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NetWORKers and their Activity in Intensional Networks

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Abstract. Through ethnographic research, we document the rise of personal social networks in the workplace, which we call *intensional networks*. Paradoxically, we find that the most fundamental unit of analysis for computer-supported cooperative work is *not* at the group level for many tasks and settings, but at the individual level as personal social networks come to be more and more important. Collective subjects are increasingly put together through the assemblage of people found through personal networks rather than being constituted as teams created through organizational planning and structuring. Teams are still important but they are not the centerpiece of labor management they once were, nor are they the chief resource for individual workers. We draw attention to the importance of networks as most CSCW system designs assume a team. We urge that designers take account of networks and the problems they present to workers.

Key words: activity theory, collaborative work, communities of practice, social networks

Modern work and the rise of intensional networks

In the past, much work took place in relatively stable settings. Many people were employed by large corporations. Long-term established relationships existed between businesses, suppliers, and customers. It was not unusual for white collar workers to stay at the same company for decades (Cappelli, 1999). Even blue collar workers subject to cycles of hiring and firing were often rehired by the same companies when economic conditions improved. Employees worked for long periods in "communities of practice" (Wenger, 1998) in which they built up considerable expertise in the details of their job.

Research on communities of practice has documented a number of important characteristics of this style of work: workers operated within clearly defined organizational and social roles, they were highly familiar with one another and shared considerable social, cultural and organizational knowledge that served as a backdrop for work and interaction. Workers were generally (but not always) colocated, making it possible to have frequent interpersonal communications that contributed to the creation of shared knowledge, and facilitated the smooth execution of work tasks (Kraut et al., 1993; Whittaker et al., 1994; Nardi and Engeström, 1999). The bulk of the CSCW literature reflects this view, generally assuming that workers are organized into *teams* with clearly defined stable roles (e.g., Jarvenpaa

and Leidner, 1999; Mark et al., 1999; Gutwin and Greenberg, 2000; Olson and Olson, 2000). The aim of technology has been to provide support at the team level, as indicated by the large number of tools designed to support work within a single organization, such as Lotus Notes, and the interest in workflow (Winograd and Flores, 1986; Malone et al., 1989; Nutt, 1996), both of which presuppose a stable organizational backdrop and predictable structure to workplace interactions.

As recent management literature has documented, however, these working conditions are rapidly becoming obsolete (Jacoby, 1991; Oravec, 1996; Bishop, 1999, Cappelli, 1999). Many companies are downsizing, reducing layers of management, and automating routine jobs. There is an increased focus on business relationships *between* companies (Ancona and Caldwell, 1988). New kinds of alliances are being formed between businesses, suppliers and customers (Nohria and Eccles, 1992; Wildeman, 1998). Relationships *outside* the organization such as those with government and the press are increasingly critical to many businesses. Within organizations, constant reorganizations mean workers' responsibilities, colleagues, and reporting relationships change frequently. On the technology front, there have been massive increases in the uptake of communications technologies such as email, voicemail, instant messaging, fax, pagers, and cellular telephones, as well as personal digital assistants. These technologies have led to changes in established work-based communication practices (Markus, 1987, 1994; Sproull and Kiesler, 1991; Nardi et al., 2000).

One consequence of these organizational and technical changes is that many corporations operate in an increasingly distributed manner, with workers, contractors, consultants and important contacts such as those in the press located in different parts of the country or across the globe. Companies are also experimenting with outsourcing functions; job roles that were previously handled internally are now organizationally and geographically separate from the company. In this paper, we hope to provide a developmental expansion for CSCW research and development by focusing attention on the many social forms in the workplace that are not strictly team-based.

Intensional networks

While there has been much high level description of the consequences of new styles of working (Nohria and Eccles, 1992; Castells, 1996; Oravec, 1996; Lloyd and Boyle, 1998), we know of few attempts to carry out "on the ground" analyses of the consequences of these new styles (although important contributions have been made by Smith, 1994; Engeström, Engeström and Vähäaho, 1999; Østerlund, 1996; papers in this issue). This paper presents a study of worker's reactions to, and strategies for, dealing with the new demands of the workplace. We present our research on *intensional networks* from a study of collaboration across organizational boundaries. We argue that the creation, maintenance, and activation of personal social networks – what we call netWORK – requires deliberate,

careful work for today's workers. At present, netWORK is a kind of hidden work unaccounted for in theory and practice. The "netWORKers" we studied were encountering many of the new workplace problems and conditions described above.

New economic conditions and ways of working require that we expand our theories. A core concept in activity theory is the subject. The unproblematic assumption of a subject works well in classical activity theory which took the perspective of the individual (Leont'ev, 1974). However, if we want to study joint activity, which is essential for understanding the networked nature of today's workplace, the development of a *collective subject* is important. It has probably been pertinent all along to study collective subjects, but current conditions make this omission even more obvious. It is time to ask questions such as: How and why do people get together for collective activity? How do people find and communicate with one another for purposes of joint work? Can we rely on notions of "teams" and "communities of practice" to understand collectivities in today's workplace? Our data suggest that these concepts are insufficient to account for important forms of collective activity in the modern workplace. In this paper we document the ways people create, maintain and activate intensional networks as a key part of the process of developing a collective subject in many workplace settings.[1]

We were led to intensional networks through our investigation of cross-organizational collaborations such as those a worker might have with customers, vendors, contractors, consultants, business alliance partners, and workers in other parts of an organization. Intensional networks are the personal social networks workers draw from and collaborate with to get work done. We will argue that it is increasingly common for workers to replace the organizational backdrop and predetermined roles of old style corporate working with their own assemblages of people who come together to collaborate for short or long periods. These assemblages are recruited to meet the needs of the current particular work project. Once joint work is completed, the network has some persistence: the shared experience of the joint work serves to establish relationships that may form the basis for future joint work. This style of work has long been common in the building trades and in Hollywood productions. What is new is that it is rapidly permeating corporate life.

Intensional networks exhibit aspects of both *emergence*, being called into existence to accomplish some particular work, and *history*, drawing on known relationships and shared experience. Intensional networks are not stable in the sense of actor-network theory (see Engeström and Escalante, 1996), nor are they completely extemporized. In this paper, we document the intensional networks we observed in a number of very different workplaces. We describe how intensional networks are always in an ongoing process of constitution through acts of *remembering* and *communicating*.

We chose the term *intensional* to reflect the effort and deliberateness with which people construct and manage personal networks. The spelling of the term

is intended to suggest a kind of tension and stress in the network. We found that workers experience stresses such as remembering who is in the network, knowing what people in the network are currently doing and where they are located, and making careful choices from among many media to communicate effectively with their contacts. At the same time, “intensional” also suggests a “tensile strength” in network activity; we found our informants endlessly resourceful and energetic in their everyday collaborative activities within their networks.

Finally, our term resonates with intensional logic which develops a framework and semantics for describing a system of many “possible worlds” or “versions” (Schraefel, 1997). A social network is a complex, dynamic system in which, at any given time, various versions of the network exist in different instantiations. Part of the network may be actively embodied through intense communications as a major project is underway. Other parts of the network are instantiated differently, through less intense communications as well as acts of remembering. These instantiations, or *extensions*, of the network vary according to context-dependent dimensions. The dynamics of networks are necessary to understanding their flexibility and strength as crucial resources for today’s workers. We will give many examples of the fluid “versioning” of networks in the empirical sections of the paper.

Our study documents the difficulties presented by the new ways of working. As we listened to people talk about working across organizational boundaries, we heard a great deal about the problems of recruiting labor or alliance partners, establishing working relationships, and choosing communication media to facilitate the delicate and constant tasks of communication. It became clear to us that the work behind the constitution of a collective subject for the accomplishment of joint work is an important activity in its own right.

A network is not a collective subject. A network is an important source of labor for the formation of a collective subject. Our goal is to investigate the problem of how people come together for joint work, that is, how the personnel for a collective subject find one another and establish relationships so they can collaborate. Because so much effort goes into simply creating and maintaining the network itself, we believe understanding how collective subjects are formed entails understanding how personal social networks function in today’s workplace. We advocate that proposals for CSCW technologies consider the fundamentally networked nature of relationships in the workplace, relationships that go far beyond a simple notion of teams with fixed organizational roles.

We contrast our accounts of intensional networks to activity theory accounts that investigate “knots” (Engeström et al., 1999) and coalitions (Zager, 2002, this issue). We also analyze work on communities of practice (Wenger, 1998), actor network theory (Law and Callon, 1992; Latour, 1996), and sociological accounts of strong and weak ties (Granovetter, 1973).[2]

Another reason intensional networks interest us is that they belie what we call the “rhetoric of virtuality.” This rhetoric locates workers in “virtual” or “ad hoc” teams in “cyberorganizations.” Thought takes place in “distributed minds” through

a "collective intelligence" in "sentient organizations." "Distributed leadership" enables the smooth function of "self-healing systems." (See for example, Fisher and Fisher, 1998; Lloyd and Boyle, 1998, as well as countless articles in the mass media). Peter Russell (quoted in Lloyd and Boyle, 1998) put the matter vividly: "As worldwide communication capabilities become increasingly complex, society is beginning to look more like a planetary nervous system. The global brain is being activated . . . No longer will we perceive ourselves as isolated individuals; we will know ourselves to be part of . . . the nerve cells of an awakening global brain."

Terms such as *virtual* and *cyber* mask important realities in the workplace (Schwarz, Nardi and Whittaker, 1999). Much has been written about the virtual corporation, but there has been little study of the additional burdens that "being virtual" demand. People do not magically come together "virtually," in friction free interaction smoothly mediated by technology, to collaborate. A great deal of human communicative work is involved in bringing people together to make collaboration possible. The rhetoric of virtuality involves a process of "deletion" in which real people are "deleted" as work is described as invisibly distributed in a "system," and intelligence is no where in particular, certainly not in the minds and hands of specific workers. (See Star (1989) on "deletion," i.e., the use of rhetorically charged words that hide complex realities.) We will try to bring to life the nitty-gritty of actual people pursuing joint work in everyday situations to counter some of the effects of the rhetoric of virtuality and to illustrate some of the new challenges that virtuality brings to the workplace.

Activity theory is especially well-suited to this goal. One of the strengths of activity theory is that it posits a sentient subject engaging in conscious actions attributable to specific objects (see Kuutti, 1996). The rhetoric of virtuality nullifies the aware subject, denying place, body, intention, history, struggle, and effort. As we will see in informants' descriptions of their work, people are just as engaged in human struggles and enmeshed in their histories and intentions as ever.

The netWORK study

NetWORK is our term for establishing and managing relationships with the wider world – customers, clients, colleagues, vendors, outsourced service providers, alliance partners in other companies, venture capitalists, funding agencies, the press, strategic peers, in-house experts such as legal and human relations staff, and contractors and consultants. In our study we found that netWORKers rely heavily on their own personal social networks as they seek to get work done in today's world of organizational boundary crossing. Our investigation is an on the ground look at the "network society" described by Castells (1996). The aim of our research is to better understand new organizational forms and demands, in order to design technologies that address problems and gaps arising from new ways of working.

Table I. Study participants. All names are pseudonyms. Names in bold are study particapants quoted in the paper

Informant; size of organization	Area	Function	Job activities
Ed, 1	Mass media; Internet	Production; design; management	Project coordination, animation design
Ella, 1	Non-profit	Organization	Consulting; planning, facilitating
Jay, 2	Multimedia; Internet	Design; production	Web design, T-shirt design
Kathy, 1	High tech	Marketing; communications	Consulting; strategic planning
Lynn, 1	Law	Public defense	Try/research appeals cases
Nora, 1	High tech	Public relations	Consulting; press contacts
Joe, 20	High tech	Development; management	Develop intranets, extranets, web sites
Laura, 25	High tech	Executive management	Manage employees, planning, selling
MediaMax, *12*	*Multimedia; Internet*		
Ashley	"	Production management	Co-owner; managing, budgeting, planning
Gary	"	Executive management	Co-owner; managing, selling, planning
Rachel	"	Production	Project management, client contacts
Jeff	"	Design, development	Design, programming
CreativePix, *20*	*Mass media; Internet*		
David	"	Production; management	Founder, creative director, directing
Greg	"	Production, design	Creative director, drawing, animation
Jill	"	Management	Managing, selling, strategic planning
Insight, *700*	*Internet*		
Emma	"	Management, design	Manage designers, developers, planning
Jane	"	Management, strategy	Business development, outside contacts
TelCo, *100,000+*	*Telecommunication*		
Carl	"	Public relations	Press contact and releases, event planning
Dale	"	Secretarial	Clipping, vouchers, secretarial
Barry	"	Management, public relations	Internet marketing; managing
Alan	"	Management, tech transfer	Managing, identify market opportunities
Wanda	"	Tech transfer	Identify market opportunities, facilitate communication

We carried out in-depth interviews and observations in a small representative sample of people who work across organizational boundaries. All of these people were experienced users of a variety of technologies. We interviewed twenty-two workers in twelve organizations. In four organizations, we studied two or more workers; the rest were single individuals from various organizations (see Table I). We audiotaped conversations in informants' workplaces and observed them at work in some cases. People in our sample included public relations specialists who work with the mass media, an executive who transfers technology across corporate boundaries, an attorney who appeals life sentence cases, graphic artists, Web designers, a non-profit consultant, small business owners, executives at an Internet company, a secretary, and others. Some of the people in our sample were independent contractors or consultants, some worked for a very large company, some for a medium size company, and some for small companies of fewer than 100 people.

About half the sample was male and half female. Most were in their 30s or 40s, with a few in their 20s and 50s. Most worked in California; some in New Jersey. All but one had a college degree. Some had been to film school, law school, or graduate school.

In semi-structured interviews, we asked people about the work they did and how they communicated. We learned about their use of communication media including phone, cell phone, voice mail, conference calls, fax, Fed Ex, email, email attachments, videoconferencing, pagers, groupware, the Internet, FTP, the Web, chats, intranets, and extranets, as well as face to face. About 50 hours of interviews resulted in over 1000 pages of transcripts which we analyzed for recurring patterns relating to the questions we asked about communication activities. In this paper, we quote extensively from the interviews. All names are pseudonyms and details have been changed to provide anonymity.

netWORK

The term "networking," as in cultivating useful others, has been in use since at least 1940 (Webster's New Collegiate Dictionary). But with the immense growth of the network society (Castells, 1996), it is important to understand and document more precisely what goes into the creation and maintenance of ever-more important personal social networks. NetWORK tends to be hidden work, unaccounted for in workflow diagrams or performance evaluations. It is simply necessary background labor that smart workers take on so they can do their jobs effectively (see Nardi and Engeström, 1999; Nardi and O'Day, 1999 on invisible work).

Many of our informants emphasized the centrality of personal relationships and networking for the success of their work. "Kathy," an independent marketing and communications consultant, remarked that she was able to go independent, a long cherished dream, only when she had a personal network in place.

> Kathy: Well, I always had the idea even when I was in college that one day I wanted to work, be my own boss, and I wasn't quite sure what that was going to look like. So I got into consulting and I began to notice in the type of consulting work that I was doing for companies, that I could do that on my own. But I waited until I had a network set up – not a computer network, but a network of people, of acquaintances and such, and just so that I felt comfortable about my skill set, that I could leverage it into a variety of different areas.

"Gary" was the principal of a small media firm, "MediaMax" in San Francisco. MediaMax employed twelve people to create Web pages, CD-ROMs, and user interfaces for computer games and special purpose devices such as high-end slot machines. Gary noted that, "It took a long time to realize that it [business] is all about relationships and about keeping in touch with people. You really have to keep in touch."

Because organizations are in perpetual flux, netWORK activity is constant and intense. NetWORK in intensional networks takes place in a landscape of

great heterogeneity, with widely varying employment relations, work histories, and professional identities. People may still do considerable work in teams, but much crucial work takes place outside the immediate team, in fact often quite far afield.

As an example of today's heterogeneous workplace, and an illustration of the complexity of modern working relationships, we consider a description provided by Gary. In the interview segment below he described the motley crew populating his office including clients, freelancers and regular employees. During the period of our research, some of the regular employees had migrated from contractor status to being full-time permanent employees. This segment came from a second interview with Gary a few months after the first interview:

> Gary: And we actually have two new freelancers who are working here [in our office] on the "Casa" project. And the client who's here all the time.
> Interviewer: The client is here. Why is that?
> Gary: Because he's an art director, and he wanted to be in control of what, you know, was being created. . . . And he also actually . . . lives in San Francisco.
> Interviewer: Oh okay. So he doesn't have to commute.
> Gary: He doesn't have to truck all the way down to Palo Alto [where his company is]. And you know, his bosses aren't around, so you know. . . . *(Laughter)* But he seems happy, you know, he rides his bike here, and . . .
> Interviewer: So is he here every day?
> Gary: He's here every day.
> Interviewer: And they don't need him at [his company]?
> Gary: Well he's working on this project and I think another project, and on the other project he has meetings with a freelancer here using the conference room . . .
> And two freelancers are here everyday. And one is a production artist and the other is a coordinator, production coordinator, and she also is ink and painting as well.
> Interviewer: Okay, one is an artist and the other is a coordinator. So that's a job that "Carey" [a MediaMax employee] used to do, or . . .?
> Gary: Yeah, it's a job that Carey used to do. Carey's more transitioning to computers and MIS. Making sure that everything's running and . . . that's an issue, even with twelve employees, you know, it's amazing [what a big job it is].

Here Gary remarked on how in his office space, a loft in downtown San Francisco, he had a client, two freelancers and a regular employee. One of the freelancers was doing something the employee used to do, typical of the fluidity of function in today's economy.

There was more.

> Gary: [Another] one is the art director who's always here, he's the older guy with no hair.
> Interviewer: Okay. Yeah . . .

Gary Then there's a producer from [another company] who also has an apartment up here in San Francisco.
Interviewer: He likes to be here?
Gary: He comes either at the end of the day or the beginning of the day. And he checks in often. And then, uhm, there's a, our 3D artist who works at home . . .
Gary: . . . And there's a 2D animator who, who comes in and just drops off his drawings and so there's no email with him. Kind of old-school. . . .
Interviewer: . . . So . . . actually, I never totally understood, people like "Joe" and "Sally," are they employed?
Gary: Yeah, which means they have healthcare benefits and those kinds of things. And I think when you were [first] here, we'd just done that.
Interviewer: Maybe, or you were in the process.
Gary: Or in the process, well, and it's happened.

Gary went on to explain his small company strategy of having a "core group" augmented by contractors. Part of the core group (Joe and Sally) were recently contractors in Gary's network. People often flow back and forth across employment boundaries:

Gary: . . . What we're going to use from now on is to have a core group that has their own specific skill set and then hire on an as-needed basis for the project.
Interviewer: Because you have to be flexible, right, I mean . . .
Gary: Yeah. I mean we have to be scalable. And you know, we're hopefully going to be able to keep everybody who's here [as permanent employees] always busy. Or at least, you know, working on [something for the company]. For example "Tom" is working on Casa, but he's also at times on the new letterhead. . . .

We went on to ask about how Gary found contractors ("freelancers"):

Gary: Well for us it's, uhm, a lot of people we work with we already know . . . [W]e try to include freelancers in all the company's meetings that we have and that kind of stuff. But for us, we usually work with existing relationships we have with freelancers.

Gary noted the tension between being in and out of the core group. He attempted to mitigate the tension by including freelancers in company meetings. Gary underscored that existing relationships in a social network were the pool from which freelance resources were drawn.

An important point about this description is that it paints a picture of an "organization" that is very different from the classic corporation. It is hard to imagine how these complex working roles might be captured in a formal organizational chart. A second crucial point is that this complexity introduces additional work for the participants in tracking and remembering the various roles and responsibilities of different individuals. Who is working with whom on what, and for how long? Who

knows what person X is up to and who completed project Y? These demands are very different from the classical organization where responsibilities are closely tied to a relatively small number of assigned roles and where projects structures are more clearly delineated.

To take a different example, we will examine "Jane's" work for an Internet company, "Insight," with about 700 employees. Jane's job was business development – finding partners for the company. She called people on the phone, most of whom she had never met, explaining, "We're looking at your industry, we'd love to have a conversation with you." Though she didn't know the people she called, most of them were contacts activated through her personal network at Insight. Jane was not often in a position to exploit direct existing relationships as Gary could, but she was usually at only one remove from potential business partners through her network:

> Interviewer: How would you know who to contact?
> Jane: Usually, we'd have a contact here. So usually, somewhere in this building somebody knows at least one person at that company. ... If [I] don't have a contact ... then ... I would send an email. I would send an email to sales and business development and say, "Does anyone have a contact of the right person at this company?" If we don't, then the next step would be we call the company headquarters and ask, you know, who's the head of their business development.
> Interviewer: And then you would call them up.
> Jane: Right. We would call them up and schedule a meeting. Now, normally the first meeting is a conference call.

Once the partner relationship was solidified, Jane brought them to her office and they talked about the work:

> Jane: So we actually bring all the potential partners in and start talking with them, and explain to them what our local strategy is and what we'd like to accomplish, and they do the same. And then, in the room is usually myself, a business development person, and most likely a salesperson from the Insight team. And then, from their side most likely is the same type of group.

So netWORK activity for finding partners started with Jane activating her contacts at Insight, then moved to establishing contact with potential partners she hadn't met but wished to engage, to a meeting composed of the partners, Jane, another business development person, and a sales person. It is important to emphasize that Jane had a complex task of constructing the network in order to explore potential new partnerships, and she used contacts within the company to do this. Again the picture differs markedly from the classic corporate model in which business depends upon established, stable relationships. Jane's intensional network grew, adding new contacts as the joint activity demanded. Later, when the work had reached a certain fruition, network activity slowed. But from the point of view of an individual in the network, and the organization, the contacts now existed as part of the network, however dormant they might lie after joint work ceased.

"Ed," an independent TV producer, contracted for organizations such as MTV, Disney, Sesame Street, and Nickelodeon. He described how he put together a crew to produce commercials and animations:

> Ed: And that's a multidisciplinary kind of a task when we produce them [commercials]. We typically work with an ad agency. They come to you with story boards. They ask you to budget out how much it would cost. You give them a bid and you sign that you are going to produce it for that and then you have to hire the talent. You have to hire the camera crew. You have to hire the stage. You have to have the animation guy and you need to cue it, you need to put it together and deliver it.

Ed himself had to "hire the talent." To do this, he drew on many years' worth of contacts in the TV industry. Part of his value to organizations such as Disney was that he was able to activate his network to pull together a production crew quickly. One "version" of Ed's network, using intensional logic terminology, was the version he activated for the work he conducted in the context of a particular commercial or animation.

Ed went on to describe a specific project he had worked on for Disney. The work involved a set of animated characters that would populate shows on the Disney channel and an Internet site:

> Ed: And the groups that are involved in the making of that [the animation] are people at the Disney Channel. The Disney Channel is in Burbank, and there are several groups inside the Disney Channel that need to be in touch with me on a regular basis.
> Interviewer: Which are they?
> Ed: Well, there's the woman who's the head of it. Okay. Her name is "Suzi." She's the head of on-air promotions. And then she has a producer working under her, a guy named "Bill," who has an assistant working for him, named "Catherine." And then there's the legal department, a guy named "Fred" who works in the legal department. And then there's a person who's been assigned to take care of the online. His name is "Ben." And then there are various people who work with him. . . .
> . . . It's just, there are these groups: the online group, the legal group and then, out of New York, is a writer named "Frank," and another writer he works with. Then, creatively, we are working with a production house, "CreativePix", here in San Francisco. And we're also now working with a group called "Mega Media" that does computer graphics. So . . .
> Interviewer: That's a lot already.
> Ed: Yeah, it's a lot.

The people involved in producing the animated characters were not a team or community in any sense; they were distributed across professions, companies and locations. They were not even a virtual team because many of them would never communicate with one another in any way. And yet, from the point of view of

Ed, who was charged with getting the work done, the people he enumerated were all players in the making of the animated characters. Ed drew them into the work at various times, for varying reasons. In intensional style, Ed carefully activated selected portions of the network on an as-needed basis. His work was located in and distributed across a network structure – not a team, community, or virtual team. Within his intensional network, Ed activated a specific version of the network in the context of getting the Disney work done.

Key netWORK tasks

To ensure a steady supply of "raw material," in the sense of a potential pool of labor or contacts for future joint work, netWORKers constantly attend to three tasks:

1. *Building a network*: Adding new contacts to the network so that there are available resources when it is time to conduct joint work;
2. *Maintaining the network*, where a central task is keeping in touch with extant contacts;
3. *Activating selected contacts* at the time the work is to be done.

NetWORK is an ongoing process of keeping a personal network in good repair. In the words of one study participant, "Relationships are managed and fed over time, much as plants are." Two key actions come into play in constituting a network: *remembering* and *communicating*. We will discuss these actions in the context of building a network, maintaining a network, and activating network contacts.

BUILDING AN INTENSIONAL NETWORK

"Jill," was a principal in a small media firm, "CreativePix," mentioned in the previous interview segment by Ed. CreativePix made commercials for large companies such as Coca-Cola. Jill explained how she and a colleague, "David," invested considerable time and money in making what they knew would only be a potential future contact for their firm:

> Jill: You know, I went to Detroit last week. David and I went to L.A. for the day for meetings, then flew on the red-eye to Detroit, came back the next afternoon. And it was all to try to land a job that I knew we had very little chance of getting. But, I felt we had to make the trip to make the presentation, and David did a brilliant presentation. Probably– -like maybe we can pull a rabbit out of the hat and get this job – but, I knew that that was a long shot so it was also just a creative connection with them for the future.

They did not get the job but they did expand their network.

Networkers often look out for each other. A secretary, "Dale," worked for "Carl" at a large telecommunications company, "Telco." She wanted to transfer to a new location and found a job through her network and its extensions. She related the following:

> Dale: Because I was looking and "Dottie" happened to have walked by, said, "Are you trying to get back to [your former location]?" And I said, "Well, I'm looking, but there's nothing there." And she said, "There's gonna be." And so –
> Interviewer: Oh, she knew ahead of time! She has friends down there, or . . .?
> Dale: The secretaries that were leaving are friends of hers. She used to work with them.
> Interviewer: Oh, okay.
> Dale: So it really does – it is who you know, you know. Not what you know!

Networkers may look for specific individuals to fill out their networks for key functions. "Greg," creative arts director for CreativePix, deliberately sought someone he could call on at the companies he contracted for if trouble arose:

> Greg: What I usually do is find a guy who's like my counterpart on the other side. Sometimes it's the client. Sometimes it's the copywriter, sometimes it's the creatives. You know, if push comes to shove, there's some real problem, I know I can call this guy and be frank. Or woman.

As Castells (1996) has pointed out, today's social networks span the globe. Those in our study who had worked internationally often commented on the culture of those they recruited for their networks as germane to their decisions about allocating work. Greg was recruiting animators for a "George of the Jungle" segment:

> Greg: I'm thinking about the Hungarians. As opposed to why we didn't take George of the Jungle to China. And it's because we felt that the Hungarians had a certain black humor which translated to this particular job. Where the Chinese are very good at more literal, you know, superheroes fighting the meteor, you know, punching the meteor. But a character with a wry expression is something that Eastern Europeans totally get. You know, that kind of cartoon vernacular.

MAINTAINING THE NETWORK

Once contacts are in a network, they often require "care and feeding." While dormant contacts may be activated after surprisingly long periods of time, many of our informants spoke of the need to nurture relationships. This was accomplished through intermittent interaction, or "keeping in touch." Our informants talked about keeping contacts (often customers or clients) "happy" and feeling "taken care of." They emphasized that small personal touches such as taking people to the most fashionable restaurant or playing a round of golf had out of proportion rewards.

"Barry," a public relations executive at TelCo described netWORKing with customers and press contacts:

> Barry: You manage it. It really is a planned program of activities. And you know, it's like anything else, it's a variety of different communications and different forms over time, from calling, sending a fax, something to read,

> arranging a meeting with the person who's senior executive, offering a theater ticket, inviting someone to a seminar, sending an advanced copy of a particular report when you have a major announcement, calling them first. Remembering their wife's name or their husband's name, understanding what their hobbies are. If one of these people builds canoes and you come across an article about canoe-building you send it to them. I mean it's – in many different ways it's demonstrating an understanding of who they are and what they're interested in.

In this interview segment, Barry revealed the deliberateness with which he cultivated his network. In order to keep his network current, he needed to take action to "demonstrat[e] an understanding of who they are." He emphasized remembering details about the lives of his contacts and remembering to communicate with them at appropriate moments. He enumerated the many different forms communication could take– -calling, arranging a meeting, and so forth – and the care with which he chose a particular communication medium.

Keeping in touch involves remembering who to keep in touch with. We were surprised at the difficulty this task caused study participants. It is difficult for people to remember who is in their network for several reasons. Networks get large. People move around from company to company. They change roles. Remembering a network thus involves remembering who is in one's personal network, as well as where they are currently working and what they are doing. In today's economy where workers migrate often from company to company, tracking a personal network is an important aspect of netWORK. People used their own memories, paper-based tools, and computer databases of various kinds to remember their networks.

Carl dealt with the mass media in his public relations position at the telecommunications company in our study. He constantly tracked journalists and the changes in the publications they worked for, as well as their areas of interest. During an interview he showed us a stack of paper cards that he used to remember his media contacts. Flipping through the cards, he remarked:

> Carl: "John Smith," no, he's not the telecommunications reporter anymore, he went back to sports, you know. Here's the other people, here's "Sam Jones" who took over.

Carl also used an online database to remember media contacts. And he used public relations events as opportunities to "refresh his list" as he put it. The following interview segment relates to a high profile media event at Carl's site to which all the important American media were invited:

> Carl: I called him [a well-known journalist] as a result of this event that we were staging, because that was a *wonderful* opportunity to refresh your list, get back in contact with some of these people you haven't talked with in a while. And, ah, he was not able to come then BUT he said, "*I'm devastated I'm not going to be able to be there. This is great that through the years [we've worked together].*"

"Refreshing the list" involved renewing old contacts in the event they would be needed for some future project. The journalist took the opportunity of Carl's call to refresh his list too, by explicitly drawing attention to his relationship with Carl in his "through the years" comment. Carl kept careful track of the contacts in his network, drawing on several sources of memory, as well as taking advantage of key communication opportunities to keep contacts current.

Carl also used the media event to maintain contact with a journalist he knew by facilitating a coveted introduction of the journalist to the CEO of the telecommunications company. Here we find in a single event a new contact being added to the network of a journalist, and the strengthening of an existing contact for Carl:

> Carl: In fact, "Ken Swift" [the journalist], is a very important guy, obviously. I am probably a little far down the food chain for him to spend a whole lot of time with. But I can get a[n] [email] reply from him based on – he'll shoot me back an email, but it's based somewhat on the fact that when he walked in here [to the media event], he walks in and says, "*Hey, I'm sure there's a line to meet the big guy, right?*" [i.e., the Chief Executive Officer]. It's like, "Ken! Didn't I introduce you to the last big guy? Come on!" Actually I was able to kind of deliver him right into – I looked around, saw where [the CEO] was and actually, "Gail" was with him then. She was right at his elbow. So I like – I grabbed her. I said, "Ken wants to meet him. I'm bringing him right over." And Ken and Gail are good friends. I was able to like deliver Ken right into Gail's arms; you know, big hug, right at the elbow of [the CEO]. That's going to make him answer my next email.

The introduction ensured continued contact with the journalist, more contact than was justified by Carl's relative rank ("a little far down the foodchain"). Adding a new contact to the journalist's network, and activating a contact for Carl all happened – on one level – in the wink of an eye, the time it took for the "big hug." On another level, however, a good deal of prior history preceded the exciting moment. Carl drew on his existing relationships with Gail and Ken, on Gail's existing relationships with the CEO and Ken, and on the careful staging of the media event, which was, after all, expressly designed to create just such moments of dramatic network activity.

The journalist-meeting-the-CEO event embodies both the emergent character of intensional networks and their rootedness in a history of past relationships. On the emergent side, Carl seized an opportunity that could not be scripted beforehand, reacting quickly when he saw an opening in the CEO's access – "I'm bringing him right over." On the other hand, significant history and deliberate planning of the whole event preceded the encounter. Carl evoked the history at the event itself when he said to the journalist, "Didn't I introduce you to the last big guy?" And Carl revealed to the interviewer the bit of history that Ken and Gail were good friends, in explaining how someone could be precipitately thrust into the arms of another. The body, then, is a site of spontaneous communicative activity, as well as highly staged communication events.

But people also experience problems in maintaining their networks. Gary, of the small media firm, talked about how he sometimes forgot who was in his network. He used a computer tool that beeped after specified intervals to alert him to the fact that he had not called a contact in the database:

> Gary: You really have to keep in touch. Otherwise . . . You know, I forget about them.

Gary described how he would sometimes get a phone call from a prospective client he didn't remember well.

> Gary: I'll go "Can I call you back?" and hang up and go, "Now who is this guy? What's he want?"

David from CreativePix explained how he renewed contact with important contacts in his network, and how this renewal process led to further work collaborations:

> David: It also happened that I was going to New York at that point. And "Shirley's" husband is somebody who used to be a partner of mine in New York. When we had an office back there. . . . And you know, so what it turned into was then she said, "Why don't you come over on Sunday, you know, for dinner?" So my wife and I went over . . . After we had dinner – these are people that I know really well, that I have been working with on projects recently. And I realized. . . . I mean so we sat down, and one of the questions from them was, "So what are you guys doing?" And you realize that some people that you know well actually . . . they'll still give you work and all that kind of stuff based on who you are.

ACTIVATING NETWORK CONTACTS: LIVE SUBNETS

People build and maintain their networks. Then comes time to activate contacts for joint work. At any given time, there is a portion of a worker's network that is "live," in the sense that the worker is communicating frequently and actively with contacts in that portion of the network. The rest of the network hasn't gone away, it is just less active, existing as other versions of the network. We call the active portion of a network a "live subnet." A live subnet is a possible instance of an intensional network, rendered in a particular context of joint work.

Activating a network involves remembering who to contact for a particular need. Ed, the TV producer, noted the need to be able to contact many different kinds of people for various aspects of his work:

> Ed: I need to be able to track them back. Art directors, artists, you know, people that can draw in a certain way. People that could give me money. Lawyers, people that take away my money.

Ed underscores the heterogeneity of his network and the work of "tracking back" different players in his network.

People keep track of hundreds of other people,[3] remembering them along many dimensions. In this interview segment we are talking about the personnel for one of Greg's current projects. Greg indexes potential staff by their various expertises:

> Greg: Yeah. And half of 'em have worked here and I know them personally and I know their strengths and weaknesses. And so I say, "Well, this guy can really draw guys in tights, you know, superheroes, and this guy's really good with, you know, pigs with no pants." And usually, it's one or the other. It's rare that you find somebody who can draw everything. I mean there are people like that but usually people are specialized.

Greg remembered these things in his head despite changes in people's work:

> Interviewer: Do you have it in a database, sort of the way you have all these people, or is it in your head?
> Greg: Yeah, it's in my head pretty much. And it's constantly shifting and people are constantly sending me resumes and reels [visuals] and stuff like that. I have a core group of people that I return to over and over again.

Having the "core group" made the remembering easier for Greg, as well as providing other advantages of familiarity.

When a portion of a network is activated for ongoing joint work, it is a kind of living entity that must be carefully attended. When a set of contacts is "live," the relations that keep it going must constantly be renewed through acts of communication. The live portion of a network is not a static structure but a result of human interaction. Communication that activated live subnets entailed deliberate choices about *communication medium* and *language*.

Media choice

The proliferation of communication media now available means that people are presented with problems of media choice for communication in the activation of live subnets. Media choice was important in all aspects of netWORK, but seemed to be most artfully calibrated in the thick of joint work, so we will highlight the relationship between live subnets and media choice.

Most media choice research emphasizes *sender preferences*, such as preferences relating to the affordances of various media (Short et al., 1976; Daft and Lengel, 1984). For example, some people like email because it provides a paper trail, while others find the immediacy of phone communication desirable. While our informants had sophisticated and precise ideas about the affordances of various media, we found a simple model of sender preference and affordances was insufficient to explain how people used media to communicate within their networks (Whittaker et al., 1999).

We found that media choice depended heavily on two intensional network factors: *recipient preference* and the *developmental history of interaction*. Media choice was a social and contextualized activity occurring within the activities of

a worker's personal network, not simply a matter of individual evaluation of the physical affordances of media.

While senders had their own media preferences which entered the calculus of choice, they were highly responsive to the preferences of those to whom they sent messages. The power of recipient preference is shown in the following quote. "Rachel" worked for the multimedia firm that produced Web pages, CD-ROMs and other media. She described her frustration at having to use email as her client demanded, instead of the using the phone, which she personally viewed as more appropriate. She acquiesced to her clients' wishes for using email despite the fact that she considered the phone to be a more efficient and a less threatening method of carrying out the interaction.

> Rachel: The publisher's company was about four blocks away. And we would only email each other back and forth. I preferred to pick up the phone. But this company had a policy whereby everything had to be documented and emailed. And so instead of actually being able to pick up the phone and saying, "*Would you like the bird in the animation to be red or white?*" I had to sit down and email that. And so I spent all my time emailing. It was so frustrating. Because it was their policy, not ours. And it was a very defensive type of approach to take with your vendor ... It was more like working with some lawyers than working with a publisher, you know?

A similar argument was offered by Kathy. As a marketing consultant she felt that often her choice of medium was determined by her client:

> Kathy: Sometimes those [media choice] decisions are made for you, because people say, "I can't handle voicemail, please send me email, I respond to that faster." So if they respond faster, then I'm going to use whatever method is quickest. ... So one answer is if I'm told [to use a particular medium].

Information about recipient preferences has even been institutionalized for some professions through proprietary databases. Journalists, for example, reveal their media preferences and times they prefer to be contacted to companies such as MediaMap. MediaMap bundles this information into a software system called MediaOnline and sells it to public relations specialists. Carl explained:

> Carl: There are in fact, there are services such as MediaMap and things like that, that make a business of, not only providing press contact names and numbers, but they'll have information in their [database] about, okay, "*This is what this person covers for this magazine*," and they have information about the magazine if you don't know enough about that. They will even have how the person prefers to be contacted. "*This person prefers to be contacted by email, you know, do not phone them or else you obviously haven't read this and ... they'll yell at you. You can call them in the mornings on these days, but don't call them in the afternoons or they'll bite your head off.*"
>
> In fact, that's one of the reasons I was returning calls Friday. Friday is good for the trades. They are already through their deadline. You know, they

> might be taking a breather from the deadline they just had and starting to think about next week's deadline. Dailies. You know, you talk to dailies in the morning because in the afternoon the guy or gal is working on their story and doesn't want to get some, "*Hi, just thought I'd call and talk to you about* ..." You know, "*Don't talk to me now! Bye*!" So again, knowing the customer and what they prefer and how to approach them and stuff like that is I think a big part of it.

Carl revealed detailed knowledge about when and how to contact journalists, and used a comprehensive online source to extend his knowledge. Acts of remembering constantly informed his communication activity: knowing the "customer" (he referred to his press contacts as customers), thinking about what day it was and what a particular journalist was likely to be doing, and accessing the database to avoid mistakes.

Our interviews also indicated that media choice was influenced by developmental factors in a trajectory of events (Engeström et al., 1999) including project history and the personal history of interactions with given people in a network. Media choices were not simple evaluations of media affordances for isolated communication events, but part of ongoing judgments about communication couched in a specific history of project work and social interaction.

Projects moved through stages. Our informants described how different media were appropriate at different stages of a project. In the following quote Kathy noted the different phases of a project, and how different media were used at each stage:

> Kathy: And those [phone conferences with 100 people] mostly are one way. Like if you are communicating to some financial analysts ... We set it up so they couldn't ask questions because we didn't want them to ... But we did give them the option of faxing their questions in, and then it was our choice as to whether we would answer them or not. So, when it's one way, it's fine because you're just delivering your message and then, usually if someone has interest, then you'll follow up with a live conversation by phone or in person.

The first communication phase was to broadcast information to large numbers of people without giving them the chance to respond. This was then followed up with more interactive conversations with selected people, entailing the use of different media, or the same medium used very differently, here the phone.

Jane, in business development at the Internet company, observed that after she had had an initial telephone call with potential partners she could judge how serious they were. If they were serious she set up another, longer meeting, either a formal conference call if they were on the East Coast, or a face to face meeting if they were local. The length of time she would spend with potential partners lengthened as she perceived their interest to grow. She would also shift from phone to face to face when possible, though the phone was serviceable when travel was impracticable.

> Jane: I would send an E-mail. I would send an E-mail to sales and business development and say, "Does anyone have a contact of the right person at this

> company?" . . . We would call them up and schedule a meeting. Now, normally the first meeting is a conference call. . . . Actually almost all the time the person uses a conference call . . . and it's actually a pretty small group. It could be just me and somebody from business development. . . . And the main objective of that meeting is to explain to them why we're calling, explain to them, you know, what we've done to get to this point. We've got a strategy, we've got a bunch of research, and would they be interested in even looking at an opportunity to partner with [us]. The call could literally last 30 minutes, at tops; very short. Most everyone says, "Oh yeah. That'd be wonderful!" But we can always get a sense of how serious they are. And so we immediately have them judged off that phone call. We then usually within four to five days after, I'll call to set up another meeting, depending where that company is. So, if they're on the East Coast, most likely the next call is a conference call again. And it's probably an hour, at least.

Abrupt unexpected events were also part of the developmental flow that sometimes affected media choice. Kathy noted how a difficult event could rupture the flow of communication in a project, requiring a change in medium:

> Kathy: Sometimes situations [in a conference call] get really heated and people will disagree, and so you just have to say, "Okay. We're going to take this off line." You know, that's kind of a word people use if you need to take that new situation and talk about it, [but] not in this conference call because this conference call has a goal.

Kathy invoked an immediate crisis – people getting "heated" – but with reference to the larger "goal" of the conference call. It was in fact the goal that set her course of action: she chose to complete the stated goal of the conference call rather than to let people vent emotion. Here again we see the characteristic of actions within intensional networks; they are both emergent and part of a larger trajectory with its own history.

Media choice is also affected by the history of one's working relationship with others. Ed sometimes contracted for Jill's company, CreativePix:

> Jill: I mean, in the case of Ed – we know Ed very well so, if he were on his phone at home I think there would still be a tight link between us and him, as opposed to reading between the lines that one does on a conference call with somebody else you don't know as well.

So here the phone could be chosen as a medium capable of providing a "tight link" because Jill and her colleagues knew Ed so well. On a conference call with those they didn't know so well, it would be more a matter of trying to read between the lines. Same medium, different history of interactions.

In the following quote Kathy described why she chose an expensive conference calling service. She felt that her relationship with her client demanded that she appear consummately professional. She was not on such intimate terms with the client that any old communication medium would do:

> Kathy: Yeah. Actually [my long distance provider] did the conference call this morning and it was a $15.00 setup plus 52 cents a minute.
> Interviewer: Yeah, actually, I hadn't even thought about the technicalities of that. That's quite expensive.
> Kathy: Uh-huh.
> Interviewer: So you call them and then they call the participants. [Why do you use such an expensive service?]
> Kathy: Well, I think it's more professional and I feel more comfortable that actually it happened . . . Even if I had my phone, and a lot of people have phones that you can conference call on, I'd probably do that and, actually, my phone *does* have a conference call, but I don't think – it's not sophisticated enough. I don't think it's good enough in order for me to present a professional image.
> Interviewer: How does the other person know the difference?
> Kathy: Well, one, the person calls them and says "I'm calling you to put you on a conference call." You know, which confirms who's on the call. . . . So that's like they're being guided kind of thing, and you can do a roll call which is, you know, "so and so here, so and so there."

Media choice, then, involved the social network factors of recipient preference as well as the developmental history of interaction the informant shared with his or her contacts.

Language

Crossing organizational boundaries often involves dealing with people very different from oneself. In our study people told us how they consciously changed their language to adapt to those with whom they were working. This is a remarkably fine-grained adjustment in response to the heterogeneity of people's networks.

Rachel, a producer in the firm that creates Web pages, had three concurrent projects with three very different groups. She tailored her language to each individual group, to foster communication, to maintain the sense of connection as the work proceeded:

> Rachel: So actually when I took on more than two projects in the beginning I was a little bit apprehensive that I'd be able to just switch gears and even vocabulary because "BigBank" is very corporate; "StateUnion" is very union; and "Electronic Gaming" is a very kind of New Age-y, entertainment-y kind of thing. So just changing languages is hard.
> Interviewer: Give me an example. I mean, are you conscious . . . or does that happen automatically?
> Rachel: Oh yeah, at BigBank, for example, I'll pick up the phone and I'll talk about the progress of the project and I'll say something pretty corporate like, "*Hey, we're moving forward; we're going to upload next week. Schedule is*

> *on board*." That kind of corporate talk. And they use that term "folks" a lot. "Folks," and "getting on board," and "moving forward," and all that kind of stuff. So I'll use that on one phone call.
>
> Then I'll talk to LocalUnion which is more union based, and I'll have a more kind of, the client is a woman, I'll have more of a sisterly conversation about how hard it is to move things through bureaucracy and what a great revolution we're forming to get this demo through. And it will be a lot more about getting stuff through and the battle that we're fighting against the bureaucracy, which is very different language from BigBank.
>
> And then with Electronic Gaming, I'll have more of a cool and laid back kind of "*Hey, it's cool*" kind of thing. "*Hey, did you get that shot?*" That kind of conversation with them. More entertainment kind of vocabulary.

Greg, creative arts director in the firm that produced commercials, discussed how his engagement with the global economy affected his language choices:

> Greg: And the two times where I've done, where I've actually gone to Asia, you know, the first thing I learned is actually how much of what I say on a day-to-day basis is uninterpretable slang. Because when you're talking through an interpreter and you get questions like, "Where's the damp chicken?" you realize that you'd said, "Well, he's as mad as a wet hen." That it's being, everything is being translated literally, and the questions are ... So suddenly you develop this very pedantic, slow, concrete way of describing exactly what's ... you know. And they're all taking notes in Chinese or Korean or whatever. So that's interesting.

Rachel explained the care with which she activated phone communication with her contractors who worked at home. She wanted them to be loyal to her company, so she put herself in their "space" mentally, imagining their surroundings and responding to them on their terms, using what she called "intermediary language":

> Rachel: And what I try to foster in all of our independent contractors is an allegiance to the company – to this company.
> Interviewer: How do you do that?
> Rachel: I talk to them. I realize that they are at home in their home setting. I don't call them up and talk business right away. I'll call them up, for example, one of my programmers off site is working on fixing up his house. I'll call him up and say, "Hey! How's your floor going?" or "Your windows!" and kind of get into his world. And he'll talk to me and we'll chat about this and that and then I'll get to work stuff. Cause I know, I've worked at home before. I know what it's like when you get this business call and you're in your home setting. It's just kind of sometimes invasive or intrusive, and you need to walk a fine line whereby you have that kind of intermediary language. And I don't think it's a ruse. I think it's just a part of conversation that you're meeting each other somewhere.

Rachel referred to the "intermediary language," she used to insert herself and her work concerns carefully into the home environment where the contractor was working. She noted that it was explicitly her strategy to gain allegiance by talking to contractors in the context of their own space and situation, even though she was not physically sharing that space or situation at the time she talked to them. Through skillful use of language, she was able to "meet" them "somewhere."

Social forms that structure collaboration in the workplace

Our research investigated intensional networks. Other related research efforts have analyzed *communities of practice* (Wenger, 1998), *actor-networks* (Law and Callon, 1992; Latour, 1996), and networks of *strong and weak ties* (Granovetter, 1973). In the activity theory tradition, two new forms have recently been described: *knots* (Engeström et al., 1999), and *coalitions* (Zager, 2002, this issue). We compare intensional networks to these forms. They are not all completely disjoint, nor do they all differ on exactly the same dimensions. These social forms represent efforts to describe social relations in the workplace that we believe are important for understanding collaboration in today's economy.

COMMUNITIES OF PRACTICE

Wenger (1998) highlighted "communities of practice" as loci of learning in corporations and other institutions (see also Lave and Wenger, 1991). He observed that learning is situated and takes place in the thick of ongoing practice. While training classes and manuals have their place, much learning is informal and practice-based ("learning on the job"). Workers learn the practices of their profession through direct participation in a community of practice.

Wenger noted that sustained workplace relationships buttress communities of practice. He described a group of female insurance claims processors working in a traditional clerical office environment (Wenger, 1999). Tight connections characterized the claims processors' community of practice. The office was a familiar environment where everyone knew everyone else. Birthdays were celebrated and gossip exchanged. There was also a negative aspect to the connectedness: the claims processors were closely monitored, having to meet daily production quotas. Many found this stressful.

Intensional networks differ considerably from communities of practice. First, a community of practice is a more encompassing and general concept than intensional network. Because Wenger was drawing attention to a general process of learning, he defined community of practice broadly to describe a locus of learning for general sociological categories such as family members, workers, students, scientists, musical groups and so on (p. 6). We are trying to pin down a more specific form of workplace practice than such a general term can capture.

Wenger (1999) observed that indicators of a community of practice include dimensions such as "mutually defining identities," "local lore, shared stories, inside jokes, knowing laughter," shared jargon, "very quick setup of a problem to be discussed," absence of conversational preambles, and "shared discourse reflecting a certain perspective on the world" (pp. 125–126). As we have documented, the social landscape is quite different within intensional networks. We found people consciously changing their language to suit different audiences, lacking a shared sense of humor (not to mention knowledge of specific jokes), carefully planning conversational preambles, and putting considerable effort into setting up "problems to be discussed," as well as establishing the working relationships themselves. Intensional networks are more heterogeneous than communities of practice, including people with whom the worker may share little, especially in the initial stages of contact.

Another important difference is that intensional networks are *personal*, rather than being shared by multiple people. In contrast to communities of practice which take place against a backdrop of shared culture and practice, intensional networks are maintained by individuals. Joint activity is accomplished by the assembling of sets of individuals derived from overlapping constellations of personal networks. These individuals have to create sufficient shared understanding to get work done, but such understanding must be collectively constructed rather than existing historically in an ongoing community.

An additional difference is that a community of practice and an intensional network are both loci of work, but in a community of practice we can usually point to a specific place such as a classroom or office as the site of work or workplace communication. For example, Orr (1996) studied copier machine repair people who spent most of their time in the field, but who met together on a regular basis to socialize and discuss problems and to tell "war stories" which embodied knowledge about how to tackle difficult copier repair problems.

An intensional network is often much more distributed. The work happens in phone calls, emails, exchanges of documents, and face to face interactions in diverse settings. These settings are often far from any place that workers' would even metaphorically consider a "community." Even when physical space is shared, the heterogeneity of interacting intensional networks, such as that described by Gary in our first example of the media loft in San Francisco, means that insider jokes, shared identities and perspectives, and so forth, are lacking. These things may, however, be present in subsets of the network such as the "core group," noted by Gary.

Communities of practice are perhaps more characteristic of traditional offices such as those devoted to clerical work (e.g., the claims processors), rather than the kinds of highly self-directed work we found as we investigated boundary-crossing work. Other studies of communities of practice have considered the work of butchers and tailors (Lave and Wenger, 1991). In these craft-oriented work settings, we would expect to find shared sensibilities among people doing similar

work of a fairly routine nature in a stable physical setting such as a tailor shop. By contrast, we investigated people encountering new territory as they crossed boundaries into others' worlds to accomplish joint work where shared understanding had to be created.

Østerlund (1996) attempted to apply the notion of community of practice to the copier salespeople he studied at a large American copier company. However, after a lengthy ethnographic investigation, he found that rather than having access to a ready community of mutual support and shared understandings, new salespeople had to form personal relationships, one by one, with colleagues and other specialists in order to learn their jobs. Although Østerlund did not use our terminology, his work is a rich case study of the intensional networks of copier salespeople. Østerlund's observations match ours in many interesting ways, such as the carefully chosen and varying language salespeople used with different customers, the focus on creating, maintaining and activating personal relationships as the core of the salesperson's activity (and as the very source of success or failure in saleswork), and the extreme heterogeneity of salespeople's networks including all kinds of customers as well as many different kinds of specialists within the copier company.

The copier salespeople were constantly engaged in the task of understanding the world from someone else's point of view, rather than from the point of view of a single community of practice to which they belonged. Østerlund described the activity of a salesperson, "Carol," whose activity involved [learning] "to talk the customer's 'language,' learn[ing] to see and use the functions of [the copier company's] equipment from their perspective, and learn[ing] to understand their potential interest and influence in the decision-making process for the purchase of new equipment" (p. 125). Østerlund observed that the "war stories" characteristic of communities of practice were non-existent among sales people; information exchanges took place within heterogeneous networks, and the information was constantly changing, rather than settling into oft-told tales shared among a single trade group.

Mortensen and Hinds (2001) studied twenty-four teams and found that no team was in complete agreement about team membership, suggestive of the more fluid, less definitive social forms we believe are important in today's economy.

KNOTWORKING

A closer approximation to intensional networks is provided by the concept of "knotworking" developed by Engeström et al. (1999) within an activity theory framework. Like us, Engeström and his colleagues have noticed that a great deal of work in today's workplace is *not* taking place in teams. They pointed to non-team work configurations such as airline crews, courts of law, and groups of radiologists who assemble at work in a situation driven way (see Barley, 1988). The authors observed that an important form of work group is a "knot" in which "combinations of people, tasks, and tools are unique and of relatively short dura-

tion." Knots bring together "loosely connected actors and activity systems." Just as we see intensional networks as an important form of workgroup configuration in today's economy, Engeström et al. described knots as a "historically significant new form of organizing and performing work activity." The authors contrasted knots to communities of practice, noting the differences between the two in terms of knots' loose connections, short duration of relationships, lack of shared lore, and so forth.

The intensional networks we observed differ from knots in several ways, however. First, intensional networks often involve long-term relationships (Østerlund, 1996 also provides data on this point). Second, the joint work may last for long or short periods of time. Third, the knotworking that occurs within established institutions is more structured in terms of the roles it draws upon. For example, neurosurgery requires a neurosurgeon, an anesthesiologist, a neurophysiologist, a scrub nurse and various nurses assuming other roles (see Nardi et al., 1996). Likewise, an airline crew must have pilots, flight attendants, and so forth. These roles are obligatory and non-negotiable. In contrast, work that is mediated by intensional networks results in more flexible and less predictable configurations of workers. Fourth, in intensional networks, workers are not thrown together in situation-dependent ways or assembled through outside forces (such as hospital staffing personnel). Instead, work activities are accomplished through the deliberate activation of workers' personal networks. *Configuring labor is up to workers themselves*, whether it is a public relations specialist enlisting a journalist to do a story, or a media firm finding animation experts, or a business development executive seeking new business partners. In Engeström et al.'s examples of knotworking, knots form either through corporate or institutional agency (airline crews, courts of law), or they are pulled together in unscripted ways as situations unfold (e.g., Engeström's example of the capture of a mental patient). Intensional networks, by contrast, are grounded in the deliberate activation of personal networks that have been carefully cultivated, often over many years.

Intensional networks may coexist with conventional teams. At the Internet company, Insight, intensional networks were important, as we have documented. However, teams were important too. Insight was a particularly interesting case study for us because at the time we began the research, knots, called "virtual teams" within Insight, were a key form of organization. But literally overnight, Insight moved to a more conventional team-based organization. In a huge company-wide reorganization (plotted over a period of months but implemented in one dramatic day), the company jettisoned virtual teams and put conventional teams in place. What employees referred to as a "pool" of resources was replaced by small teams. For example, under the new system, a team might consist of a producer, an engineer and a designer working in, say, the international group. In the old system, everyone was in the "pool" and would be recruited on as needed-basis, rather than being part of a group responsible for international.

The following dialogue with Jane took place about four months before the reorganization. Jane described the virtual teams and spoke of the tensions they created that in part led to their demise.

> Jane: So, the producer's main job is they are the project leader, so they are responsible for coordinating all of the individuals that they have to pull in to get this product out. So they might actually have to pull in a salesperson. And we call these the virtual teams.
> Interviewer: Uh-huh. Why do you call them virtual?
> Jane: Because they come together and then at the end of a project, they disappear.
> Interviewer: Okay.
> Jane: So each person on the virtual team actually reports to a different organization in the company.
> Interviewer: Uh-huh. Uh-huh.
> Jane: But in order to get a project successfully done, they have to pull together as a team, create this project, create this plan, create this schedule, and then when it's done, they go off and do something else and work with a different group of people in the company.
> Interviewer: So how long are they together?
> Jane: So it varies. There can be a project that is four days long. There could be a project that is –
> Interviewer: Four days?
> Jane: Yeah.
> Interviewer: That's right!
> Jane: There could be a project that's ten months. So the challenge of the virtual team is you're always working with different engineers or different designers, or a different project lead who manages it differently, who tends to like to work different hours, a different style, has a different communication element. So a very short project makes it challenging because you have to understand those elements very, very quickly. In a very long project, the difficulty is usually you actually have people coming in and out of the project. So there could be, you know, you have an engineer set on a project for a very long time, and guess what? They get pulled off to do another project and they substitute somebody else in, or they leave, but whatever, there's always an element that you have to adjust for.

Employees we interviewed about the reorganization recognized the possible loss of efficiency in having workers with some "downtime" if their work temporarily slowed and they could not be randomly assigned to other business units that needed labor. But they welcomed the new structure as more "cohesive" and personally satisfying. They felt they could be of more value to the company since their special expertise could be brought to bear on problems they knew something about, rather than being used more generically as what Bishop (1999) called "worker widgets."

We are not saying that knots are destined for failure; clearly, they have operated historically in many settings as Engeström et al. have documented. What we are saying is that if there's one thing that characterizes the new economy, it's change, and social forms such as knots, teams and networks are part of the repertoire that corporations and workers are experimenting with as they attempt to meet the demanding conditions of the marketplace.

From our data, we believe it isn't always so easy to make a clean distinction between knots and intensional networks. For example, "Lynn," an attorney who appealed life sentences on a contract basis for the state of California, functioned in ways that exhibited aspects of both knotwork and netWORK. Lynn's situation might seem a classic knot: she was an independent contractor called in by the state to provide legal services for indigent prisoners. She worked with different prisoners, attorneys and judges as cases came and went. When Lynn began to describe her work, specifically how attorneys were chosen for specific cases, it sounded like knotworking:

> Lynn: There is a real effort made to match the seriousness of the case, based usually upon the sentence and the charges, with the level of experience of the lawyers on the panel.
> Interviewer: And that's determined by years, or by?
> Lynn: Years and quality of work. Success record in this line of work is pretty hard to come by, so, that kind of thing. And then they call on the phone and ask if you're available to take a new case and give you a little bit of information about it.

This description suggested an institutional formula being applied to the recruiting of a contract attorney to form a knot. (The knot, by the way, was neither formed quickly, nor was it of short duration as appeals can drag on for years.)

But then Lynn went on to describe a give-and-take in the management of the work more characteristic of a network:

> Lynn: So in the process from the time I'm appointed until the time I've read the record, the forty days [which we usually get to read the record] is very often pushed far beyond that limit to maybe three or even six months, depending on how complicated it is, how long the record is, if I need more information.
> Interviewer: So you can do that? I mean, you can push it?
> Lynn: Yes, yes. They don't like it, but you can do it. Because there's a relatively small amount of people doing this work, and a very small amount of people at the highest level of experience, which is where I am, they have to sort of accommodate you to a certain extent because, otherwise, the whole system would grind to a halt.

So here we see the invocation of a network of "people at the highest level of experience." Network behavior came into play in the attorneys' practice of "pushing it" because they knew that they would likely be "accommodated" as specific individuals with specific known expertise, despite the fact that they were not as

"available" as they should be. The system did not function through purely bureaucratic procedures of applying formulas of years of experience and availability to form knots, but flexibly accommodated specific individuals known to one another in the small legal circles of life sentence appeals in the state of California.

An important aspect of knotworking and netWORK is a *temporal patterning* of ebb and flow in network activation and deactivation. Engeström and his colleagues observed a dynamic in knotworking they called *pulsation* in which a knot would come together to accomplish work, and then dissipate as the work concluded.

This dynamic seems to operate in intensional networks too, though in a somewhat different way. The difference is that the intense interaction of pulsation in a network leaves behind a transformed network, whereas the accomplishment of joint work in a knot does not change the personal networks of workers in any work-related way (e.g., airline crews would never recruit their own labor). In an intensional network, even after the pulse slows – the activity has ebbed – there is a strengthening of the network for future joint work, or possibly a rupture in the case of conflict. In either case, the network *is transformed* as a result of the activity in a way that does not seem to be characteristic of knotworking. For example, after intense interaction within a network, media choice decisions may change in the future. A technology like the telephone might be more effective once a close bond has been established, as Jill suggested of her interactions with Ed. An obvious transformation is that a particular contact, once established, may be tapped for future work or information gathering. The historical experiences of workers in intensional networks qualitatively change the way they behave toward one another in their networks in future interactions. While this is probably somewhat true of knots, it does not seem to be as central. Future research will be needed to uncover the extent to which these differences are important.

COALITIONS

Zager (this issue) described a collaboration configuration he called a *coalition* which shares many of the characteristics of knots in being temporary, loosely bound, and fluid. Zager noted that coalitions are "temporary collaborative forms [in which] constituent individuals and teams are connected by shared interests; constituents are part-time members of the coalition; membership in the coalition at any moment is fluid and diffuse; the coalition is loosely bound." Zager's language echoes that of Engeström et al. as they described knotworking.

Coalitions, however, differ from knots in that they occur in large distributed organizations where parties to the function of the organization are separate and often out of communication with one another. (Examples of knots to date have involved collocated assemblages of relatively small size.) Zager observed that in many situations, such as breakdowns in large organizations where problems ramify throughout a system, pieces of the problem get solved by various parts of the organization as they contribute their specific expertises. However, often no one

person has a sense of what is going on in the system as a whole. The perspectives of players in the disparate parts of the system may in fact be quite different, more different than those of a knot where at least everyone has some shared sense of the situation through collocation and/or fewer players.

Zager described a breakdown in a large networked computer system in which collaborators in New York, London, Paris and Tokyo had to troubleshoot a single problem. No one had the possibility of seeing the whole scope of the problem in the system. If we consider an airline crew or a court of law, at least everyone knows the basics of what is happening, even if their viewpoints are opposed, as in a court, or if responsibilities are sharply divided, as on an airplane. If the plane takes a nosedive, everyone "gets it" about what is happening at some crucial level. When a computer system fails, even the symptoms of the problem may look quite different from different vantage points, because of the distribution and complexity of the system. Often no one has a grip on the basic nature of the problem, as is possible in a more bounded space such as a courtroom.

So while knots and coalitions are similar, it is worth making a distinction between smaller, more discrete knots where certain kind of interactions are possible, and more distributed coalitions. In coalitions, the scope of the organization introduces new communication and coordination problems likely to require different technical and social solutions. Zager is working on solving coordination problems in coalitions, developing software to connect parts of coalitions more effectively, allowing different players to change their perspectives as needed (Zager, 2002, this issue).

Coalitions differ from intensional networks on the dimension of intentionality. An intensional network is a deliberately configured and persistent personal network created for joint work. A coalition is highly emergent, fluid, and responsive to state changes in a large system. Zager calls collaboration in coalitions collaboration "on-the-fly." He noted that in the computer system breakdown, the administrators and help desk personnel failed to notify other players of the nature of the problem, which led to further problems. "People duplicated each other's efforts and chased their tails at a time when restoring service should have had the highest priority" (Zager, 2002, this issue).

Zager observed that rather than having shared goals (in the activity theory sense of motivations) throughout a coalition, the different parts contribute, for varying reasons, to a "single outcome." Zager thus draws our attention to the distinction in activity theory between an *object* (a single outcome) and a *need* which motivates the object (see Davydov et al., 1982). When the computer system failed, there was a shared sense of wanting it to become operative again – the object – but the reasons for wanting it to become operative varied greatly.

ACTOR-NETWORKS

Actor-network theory (Law and Callon, 1992; Latour, 1996) expands the notion of a network to include non-human actors. So technologies, for example, become key actors in a network. Actor-network theory stresses Machiavellian power and persuasion as crucial forces of change.

While these notions from actor-network theory are important, they did not particularly speak to what we learned of intensional networks. Certainly any situation can be analyzed for its power relations. Certainly people in intensional networks persuade other people. However, what struck us about intensional networks was not that Machiavellian power ruled the day, or that technology took on a life of its own, but rather that an incessant buzz of small but crucial communications and reflections shaped people's worklives and consciousness. The network seemed always to be emerging through communications and rememberings, rather than having firm footings in institutional structures inhabited by Machiavellian "princes."

On another level, we found the open-endedness of an actor-network to be problematic for understanding joint work. While intensional networks can be vast, we can pretty clearly delineate who is in a live subnet as joint work proceeds, using the concept of an "object" supplied by activity theory. We see that the making of a commercial organizes a network, or the transfer of a technology, or the forging of an agreement between business partners. These activities involve a common object, which leads to the activation of particular subnets (remembering of course that vastly different needs may be served by a single object, as Zager pointed out). The object scopes the active part of an individual's network.

Miettinen (1998) noted that in actor-network theory we have no such scoping:

> Since in any . . . network the number of potential elements is almost unlimited, actor-network theory has difficulties in identifying the relevant actors and structuring the analysis of relationships between them. In empirical accounts . . . the most prominent actors, those speaking most loudly, tend to be selected: innovators, managers, politicians, the "princes" of network construction. . . . The work of engineers and users remains marginal. (Miettinen, 1998)

So while we occupy common ground with actor-network theory as it stresses the networked nature of work in today's economy, we are, for the most part, heading elsewhere with intensional networks. Intensional networks are not primarily about the power bases of persuasive corporate princes, but about ongoing processes of countless everyday communications and rememberings. In a landscape of intense corporate and organizational flux, a thousand judgments, decisions and reflections occupy a netWORKer's "mindspace," as one study participant put it. Workers adjust and respond to changing market conditions, pressing deadlines, organizational realignments and upheavals. Workers' days involve continually calibrating to the media preferences of others, tailoring their very words to vocabulary judged

suitable for varied audiences, and investing energy in devising ways to remember who is in their network and what they are up to.

STRONG AND WEAK TIES

One of the most important theories in network studies is the theory of strong and weak ties (Granovetter, 1973). Granovetter defined the strength of ties as "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (parentheses in original).

In general, we think it is difficult to operationalize notions of "strong" and "weak" ties, especially in the workplace. While clearly some people know each other well and can be considered to be old friends or close relatives – "strong ties" – most relationships are more ambiguous. Measuring variables such as "intimacy" is not straightforward. We have noticed that when researchers talk about strong and weak ties they often abandon Granovetter's definition and substitute an easily measurable, and usually very narrow, operational definition. So for example, Friedkin (1982) studied "information flow" among faculty members in the biological, physical and social science divisions of two universities. He defined a strong tie as simply one in which, for a pair of faculty members, each had discussed their own and the other's research. A weak tie was one in which only one researcher's research was discussed. The first three aspects of Granovetter's definition were not used at all.

A notion of strong/weak ties occasionally entered our informants' discourse when they talked about working with their friends or colleagues of long standing. Granovetter's first dimension, length of relationship, was thus sometimes salient for our study participants. Greg described how part of his value to Disney was that through long association with them, he knew what Disney liked:

> Greg: Disney doesn't like orange, because Nickelodeon has orange. There's like a million of these little rules, and you try and . . . over the years I've gotten good at, you know, using the Socratic method to get it out of them.

Jane's description of establishing business relations at Insight is consistent with the weak ties formulation. New business contacts were explored indirectly by seeking out people at Insight who had prior contacts with the potential partner. Often the Insight employees were people previously unknown to Jane.

When we listened to our informants talk, they mentioned friendships and bonding, which suggested something akin to strong ties. On the other hand, they also talked about such matters as the mechanics of refreshing lists, remembering their networks, and choosing their language carefully, suggesting a complex relationship to those they worked with that does not boil down to a simple dichotomy of strong and weak ties. Bursts of intimacy could be followed by months of lack of communication, making simple notions of strong and weak ties incomplete for us as we studied netWORK.

We described how networks pulsate as live subnets are activated. When engaged in interaction within a live subnet, network ties are intense; when outside the space, the ties decline in salience (so much so that conscious effort must sometimes be devoted to the very remembering of ties). An intensional network must be looked at in terms of what people are doing at a particular time in order to understand its dynamics – its specific instances which change as context changes. It is here, in particular, that the concepts from intensional logic help us to see the dynamism at the core of intensional networks, a dynamism that is missed by more static descriptions such as those provided by simple notions of strong and weak ties.

The dimensions of emotional intensity, reciprocal services and intimacy vary temporally in intensional networks, depending on the current context of activity. Strength and weakness of ties are not so much stable properties of an intensional network as they are variable manifestations of ongoing processes of network activation as they occur through actions of remembering and communicating.

Conclusion

We have tried to come to some understanding of how the "raw material" for the formation of collective subjects is created and managed in today's workplace. We want to encourage attention to the many non-team social forms that operate in the workplace under modern conditions of flux and instability. Understanding these forms is crucial to designing technology that meets needs in today's changing world. We developed the concept of intensional networks, and compared intensional networks to other forms such as communities of practice, knots, coalitions, actor-networks, and networks of strong and weak ties. The reduction of corporate infrastructure means that instead of reliance on an organizational backbone to access resources via fixed roles, today's workers increasingly obtain resources through personal relationships. Rather than being embraced by and inducted into communities of practice, netWORKers laboriously build up personal networks, one contact at a time.

Paradoxically, we find that the most fundamental unit of analysis for computer-supported cooperative work is not at the group level for many tasks and settings, but at the individual level as personal social networks come to be more and more important. Collective subjects are increasingly put together through the assemblage of people found through intensional networks rather than being constituted as teams created through organizational planning and structuring. Teams still exist of course, but they are not the centerpiece of labor management they once were (see Schwarz et al., 1999).

Intensional networks solve two key problems in today's economy. First, they provide a resource for individuals for their own career development, as in the case of Kathy establishing her consulting practice or Dale looking for a new job. They provide labor to small businesses and independent consultants such as Ed. Second, intensional networks are a critical resource for workers' organizations,

providing a pool from which to recruit labor and partners, a conduit for achieving corporate goals, and a vital source of information organizational planning and execution. Carl, for example, used his personal network of journalists to publicize his company's activity and to gather information about the press useful for his public relations work.

Although intensional networks are ego-centered, portions of any individual network overlap with portions of others' networks, so they do not have the "one-off" character that the notion of an ego-centered network might suggest. Within professions and activity systems, networks overlap, giving a sense of connection to workers even under the conditions of flux that characterize today's economy. Intensional networks are extended through the networks of others, as we saw with Jane recruiting partners through the networks of her colleagues. One of the most important resources we share with each other is access to those in our social networks.

We began our discussion by noting that the rhetoric of virtuality hides much of what goes on in the workplace, i.e., netWORK. As we have tried to show, today's workplace seems to be anything but "virtual." We found that vigorous, deliberate netWORK kept the workplace humming, as netWORKers recruited labor, kept track of their contacts, and did what they had to make new contacts (whether taking a red-eye to Detroit or deconstructing wet hens). The rhetoric of virtuality "deletes" these workers, these real people who are calling contacts on the phone, trying to figure out what jokes they will laugh at, wondering whether it is a good time to engage in conversation, remembering spousal hobbies, hopping on airplanes for some face time, and keeping track of who can draw pigs with no pants and who can't. The rhetoric of virtuality also deletes the additional work that falls on individual workers in the virtual corporation. The reduction of corporate infrastructure means that instead of reliance on an organizational backbone to access resources via fixed roles, today's workers access resources through personal relationships. Other accounts of the virtual organization have stressed the benefits of the streamlined, nimble, democratic workplace. It seems however, that individual workers incur some of the costs associated with these corporate gains (Schwarz et al., 1999).

We have drawn attention to the fact that intensional networks are historical entities grounded in real, carefully cultivated social relationships, not ethereal virtualities. Intensional networks have their own developmental trajectories that encapsulate work relationships, shared experiences, and a sequence of carefully staged communications. Networks exist in a process that unfolds over time as workers remember and communicate. Workers are transformed by the historical events that take place in their networks, and they transform others.

Intensional networks are not bundles of static properties. They dynamically pulsate as activity ebbs and flows, as different versions of the network come to life. Live subnets are the active parts of a network that keep a worker most occupied, though more distant contacts are to be remembered and tended to for future joint work. This varying network activity is captured by the notion of intensional

possibilities that are instantiated as specific extensions depending on the activity or context. Intensional networks emerge in the heat of the moment, and at the same time, exist outside a given moment as histories of interactions that shape situational actions.

Our findings also have implications for new technologies. Given the centrality of intensional networks, we need new tools that will help workers to create, maintain and activate their personal social networks. For example, it is clear that the current generation of contact management software cannot represent the dynamic qualities or communication-centric nature of these networks. We need tools that help workers organize their work around currently active contacts, with easy access to information associated with those contacts, as well as techniques for identifying when other aspects of the network need to be reactivated. At the organizational level, technologies that recognize the diversity of workers, including contractors, consultants, alliance partners and regular employees, need to be developed to enhance communication and information access across boundaries that vary depending on the nature of the worker's relationship to the company and to fellow workers.

Intensional networks coexist in today's economy with teams, communities of practice, knots, and coalitions. Intensional networks represent an important historical social form that undergirds activity in today's workplace of fast-paced change and continual institutional flux. Joint work is accomplished in intensional networks as workers attend with energy and mindfulness to the never-ending tasks of netWORK.

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Notes

1. In the 1950s, social anthropologists discovered that group-level terms such as "tribe" no longer worked in some urban settings. Like us, they developed concepts of egocentric networks to describe what they were observing. Fieldwork in Norwegian towns (Barnes, 1954), London families (Bott, 1955), and African cities (Epstein, 1961) led to the development of complex theories of network behavior. See also Mitchell (1969). This thread of research, highly relevant to what is happening in today's economy, has, sadly, not been mainstream in anthropology. However, there are important contributions to network studies by scholars such as Wolfe (1978), Freeman (1988), Johnson (1994) and White et al. (1999).
2. Wellman and Gulia (1998) made the interesting point that, "There is so little community life in most neighborhoods in western cities that it is more useful to think of each person as having a personal community: an individual's social network of informal interpersonal ties . . ." These personal communities are similar to intensional networks. In Wellman and Gulia's empirical

worked they are scoped within interactions that take place on the Internet, and usually not for purposes of work.

3. Although we did not attempt quantitative treatment of intensional networks, we did ask informants how many people they thought were in their networks. Answers ranged from 100–500, probably underestimates because of the problems of remembering. Many people said "100" when we asked about how many people they might be dealing with in one way or another at a given moment (a live subnet). We could argue that this question of how big a network is not meaningful because people are so adept at expanding their networks, drawing on the networks of others, when a specific need arises, as we saw with Jane and others. Nonetheless, further quantitative research in this area would be interesting.

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