford different levels of accountability. For example, in Babble a programmer says:

"When Eugene comes on Babble, I ask him for help because he's a Java programmer. He has to answer me."

– Software Engineering

In this instance, the software engineer asks Eugene for help because Eugene is an expert in the technology (Java) but also because the social proxy in Babble makes Eugene socially accountable to him. There is intersubjectivity: I know that you know that I have a question. This intersubjectivity, and consequently the accountability is not supported in all CMCs. IM has different technical and social affordances. It affords a bit more room to maneuver. IM is somewhat similar to chat in that it is but synchronous but it is largely peer-to-peer. Access is manages via buddy lists. Although it is synchronous, messages will stay on a recipient's screen until they are responded to or deleted. In AOL Instant Messaging, a message will appear on another users screen but the sender will have no confirmation that the message has been seen until the recipient responds. One instant messaging user at AT&T makes the following comment:

"One thing I like about [IM] is that I'll see a message but I won't have to acknowledge my presence. So I'll respond to them later when I have time."

Put another way, there is a plausible deniability afforded by instant messaging that is not afforded by Babble. The instant message recipient can deny having seen the message until he is ready to respond. This is not the case in a Babble exchange because the sender received immediate feedback when the recipient views the message via the social proxy – his marble moves to the center of the conversation circle.

Now consider a static medium like the Web. My field study of Web (intranet) use at Boeing revealed that the inability to contact collaborators directly via the Web caused some users to avoid the Web interface entirely and rely on face-to-face interactions. The tool I studied was called the 'Worktool.' It was used by the Boeing Space Flight Operations group to manage technical studies of mechanical and structural improvements to the Space Shuttle Orbiter vehicle. Files are posted to the Worktool, new 'tasks' are created, but no 'presence' information is provided regarding the activity and whereabouts of collaborators. This tool was underutilized. When use, or disuse as the case may be, is framed in terms of social affordances we can posit that adoption failed because the tool was not designed to afford accountability via synchronous communication. One user explains:

"Most of my communication is NOT through the Worktool. I get my most effective input by going out and seeking these guys one-on-one and going to their desk and knocking on doors and saying "OK I'm here!" you can't get rid of me until you give me what I need."

In effect, since the worktool failed to afford it, this user invoked accountability the good ol' fashioned way: by stating his demands verbally and face-to-face. An analysis of three technologies – chat, instant messaging and the Web – suggest that design decisions do have ramifications. This is not to suggest that design determines use. Rather that certain interface features, such as the social proxy in Babble, afford specific social interactions. Whether or not these interactions are enacted and furthermore, to what extent these interactions impact adoption are subject to the social context of the groups using the technology.

Measuring Social Affordances

The question remains are social affordances real? One way scientists go about validating their work is by triangulating facts using multiple methods. Object affordances have been measured. For example, in laboratory experiments, subjects have been able to reliably and accurately perceive the 'climbability' of a given set of stairs for a person of their own stature. (Climbability was determined in a pre-test.) Also people even children reliability turn knobs, pull levers,

push panels. What you see here is a graph showing results from a quantitative study I conducted with my advisor, Gloria Mark. In this study we examined media effects on math performance. We were curious if social effects of being observed via screen sharing and video could be measured. The screen sharing technology we used was Microsoft NetMeeting. Netmeeting replicates one user's screen to any number of other users screen. It creates the context known in interface design as WYSIWIS: what you see is what I see. Figure 3 shows that we found subjects performed worse when tasked with solving 10 math problems while being observed via screen sharing and 2-way video compared to when alone.

Interestingly, subjects required approximately 1.5 min longer to solve the problems while observed. Surprisingly, we also found no significant difference in awareness of the observer's presence between the screen sharing and the two-way video conditions. This is surprising because application sharing lacks visual feedback of the observer. Where is the sense of presence coming from? This finding contradicts social presence theory which claims that media like video which provides the most visual feedback of others produce the greatest sense of social presence.

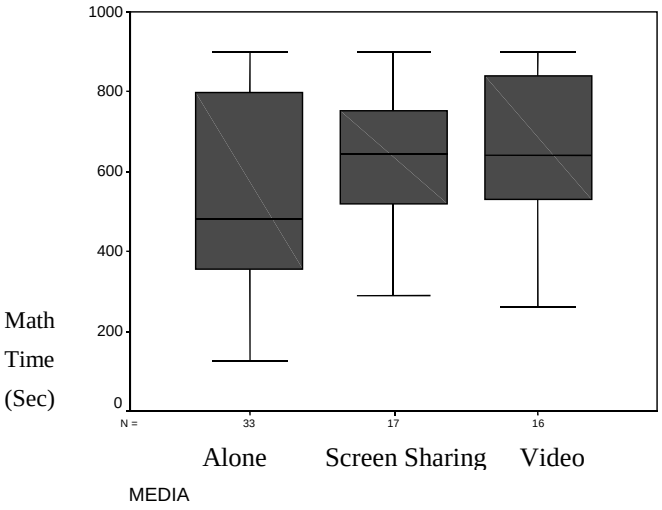

Figure 3: Time to Solve 10 Math Problems Across Media

How do users perceive the experience of performing while being observed via screen sharing? Do they perceive what I call 'social affordances?' Our interview data indicate they are very aware of the visibility afforded by screen sharing. For example, one user says:

"In the video I felt like the observer was just looking at my face...In the shared application, they could see exactly what you are doing. *When I move the mouse around and stuff... I move it to 14 minus 3 and they can see everything you do.*"

And again, as was the case with Babble, many subjects cast the issue of visibility in terms of social accountability.

"When I was alone, I wouldn't think about [a math problem] as much, I would just hack through it by clicking. In [screen sharing] *I looked stupid if I clicked on random things… I thought about it more...You want to make a good impression!"*

In short, screen sharing affords visibility and also social accountability in the context of the laboratory. Subjects seemed to feel accountable to do as well as they could for the observer. I also found a similar sensitivity to the visiblity afforded by screen sharing in my field studies at Boeing where users expressed feeling "exposed" to others while manipulating the screen in a NetMeeting conference.

Accountability is just one interpretation of this data. It can also be seen as an instance of impression management in the Goffmanesque sense. I've examined impression management and other social affordances of all the technologies I have mentioned here. Other interpretations include privacy, trust, and cohesion. However, accountability is the one interpretation that can be effectively summarized in a short paper such as this.

Implications

Since social affordance theory identifies and describes specific ways design mediates social interaction, it can be used to inform design. For example, traditionally 'media spaces' using video and application sharing have been designed to maintain a perpetually 'open' channel of communication between users. Yet, because these technologies afford continual monitoring of users' face and screen activity, and because monitoring, which is both a social and perceptual act, can have negative effects on performance, a better design for a media space is one which includes an interface allowing users to 'shield' their screen activity and video image. A design which allows users to temporarily suspend and easily restore the communication channel would minimize the negative social effects on performance. Thus, in much the same way the concept of physical affordances can guide design of 'user friendly' software, I believe the concept of social affordances can guide design of 'group-friendly' software. This research provides the conceptual groundwork for future studies examining specific *design and adoption tradeoffs.*

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