Informal communication re-examined: New functions for video in supporting opportunistic encounters

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0. Abstract

Many systems have used video to support formal distributed meetings. Rrecent research, however, indicates that most workplace interactions are not group meetings. Instead they occur spontaneously for short periods of time, frequently between two people who discuss topics that build on prior discussions. In this paper, we characterise these informal interactions, describe their value, enumerate the functions they accomplish. We consider ways to design video-based systems to support such informal interactions among different types of distributed groups. We discuss some existing applications that support various aspects of informal communication and consider ways to build on those ideas to build systems designed specifically for opportunistic and spontaneous encounters.

Keywords: Informal interactions, opportunistic communication, collaboration, video-mediated communication, distributed groups.

1. Introduction

How and when do office workers interact? Most CSCW research and commercial software for video-based interaction presupposes that people most often interact in formal meetings. According to this view, people have long interactions on pre-planned topics, often with multiple people and frequently in a room designed for meetings. However, according to some preliminary but detailed data about the interaction patterns of people in real life workplace settings, the vast majority of interactions look rather different. Workplace interactions are short, on the order of seconds rather than minutes or hours (Kraut, Fish, Root & Chalfonte, 1990a; Whittaker, Frohlich, & Daly-Jones, 1994a). They tend to be spontaneous in that they occur because one person happens to be near another at a time when one wants to ask for or provide information. They are often continuations of prior conversations. They usually involve only two people who discuss a single piece of information, and they often involve a reference to a document.

As this book has shown, when video is used to support planned meetings, its benefits are relatively subtle and subjective. Video helps people manage the mechanics of conversation and understand nuances in meaning, and participants find meetings more satisfying if they can see one another (Isaacs & Tang, 1993; Dykstra-Erickson, Rudman, Hertz, Mithal, Schmidt & Marshall, 1995; Rudman, Hertz, Dykstra-Erickson & Marshall, this volume). But the presence of video does not have dramatic, immediately apparent effects on the work at hand, unless that work is inherently visual (Ochsman & Chapanis, 1974; Argyle, Lalljee & Cook, 1978; Short, Williams, & Christie, 1976). Although we certainly consider it important to enable richer interactions in pre-planned meetings, in this chapter we focus on the possibility of using video to support the more common, but less noticed, unplanned interactions, and in particular in the initiation of such conversations.

Our notion is that video may be a natural medium to support impromptu interactions because such interactions depend on each person knowing that the possibility of an interaction exists. Visual information is crucial for supporting the "sightings" that are a prelude to impromptu workplace conversations (Kendon & Ferber, 1973, Fish, Kraut, Root & Rice, 1993, Kraut et al., 1990a). We believe that, in addition to supplementing the verbal channel in interactions once they occur, video could also help make those impromptu interactions possible. Only a few systems have been designed to support the informal interactions that occur among co-located people in the workplace

(Root, 1988; Tang & Rua, 1994; Bly, Harrison & Irwin, 1993; Gaver et al., 1992), and none are designed to enable purely chance encounters (although they sometimes happened in the existing systems). In this chapter, we will explore the type of applications that could be designed to support informal, and in particular, spontaneous communication.

1.1 Current VMC Systems

Most of the commercial video-based communication applications have focused on pre-arranged, relatively formal and extended interactions. For example, PictureTel supports meetings between groups of people sitting in meeting rooms at two or more sites. The use of a dedicated conference room means that such meetings are often arranged days or weeks in advance (Mosier & Tammaro, 1995, Tang & Isaacs, 1993, Sellen & Harper, this volume). Desktop video conferencing products such as ProShare and ShowMe allow for conversations between two or more people who are sitting at their desks, but the design of these systems tend to encourage extended interactions. The long start-up time and complex activities necessary to set up connections make people less inclined to invest the effort for brief, single topic interactions (Tang & Rua, 1994; Whittaker et al., 1994a).

A variety of research labs have built systems to enable quick connections between two or more people. Bellcore's Cruiser (Root, 1988), Toronto's CAVECAT (Mantei et al., 1991), SunSoft's Montage (Tang & Rua, 1994), DEC's Argo (Gajewska, Kistler, Manasse & Redell, 1994), and the Media Spaces at Xerox PARC (Bly et al., 1993) and EuroPARC (Gaver, et al., 1992) are examples of systems designed to be used from the computer desktop. However, like their commercial counterparts, all these applications except the Media Spaces and a feature of the Cruiser system (described below) are "connection-based" in the sense that a person *explicitly decides* to initiate an interaction. We will argue that these unplanned but intentional interactions are but one style of impromptu interaction; there are other more opportunistic types of informal interactions that have not been fully explored. We claim that these other classes of interactions are frequent and crucial for accomplishing work. Despite their importance, informal interactions are especially hard to support in distributed groups. We therefore characterise design requirement and discuss technologies to support informal communication across distance.

The above systems have three features that allow for the possibility of supporting opportunistic interactions. One is "virtual shared offices," where people keep a connection open between their offices indefinitely. Users of Xerox's Media Spaces were encouraged to do this, and users of Cruiser and Montage also created virtual shared offices on their own. In these cases, people can have extremely quick, spur-of-the-moment interactions because the link is "always open." However, interactions can occur only among those who are already connected. There are no facilities for overriding or interrupting existing links, and so others cannot join existing interactions unless they are physically near one of the people sharing a link.

Another example is the Autocruiser feature in Cruiser, which automatically made connections with a random series of people, each of which timed out if no one enabled the connection. This feature was intended to encourage opportunistic communication, but when tested, users found it "highly objectionable." The authors explained that "[u]nlike the random encounters that occur multiple time a day when two people are colocated, the Autocruises did not allow people to conduct the subtle nonverbal negotiations that regulate the entree into conversation." (Fish, et. al, 1993, pp. 52). This experience indicates that it is not enough to simply enable opportunistic communication; rather, the system must be designed to help people initiate these interactions naturally.

Finally, Portholes enabled awareness through a matrix of static images of other people's offices, and those images were updated every five minutes (Dourish & Bly, 1992). Upon seeing that someone was available, users within a site could create an audio-video connection. The Argo system also included a "hallway" of slowly updating video images (Gajewska, Manasse & Redell, 1995).

These findings give us a glimpse of the possible design requirements for a system that enables impromptu communication, but they are just the beginning. In this chapter, we will explore in more detail the requirements for a such a system. We will do this by describing the current data about informal interactions, presenting a new classification of the functions they fulfill, and then speculating about desirable properties of an application designed to support informal communication among distributed people. We hope this exploration will help illuminate the value of video in supporting informal communication and stimulate ideas about how to do so successfully.

2. A Look At Informal Communication

2.1 Types of Informal Communication

We begin with a taxonomy of interpersonal communication proposed by Kraut et al. (1990a). They proposed four types of interactions:

(a) Scheduled: Meetings that are planned in advance by both parties.

(b) Intended: Interactions that occur when one person seeks out another to discuss a specific topic, but where there is no pre-arranged plan to talk.

(c) Opportunistic: Interactions that occur when one person happens to see another and remembers that they wanted to discuss a particular topic with them.

(d) Spontaneous: Interactions that occur because two people happen to see each other and get into a conversation on a topic not prepared by either person.

As mentioned, the majority of commercial and research focus has been on supporting scheduled interactions. We propose to focus on the latter three, all of which we include in the term *informal*.[1] As we have indicated, a number of systems have been developed to support intended interactions, but few have focused on opportunistic and spontaneous interactions. We are particularly interested in these last two types of interactions (which we will call *unintended*), in part because of the absence of systems to support them, and in part because our data suggest that a great many workplace interactions are of this type. Our data remain suggestive, however, because they do not systematically distinguish between the three types of informal interactions. The following is a brief summary of the existing evidence about the nature of informal communication in the workplace.

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1. Note that "informal" refers to the way in which the interaction is initiated, not necessarily the tone of the interaction; scheduled interactions may also be conducted in an informal manner. Although we believe the term "impromptu" better characterises the nature of these interactions, we use the term "informal" because it has been used in the past (Kraut, et al., 1990a).

2.2 Characteristics of Informal Communication

The following are two illustrative examples of informal communication in the workplace. They are taken from an observational study in which two mobile professionals were "shadowed" for a week. The first subject, Richard, was a surveyor (or assessor, in US English) working for a small city centre consultancy. The second subject, Bina, was a public relations manager for a large research laboratory. We used a remote camcorder and radio microphone to record their interactions with colleagues, clients, and others, resulting in a corpus of 402 face-to-face and telephone conversations with 99 interactants, 377 of which were found to be informal. We refer to these data as the HP corpus. The research method and more detailed results are described in Frohlich (1995), O'Conaill & Frohlich (1995), and Whittaker et al. (1994a). In the following extracts Richard initiates brief conversations with Frank, a colleague working in the same open plan office.

Extract 1.[1] A short opportunistic interaction (ROffice47, 0min:8sec)

> *Richard is standing up reading a document behind his desk when his colleague Frank*
> *walks into view on his way to his own desk from another office.*
> 1 R: Frank can you reath read this report for me?
> 2 F: Now?
> 3 R: Aye if you've got a minute
> 4 F: Yeah

This interaction is completed in 8 seconds. Richard sees that Frank is moving around the office and hence is not currently engaged in work, so he opportunistically solicits Frank's help. The shared visual environment affords Richard this information about Frank's availability and allows Frank and Richard to look at, and then physically exchange, the document. The interaction is brief and has no formal openings or closings, such as greetings or farewells.

The following interaction shows an unplanned conversation between Richard and Frank that occurred immediately after Frank had finished a phone call to a client. It arose because Richard

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1. The following conventions are used in the transcriptions:

() indicates an untranscribable utterance	(0.5sec) indicates a pause length
- indicates cut off	? indicates rising intonation
: indicates stretch of the preceding phoneme	

heard Frank's phone call and opportunistically monitored the outcome. It continues with Richard offering unprompted advice and assistance.

Extract 2. An intended interaction leading to unprompted advice (ROffice 66, 28sec of 1min:36sec)

Frank is on the phone across the office from Richard. Frank puts down phone.

1	R:	Is he alright?
2	F:	Yeah
3	R:	Which one's he's got? there's a restaurant
4	F:	I said that I'll do this one initially and then further afield
5	R:	Which one's that?"
6	F:	That's: eighty two whiteladies road it's the offices
7	R:	Oh, yeah we act for the landlord on that one. I did a rent review against him on that
8	F:	Right ()
9	R:	His shop it might be worth checking out he's got a sub-tenant
10		downstairs who's got a clothes shop
11	F:	Yeah
12	R:	Might be worth trying to get in with them as well
13	F:	Yeah alright

Again the interaction begins without formal initiation. The interaction has a history, revealed by the implicit shared context between the participants. Without being told, Richard knows the identity of Frank's caller (Line1), and details of the case (Line3). The shared context results in a condensed and cryptic conversational style. Towards the end of the fragment Richard offers unprompted advice to Frank (Line12), which eventually results in an agreed action for Frank to report back (not shown). Thus an unplanned conversation led to a detailed task-oriented discussion.

These conversations, which are representative of the HP corpus, along with data from various other sources, suggest a characterisation of work in which people are engaged in multiple intermittent and interleaved collaborative tasks. Workers frequently seek out and are sought out by their coworkers for brief interactions. These conversations often have a history of prior interactions and workers are often concurrently engaged in multiple interaction threads. More specifically, the available data show that, despite some variation due to job type, interpersonal communication has the following properties:

- Frequent. Office workers spend between 25% and 70% of their time in face-to-face conversations with others, depending on job specification (Kraut et al., 1990a, Panko, 1992, Sproull, 1984; Reder & Schwab, 1990; Whittaker, et al. 1994a).

- Brief. Conversations generally last only a few minutes, with lower estimates at 1.9 minutes (Whittaker et al., 1994a), and higher estimates under 15 minutes (Kraut et al., 1990a; Reder & Schwab, 1990).

- Unscheduled. About 88 to 93% of professionals' interactions are unscheduled (Kraut et al., 1990a, Whittaker et al., 1994), with lower figures of around 60% for managers (Panko, 1992).

- Often dyadic. For professional workers, 84% of meetings are dyadic (Whittaker et al., 1994a), although this figure is lower for managers. Panko (1992) estimates that dyads account for 40 to 45% of all managers' interactions, whereas MacLeod, Scriven & Wayne (1992) found that figure to range from 58% to 63%, depending on level of management.

- Frequently supported by shared objects such as paper documents or designs (Luff, Heath & Greatbatch, 1992; Tang, 1991; Whittaker et al., 1994a).

- Intermittent. The purposes of interpersonal interactions are seldom achieved in one interchange, so that such conversations occur over intermittent episodes (Whittaker et al., 1994a), with participants on average interacting with each other 2.5 times per day (Kraut et al., 1990a).

- Lacking formal openings or closings. Whittaker et al. (1994a) showed that only 11% of the conversations observed were prefaced by greetings and only 3% included a formal farewell.

- Dependent on physical proximity. Numerous studies have shown that the closer together offices of coworkers are located, the more likely they are to interact (Allen, 1977; Festinger, Schachter & Back 1950; Kraut, Egido & Galegher, 1990b; Kraut et al., 1990a).

In other words, based on the available data, upwards of 80% to 90% of interpersonal interactions in the workplace are not preplanned meetings. They are therefore are not studied in the literature and not supported by the majority of video-based systems on the market. However, these data examine exclusively office settings (and only a few at that), which of course are not representative of the full range of work settings. But we speculate that workers in non-office settings may be even less likely

to engage in formal, meeting-based interactions. In any case, given the ubiquity of office work, these numbers provide a compelling argument for further pursuing this aspect of communication.

2.3 The Value of Impromptu Communication

Informal communication is vital for achieving certain types of work-related tasks. Research on scientific collaboration has shown that physical distance is the strongest predictor of collaboration between researchers. Physical proximity promotes frequent, impromptu face-to-face communications, which are crucial for the planning and negotiation phases of projects (Finholt, Sproull & Kiesler, 1990; Kraut, et al., 1990b). Work on software development also has demonstrated that the degree to which projects engage in interpersonal communication strongly predicts project success (Kraut & Streeter, 1995). Furthermore, other work has shown negative impacts on teamwork when opportunities for *ad hoc* communication are reduced, as in remote collaboration. Work becomes more difficult to coordinate and advance despite the use of longer and more task-focused meetings in remote settings (Kraut, et al., 1990b). This finding is confirmed in other work on the isolation experienced by teleworkers trying to collaborate over long distances (e.g. Kraut, 1987; Olson, 1987). Sociological studies of organisational life stress the primary role of mundane office conversations in helping workers learn, understand, adapt, and apply formal procedures and processes (Suchman & Wynn 1984; Boden 1994).

Data from the organisational communication literature adds evidence that interpersonal communication improves group performance and helps keep organisations healthy. Several such studies have looked at strong and weak ties within organisations, where strength is a function of frequency of contact, reciprocal favours or obligations, emotional intensity, and intimacy (Granovetter, 1973). A common finding is that although both high and low performing groups maintain both strong and weak ties, high performing groups tend to have a higher *proportio*n of weak ties than do low performing groups (Nelson & Mathews, 1991). It is likely that the weak ties examined in these studies are based largely on informal communication, and in particular on opportunistic and spontaneous communication. Nelson & Mathews (1991) explain that weak ties to those outside a work group reduce a group's tendency to become insular and to negatively stereotype other groups. Weak ties also have been found to enhance "information flow and permeability of organisation boundaries,"

and to "foster flexibility and effective decision making" (Nelson & Mathews, 1991, pp. 371). Groups with many weak ties were also more accepting of innovations (Nelson, 1986).

Despite research from a various disciplines showing the value of informal interactions, evidence indicates that people in the workplace do not recognise its value. Kraut & Streeter (1995) found that impromptu communication is under-utilised compared with its value, whereas formal communication techniques are overused relative to their value. Our own preliminary evidence supports this result. In a series of interviews with a dozen employees in a Fortune 500 U.S. corporation, we found that although people reported gaining most of their work-related news and information from informal interactions, those same people said they used almost exclusively formal approaches to convey information to other parts of the company. Most commonly, they reported their information to a high-level management group and asked that they pass the information down the hierarchy in their staff meetings. In many cases, they wrote a document to convey information and either gave it to managers to give to their employees, or made it available to employees directly (in email, mailings to the home, or by publishing it on the company's internal World Wide Web pages). Some also gave formal presentations to supplement the document. When we asked information disseminators if they had considered spreading their information through word of mouth, they either had not thought of it or did not trust it. They were concerned that information passed informally would be distorted and misinterpreted and might not become available to all the intended recipients.

2.4 How Does Informal Communication Achieve Its Effects?

Although current research indicates the value of informal communications, much less is known about how they deliver this value. A number of promising suggestions have come from McGrath (1991), who suggests that workgroup communication can contribute to the social as well as the production function of the group. He notes that the social function includes both member support (e.g. making sure people feel their contributions are valued) and group maintenance functions (e.g. keeping people informed of others' activities and ensuring that the groups' contributions are coordinated to achieve a common goal). In the rest of this section we develop these insights further with reference to the informal interactions contained in the HP corpus.

Based on a content analysis of 377 unscheduled face-to-face and telephone interactions in the HP corpus, we developed a simple classification of the functions of informal communication. We identified six functions: tracking people, taking or leaving messages, making meeting arrangements, delivering documents, giving or getting help, and reporting progress and news.

2.4.1 Tracking people

Tracking people involves identifying the current whereabouts, activities, and future plans of intended interactants. Often people track each other by making requests as part of a search for a colleague, as in Extract 3 when Maureen asks Bina about the whereabouts of a mutual colleague.

Extract 3. A tracking request made by Maureen to Bina about Ian (BOffice35, 9secs).

> *Maureen pops her head over the wall of Bina's cubicle.*
> 1   M: Bina you don't know when Ian's due- oh here's Jane now- know when Ian's back?
> 2   B: Tomorrow I expect
> 3   M: Ahh
> 4   B: Oh yeah he's out today yeah

In other cases, people volunteer information about their future whereabouts by announcing to nearby colleagues a planned departure from their workspace. In one typical example from the corpus, Bina's colleague told her of some forthcoming days off to flag a problem with their joint work plans. The benefit of tracking interactions seems to be that they provide co-workers with a sense of each others' current and future availability for help, advice, and joint work.

2.4.2 Taking and leaving messages

Taking and leaving messages refers to contacting someone via a third party. This situation was particularly common on the phone, since two thirds of outgoing calls from Bina and Richard failed to reach their intended recipient. There were numerous interactions in which the caller asked the recipient to take a message or accepted an offer to leave a message. When the recipient was a colleague rather than a receptionist, the message often developed into an extensive explanation of the context. A similar pattern can be seen in the roaming encounters of Richard and Bina around their office sites. When they failed to find someone, they often left detailed messages with 'covering' colleagues, as when Bina leaves a message for Catherine with Sue (Extract 4).

Extract 4. Bina requests that Sue take a detailed message for Catherine (BRoam12, 1min02sec).

```
1     B:   Sue would you do me a favour (0.5sec) when Catherine's free could you
2          ask her about the Pisa Science Centre and (0.4sec) say that they're
3          updating this new booklet?
4     S:   Mmh hm
5     B:   Of the () ninety three and do we really want this under there or not
6     S:   Right
7     B:   Because I think all contacts will want it through here as opposed
8          to centred there (0.9sec)
9     S:   Right what (do you call this)
10    B:   Its called HP- I'm go- I can leave this with you
11    S:   OK
```

This interaction continued for 11 more turns as Bina and Sue clarified the message. While these interactions may seem inefficient, they have the positive side effects of informing message takers of their colleagues' activities, affording practice in covering behaviour, and providing message leavers with natural opportunities to make new contacts for future enquiries. Thus, these interactions support both social and production functions for the workgroup.

2.4.3 Making meeting arrangements

Making meeting arrangements refers to scheduling future interactions. A few interactions in the corpus were devoted entirely to this function, as when Jane invited Bina for lunch (Extract 5).

Extract 5. A meeting invitation or offer made by Jane to Bina (BOffice31, 0min:16sec)

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1     J:   Had any lunch?
2     B:   Yea::h
3     J.   Oh you have
4     B:   Oh have you already bee- you going now
5     J:   No no I was just going to pop into the buffet to just get a couple of leftovers
6     B:   No: I I went 'cos I couldn't wait
```

As with taking and leaving messages, such offers and requests often result in discussions that inform people of the commitments and plans of their co-workers.

2.4.4 Document delivery

Document delivery refers to handing off a document with actions attached to it. A simple example is shown in Extracts 6, where Rose requests a signature on a signed letter.

Extract 6. Rose hands over a letter to Richard for signing (ROffice50, 0min:8sec)

1   Ro: () *Hands over document*
2   Ri: Ah right
3   Ro: Do you need to sign the cross rep () yeah you do
4   Ri: Ah right

More complex examples of document delivery in the corpus involve discussions of individual actions associated with different parts of a document. All such interactions provide opportunities for each party to query, check, and discuss the quality of actions associated with their documentation. The coordination aspect of this activity helps explain why people often carry out apparently simple office tasks interactively, rather than develop or adhere to asynchronous 'workflow' procedures that appear at first glance more efficient.

2.4.5 Giving or getting help

Giving or getting help refers to joint problem solving for one person's benefit. This type of interaction most commonly consisted of a question-answer exchange. Often these questions were shouted from a distance and resulted in short, simple answers as in Extract 7. They are equivalent to turning aside to look something up in a reference book.

Extract 7. Rose requests help from Richard (RRoam21, 28sec).

1   Ro: Richard have you got any of the amendments?
       On phone behind pillar
2   Ri: () nine three four (1.0sec) seven four three (1.1sec) okay thanks bye.
       Puts phone down.
3   erh yeah erhm hang on I haven't I've got a few there's only these little bits here.
       Walks over to Rose
4   Ro: Well ([)
5   Ri: [I can feed you them page by page if you want

Spontaneous offers of help also arise in the course of work-related conversations such as that shown in Extract 2 where Richard asks Frank about the progress of a phone call and ends up giving advice about what to do next. Another example was when Rose reminded Richard of an approaching deadline for a document delivery by walking up to him on the phone, pointing to her watch and saying "It's twenty five past four," (ROffice41). These interactions furnish workers with not only willing, fast, and effective resources for problem solving, but also lightweight forms of supervision

that provide natural checks on the timing and quality of their work. The fact that everyone acts as resources and supervisors for each other is yet another mechanism by which everyone becomes informed about and involved with each others' work.

2.4.6 Reporting progress and news

Reporting progress and news refers to updating people with relevant information. Such reports were often offered spontaneously upon some event or encounter, such as when Bina meets Nigel in the coffee area and begins an account of a meeting (Extract 8).

Extract 8. Bina offers a news report on Adjay to Nigel (BRoam42, 26sec of 1min:42sec)

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       Noise of coffee machine being switched on.
1      B:  I just spoke to Adjay and he suggested splitting out the bit about fault
2          tolerance into two bits Rod's bit and his bit so two sessions I'm () but they
3          want to talk separately so
4      N:  Ah OK I hadn't realised he was going to talk about fault tolerance
5      B:  Well he he was going to be involved in that and they've decided
6          they'd like to split it and I thought well- yes we'll do that then
7      N:  Mmh
```

Often the initial statement has a dramatic tone and prefaces a longer 'story'; as in one instance when a colleague begins a conversation with "Can you believe it Bina?" Furthermore, the end of the report is usually an occasion for the recipient to provide a reaction or assessment of the news. In this case, Bina told her own story by way of sympathising with her colleague's complaint.

Direct requests for updates were also common, as in Richard's "Is he alright?" to Frank after Frank's phone call in Extract 2. Note that these exchanges are not always between teammates working on the same projects. Reporting progress and news is a flexible way of maintaining and consolidating contact with ex-teammates and others with whom there has been contact in the past.

We can now see how informal interactions contribute to McGrath's (1991) three functions of groupwork. Many help, news, and document-related interactions contribute to the production function of a group by solving individual or shared problems as they arise, providing relevant pieces of information at just the right time, and by controlling the quality of transactions and outputs. In addi-

tion, tracking, message, and meeting arrangement interactions are indirectly supportive in that they provide ways of sustaining and planning the other kind of contacts with absent or busy partners.

These last three kinds of interactions, however, are more central to the social functions of the group, i.e. group maintenance and member support. They help group maintenance by providing ways for members to learn about each other's activities, and therefore to adapt their contributions to the group's output. Document, help, and news related interactions also help maintain the group by monitoring and controlling individuals' work in ways that bring it into line with group objectives. They also help keep people mutually accountable for their commitments. We can easily imagine that the combined effect of these interactions is to make people feel 'part' of the group.

Finally, through message, help, and news related interactions individuals receive several forms of 'member support.' Message-taking constitutes practice in covering for others and hence trains people in new roles and responsibilities. Getting help provides emotional as well as task support. Reactions to progress reports are natural occasions on which to praise people for achievement, while news updates help maintain long-term relationships with people who may become closer colleagues in future group work.

2.5 Types Of Groups Engaging In Informal Communication

So far we have assumed that the nature, function, and value of informal communication is the same for all types of workgroups. However these characteristics may differ depending on the type of group. In this section we present one way of looking at different types of workgroups so that we can draw conclusions for technology support. We do not suggest this is the definitive classification of workgroups; the literature here is vast, encompassing group theory and organisational behaviour. Rather, we present one possible workgroup taxonomy as a thought exercise that highlights some of the issues that arise from different groups' needs in supporting informal interactions.

We often think of workgroups in terms of our immediate colleagues. These are the people with whom we perform our primary work function. However, people also have many interactions with colleagues throughout and outside an organisation. We suggest that there are three types of workgroups in addition to project groups: cross-functional, peer, and external.

Cross-functional groups are those that cross organisational boundaries, often to perform a short-term activity. For example, a short-term workgroup crossing the finance and production departments may form to clear an expense claim or place a purchase order. Peer workgroups are networks between people of the same profession or past colleagues. These groups provide professional guidance and support that may not be available within the project group. Finally we use the term external to describe the many relationships that exist with partners outside the organisation. Clients, suppliers and contract staff would fall into this category..

	Project	Cross-functional	Peer	External
Functions of communication	All	Document delivery, giving and receiving help, taking and leaving messages	Giving and receiving help, reporting progress and news	Tracking people, taking and leaving messages, making meeting arrangements
Duration of group	Long term	Varies	Long term	Varies
Frequency of communication	Daily	Varies	Daily to intermittent	Sporadic
Physical location	Traditionally co-located	On/off site	On/off site	Off site
Recognised by organisation?	Yes	Yes	No	Yes
Equipment under control of group?	Yes	May cross departments	May cross departments	No

TABLE 1. Characteristic differences by group type

All four group types have different needs and constraints that affect their patterns of communication. Based on a preliminary analysis of the HP corpus using these definitions, we consider how communication in these workgroups might differ. These are summarised in the Table 1.

2.5.1 Project workgroup

A preliminary analysis of the HP data indicate the majority of communication occurs within project groups. These groups tend to be formed for long durations and communication can be expected to be varied and frequent (McGrath, 1991). Project groups engage in all the communication functions

described previously. Organisations commonly locate members of a project close together, although more groups are being asked to work across distance. Project groups are formally recognised by their organisations, and so management is likely to support investments in technology for their work. Additionally, the group is likely to have control over their equipment and they may be able to customise solutions for specific group needs.

2.5.2 Cross-functional

Cross-functional groups provide support to other groups within an organisation. Their communication requirements focus more heavily on document delivery and discussion, giving and getting help, and taking or leaving messages. Because their communication is document-centric, these groups have traditionally been supported by structured workflow systems designed to pass documents from one part of the organisation to another. From the above analysis, we see an additional need to facilitate discussion and advice-giving during handovers. (See also Harper & Sellen, 1995).

The long-term duration of such relationships and their recognition by organisations again make them likely candidates for technology support. However, the communication requirements may be sporadic so the technology may appear at times to be under-utilised, which may make expensive systems difficult to justify. Cross-functional group members are likely to be spread out, perhaps within a building or even across sites. The ability to track members or leave detailed messages during active periods would be useful. Although the control of equipment is within a single organisation there may be departmental differences. Standardisation of technology would be desirable.

2.5.3 Peer

Communication within this group is supportive in nature, giving and receiving advice, and reporting news and progress. Our preliminary look at the HP corpus indicates that these conversations are sporadic but last longer, possibly because peers are less likely to be co-located. Peer communications are less task-focused than that of project groups and provide more of the social rewards of communication. When peers are co-located, initiation of such communication often requires low effort, as when Richard remarks loudly on a report, inviting Jerry to enter into a discussion with no

formal greeting or opening sequence. Support for such low-effort initiation represents a challenge when parties are distributed. Since peer groups are not formally recognised by organisations, they may be unlikely to receive formal support. However, the field of scientific research may be an exception, because peer collaboration is considered especially valuable (Pickering & King, 1992). Equipment compatibility may be an issue if members are in different organisations.

2.5.4 External

Communication with external parties is usually relatively formal and frequently revolves around formal meetings. External groups are not co-located, so their communications are especially likely to include meeting arrangements, taking and leaving messages, and tracking, in addition to task-focused communication. Activities among external parties can range from simple process tasks to complex negotiations. Communication may also vary from daily conversations to sporadic inter-changes. Some of these relationships, such as those with customers, can be among the most important for an organisation and are therefore likely to attract investment. However, equipment will span different organisations so standardised solutions will be required.

3. Design Implications

So far we have characterised the subtlety and complexity of informal interactions among people who are co-located. We also have documented the sheer frequency of informal communications and their crucial contribution to the social and production aspects of team functioning. And we have noted the important role that a shared physical environment has on initiating and maintaining informal conversations. But fundamental changes are taking place that reduce the frequency of informal communications. Many organisations have been spreading their operations across geographic sites and they are forming strategic alliances with other organisations in distant locations. In addition, more people are telecommuting from home and connecting into work while travelling on business trips. As a result, many people are expected to collaborate with others who are distributed across many locations, sometimes in different countries and different time zones.

Given the importance and frequency of informal communication, how can we support it in these newly distributed groups? In particular, what role will video play in that efort? Providing technological support for informal interactions is a challenge because, unlike meetings, which happen at predetermined times among predictable groups of people in predefined locations, informal interactions have few defined variables. They occur with little notice for short periods of time, often between participants whose identities cannot be predicted in advance. The topics are unplanned, but they often build on previous conversations, so any document or supporting material may become relevant. We attempt to take on the challenge of providing support for informal interactions by dividing the problem into two issues. We first consider how we might help people *enter* informal interactions and then discuss features that might help support those interactions once they begin.

3.1 Entering Interactions

We have been making the distinction between intended interactions, those that occur when someone decides on the spur of the moment to contact another person, and opportunistic and spontaneous interactions, those that happen when people happen to be at the same place at the same time. We first discuss lessons learned from existing systems for intended interactions, and then we speculate on ways to support opportunistic and spontaneous interaction.

3.1.1 Intended interactions - The connection problem

From studies of informal communication in the workplace and of existing prototypes that support intended communication, we know that the majority of people's attempts to reach others are initially unsuccessful (HP corpus; Fish, et al., 1992). We mentioned that 67% of attempted phone calls in the HP corpus did not reach the intended recipient, and in the Montage study, 75% of all attempts to reach someone were unsuccessful (Tang, Isaacs & Rua, 1994).

Why is this? One problem with intended interactions is that the availability of the recipient is not guaranteed. One method of helping people find good times to interact is to use techniques such as "glancing" (Root, 1988; Tang & Rua, 1994) to offer people information about the availability of the recipient. By "looking into" the recipient's office they can see whether the person is present and available for conversation. Once availability has been established, it is critical to establish connec-

tions (such as audio, video, and data sharing) extremely quickly and easily. Studies of existing pro-

totypes show that if a connection is not made within a few seconds, people tend to use the system

for longer, more formal interactions (Tang & Isaacs, 1993; Fish et al., 1992).

On occasions when recipients are unavailable, it is useful to provide mechanisms to set up future

contact, most notably the ability to leave a note in a prominent place. Montage, for example, allows

people to leave an electronic "Stickup" note on the screen of someone they tried to contact. The

recipient can use that note when they return to establish a video connection with the sender. This

feature was well received by users (Tang, et al., 1994).

In addition, we have shown that people often go to another colleague if they do not find the person

they seek. Perhaps a system for intended interactions could allow people to designate a "next rele-

vant colleague" to whom people could "go" when appropriate. Another possibility is to provide a

"contact method" for the recipient. A more sophisticated but complex design would allow the user

to specify different people for different topics. In addition, we noted that people often announce to

their colleagues upcoming events that will take them away from their work area, thus encouraging

others to handle pending business with them. A distributed system might support a similar activity,

perhaps by enabling a group video connection or a prominent place to leave a note to a group.

In the Montage system, people can post an image for those who glance to indicate they are not in

the office (Tang & Rua, 1994). They can also write a message on the image to give more informa-

tion. Data from an extended use study showed that 87% of the times users put up the "not avail-

able" sign, they wrote a note indicating their whereabouts and/or when they would return. They

never specified another person to contact, however. This finding indicates that a forwarding feature

might need to be built in to facilitate the behavior.

Finally, it might be useful to provide a message capability that goes beyond text or voice alone.

Users may want to make better use of missed connection events by leaving richer multimedia mes-

sages incorporating a combination of voice, gestures, writing, and documents.Wang's Freestyle

system allowed users to do this by freezing the image of a document on the screen, which users

then annotated and spoke about in a recorded "voice over" message (Francik, Rudman, Cooper, &

Levine, 1991). Frohlich and Daly-Jones (1995) tested a similar pen-and-voice messaging facility called Voicefax against standard PC fax and voice mail messages. They found that people used significantly fewer Voicefax messages to perform the same task with higher perceived quality. It is not hard to imagine a video-based variation on these systems that allowed users to switch on a local document camera to record a video message for dispatch with its associated documentation.

In sum, features that would be useful to set up contact include:

- The ability to very quickly glance into colleagues' offices to check their availability

- Rapid connection once availability is established

- The ability to leave a message if an attempt to contact is unsuccessful

- A way to leave a notice indicating where you are and when you will be back

- Multiple-way audio-video connections for group announcements (e.g. to "pre-announce" when you will be unavailable)

- Forwarding, i.e., a way to designate a "next relevant colleague"

- Multimedia messages

3.1.2 Opportunistic and spontaneous interactions

Since unintended communication is initiated by the co-presence of the interactants, technologies to support remote opportunistic and spontaneous communications need to provide methods for interactants to become aware of and encounter one another serendipitously. As we saw from the HP corpus examples, people develop awareness in the physical world by seeing others in nearby locations as they go about their workplace activities. People often run into others in common areas, e.g. hallways, coffee areas, office supply areas, cafeterias, printer areas, parking lots, etc. When people move into a common area, they recognise that they enter a "public" space where they might be observed and approached for conversation. As a result, people use visual cues to signal to others the degree to which they are receptive to interactions.

In a distributed environment, people can use video to stay aware of others' availability. In the PARC Media Space, for example, a camera was placed in a commons area largely to help people stay aware of others' whereabouts (Bly, et. al., 1993). People can use such video to see when people come into camera range. They can see such things as body position, facial expression, eye contact, and other cues about a person's focus of attention. They can tell whether a person is already involved in an interaction, and if so, whether it might be appropriate to join. In other words, video allows people to use many of the same cues they use in a shared physical environment to understand who is where and whether they are willing to interact. We described many examples from the HP corpus when people used visual cues to time their opening comments. There were other cases when people used visual cues to indicate they would prefer not to initiate conversation. People also used visual cues on occasion to show that they were ready to end interactions.

Still, simply providing video access among remote collaborators is not sufficient for enabling smooth entry into interactions. People also need to know when they are likely to encounter others so that they can adjust their demeanour appropriately. The Autocruiser feature of Cruiser was not well received in part because people were given no warning of pending video connections and because they had no relevant shared context when a connection was made (Fish, et. al, 1992). The Montage system used approach sounds to signal a pending interaction and a slow video fade-in effect to soften the intrusiveness of the video connection (Tang & Rua, 1994). Perhaps such sounds and video effects could be used to signal the proximity of others. In addition, certain "places" in a shared electronic work environment could be created where people could "run into" others. These places might provide other attractions that draw people (e.g. daily news, schedule of events, progress schedule) so that unintended interactions might occur.

In our experience, users of video systems often ask for the ability to control visual access. One way to do so is to design all connections to be symmetric so that no one can watch or listen without being seen and heard themselves. In addition, explicit access controls can be provided.

These ideas suggest the following components for a system to support unintended interactions:

- use video (and possibly audio) to allow people to see who is available

- use video to convey whether a person is open to an interaction

- provide cues when people are in an on-line "place" where they might see and be seen by others

- provide contexts with useful information where people are likely to see others

- provide symmetric audio and video; if you can see or hear, then you are being seen and heard

- provide the ability to control visual access

3.2 Supporting Conversations

Once people successfully initiate an interaction, they need support for it, whether it began as an intended or unintended interaction. Many informal conversations include references to on-line and paper documents, from scribbled notes to published papers (Whittaker, et al., 1994a; Harper & Sellen, 1995). People should be able to bring such documents into a discussion at a moment's notice. They also should be able to see each other pointing and writing on documents. Since many conversations are continuations of previous discussions, it may be useful to help people keep track of their concurrent discussions so they can easily restore the shared context when a new "install-ment" occurs. This function is supported in a prototype (Whittaker, Swanson, Kucan & Sidner) that kept track of conversational threads and represented them on the user's desktop as "piles." The piles could be accessed rapidly and used to regenerate the context of an ongoing conversation.

A related concept is to enable people to store different aspects of their conversations, including documents, audio, video, and screen snapshots. By storing these conversation components, people could keep track of progress, keep others informed, and perhaps resolve later misunderstandings. One such system is Filochat, a conversational support tool that co-indexed user's pen strokes dur-ing note-taking to an audio recording of the meetings. Field study results showed that this system helped people regenerate the context of prior meetings from handwritten notes (Whittaker, Hyland & Wiley, 1994b). A system developed at Xerox PARC called WhereWereWe enables real-time video capture, indexing, and playback during conversations, which was used successfully to sup-port and track design and planning sessions (Minneman, et al., 1995).

Storing conversations might also help those who wish to convey a message to a large group but do not trust word of mouth. For example, creators of information could make their message easily available on line (in text, audio, video, or otherwise), so that anyone passing on that information could easily share the first-hand version. The information might include a link to the information creator so that people could easily contact them (though video or otherwise) if they had questions. Perhaps mechanisms could be included to track those who had seen the message so that the information creator could contact groups who had not received the message.

Ideas discussed to support interactions that happen spontaneously include:

- Ability to share existing on-line and paper documents and material created on the fly

- A mechanism to help track and restore multiple, ongoing conversations with different people

- The ability to store and retrieve parts of conversations in a variety of media

3.3   Range Of Needs For Different Groups

As we discussed, not all types of groups are alike, and those differences suggest different requirements for supporting informal communication. One obvious design implication is that people tolerate different levels of privacy violations from different types of people, especially when video is involved. Our studies of workgroup communication indicate that many people find it acceptable for other workgroup members to interrupt them, overhear their conversations, view many of their documents, handle issues for them in their absence, and so on. Support for workgroup interaction could take advantage of this openness to provide ongoing, lightweight access to each other's whereabouts, activities, and stored materials. However, this arrangement would be unacceptable for external groups, or possibly peer and cross-functional groups. For those groups, it would be useful to create contexts where access is open while limiting or blocking awareness in other contexts.

In general, it may make sense to build in a notion of groups, which people may define and control as an entity rather than specifying access on a per-person basis. Of course, group membership is often fluid, especially for *ad hoc* teams. A community of peers may not even see themselves as a "group." There may be a need for official groups, where all the members acknowledge the bound-

aries of the group, as well as unofficial groups, which a person creates a group to characterise the level of access they will allow a set of people.

To support external groups, tools must interoperate across computer platforms. Even within the same company, different groups often work on different hardware using different software. A system designed to support their ability to notice each other and enter into unplanned conversations should run smoothly across a variety of platforms.

Possible ways discussed to handle different types of groups include:

- A notion of groups built into the system

- A lightweight mechanism to easily specify and change levels of access for groups

- Easy access to the technology to accommodate fluid changes in group membership

- Interoperability across platforms to enable collaboration across external groups

4. Conclusion

Our goal in this chapter was to call attention to the importance of informal communication — and in particular opportunistic and spontaneous interactions — for the healthy, productive functioning of groups, and to point out how video is a natural tool for supporting such behavior. We have discussed a range of activities that occur through informal communication among a range of types of groups, and we have considered a variety of implications for the design of systems to support that work. We do not expect that any one system could provide all the support we explore; we raise the ideas as possible considerations when designing a system. We also do not expect that all our suggestions will turn out to be useful. Since no such system directly addresses unintended interactions, we can only speculate based on our knowledge of such communication in the physical world and on design principles of other CSCW systems. We hope we have stimulated thought on the issue and encouraged researchers and practitioners to consider either building tools to support informal communication or designing into other systems mechanisms to support informal communication.

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