A language/action perspective on the design of cooperative work

Terry Winograd
Stanford University

Abstract:

In designing computer-based systems, we work within a perspective that shapes the design questions that will be asked and the kinds of solutions that are sought. This paper introduces a perspective based on language as action, and explores its consequences for practical system design. The language/action perspective is contrasted to a number of other currently prominent perspectives, and is illustrated with an extended example based on studies of nursing work in a hospital ward. We show how it leads to particular analyses of that work, which reveal potentials for creating new designs that can make the work (and the workers) more effective.

1. Preliminaries

This paper reflects an approach to the design and analysis of computer-based systems that is not yet prevalent within either academic computer science or practical data processing, but which has been widely discussed and justified (see, for example DeCindio et al., Ehn and Kyng, Flores, Gerson, Kaasbøll, Kling and Scacchi, Nygaard, Suchman, Winograd and Flores). Some of the major issues (not necessarily agreed upon by all) can be summarized:

1) In designing computer-based systems for practical situations, we need to consciously focus on the questions of context and application, rather than concentrating on the internal structure and operation of the computer system. The structure of a system determines the possibilities for action by the people who use it, and it is this action structure that is ultimately important. We can develop systematic methods and associated tools for design of that structure.
2) Design is *ontological*. That is, when we introduce a computer-based system, we are not just designing its structure and function, but are participating in the larger design of the organization and collection of practices in which it plays a role. We are designing (or re-designing) the work, not just the tool.
3) In describing or constructing any system, we are guided by a perspective. This perspective determines the kinds of questions that will be raised and the kinds of solutions that will be sought. Its scope is not limited to the computer system itself—it is a perspective on the organization and the kinds of actions people take within it.
4) One can consciously apply a perspective as a guide to design. It will not provide answers to all of the specific design questions, but serves to generate the questions that will demand answers.

Within the community concerned with the design of computer systems, there is a growing recognition of the importance of perspectives, and the need to become more explicitly aware of how they determine design. One does not have the choice of *whether* to have a perspective, but can choose to adopt or strengthen particular perspectives that can lead to better designs.

One body of research that has set out to explicitly articulate a perspective for system design is the one based on understanding *language as the primary dimension of human cooperative activity.* It draws on work developed by Flores and his colleagues at Stanford University, Logonet, and Action Technologies [see Flores (1981), Flores & Ludlow (1981), Winograd & Flores (1986)], and has been the basis for designing commercially successful computer systems.

This paper is an attempt to clarify and illustrate that perspective. It addresses concrete questions of system development, looking at examples drawn from the nursing work in a hospital ward, as studied by Kaasbøll (1986, 1987) and Fafchamps (in preparation). The examples were chosen because there was a body of careful description and analysis of the setting and the structure of work. No actual computer system has been introduced into the work or even designed in detail. The goal here is to illustrate the kind of analysis that is relevant to the broad design questions that would guide work on a computer-based system.

2. Perspectives

A number of writers have described perspectives that designers bring to computer-based systems. Nygaard (1985) argues that the perspective of a computer scientist (or systems analyst) differs in important ways from the perspectives of people within the organization. Ehn and Kyng (1984) propose a 'tool perspective' that takes the 'labour process' as its origin, rather than data or information flow. This shift leads to significant differences in attitudes towards skill and hierarchical control of work, with numerous implications for design. Kling and Scacchi (1982) distinguish a narrow system-oriented perspective from a broader 'web' perspective in which the computer system is situated in a complex of political, economic, and social factors that shape its structure, use, and effects.

This paper identifies a perspective by its declaration of what people do in an organization. The most prominent perspectives in the current literature suggest the following:

1) **People process information and make decisions.** This is the predominant perspective, both in traditional data processing and in current artificial intelligence approaches. The organization is a collection of 'components' (some human, and some mechanical), each of which 'processes and transmits information.' Information processing includes 'decision making' based on a structure of goals, plans, and knowledge. The activity of the organization is understood by analyzing how the information is entered, stored, and transmitted, and how decisions are made on the basis of it.

2) **People carry out functional roles, using collections of materials, according to stable rules.** In his development of 'coordination system technology,' Holt (1983) presents a 'role/activity theory' based on primitive notions of role, action, and interaction. Rather than emphasizing the cognitive activity of individuals, it focusses on their roles (which specify sets of behaviors) and on the temporal and spatial structure of their potential interactions (behaviors in which more than one role takes part), using Petri nets as a theoretical tool. The goal is to specify the rules of interaction: "If it's rules the computer can help; if it isn't, it can't" (Holt 1983). DeCindio et al. (1985) also characterize th activities in an office as the rules of a game an propose a design methodology based on determinin these rules and the strategies that go along wit following them.

3) **People create and maintain a structure o authority.** Every organizational structure include lines of responsibility and authority embodied in th patterns of activity. It has been pointed out (b Kling and Scacchi (1982), among others) tha system designs based on idealized concepts c information and function may fail (throug non-acceptance or subversion) if they do not respe the existing authority structure or if they change in politically unacceptable ways.

4) **People negotiate and promote competin interests.** Most of the analyses above adopt som sort of 'harmony perspective' in which shared goa and values determine the activities. Ciborra (1985 Sandberg (Nygaard, 1986), and others have argu that a 'conflict perspective' may be more relevant settings in which the competing interests of th various parties play a prominent role. Systems f negotiation are no less amenable to automati than those for harmonious action, but must respe different priorities.

5) **People enter into personal relationships.** every human setting, regardless of organization purpose, people form personal relationships a express them through their activities. This includ individual relationships and group identificati ('morale', 'corporate culture,' etc.). System desi can have a significant impact on the developme and expression of relationships. If we take t individual components as information processo these other dimensions of human interaction may neglected.

Each of these perspectives generates an importa domain of questions that lead to design. The focus this paper is another perspective on what people c they *act through language*. This does not just me uttering and writing sentences in a natural langua such as English. As the following sections w demonstrate, there is a coherent broader view language activity, which includes interactions wi computers and covers the use of formal and techni languages (such as mathematics) as well as ordina language.

As a broad framework for outlining a language/action perspective, we will adopt the traditional subdivisions of linguistic theory: *syntax*, *semantics* and *pragmatics*. We will use these terms in a more general sense than one finds in the technical linguistic literature. The point is not to delineate precise boundaries, but to make distinctions that help organize an understanding of what people do.

1) **Syntax** is the structure of the visible (or audible) forms of language. The syntactic rules (or 'grammar') of a language determine the form of the basic elements (letters, words, etc.) and the ways in which they can be combined. In an extended sense one can talk about the syntax of an equation, a spreadsheet, or an invoice, or even of an event such as buttoning a menu item on a screen. What distinguishes syntax from the other levels of analysis is that it does not take into account any interpretation or attribution of meaning.

   Further distinctions among analyses of sound patterns (phonetics and phonology), word-internal structure (morphology) and phrase structure (syntax) are not relevant here, so 'syntax' is used to cover all of these aspects and their analogs.
2) **Semantics** is the systematic relation between structures in a language and a space of potential meanings. It includes the definitions of individual elements (e.g., words) and the meaning that is generated by combining them (e.g., the meaning of "Jill sees Bill" as different from "Bill sees Jill"). In extension, one can talk about the semantics of a particular blank on a form, or of an operating system command.
3) **Pragmatics** deals with issues of language use. A classical example is "It's cold in here" spoken by a master to a servant. Although the literal meaning is a statement about the temperature, the intent is to evoke an action by the servant. Two fundamental aspects of pragmatics can be distinguished, as described below: *action* and *context*.

The following sections will describe each of these areas in more detail. Section 7 recapitulates the distinctions in the context of the hospital example, illustrating how the theoretical framework applies to a particular situation.

3. The pragmatics of language action

The language/action perspective emphasizes pragmatics—not the form of language, but what people do with it. The theory of *speech acts* is a useful starting point for understanding. However, as the following sections will show, speech act theory is only one part of a larger picture.

3.1 Speech act theory

Austin (1962) noted that not all utterances are statements whose truth or falsity is at stake. Performatives, such as "I pronounce you husband and wife" are actions, which can be made appropriately (felicitously) or not, but which are neither true nor false in a simple sense. Similarly, the language actions of commands, questions, and apologies are not descriptions of a non-linguistic world.

Searle (1975) identified five fundamental 'illocutionary points'—things you can *do* with an utterance:

Assertive: Commit the speaker (in varying degrees) to something's being the case—to the truth of the expressed proposition.

Directive: Attempt (in varying degrees) to get the hearer to do something. These include both questions (which can direct the hearer to make an assertive speech act in response) and commands (which direct the hearer to carry out some linguistic or non-linguistic act).

Commissive: Commit the speaker (again in varying degrees) to some future course of action.

Declaration: Bring about the correspondence between the propositional content of the speech act and reality (e.g., pronouncing a couple married).

Expressive: Express a psychological state about a state of affairs (e.g., apologizing and praising).

Three points deserve note:

1) The illocutionary point of an utterance is interpreted by speaker and hearer in a background. A commissive need not include the words "I promise" or "I will," but can be "I guess" or "a dollar" (in response to "Can you give me anything?") or just a facial gesture. The identification of a language act depends on the backgrounds of speaker and hearer, and is always open to differences of interpretation. In fact, the same utterance may be interpreted as different types of act. "It's time for lunch" might be interpreted as an assertion and as a directive, depending on who says it to whom in what circumstances.
2) Directives and commissives (which will informally be called 'requests' and 'promises' here) always deal

with a future action. They differ in whether the action is to be taken by speaker or the hearer.

3) Speech acts take effect by virtue of public declaration—by mutual knowledge of hearer and speaker that the act has been made. This is especially obvious in the case of declarations and expressives (an apology muttered but not heard is not an apology), but is equally true of the others.

3.2 Conversations for action

Speech acts are not individual unrelated events, but participate in larger conversational structures (see Flores (1981), Flores & Ludlow (1981)). In a simple *conversation for action*, one party (A) makes a request to another (B). The request is interpreted by each party as having certain *conditions of satisfaction*, which characterize a future course of actions by B. After the initial utterance (the request), B can accept (and thereby commit to satisfy the conditions); reject (and thereby end the conversation); or counter-offer with alternative conditions. Each of these in turn has its own possible continuations (e.g., after a counter-offer, A can accept, reject, or counter-offer again). The overall structure is diagrammed in Figure 1 (reprinted from Winograd & Flores, 1986), with circles representing conversation states and lines representing speech acts.

This diagram is not a model of the mental state of a speaker or hearer, but shows the conversation as a 'dance,' in which the acts generate the structure of *completion* of the conversation. Each party has a pattern of expectations about what might happen next, as the conversation moves towards mutual agreement that the action has been completed (or that it will not b completed). Of course there are other possibilities i which the conversational acts themselves are taken a a topic, for example in questioning intelligibili ("What, I didn't hear you") or legitimacy ("You can order me to do that!"). But the basic logic deals with th progression of steps towards mutual recognition completion.

In the 'normal' course of events, B at some poi asserts to A that the conditions of satisfaction ha been met (moving to state 4). If A declares that he she is satisfied, the conversation reaches a successf completion (state 5). On the other hand, A may n interpret the situation in the same way and ma declare that the conditions have not been me returning the conversation to state 3. In this sta either party may propose a change to the conditions satisfaction. In any state one or the other party ma back out on the deal, moving to different states completion (states 7 and 9).

Several points about this conversation structu deserve note:

1) We are using 'conversation' in a very general sense indicate a coordinated sequence of acts that can interpreted as having linguistic meaning. It ne not be a spoken conversation, or even the use ordinary language. A doctor who writes treatme requests on a patient form is engaged in conversation with the nurse who will administer t treatments, even if they never speak face-to-face.

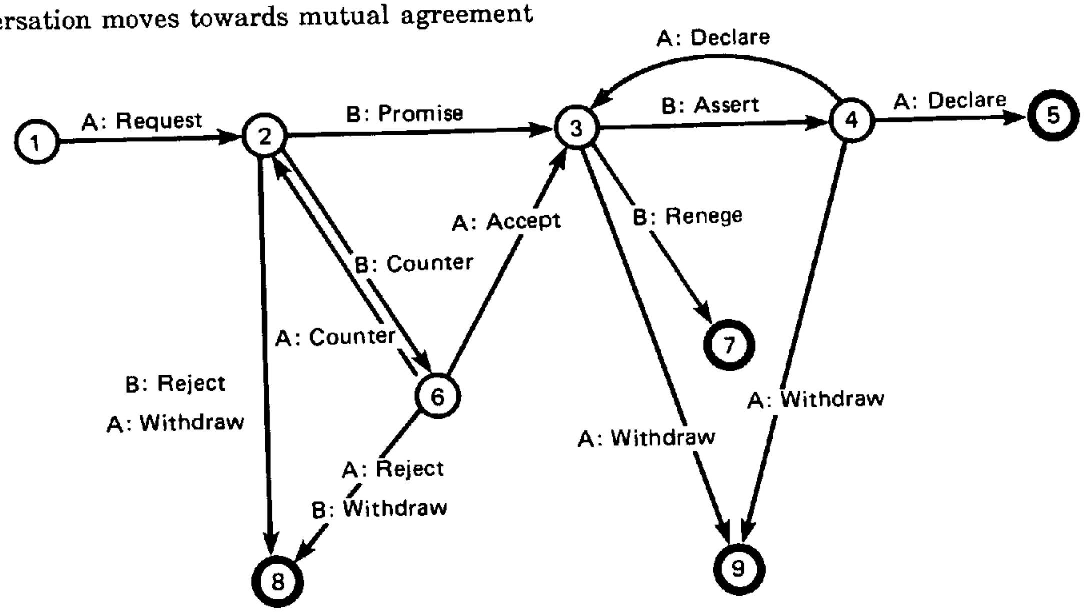

Figure 1. The Basic Conversation for Action.

2) It is initiated by a request (a corresponding structure can also be initiated by a promise), and therefore is rooted in the anticipation of some future action.
3) At each point in the conversation, there is a small set of possible action types, determined by the previous history. Each type has unlimited possibilities for detailed content. For example, the action 'counter-offer' includes any number of possible new conditions of satisfaction.
4) All of the acts are linguistic—they represent utterances by parties to the conversation (or silences that are listened to as standing for an act). The act that follows a promise is an assertion (an assertive speech act) from the original hearer to the requestor that the request has been satisfied. It is followed by a declaration by the requestor that it is satisfactory. The actual doing of whatever is needed to meet the conditions of satisfaction lies outside of the conversation structure.
5) Many acts are 'listened to' without being explicit. If the requestor can recognize satisfaction of the request directly, there may be no explicit assertion of completion. Other acts, such as declaring satisfaction, may be taken for granted if some amount of time goes by without a declaration to the contrary. What is not said is listened to as much as what is said.
6) Conditions of satisfaction are not objective realities, independent of interpretations. They exist in the listening, and there is always the potential for difference among the parties. This can lead to breakdowns (for example, when the promiser asserts that the commitment is satisfied and the requestor does not agree) and to a subsequent conversation about the understanding of the conditions.
7) There are a few states of completion (the heavy circles in the figure) in which it is mutually recognized the neither party is waiting for further action by the other. All other states represent an incomplete conversation. Completion does not guarantee satisfaction. For example, if the promiser takes the action of 'reneging,' the conversation is completed without the original request being satisfied.
8) The network does not say what people *should* do, or deal with consequences of the acts (such as backing out of a commitment). These are important human phenomena, but are not generated in the domain formalized in this network.

Conversations for action are the central action structure for human organizations. We work together by making commitments so that we can successfully anticipate the actions of others and coordinate them with our own. The emphasis here is on language as an activity, not as the transmission of information or as the expression of thought. Although people think when they use language, and often describe things in language, the relevant structures for analysis are the language acts and the conversations into which they are woven. In computer system design, we are not concerned with duplicating the knowledge or thought patterns of people, but with the structure of their language interactions and the embedding of those interactions in computer systems. The rules of conversation structure (such as those represented in the simple diagram above) can be embodied in computer-based tools, as long as they are sufficiently precise and recurrent.

This recurrence may be universal (as with the diagram of Figure 1) or particular to a setting. For example, certain kinds of requests are made implicitly on the basis of a long-term declaration. A boss does not explicitly request each worker to come to work each morning, although the conversation proceeds (in those cases where there is a breakdown) as though he or she had. The recurrent request is listened to as an effect of the declaration "You're hired" within a shared understanding of common practices.

3.3 Other conversations

Conversations for action (CfA) form the central fabric of cooperative work. However many language acts do not participate directly in the completion of a CfA. Remarks such as "They're planning to remodel the West Wing next summer" need not relate to any specific future actions of speaker or hearer. From a cognitive perspective, one might choose to characterize these as 'conveying information' without a particular motivation in action. From the perspective of language as action, the primary concern is with the role that all conversations (or utterances within conversations) play with respect to action and potentials for action. We distinguish several additional kinds of conversation that go along with conversations for action: *conversation for clarification*, *conversation for possibilities*, and *conversation for orientation*. There is no sharp line between them, but they are accompanied by different moods.

In a **conversation for clarification** the participants cope with or anticipate breakdowns concerning interpretations of the conditions of satisfaction for a CfA. The conditions are always interpreted with respect to an implicit shared background, but the sharing is partial and needs to be negotiated. As a simple example, the request "Give the patient some diazine" might evoke responses such as "Right now, or with the morning meds?" or "What dosage?". One can never guarantee that everything is totally precise. Precision is relative to each party's implicit anticipation that the other party will have a sufficiently shared background to fill in the rest of the details appropriately.

In a **conversation for possibilities**, the mood is one of generating conversations for action. Specific conditions of satisfaction will emerge in the course of the conversation, and associated conversations for action will be initiated. Many gatherings that are called 'meetings' are in this mood. The meeting is a failure if some action does not come out of the discussion. Some conversations for possibilities are highly routinized. For example, 'work rounds' on a hospital ward is a routine conversation for possibilities, during which the medical team visits each patient and specific requests ('orders') and commitments are generated.

In a **conversation for orientation**, the mood is of creating a shared background as a basis for interpreting future conversations. This shared background includes specific knowledge, interpersonal relations, and general attitudes. The most obvious examples are meetings labelled 'orientation,' in which newcomers begin to develop the understanding that is required to function in the organization. Conversations for orientation are prominent in less formal settings ('shooting the bull' or 'telling stories'). The mood here is not directed towards action, but it is important to recognize how critical it is for people to develop shared orientation as the basis for future effective action and appropriate interpretation of language acts.

4. The pragmatics of context

Many current linguistic theories deal in some way with context or 'situation' (see, for example, Barwise and Perry, 1983). They focus on 'deictic' expressions, whose meaning is rooted in the conversation situation (e.g., "you," "here," and "tomorrow") and on 'anaphoric' expressions (such as "that old man" and "the othe one") whose reference depends on complex factors of th previous conversation and shared setting of speak and hearer (e.g., what is mutually visible).

But there is a deeper problem. The interpretation every term and every sentence depends on situation, carried in the background of speaker and hearer. F example, a phrase that would convey a specific reque in a face to face conversation might become ambiguo and improper in an on-line system where the eventu reader's identity is not known to the writer (especial if there is no opportunity for conversations f clarification). Language that has one meaning to nurse on a hospital ward may mean complete different things to the patient, or even to that san nurse in a later conversation.

The meaning of a language act exists in t interpretations of a speaker and a hearer in a particul situation with their particular backgrounds. If eve situation and background were incomparably uniqu there would be no way to provide for regular pattern But of course this is not the case. In every setting the are regularities—or 'recurrences'—that can identified and/or declared.

Individuals: The most obvious regularity is that personal identity. We can identify individuals a expect their interpretations to remain relative stable: what I read today, I will understand in t same way tomorrow (more or less). Of course the are ever-changing moods', and each pers experiences learning and personal change. V cannot assume the existence of an objecti 'individual' that stays stable. However, t differences are small compared to the differen between the backgrounds of different individuals.

Roles: In organizational settings, the regularity often not of specific individuals, but of declar roles. The role of 'head nurse' or 'attendi physician' may be filled by different people different days. A role can be defined as the potent to enter into certain conversations. For examp some conversations for action about patients can initiated only by the attending physician, wh others can be initiated by a nurse. Often, roles associated with the potential to make declaratio The obvious cases include Austin's "I pronounce man and wife," but even in more mund circumstances, roles determine the potential declaring a domain of potential action. For exam many kinds of conversation in the hospital can only be initiated by doctors.

Professions: Although being a nurse or doctor does not define a narrow role, it reflects regularity in the background a person brings to a language act. A crucial part of professional training is learning a jargon—the distinctions and associated terms that provide a basis for inventing and taking relevant actions. 'Profession-oriented languages' (Kaasbøll, 1986) are an attempt to integrate this specialized language structure into the design of computer-based systems.

Locations: The location of an utterance in time and place provides a regular structure that affects its interpretation, not only in the deictic and anaphoric effects mentioned above, but in deeper ways as well. 'Resuscitation' means very different things at an emergency site and on an intensive care ward, even when the same people are involved. As with people, locations are often recurrent in terms of functions, not individuals.

5. Semantics

Section 3 described the structure of conversations without regard to their particular conditions of satisfaction. These conditions reflect a 'propositional content,' which can be characterized in terms of semantics—the relation between linguistic forms and a world of action that they concern. There is no sharp boundary between semantics and pragmatics, or between language use and 'literal meaning.' But there are different spheres of concern. Traditionally, semantics has been described as a correspondence between forms in a language and some kind of 'truth conditions' on the world of which it speaks. As a simplified example, "The patient has a fever" is correlated with a particular objective condition (identified as "having a fever") of some individual who is a "patient." Pragmatics deals with how such statements are interpreted in situations (for example, knowing which patient the doctor has in mind) or are used (for example, as a statement to a nurse in order to evoke certain actions).

Most semantic theories concentrate on how meaning is derived from the way that different words and phrases are combined, and take for granted a collection of basic terms—the nouns, verbs, adjectives and the like—that refer to identifiable objects, properties, relations, and events in the world.

From the perspective of language as action, meanings of words cannot be defined in isolation from a particular conversational setting in which they are used. Calling someone a "patient" is contingent on a complex set of medical practices and roles, and the property of "fever" depends on the context of language use, not just the thermometer reading. Distinctions that are reflected in the choice of words are neither fixed nor individual. They arise through recurrent patterns of conversations, in which breakdowns of action lead to new distinctions (see Winograd (1985) and Chapter 5 of Winograd and Flores (1986)).

In everyday settings, we are largely unconscious of language itself—of how its structure emerges and shapes conversation. In an unfamiliar world (for example the hospital with its medical jargon) we notice that words have 'different meanings,' and from this we can look at the question of how all meanings arise. From the standpoint of design, several issues need to be addressed:

1) What domains of distinctions are taken as background?

Everyone in a normal work setting shares a natural language and a lifetime of cultural experience. The everyday use of language takes this for granted, in applying ordinary natural language terms and structures, as well as standard technical language forms, such as those of mathematics and the clock and calendar. Others will be specialized to a technical area such as medicine. The boundary between natural and formalized domains is not sharp—many words are used in both informal and semi-formalized, or stylized ways. "The patient is in stable condition" has a technical interpretation distinct from the natural one. In some cases, such distinctions may be set down by formal rules; in others, learned through practice.

As mentioned above, research on profession-oriented languages attempts to identify such domains of meaning and build them into computer-based tools for supporting work. Kaasbøll (in preparation) points out problems, such as locally-used distinctions that are not standard to the field and not immediately available to system designers. For example, the nurses in his study referred to a lung-function test apparatus as 'the Ohio,' which was its brand name, and they had no more general term. In some cases such matters are of critical importance to conditions of satisfaction. In the medical profession two different kinds of terms are used to describe medications: brand names ('Tylenol') and generic names ('Acetiminophen'), which apply to anything of equivalent chemical composition. A request made for a brand name may or may not be satisfied by an equivalent generic, depending on a complex interaction of standard practices and local regulations.

Suchman (forthcoming) describes the problems that arise from failing to account for differences in semantic interpretations when designing user interfaces. In a 'user-friendly' interface for a copier, language about the machine and the user's actions appeared in various forms on the screen, using distinctions and words that made perfect sense to the copier-designers, but that led to serious breakdowns for users without the same background. In one case, failure to distinguish the "document cover" from the "bound document aid" led to interpreting help instructions in a way completely different from what the designers intended.

The point here is that the system designer cannot assume that the semantics—the mapping from words to distinctions of interest—will either be 'natural' or follow some existing formal specification of the domain. Meaning is relative to the actions made in language and as a result of language.

2) How do new distinctions emerge?

New distinctions are always emerging because of new breakdowns or anticipation of them. This happens slowly (relative to everyday activity), which makes it at times invisible. A frequent reason for the failure of computer systems is that they 'lock in' a set of distinctions that was observed by the designers, without leaving room for evolution. Gradually people find more and more need to 'work around' the system, leading to complexity and chaos. In such cases, the power to declare new distinctions falls to the system engineers, since they can make changes to the program. They may be the least well qualified to do this in a way that makes sense for the work.

For example, a patient's diet might be recorded as one of a fixed set of choices, such as 'no salt', 'diabetic', etc., based on the current dietary forms. Imagine that a new form of diet is added, such as limiting the cholesterol within the existing diets. The new distinction is not simply one more alternative but a potential modification of the pre-existing choices (except for 'no fat' which by definition has no cholesterol). We might add a collection of new diets such as 'no salt low cholesterol', 'diabetic low cholesterol', etc. but this is a work-around. If a further qualification ('low potassium') is added, the system wil begin to bog down. What is needed is an interpretatio of diet as combining a set of separable dimensions instead of as a simple choice. The original systen designer could not anticipate this need.

3) How are distinctions indicated?

Much of the traditional work on natural languag semantics adopts the idealization of a relativel straightforward 'compositional' mapping from forms t meanings. Put simply, each basic term (word) has meaning, and each phrase or sentence has a meanin that is made up from the meaning of its parts in standard way. Some current research goes furthe focussing on the effect of context on meaning. It i based on structured analyses of contexts (both th linguistic context and the situation of the speaker an hearer) and the relation between those structures an the meanings of utterances. There has been som interest in applying the resulting theoretic framework to non-natural languages, such programming languages and human-comput interfaces (CSLI, 1984). It is beyond the scope of th paper to survey the relevant work. It has significa limitations, as discussed by Winograd (1985).

4) Where are metaphors used?

Most semantic theories break down when faced wi metaphorical use of language. At first glance, it mig seem that metaphors are not relevant to syste designers. Dealing with "My love is a red red ros seems less important than "Give him half a Dispril But unconscious metaphor is a central part of language use, including language about and withi computer systems (see Lakoff and Johnson, 1980).

Andersen and Madsen (1986) have studied the use metaphors by library workers using a computer-bas system. They note metaphors based on physical spa ("Here's how to leave this database and enter the oth one."), communication ("Then it asks whether you wa to continue"), and intention—which they call 'organism metaphor'—("It doesn't want to log you in." These appear in the informal language of people usi the system, and are embodied in the system design a documentation. Some modern interfaces make caref explicit use of metaphors (e.g., representing comput files as objects on a physical desktop) to help structu interactions. In unsystematic cases, the results can confusing. For example, the physical metaph suggests the usual rules of physical bodies (e.g., y can't be in two places at the same time) and leads to confusion when the actual situation does not obey them.

6. Syntax

Linguistic theories of syntax concentrate on the particular properties of natural language phrases and sentences, and on the rules that generate appropriate combinations. We use 'syntax' in a somewhat more general sense to stand for the regularities in form in any recurrent pattern of linguistic interaction, including those that do not involve natural language directly. What distinguishes a description as 'syntactic' is its focus on the relation of the forms, rather than on the meanings they convey.

In fact, much of standard systems analysis is best characterized as a syntactic analysis, dealing with the 'paper flow' or 'information flow' in terms of syntactic items (relations in a data base, forms to be filed, etc.). In analyses like the wallgraph described below, the emphasis on syntactic structure can obscure the underlying meanings, since it is so strongly rooted in the particular forms that happen to have evolved or been previously designed.

Natural language structure can be divided into two areas: *sentential* syntax of individual phrases and sentences; and *discourse* syntax of conversations. The same distinction can be applied to computer-mediated interactions. There are relatively natural smaller units of conversation (individual messages, forms, commands, etc.) whose internal structure can be analyzed as obeying a grammar. These are combined into larger structures (terminal sessions, protocols, etc.) in which issues such as turn-taking (the order in which participants can act) play a role.

Although there are many important issues to be discussed in the syntactic domain (including much of what goes under the name 'human-machine interaction'), they are not the ones addressed in this paper, since they have received substantial attention elsewhere. In a way, syntactic analysis starts from the wrong end. We want to understand the structure of the the work, and have the detailed interaction structure follow from it, not design the forms and let the work adapt around them.

7. An example

The scattered medical illustrations used above were motivated by the case study described by Kaasbøll (1986). Researchers in the Florence project of the Scandinavian SYDPOL (System Development and Profession Oriented Languages) research program have studied a hospital in Norway, analyzing it from what they call a 'systems perspective.' They focused on the tasks associated with giving medications in a ward for children with respiratory problems. In collaboration with the nurses, they created a graphical system description reflecting the paperwork associated with medication. It took the form of a 'wallgraph,' with icons representing the various documents used on the ward, and arrows representing the flow of information from one to another. Table 1 paraphrases Kaasbøll's verbal description of a part of the activities that were analyzed.

Each nurse has a special responsibility as the *team nurse* for a small group of patients.

On the day shift, one nurse (called the *treating nurse*) has the task of giving medicines. Her working day may be characterized roughly by the sequence: attend the report meeting; give medicines; record the medicines given; take care of children in kindergarten or the dining hall.

The report meeting takes place from 7:45 to 8 am. One nurse informs the other staff of the status, changes and activities of each patient during the previous day and night. She has heard a vocal report from the night shift, and she reads the *Kardex* while reporting. The Kardex contains diagnosis, planning and evaluation for each patient, and a form with fixed *main patient information*. It is supposed to be up to date. Other staff take notes on their *program sheets*.

Medicines are prescribed by the doctors on *prescription forms* in cures lasting several days or in daily doses. Cures are recorded on the main patient information form and on the *medicine card*.

Medicines are given in a treatment room between 8 and 9:30 am. Patients enter after having been examined by a doctor, carrying with them a scrap of paper on which the doctor has written today's dose and possible changes in cures. Prescriptions for medicines during the intervals between the regular medicine hours are noted down on a *premedlist* hanging on the wall in the treatment room.

Some simple lung function tests are also performed in the treatment room to monitor the effects of the medicines. Tests to be taken are written on the prescription form and on a scrap taped to the medicine card or on the program sheet if there are changes. The test results are recorded on special forms.

After having given medicines, the treating nurse brings her papers to the ward office. Together with each of the team nurses, one at a time, she examines the papers. All medicines given are now registered on the *curve sheet*. Changes in cures are recorded in the Kardex, and on the medicine card and eventually on the premedlist. In addition, all sheets are compared for the sake of control.

The patients are processed one by one. The team nurse reads from her papers which medicines are to be given. The treating nurse answers by stating which are actually given, and the state of the patient. One day, when the load on the nurses was relatively low, this activity lasted from 9:30 am to 13:25 pm. During these 4 hours, at most 30 minutes were 'effective paper work.' The rest was delays, either because some of the papers were used by others, or because one of the nurses was engaged in handling interruptions. Only a minor part of the 30 minutes was used for updating and comparing. The rest of the time was spent on small conversations, initiated by findings in the information they were handling. These included:

reporting to each other about the patients' state and activities
deciding what were facts when inconsistencies were found
deciding changes in some medicines after small negotiations
reminding the treating nurse of a test that had been forgotten
investigating why a medicine was not delivered from the chemist's
finding out why a patient had to take a specific test.

Table 1: Activities on a hospital ward (adapted from Kaasbøll, 1986, p. 3)

Although no particular computer applications were developed, it is easy to imagine designing a 'medication information system' with on-line terminals (or workstations) at various sites, including the ward, the examining rooms, and the pharmacy. Many of the activities would be replaced with corresponding actions on a terminal. Doctors would enter prescriptions and later could enter modifications on an examining-room terminal instead of sending them on scraps of pap Pharmacists would fill prescriptions presented on th terminals, and so forth. Records that needed to be places where direct computer access was infeasil could be printed out and posted (for example t 'premedlist' of medications before activities, which posted on the wall). The 'information flow' could redesigned, so that redundancies would be eliminat and there would no need for manual copying or posti of information that was already available.

It is far beyond the scope of this paper to develo comprehensive design for such a system. We interested in identifying the theoretical consideratic that would guide such a design, examining the ca study from a language/action perspective. T following section reiterates the framework of t previous sections, examining the hospital work language action, with its particular problems pragmatics, semantics, and syntax. Our ma emphasis is on the pragmatics of language as acti and its dependence on context.

First, two points are worth reiterating:

1) We are designing work, not just tools. If compu systems are introduced, they will redefine t possibilities for action of all the workers, not ju those who use them directly. They will change t patterns of conversation and potentials for getti things done.
2) The system designer is not faced with the choice whether or not to adopt a perspective. It may conscious or unconscious, systematic or haphaza but having a perspective is a necessary condition being able to observe, describe, and design at all. Nygaard and Sorgaard (1985) point out, standa system development methods all adopt 'information system' perspective, dealing primar with the syntax of specific conversations, and wi the maintenance of and access to records of th conversations.

The Florence researchers developed an informati flow diagram (the wallgraph) relating the differe forms and activities, and felt that it gave an overview the work of the ward. The nurses, however, respond to the graphs in a quite different way. Their reacti was that the graphs did not show 'real nursir Kaasbøll concludes (p. 6) that "Since wall graphs sh paper flow, and 'real nursing' involves direct pati interaction, this seems evident."

But from a language perspective, the conclusion different. The problem is not in the wallgraph's fail to show real patients, with their complex emotional and physical particularities. Of course, no systematic account can capture this. But the wallgraph does not capture the conversation structure either. The tangle of boxes and lines deals with the syntax of what gets written when and where, but reveals little about the structure of completion of actions that drive the conversations. Further, it captures only the routine parts of the structure, omitting all of the 'small conversations' that seemed to fill so much time, and demand the application of nursing knowledge and skills.

To some extent, the omission of other conversations results from the way the wallgraph was created. Kaasbøll notes "There are discrepancies between the narrow intention expressed and the broad scope of the actual information processing going on. The nurses did not mention that other tasks might also be done depending on the situation. Hence, they are either not conscious of it, or they feel it is unimportant and will decrease the importance further by not mentioning it." More significantly, there was no language in which to adequately describe all of the activities. They didn't fit into the language of forms and Kardexes, so the information perspective did not allow them to be seen. The same is true of the apparent picture of substantial wasted effort (which could perhaps be avoided by automation). The apparent waste covers a structure of conversation that is not revealed from the information perspective.

From a language/action perspective, the designer is not interested in the structure of information or its flow, but in the design of the conversations that make up the work. Work does not become efficient just because it is on-line. In fact, the requirements of a system for data entry and access may have quite the opposite effect, increasing the amount of record keeping without corresponding advantages. Questions of effectiveness and efficiency appear in the domain of action (conditions of satisfaction, and their completion) and in domain of creating and using distinctions.

7A. Pragmatics: conversations

Conversations for action: There are many different conversations for action, with a variety of visible forms. Some are highly routinized, such as the primary CfA dealing with the administration of medications. Requests are made by doctors (either as standing cures or on the patient-carried paper scraps), to the treating nurse. Assertion of completion is represented on the curve sheet, and the declaration of satisfaction is implicit in the doctor's lack of questioning of the records on his or her next visit. As a precondition for satisfying these requests, the nurse must receive the medicine, and there are CfAs (with the pharmacy) to get the medications, using prescription forms to make requests. In general, conditions of satisfaction are determined in a rigid way by the codes and blanks that are made available on the forms, perhaps with extra notations in natural language. Acceptance of an offer or request is assumed whenever it is not explicitly rejected. Completion is reported on a standard form, which, like all of the other forms, is associated with standards for interpretation, which are learned as part of the relevant professional training.

In addition to these routinized CfAs, there are unscheduled verbal conversations. For example, a request may be made by a doctor to a nurse at the bedside, with immediate explicit acceptance, rejection, or counter-offer. Completion may be reported later via a note in the patient's chart. In these, as in all conversations, success depends on sufficiently similar interpretations by the different parties, and on a commitment to carry the conversation forward to completion. Rigid forms and routines are an attempt to assure this in cases where personal acquaintance and contact are not sufficient. In the hospital setting, completion of conversations can be a life-or-death matter, and there is a highly regularized structure of checks and crosschecks to ensure it for the central conversations. The regularization is both in the form of interactions (the various checklists) and the strict temporal routine of what must be done at what time. The fact that a particular action is done at a particular time can be taken for granted by all on the basis of the daily schedule of activities. This could be augmented (and partially replaced) by the use of a coordination system, in which the monitoring of completion (and coaching towards completing conversations) is incorporated in a communication medium. It is not just a matter of having the conversation on line—computer screens can be ignored just as easily as pieces of paper. The gain comes from being able to have confidence that conversations will be completed effectively, without being forced into unnecessary rigidity of routine. This is a clear example of potential for redesigning the work.

There is also the potential to replace routine CfAs with declarations of recurrent responses. For example, rather than responding to each drug request, a pharmacist might establish an automated 'prescription filling system,' which takes the data from the request and activates a mechanized dispensary. This is the general application of 'computerization,' in which computers take over those functions for which precise repetitive rules can be established. From a language/action perspective, we need to look at what the conversations are, and what implicit commitments lie in their automation. Also, there needs to be the potential for the other kinds of conversations below. If the medication request does not match the standard form for designating medications, then who is involved in the conversation for clarification, and how? In conventional system design, there will always be answers to such questions (especially after experience in use has pointed out the potential breakdowns). Through a conversational analysis we can anticipate and design for them.

Conversations for clarification: These are much less regular (as we would expect), and appear mostly as 'small conversations' within the larger structure, often verbally. The crosschecking of the various forms "for control" also functions to trigger these conversations when the different forms are not directly contradictory, but are open to conflicting interpretations. In designing for conversations for clarification, it is important to recognize their relative lack of recurrence. Recurrent differences of interpretation will lead to the declaration of new distinctions or new forms for making requests and commitments that are clear. One goal in the development of profession-oriented languages is to facilitate and regularize this process. But there will always be irregular, unexpected cases, and computer-based systems often make it difficult or impossible to deal with them by providing only rigid forms. Nygaard (1986) has emphasized the need for systems to include the possibility of 'cross-contact'—means by which workers can enter into conversations with other workers across the established lines of conversation and previously declared domains of distinctions. Something as simple as a generalized electronic mail facility can be the basis for this, but an analysis of the conversation structure can help to integrate these additional conversations in more convenient ways.

Conversations for possibilities: Looking carefully at the various forms and activities, much of what seems to be useless copying or verification of redundant information is really a routine way of creating an opportunity for conversations for possibilities. For example, in the review of medications:

> *"Only a minor part of the 30 minutes was used fo updating and comparing. The rest of the time wa spent on small conversations, initiated by findings i the information they were handling. Some example of what the nurses did: Reporting to each other abou the patients' state and activities; deciding what wer facts when inconsistencies were found; decidin changes in some medicines after small negotiations reminding the treating nurse of a test that had bee forgotten; investigating why a medicine was nc delivered from the chemist's; finding out why patient had to take a specific test."*

Most of these involve coping with or anticipating breakdown in some CfA.

The opening for conversational opportunities nee to be considered directly in system design. If tl medication review were replaced by an automat process, that opportunity would be lost. It could l reinstituted in other ways, but only if it we recognized in the analysis, and the overall organizati allowed for appropriate contact. Similarly, if the cur sheet is replaced with a table of drugs, dosages ar times, it is no longer possible for the nurses to use it as vehicle of communication (in the notes) for the "sma conversations" dealing with specific breakdowns ar subsidiary CfAs. It might well be possible to replace with a better vehicle for these conversations, once the importance is recognized.

Conversations for orientation: When asked comment on the systems analysis, the nurses felt that did not capture the aspect of their activities that dea with the 'total picture' rather than with the specifics particular medications and tests. The existir structure provides explicit routines to allow for th kind of conversation, such as the morning report, whe "One nurse is informing the other staff of the statu changes and performed activities of each patient durir the last day and night." In addition, the inform exchanges among the nurses during the day inclu both explicit CfAs and more general orientir discussion about the 'total picture.' One of tl important forms these conversations take is the tellir of 'stories,' whether in the direct line of work, or arour the coffeepot. Orr (1986) describes the importance relating 'war stories' as part of the training f servicing copying machines. One has only to spend short time in the company of medical workers to reali how prevalent this activity is. It is interesting to no that various computer 'bboards' play this role with the community of computer researchers. They oft contain extended stories, commentaries and other forms of conversation that serve for mutual orientation. This would not be directly applicable to the hospital setting, where the workers do not spend long hours in front of a computer terminal, but it illustrates a new potential for design.

The network of conversations: Finally, the conversational analysis includes not only the immediately visible conversations, but also the larger network of conversations in which they are situated. The design can have tremendous impact on these conversations, which can lead to serious difficulties and even failure of the system (see Scacchi and Kling, 1982).

One obvious example in the hospital is the legal conversation about the quality of care. All written records are potential evidence in a malpractice suit, and the people who create and manipulate them are aware of this possibility. In addition to the legal conversation, there are ongoing conversations about the hiring, evaluation, and dismissal of employees. Kaasbøll notes (1986, p. 11): "If the nurses make mistakes, they may be sued by the patients, and they may be punished by the hospital administration. This gives an incentive for not recording mistakes in the Kardex."

Certain conversations will inevitably go on outside of the written (or electronically stored) system. Explicit records will never correspond to an objective reality, but are the result of declarations by individuals, with their own interpretations and purposes. No computer system can change these fundamental facts about how humans function in organizations, but an explicit understanding of the larger network of conversations can help to recognize the roles that language acts play in a variety of conversations, and to match expectations to those roles.

7B. Pragmatics: situation

Roles: Many of the conversations go on day in and day out with participants changing roles. For example, the role of 'treating nurse' is defined by the central role in the conversations for action about giving medicines. The fact that after the treatments this nurse "takes care of children in kindergarten or the dining hall" is really the combination in one formally-defined role of two separate conversationally-defined roles. One goal of a language-action analysis is to identify the conversationally relevant roles, which can open the possibility of reorganizing or reassigning them as the patterns of work change. Some roles may disappear, as the conversational potentials of other participants are expanded. As a simple example, the role of 'clerk' (providing records from the file) may be meaningless when the retrieval of records becomes available directly to the nurses. Other new roles may emerge, for example an 'interface consultant' who helps design computerized forms.

Locations: Different workers need to be aware of the details and status of the conversations at different times and different locations. Nurses have the Kardex at the nursing station; change requests are on scraps carried by the patient; requests for medication between regular hours are posted on the premedlist on the wall; and so on. Certain people (roles) are expected to update these various representations on a regular basis. For example, the Kardex can be assumed to accurately reflect what was given except for the past few hours, while the main patient information form may lag behind. In designing the conversations, virtual locations will be created, independently of the physical ones (Andersen and Madsen's "Now we are entering the catalog data base..."). They will work better if they are developed within a coherent domain of regularity.

Professions: From Kaasbøll's description, we cannot analyze this case beyond the obvious distinctions among doctors, nurses, pharmacists, etc. A more careful analysis would make finer distinctions (different specialties, levels of training, etc.) that play a crucial role in determining who can enter into what conversations (e.g., the different possibilities open to medical students, residents, and senior physicians).

7C. Semantics

Domains of breakdown: To some extent, the domains of possibilities are determined by a straightforward model of relevant activity. Patients need to be given various drugs because they prevent breakdowns of their physical condition. They need to be given various tests to anticipate and/or prevent breakdowns due to drug effects. The secondary conversations (e.g., with the pharmacy) allow people to satisfy the conditions of satisfaction in this primary domain. However, the existing system leaves openings for individuals (or groups) to declare other relevant domains, in particular in the form of 'notes' attached to the various forms.

Along with the specific conversations and forms, the system designer participates in designing the professional language of the workplace. An intervention in the form of a new computer system will alter the language, both in interactions with the system, and in the work around it. As a simple example, Andersen and Madsen (1986) point out the change in usage of the word 'document' when an indexing system was designed for a document collection, then extended to the whole library. All of the indexed items (including books, magazines, etc.) came to be called 'documents,' contrary to prior usage. In new uses of language there is both a danger of creating confusion and an opportunity to shape the conversations and the work itself. This is especially important in a setting like the hospital, where there are conflicting languages already in use (the language of doctors, nurses, ordinary language, etc.).

Declaration of distinctions: Kaasbøll (1986, p. 10) gives an example of a technical term whose meaning was subject to argument and the imposition of authority:

> *"During a doctor's visit, the doctor and two nurses started a conversation of what 'P1' means. P-values are measures of obstructions in the lungs.*
>
> > *Doctor: It is the air in the lungs that counts, not the sounds.*
> >
> > *Nurse1: It is obvious that Peter (the chief physician) has a different opinion of P1 than you.*
> >
> > *Nurse2: One has to remember that there are individual discrepancies between the children, such that P1 does not mean the same for one child as for another.*
>
> *This discussion can be interpreted as a negotiation over the semantics of 'P1', and thus as a development of the language at the ward. It can also be seen as part of the power struggle between the two professions involved."*

The larger pragmatic analysis of conversations and roles includes the conversations in which meaning is negotiated, and their reflection in a computer system and in the training of people who use it. In looking at the problem of system maintenance, we can design conversations by which new distinctions (perhaps emerging from the informal cross-contact described above) can find their way into the formal part of the system. By creating this meta-conversation, we can cope with some of the breakdowns that come from system rigidity.

One general principle pointed out by Nygaard (1986) is the importance of having distinctions that are open to new interpretation by the workers. In practica terms, this may be as simple as having a 'Notes' field i some data record, that allows the worker to enter (an retrieve) ordinary natural language text, as opposed t 'fixed fields,' in which the distinctions are fixed b system convention.

Indication of distinctions: As mentioned above, th interpretation of a particular item in a record sensitive to situation. Consider the meaning of fillin in a 'medicine card' listing a patient's medication From a standard semantic view, each blank would t filled with a term that denoted a particular medicatio and the card as a whole (analogous to a sentence) wou enumerate the medications to be given to the patien This is mostly the case, but according to Kaasbøll (i preparation, p. 4):

> *"The sheets were filled in properly during the 3 minutes, except for a couple of observed 'missir medicines' on the medicine cards. When asked abo the 'mistakes' the treating nurse replied: 'Oh, but u know he (the patient) is going to have the medicin even if it is not written here. It is erased only becau he has been under intensive care for some days.'"*

The issue here is not the exact form of the cards. It cou just as well have been a computer system with da base entries for medications. The situation-dependen of meaning is in the people who 'enter' and 'access' tl data. Accuracy is not just a matter of having tl computer keep its records straight. In designing aı installing a system, it is critical to understand tl different potentials for interpretation and either co with them or modify them through training.

7D. Syntax

Discourse: This is the level that was visible in tl wallgraph. There is a specific collection of forms, ea with its own syntactic structure (various fields, blanl boxes for checking, etc). These are organized in larger structured collections (the Kardex, the patie record files, etc.). An analysis of this structure w reflect all of the particularities of how they are fil out, and ends up (as Kaasbøll reports) quite comp and confusing to the nurses themselves. Of course, a system we build will have such a syntax, but if we vi the items as reflecting particular steps conversations, there is order in the structure.

Sentential: The nurses use a wide variety of syntac forms, ranging from highly specialized codes specifying drug dosages ("50mg acetiminophen P

T.I.D") to informal natural language in notes. A full understanding would include a detailed account of the profession-oriented languages (there will be more than one in a setting like this where several professions interact). Medicine is an obvious example, in that medical terminology is consciously distinct from ordinary language. But in every organizational setting there is some degree of specialized language, suited to the particular conditions of satisfaction that are relevant to the conversations.

8. Blindnesses of a language/action perspective

The impacts of a technological innovation cannot be fully understood from any one perspective. Each perspective brings forth some concerns and is 'blind' to others. The coherence of a design comes from its generation within one perspective, but its success will come from anticipating breakdowns that become visible from other perspectives as well. The following list illustrates how the perspectives mentioned in Section 2 might interact with a design generated from concerns of language action.

Information processing: Traditional information system perspectives have centered on implementation problems. Analyses deal with files and records and specific channels for accessing them. They can then be used to create designs for effective and relatively efficient configurations of software and hardware. The language perspective does not have a close mapping to equipment considerations, although it does have consequences for design at this level. We cannot succeed if we design a conversation structure that makes unreasonable demands on computer resources, or that requires waiting for long periods for the system to do something. Similarly, a designer must pay attention to the specific capacities of human memory, attention, and reasoning. Our relative lack of attention to those issues here does not mean that they are unimportant. It reflects the fact that they dominate the current literature on computer system design (including the currently active interest in 'expert systems'), and need to be balanced with other perspectives.

The information processing perspective does not just include the immediate issues of data entry, storage, manipulation, and access, but also involves a larger web of issues surrounding the computer system itself. The design, acquisition, installation, maintenance, and hiring and/or training of people to use a system have their own domains of conversation, possibilities and breakdowns (see Kling and Scacchi, 1982).

Roles and materials: The language/action perspective deals with some of the same issues that arise in a role/function perspective, in particular in defining roles as patterns of potential for action. But it does not deal with the more physical issues of resources and locations associated with work. Holt (1986) notes that "What first stands out in any work environment is its architecture—that is to say its spatial-functional organization.... Functional proximity is what relates work places to each other. It is the relation which constrains and organizes the movement of people and materials..." In designing a conversational structure we cannot ignore the brute physical situation: who has physical access to what objects when. There may be a critical difference between putting a single terminal at the main nursing station, putting a terminal in each examining and activity room, or having one available by every bedside. In looking at the role of an individual, we need to recognize that his or her body can only be in one place at one time, and is limited in its ability to move from place to place. In a way this sounds mundane, but it is all too easy to design a system that would work wonderfully—if the nurse would walk over to the nursing station before giving each patient medication—but doesn't succeed in practice.

Authority: An important aspect of every human organization is the distribution of authority and power, and the mechanisms by which it is maintained. The introduction of a new technology can perturb this structure in a variety of ways, such as: facilitating detailed monitoring of performance; making it possible for subordinates to work in ways that are not understood by their superiors; and in general opening possibilities for communication that cross the previous lines of authority. An analysis of conversational roles will identify particular individuals as having the ability to initiate or respond in certain conversations, and this structure is the practical consequence of authority. But the mechanisms by which authority is established and maintained go beyond this, and need to be confronted explicitly. In the hospital, there are powerful constraints on the appropriate role behavior of doctors and nurses. The structure of interactions within the organization maintains this identity and changes can threaten it. In the nursing example, one might imagine merging the various records and thus eliminating the Kardex. But, according to Kaasbøll (in preparation):

"Nurses are traditionally a paraprofession subordinate to the physicians and their medical knowledge.... In the nurses' struggle for acceptance of nursing as a profession, the theoretical concept 'nursing process' and its practical documentation in the Kardex is of central importance for developing nursing as a science on its own. In this struggle, the Kardex as a basis for nursing decisions may be seen as the nurses' answer to the physicians' medical records."

In careful system development studies, this kind of issue has often emerged, for example between journalists and typographers in newspaper-publishing systems (Howard, 1985) and between librarians and clerks in libraries (Andersen and Madsen, 1986). The redesign of work is a negotiation among the groups already doing and supervising the work, and the results will be shaped by the interests of these groups and the compromises among them. In contrasting the 'tool perspective' to a more traditional systems perspective, Ehn and Kyng (1984) focus on this issue, looking at ways to maintain the autonomy of workers in the face of computer-based changes that can potentially be used to expand centralized authority.

Conflict: Most of the organizational models applied to information systems design are based on the assumption of shared goals among the participants. In real organizations there are always conflicts among competing goals held by different individuals and groups. In some cases this is institutionalized (as in contractual labor-management relations or internal market competition in a firm), but it is always present. A system that assumes idealized cooperation may easily fail as the result of behavior that the systems analyst might label as stupidity, sabotage, or just plain human stubbornness. An analysis that takes conflicting interests into account is not a vain attempt to dissolve them, but can channel them into explicit forms of mutually agreed-upon negotiation.

The language/action perspective establishes a structure for negotiation, based on a theory of cooperation that assumes the willingness to enter into serious conversation, without assuming shared goals or agreement. A conversation for clarification, for example, might involve each party's negotiating to get a 'favorable deal,' but it can nevertheless result in a mutual agreement. More work needs to be done in integrating a conflict perspective (see Ciborra, 1985, and Sandberg in Nygaard, 1986).

Interpersonal relations: One of the most obvious effects of computer systems is the replacement of face-to-face verbal interaction with computer-mediated exchange. In extreme cases, a job such as data-entry clerk may involve no immediate human interaction at all. Some problems that can arise from this can be characterized in conversational terms. A face-to-face interaction that is identified as playing a particular conversational role (e.g., medication record entry) often has other components (conversations for possibilities) that are lost. However, as with the issue of authority, there is also the question of people's perceptions of themselves and their relationships with others around them. This is not just a matter of 'bedside manner,' but a fundamental issue in all cooperative work environments. In a study of the introduction of a production planning and control system into a factory, Schneider and Howard (1985, pp. 14–15) noted:

In the contributing areas, Production Support personnel are constantly engaged in informal discussions, promises, and agreements.... Schedulers spend nearly half their time in meetings, competing with their colleagues over shop capacity and priority (one likens the process to 'butting heads'). Thus, a major part of the production planning and control process involves the extremely social acts of persuasion, negotiation, and, at times argument. As one Production Control expeditor puts it, 'I'm just one leaf on the tree. I try to go in any and all directions in order to get a part out. It all depends on developing working relationships with people in other departments—purchasing, quality control manufacturing engineering. It's a matter of trust built up over time. Personalities play a big role in it.'"

In their study, they show the pitfalls of trying to redesign the work to eliminate these interactions. Although the language/action perspective focusses on the conversations among individuals, it is structural, not psychological. It asks us to look at the potentials for interaction, but not the motivations and feelings that will lead to what people actually do. Questions of mood, motivation, and personal satisfaction go far beyond anything that has been dealt with here, and are essential to successful design.

9. Conclusion

Throughout this paper, we have seen how particular analyses can lead to designs that shape the nature of the work people do in organizations. The system designer emerges as an activist—someone whose technical designs are based on a larger understanding of what could and *should* be done. At first sight, this seems to justify an imperialism that wise system designers would reject. The computer professional is not typically the person whose understanding of a work situation should be followed. In fact, training in computer science can potentially lead to systematic distortions of what is relevant and important—to what is popularly called a 'computer mentality.' But designers cannot avoid responsibility either. Every time a system is built and introduced into a work setting, the work is redesigned—either consciously or unconsciously. We cannot choose to have no impact, just as we cannot chose to be outside of a perspective. We can make conscious choices as to which ones we follow and what consequences we anticipate.

Of course, we do not have full power over what will happen. In all design we must recognize the ongoing process of adaptation and evolution. We cannot design work, or language, or even computer devices in a way that establishes 'once and for all' what they will be and how they will be used. Design leads to technology, the use of which in turn leads to new breakdowns and new understanding, and back to new design. Our perspectives will shape the directions in which we look when breakdown is encountered, but we cannot anticipate the forms it will take.

Once we recognize that design is an active intervention, it is also important to recognize that the 'designer' is not some outside data-processing expert who comes into a situation with his or her own agenda and prescriptions for change. One of the unifying threads of the SYDPOL projects has been a concern with design methods in which the workers—those who will be directly affected by the system—are involved from the earliest stages. In language/action terms, we would say that they must participate in the design of the basic structure of the conversations, not just in the detailed questions of syntax that typically emerge at late stages of implementation. The role of the professional is to make clear what the different questions and potentials are, and what their likely consequences will be.

This does not mean that the system designer is purely a facilitator, with no direction. System design is a means of change, and the designer, like every socially responsible person, has the potential to introduce directions he or she believes in. As an example, The Coordinator (see Winograd and Flores (1986) and Winograd (forthcoming)) is a computer-based system for the coordination of work, designed by Flores and others at Action Technologies. It is based on theories of language action, and is explicitly designed to 'coach' its users to take clearer actions in declaring and following up on their commitments. In doing so it is a conscious intervention in how organizations go about their business, backed up by explicit training of the users in conversation theory (through courses offered by Logonet, Inc.). Its philosophical directions are not hidden in the details of design, but are explicitly taught to prospective users. Judged by commercial experience, it is a productive intervention.

Ultimately then, the practical development of a language/action perspective will go hand-in-hand with attempts to do conscious system design—to anticipate the ways in which computer systems will change the structure of work, and to enter into conversation with the people who will be affected. Through this discourse we move towards a capacity for innovative and appropriate design.

Acknowledgments

The work presented here was supported by the System Development Foundation under a grant to the Center for the Study of Language and Information. I wish to thank the participants in the CSLI working meetings on system development for their valuable contributions to the evolution of this work. Jens Kaasbøll and Kim Halskov Madsen were especially helpful in giving me access to and a better understanding of the work being done in some of the SYDPOL projects. My conversations with Fernando Flores have been the basis for my understanding, in the most fundamental ways. Without his teaching, my perspectives would have been far different. In addition to these people, Chauncey Bell, Bradley Hartfield, Françoise Herrmann, Mary Holstege, and Liam Peyton gave insightful critiques of an earlier draft.

References

Andersen, Peter Bogh and Madsen, Kim Halskov, How to handle the intangible: Metaphors in design and use of computer system, draft report, Aarhus University 1986.

Austin, John, *How to Do Things with Words*, Cambridge, Massachusetts: Harvard University Press, 1962.

Barwise, Jon and John Perry, *Situations and Attitudes*, Cambridge, Massachusetts: Bradford/M.I.T. Press, 1983.

Ciborra, Claudio U., Reframing the role of computers in organizations, the transaction costs approach, *Sixth Annual International Conference on Information Systems*, Indianapolis, December, 1985.

Research Program on Situated Language, Report CSLI-1, Center for the Study of Language and Information, Stanford, 1984.

DeCindio, F., G. DeMichelis, and C. Simoni, Petri net models of office game rules for office automation, Instituto di Cibernetica, Universita di Milano, draft, 1985.

Ehn, Pelle and Morten Kyng, A tool perspective on the design of interactive computer support for skilled workers, in M. Saaksjarvi (ed.), *Report of the Seventh Scandinavian Research Seminar on Systemeering*, Helsinki, 1984.

Fafchamps, Danielle, *Medical deliberation: an alternative approach to medical decision making*, Stanford University dissertation, in preparation.

Flores, C. Fernando, Management and communication in the office of the future, Doctoral Dissertation, University of California at Berkeley, 1981.

Flores, C. Fernando and Juan Ludlow, Doing and speaking in the office, in G. Fick and R. Sprague (Eds.), *DSS: Issues and Challenges*, London: Pergamon Press, 1981.

Gerson, Elihu M., Information systems in complex organizations: Challenges for research, Tremont Research Institute, draft, 1985.

Holt, Anatol, Primitive man in the electronic work environment, Presented at the conference on electronic work, Milan, March 1986.

Holt, Anatol, H.R. Ramsey, and J.D. Grimes, Coordination system technology as the basis for a programming environment, *Electrical Communication* 57:4 (1983).

Howard, Robert, UTOPIA: Where workers craft new technology, *Technology Review* 88:3 (April, 1985), 43–49.

Kaasbøll, Jens, Intentional development of professional language through computerization: A case study and some theoretical considerations, in Fuchs-Kittowski et al. (eds.) *Proceedings of the IFIP Working Conference on System Design for Human Development and Productivity through Participation* (Berlin, May 12–15, 1986), North Holland 1987.

Kaasbøll, Jens, Observation of people working with information: A case study, draft dated Jan 7, 1986, submitted for publication.

Kling, Rob, and Walt Scacchi, The web of computing: Computing technology as social organization, in M. Yovits (Ed.), *Advances in Computers*, Vol. 21, 1982, 1–90.

Lakoff, George and Mark Johnson, *Metaphors We Live By*, Chicago: University of Chicago Press, 1980.

Nygaard, Kristen, Program development as a social activity, to be presented at *IFIP 1986 World Conference*, Dublin.

Nygaard, Kristen, and Pal Sorgaard, The perspective concept in informatics, *Working Conference on Development and Use of Computer-based System and Tools*, Aarhus, 1985.

Orr, Julian, Narratives at work, story telling a cooperative diagnostic activity, Conference on Computer-Supported Cooperative Work, Austin Texas, December 1986.

Schneider, Leslie, and Robert Howard, Offic automation in a manufacturing setting, stud prepared for the United States Office of Technolog Assessment, April, 1985.

Searle, John, *Speech Acts*, Cambridge: Cambridg University Press, 1969

Searle, John R., A taxonomy of illocutionary acts, in K Gunderson (Ed.), *Language, Mind and Knowledg* Minneapolis: University of Minnesota Press, 197 344–369.

Suchman, Lucy, *Plans and Situated Actions: Th Problem of Human-machine Communicatio* Cambridge: Cambridge University Pres forthcoming.

Winograd, Terry, Moving the semantic fulcrun *Linguistics and Philosophy*, 8:1 (1985), 91–104.

Winograd, Terry, The design of collaboration: contrastive case study of two tools for conversatio forthcoming (submitted for publication).

Winograd, Terry and Fernando Flores, *Understandi Computers and Cognition: A New Foundation f Design*, Norwood, New Jersey: Ablex, 1986.