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Communicative Activity Analysis of a Wizard of Oz Experiment

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1 Introduction

1.1 The Experiment

In this chapter we will describe and analyze a simulation of a factual information seeking system for a subsection of the "yellow pages". The subsection contains information about (i) car hire (ii) restaurants, and (iii) personal insurance. The simulation was accomplished by use of the so-called Wizard of Oz technique[1]. In this technique, subjects who believe they are communicating with a prototype of an automatic information system are, in fact, communicating with another person via a computer terminal. The person who is simulating the system (and is called the wizard with an allusion to the American Wizard of Oz story) has at his/her disposal an information base and a set of preprogrammed "canned" response patterns. The actual simulation was preceded by an introductory session where subjects were given a set of instructions relating to the use of the system and was followed by a session where subjects were interviewed and asked to complete a questionnaire concerning their experiences and evaluations of the system.

The output of the simulation sessions were, on the one hand, a set of logged written dialogues between "user" and "system" and, on the other hand, a completed set of questionnaires. In the present study, we will only report on an analysis of the logged written dialogues.

1.2 Communicative Activity Analysis

The analysis has been guided by the "communicative activity analysis" described, for example, in Allwood [3] and Allwood, Nivre & Ahlsén [5] The superordinate perspective in this analysis is that language and communication are seen as instruments

[1] CfDahlbäck and Jönsson [9].

for individual and collective information processing in the service of social activities, the main purpose of which does not have to be communicative.[2]

Further, it is suggested that in studying the instrumental aspect of language and communication for social activity, it is often useful to distinguish 4 analytical dimensions pertaining to the phenomena observed:

A. A determining vs. determined dimension
B. A general vs. specific dimension
C. A collective vs. individual dimension
D. A global vs. local dimension

All dimensions must be related to a perspective and a level of abstraction which means that a given phenomenon can be seen as determined or general in relation to one phenomenon without being so in relation to another phenomenon. The dimensions are not dichotomous but rather ordinal and continuous which means that one phenomenon can be more or less determining, general, collective or global than another.

With regard to the application of the four dimensions to communicative aspects of a social activity features of the communicative behavior are, broadly speaking, regarded as determined and features of the social activity, context and participating individuals are regarded as determining. In particular, general determining features are given by the natural, cultural (including language system) and social institutional environment, while specific determining factors are given by particular activities or particular individuals pursuing the activities.

General features of communicative behavior are features like the general distinguishability of a phonological, morphological and syntactic aspect and the restrictions of a general nature that pertain to these aspects. Specific features of communicative behavior arise, for example, from its employment in a particular social activity by particular persons.

With regard to the dimension collective-individual; collectively determining phenomena can affect all participants in communication equally. Some of these are general such as laws of nature or certain cultural conventions. Others are more specific and dependent on particular activities. Individually determining phenomena are phenomena that differentially affect communication through the participants in the interaction. Such phenomena are mainly of three types: biological (e.g. a physical handicap affecting communication), psychological (e.g. beliefs or other attitudes affecting communication) and social (e.g. sex role, age role, social class). If the features in question are general. i.e. are shared by all individuals, they, by this very fact, also become collective (e.g. certain

[2] For a classical illustration see, for example, Malinowski´s [15] analysis of the instrumental role of language and communication for a Trobriand fishing trip

expectations) concerning motivation, rationality and agency pertaining to communication (cf. Grice, [12] and Allwood, [1].

General collective features of the (determined) communicative behavior are such features as turntaking, sequences and feedback cf (Allwood [3] and Allwood, Nivre & Ahlsén [5] Specific collective features, for example, arise as a result of the employment of communication in a particular activity. Thus, turntaking and feedback are very different in a formal lecture and in an informal conversation. In the former case, we have extremely asymmetric turntaking and very restricted opportunities for overt verbal feedback-giving from the listeners, while in the latter case we have symmetrical turntaking and quite unrestricted feedback-giving from the listeners.

Finally, we turn to the dimension global-local. Global determining phenomena are phenomena which affect communication throughout the course of an activity. Such phenomena can then, in accordance with what has been indicated above, be subclassified as general or specific and collective or individual. Local determining phenomena are phenomena which only determine communication during a phase or a part of an activity. Like global determining phenomena, local determinants can be more or less general and more or less collectively shared. We may further note, that since the difference between local and global, among other things, involves a difference in level of abstraction, communicative behavior which on a global level can be regarded as, largely speaking, determined, with general and specific aspects and individual and collective aspects, on a local level, becomes equally determining and determined. The preceding discourse, in particular the preceding utterance, always has a very strong determining influence on the succeeding utterance. Every utterance has the dual property of being determined by preceding discourse and being determining for succeeding discourse. The consequence is that local communicative behavior is determined, not only by global determining factors, but also by local determining factors including preceding communicative behavior. The result can be seen with regard to the choice of local communicative exchange patterns to continue interaction, e.g. an unclear question might lead to a clarification sequence as well as in the way each new utterance both is bound by and continues preceding discourse.

In table 6.1 below, an overview is given of the dimensions in communicative analysis and their intersection.

Table 6.1. Dimensions of Communicative Activity Analysis and their Interaction

		General		Specific	
		Collective	Individual	Collective	Individual
Determining	Global	Natural environ. Culture Language Social inst.	Human nature -Rat.mot.agent -Biol. psych social characteristics	Activities -purposes -roles -artifacts -environ.	Ind. identity -biol. -psych. -social
	Local	Activated aspects of global, collective e.g. psycho-	Activated aspects of global, individual global+ prec. global logical moods	Activated aspects of spec. coll. discourse	Activated aspects of spec. ind.
Determined	Global com. behavior	Dim. of collective com. behavior e.g. turntaking feedback sequences	Dim. of individual com. behavior e.g. phonology morphology syntax	Coll. com. behav. relevant to activity	Ind. com. behav. relevant to activity and collective com. behavior
	Local com. behavior	Activated relevant aspects of coll.	Activated relevant aspect of ind. com. behav. by prec.	Activated relevant coll. com. behav. + obligated behavior discourse	Activated required ind behavior + optional

In what follows, we will mainly consider the two rightmost (specific) columns of the diagram, i.e., we will be concerned with the analysis of a particular (specific) activity - an experimental simulation of a computer assisted system for factual information seeking. In section 6.2 we give an account of the global determining factors of this activity, concentrating on specific collective factors such as activity purpose and roles and on general individual factors such as are encoded in the Gricean maxims, cf Grice [12]. In section 6.3´, we discuss local determining factors. In a third step, we will then consider the effect of the determining factors both on a global and in section 6.4 we analyze the functional structure of individual communicative expressions and the determining role of preceding discourse. Section 6.5 contains an analysis of a specific WOZ dialogue taken from the English corpus. In Section 6.6, we discuss the possibilities of formalizing regularities and functional dependencies found in dialogues, and we conclude in section 6.7 by discussing the relation of the proposed analysis to the architecture of the PLUS system.

2. The Wizard of Oz Experiment – Global Determining Factors

2.1 Specific, Collective, Global Factors

2.1.1 Activity Purpose (Function)

The purpose or function of the activity was explicitly given to the subjects through an oral briefing and written scenarios. The given purpose had a multi-layered character as follows:

1. Participation in a scientific experiment of WOZ character (only known to the research staff)

2. Participation in a scientific study testing a prototype for an NL information system concerning the yellow pages.

3. Participation in three simulated factual information seeking tasks, where subjects are told to "play-act" the role of the user The factual information tasks concern:

   (a) Car hire
   (b) Restaurants
   (c) Personal insurance

The three tasks were described in "scenarios" (see Appendix A)

2.1.2 Roles

Persons participate in activities by occupying or playing roles which have been constituted by the activities. Such roles can often be characterized in terms of socially stereotyped rights and obligations. For example, if you are a customer in a shop, you normally have the right to receive information about the quality and price of the goods for sale and you have the obligation to pay for the goods should you should wish to acquire them.

Similarly to the fashion in which activities can be simultaneous, and superposed, roles too can be simultaneous and superposed. Imagine in the previous example that the customer was accompanied by his child in the shop. His customer role would then be superposed on his father role. The roles would still be separate, i.e., the rights and obligations of both roles would still be separately valid, even if the resulting behavior might be influenced by both roles. In general, relations between roles mirror relations between the activities they are constituted by.

Logically, an activity or a role can be a specification of, a part of or conjoined with another activity or role. Thus, the Wizard of Oz experiment and the wizard role are specifications of a scientific experiment and the researcher role, respectively and communication and the communication roles (sending and receiving) are parts of the WOZ research activity and wizard role, respectively.

More generally, two or more roles may be conjoined, e.g., to form (parts of) a third role. The communication role, the data-base managing role, the role of observing and keeping a record (log-file) of the interactions are parts or sub-roles in relation to the wizard role. Thus, the wizard role may be viewed as a conjunction of these sub-roles.

Roles are instantiated through instances of action and behavior. In particular, the following holds:

If R1 is a specification of R2 and A instantiates R1 then A instantiates R2 as well.

If R1 is a part of R2 and A instantiates R1 then A instantiates R2.

For instance, the communication role that forms a part of the wizard role is also a specification of a (general) communication role. Thus, any action instantiating the wizard-communication role also instantiates the wizard role and the (general) communication role.

Further, we may associate an extension to a role consisting of all possible actions that instantiate the role (role potential).

From the above considerations, it follows, for example, that the extension or role potential of the WOZ-communication-role is the intersection of the extensions of the WOZ-role and the (general) communication role.

Returning to the relations between persons and roles, we have distinguished two such relations (i) occupying (having) a role and (ii) playing a role. A person may occupy a role without being aware of this fact if he meets the requirements for occupying the role., He may also, however, play a role without meeting such requirements if he exhibits the expected stereotypical role behavior or intends to exhibit such behavior.

A consequence of this way of characterizing a role is that one may be assigned a role without playing it or play a role without having been assigned to it.

In what follows we will characterize roles by the rights (permissions) and obligations which are connected with the role. We will also, when the need arises, attempt to characterize the requirements which have to be met in order to occupy a role. Such

requirements can be behavioral or substantive and can concern communicative ability or certain types of knowledge and skills, such as knowledge of computers in the wizard role.

Over and above requirements, desiderata for playing a role well can be added. Examples of such additional desiderata might be speed of typing, intelligence in problem solving or perseverance, etc. Possibly, after more careful study, it might be possible to divide requirements relating to a role into necessary, sufficient and facilitating requirements for the role.

2.1.3. The Roles of the WOZ Experiment

The main roles of each instance of the experiment are:

1. Experiment manager
2. System
3. User

The roles of the interactions (wizard and user) could also be described as role positions. This is so, since the person who occupies one of these role positions, in fact, "plays several roles" or phrased alternatively participates in several "role levels".

1. The Experiment Manager

The role of the experiment manager is limited to the initial briefing and instruction phase and to a final phase where subjects are asked to complete a questionnaire including questions asking them to evaluate the system. For the study of the corpus this material is relevant only as a contextual background factor.

2. The System

The person occupying the "system position" is through the activity connected with 3 role levels where the main level is the "system level".

(a) ***Researcher role***: He or she is a researcher in computational linguistics involved in the PLUS project, more specifically, in the present situation he/she is the "wizard".

(b) ***The system role***: He or she is a "wizard", i.e. trying to simulate a factual information-giving system for the 3 selected areas of the yellow pages.

(c) *Communication roles*: The person taking the system role alternates between being in a sender role, a receiver role and a data base manager role.

Let us know try to characterize the system role in terms of the rights and obligations which connect it to the communication roles of receiving and sending information

(a) *Receiving and processing* No restrictions - the wizard is only limited by his humanly given capacity for understanding. This entailed, for example, full understanding of spelling errors, abbreviations, ellipses, cross reference, etc. (To make future studies more realistic, appropriate restrictions could well be introduced here).

Since the wizard is incrementally interpreting screen messages, he or she has increased time for data base management and choice of appropriate reply. Given the role of information provider, the system will have a tendency to interpret each message from the user as a request for information or acknowledgement of such information given. Since the wizard is acquainted with the scenarios, he/she will often be able to predict what the next move from the user will be and can use this information to interpret the user´s message. The data base manager role obligates the wizard to find relevant information in the data base and to decide whether this can be transmitted by means of available canned message forms.

(b) *Sending (production*:) As a sender, the system is also obligated by the restrictions mentioned above, however, in short form the general restriction might be expressed as "being as computer-like as possible". In the experiments carried out, the wizard, therefore:

- used canned answers as often as possible.
- used canned answers as patterns for other responses which more explicitly meant that complete sentences according to "school grammar" were used with the exception of lists, and that restricted vocabulary in the direction of official bureaucratic language was used.
- took no initiatives except those motivated by the task of providing the user with information within the three scenarios. The initiatives that were taken would, therefore, typically be questions for specification and clarification.
- did not provide information which went beyond the limitations given by the available Yellow Pages data base. In a few cases, common sense considerations were employed. For example, the wizard knew that Mexican cuisine is well-known for spicy food..

- never evaluated any products in the Yellow Pages data base, even when evaluations were asked for.

- never gave information on geographical distance. This was not available in the database for the application domain.

- restricted helpfulness to the following aspects:

  - full comprehension, e.g. the system could always identify locations (limited by WOZ personal knowledge), even though no information over and above address was available in the data base

  - suggestions for where (phone No.) the user could turn for more information

  - information given was always by the wizard believed to be correct and relevant for the user.

  - the information was presented as clearly and perspicuously as possible, e.g., attempts were made to reduce "large amounts of information" presented by asking for specifications from the user.

3. The User

(a) Subject role: On a first level, the user occupies the role of "subject-in-scientific-experiment". This carries with it the right to be treated courteously and the obligation to follow instructions given. A consequence of this could be, for example, an urge to test the system´s robustness by typing in abbreviations or misspelled words. However, this last urge is probably checked by an opposite urge to spell correctly when observed by one´s teachers. The subjects being students might have identified the situation as one in which they themselves in some sense were tested.

(b) The user role: On a second level - the main level - the subjects were asked to play the role of "user" or "information seeker" in three different scenarios. The obligations of a user are relatively restricted and are confined to communicating clearly. Since the user believes he is communicating with a machine, he/she probably believes he/she has to spell correctly and write grammatically. This is, however, counteracted by the user´s information that he/she is communicating with a new prototype with

more human-like qualities, which perhaps, therefore, could be expected to handle the lack of such features. Communicating with a machine further produces fewer obligations concerning politeness and manners. Obligations involving giving information to the system about textual relevance and coherence relations might also be diminished. Since, furthermore, the interaction is preserved on the screen, 40 lines back (about 10 messages) and a prompter ends and starts each new contribution, there is almost no need for requests for repetitions or feedback information.

The rights of the user are "to get his/her money´s worth" of correct, adequate helpful and courteous factual information. Since these rights are fairly vague and far reaching, it is to be expected that the user´s expectations might be more far reaching than the system´s capacity for providing information.

The resulting behavior of the persons in the "user role position" is probably to be seen as a compromise between the rights and obligations connected with the role of "research subject" and rights and obligations connected with the role of "user" proper. Details of the user role are given in the scenarios above.

Another perspective on the roles of "user" and "system" might be gained by comparing them to, or maybe even taking them to the instances of the "master" and "slave" roles, respectively. The use is the mater and has great freedom of action - he/she can do more or less what they want. The system is the slave who has put up with the users whims, always interpreting them charitably and cooperatively.

2.2 General, Individual, Global Factors

From a general perspective, individual communication requires both action and interaction. Communication as well as action and interaction, in their turn, are based on certain features of human nature. These features can, for example, be divided into biological psychological and social features. They include such abilities as the ability to send, receive and process acoustic or optical waves in a psychologically and socially relevant way - an activity in which the three types of features are integrated with each other.

One might also say that communication, action and interaction rely on at least three types of constraints and enablement conditions:

1. *Causal* - which pertains perhaps primarily to the interaction of the human organism with the physical environment

2. *Conventional* - which pertains perhaps primarily to the psychological and social sides of human nature.

3. *Rational-functional* - which pertains primarily also to psychological and social sides of human nature.

We will here only remark briefly on constraints and enablement conditions of the third rational-functional type. The extent to which there are constraints and enablement conditions of this type depends on the extent to which communication, action and interaction are rational and functional.

Starting with Grice [12] who formulates four maxims (quality, quantity, relation and manner) and an overriding principle of cooperation in order to capture certain preconditions (in the Kantian sense) of conversation, there have been a number of attempts at finding such constraints and enablement conditions for communication. Sometimes these attempts have been made with explicit consideration of other types of action and interaction than communication. Sometimes they have not. In Allwood [1], the connection is made with other types of action and interaction and six maxims of motivated, rational action are given. In addition, an analysis is given of the role of ethical motivation and cooperation in communication. Horn [13] presents an analysis based only on the Gricean maxim of quantity and Sperber & Wilson [21] present an analysis based on the notion of relevance. In what follows, we will make use of a combination of the principles found in Grice, [12] and Allwood, [1]

(i) start and continue communicating
(ii) perceive each other's messages
(iii) understand each other's message, and
(iv) react to each other's messages

These basic communicative functions have led to the development, in all languages, of a set of elementary feedback mechanisms, (cf Allwood [4] and Allwood,. Nivre and Ahlsén [6] which enable communicators to on-line interactively manage the functions in question. Other examples of interactive communication management functions are turntaking mechanisms, (cf Sacks et al [19]) and sequencing mechanisms (cf Schegloff & Schegloff [20].

Over and above interactive communication management, there is also a need for own communication management. A sender or a speaker needs, on-line, to be able to plan and change his message in direct response to his own ideas and the interlocutor´s reactions. A set of such mechanisms is described in Allwood, Nivre & Ahlsén (1990).

Finally, it should perhaps be repeated that features which generally are present in the communication of all individuals, ipso facto, become collectively relevant. If there is

general awareness of the features, as there is in the case of many of the features of rational functionality, they can become collectively relevant features of the awareness and intentionality which are connected with communication, action and interaction.

3. Local Determining Factors

3.1 Local Determinants

Communicative behavior on a local level is influenced by preceding discourse, especially the immediately preceding utterance, and by activated relevant aspects of the general and specific globally determining factors. In the simulated computer supported factual information dialogues we are considering here, this could involve such things as specific linguistic and cultural constraints on the asking and answering of questions. It could also involve activation of specific competence requirements by the individuals playing the typical roles of the activity. In this case, being the wizard (i.e., the system) requires a number or rather specialized competencies and abilities, while the user role requires somewhat less specialized competence.

3.2 Functional Specification of Activities

When it comes to the local activation of the function and purpose of the activity itself, this can often be captured by functionally specifying the activity into subactivities which have a means-ends relation to the activity as a whole. Each subactivity has its own function or goal which provides a local functional context within the activity as a whole. A subactivity can then be broken down into further subactivities, if this should be desirable for some purpose. As a baseline for the subactivities, we will assume a set of functions or purposes which can be realized through individual communicative behavior. When appropriate, we will refer to these as speech acts or, more generally, as communicative acts. It should here be noted that there is no one-to-one relationship between an instance of individual communicative behavior and the communicative functions, purposes, acts that can be realized through the behavior. In general, we assume that the relationship is one-to-many, since a statement like *it´s raining*, in a given context, easily, simultaneously to being a statement, can function as a request (e.g., to close the window), a warning and a reminder.[3]. It might even be argued that the relationship is many-to-many, since one can imagine individuals jointly making statements, like in the following example

A: Bill is going out
B: at six o'clock

If one feels uncomfortable with the notion of collective speech acts, one might alternatively say that A and B have both produced partial speech acts.

3.2.1 Functional specification of the WOZ experiment and the factual information seeking dialogue

[3] cf Allwood [2]

The overriding purposes of the WOZ experiment and the factual information seeking dialogue might be expressed as 1 and 2, respectively:

1. To carry out an experiment simulating a factual information seeking dialogue with a robust and cooperative computer concerning three areas of the yellow pages.

2. To provide factual information about three selected areas of the yellow pages in a way which is robust (tolerates spelling errors, nonconventional grammar, lack of spacing, lack of explicit information) and cooperative (considers the probable information needs of the user and gives quick, competent, sufficient, relevant and perspicuous information).

This purpose of the WOZ experiment can then be broken down into subgoals and subactivities like finding willing subjects, deciding how to simulate a computer, deciding what should be meant by helpful, robust and factual information, etc. Since a functional specification of the actual experiment as an activity is not our main concern in this paper, let us instead consider the purposes of the factual information seeking dialogue itself.

This overriding purpose of the information seeking dialogue can be connected with a number of more or less necessary subgoals and subactivities which serve as a means to realize the purpose.

3.2.2 Subactivities and subgoals of factual information seeking

1. *Opening interaction*
   - indicating ability and willingness to start (user and/or system)
   - opening channel (e.g., by greeting) (user and/or system)
   - identification of participants (user and/or system)

2. *Presenting query*
   - eliciting query (system)
   - presenting query (user)

3. *Evaluating query*
   - interpret query (system)
   - check if information is available and if there is a need for specification (system)
   - express evaluation of query (system)

4. *Specifying query*
   - elicit specification (system)
   - provide specification (user)

5. *Answering query*
   - report inability to provide information (system)
   - accept inability and terminate (user)
   - give desired information (system)
   - accept information and confirm receipt (user)

6. *Evaluating answer*
   - interpret answer (user)
   - check if information is adequate, sufficient, etc. and if there is a need for specification or supplementation (user)
   - express evaluation of answer (user)

7. *Specifying answer*
   - elicit specification (user)
   - provide specification (system)

8. Supplementary query
   - present supplementary query (user)
   - evaluate supplementary query (system)

9. *Expression of satisfaction*
   - elicit information regarding whether the user's information need is satisfied (system)
   - indicate that information need is satisfied (user)

10. *Closing*
    - summarize the information which has been given (system and/or user)
    - express gratitude (system and/or user)
    - indicate ability and wish to end (e.g., by greeting /system and/or user)

In shorter form the list of subactivities might be given as follows:

1. Opening
2. Query (main or supplementary)
3. Evaluation
4. Specification
5. Answer
6. Evaluation
7. Specification

8. Supplementary query
9. Expression of satisfaction
10. Closing

A further simplification would be to say that information seeking dialogues consist of:

1. An opening
2. Queries (main and supplementary)
3. Answers
4. A closing

These four functions are realized by one or more utterances, where each utterance elicits an evaluation of its own contribution and the next utterance either implicitly or explicitly gives this evaluation. If the evaluation is negative (or unclear), this can be directly reported by writing e.g. "I don't understand" or "I don't want to answer" etc., or more indirectly writing "what", "pardon" etc., or by asking for a specification or a clarification. Often the direct and the indirect negative report are combined as in "I don't understand, could you please clarify".

If the evaluation is positive,. This can also be directly reported by saying "I understand" etc. or indirectly by carrying out the evocative intention of the preceding contribution. As in the negative case, positive direct and indirect reactions can be combined as in "I understand. The answer is 2m".

All utterances, e.g. queries and answers, but also those which realize openings and closings are evaluated and, if need be, elicited, specified and clarified. Evaluation is, thus, a necessary ingredient of communication,. While elicitation, specification and clarification are useful ancillary communicative moves.

4 The Functional Structure of Individual Communicative Expressions and the Determining Role of Preceding Discourse

4.1 Obligations and options

Let us now take a closer look at the functional structure of an individual communicative expression (we will use the term communicative expression as the general correspondent to what in spoken language is called an utterance). With the possible exception of the first and the last communicative expression of an interaction, the functional structure of a communicative expression can be characterized as follows:

1. Obligated (functions obligated by the (immediately) preceding discourse)

2. Optional (functions which are not obligated by preceding discourse)
3. Obligating (functions which are obligating for the (immediately) succeeding discourse

Above we have argued that each communicative expression with all its functions is relevantly influenced by certain global and local determining factors. Among the local factors, we have mentioned that an important part is played by the discourse which precedes a given expression (in particular the immediately preceding expression).

The obligated functions of an expression are, thus, those functions of an expression which, in a given context, meet certain obligating functions of a preceding expression. Two main types of obligating and obligated functions may be distinguished (cf. Allwood, Nivre & Ahlsén, [5]).

1. Obligations arising from requirements of interactive communication management

2. Obligations arising from requirements generated primarily by the interaction of the evocative dimensions of (non-management directed) communicative acts with the embedding (activity) context.

4.2 Obligations and Options arising from Requirements of Interactive Communication Management

Interactive communication management includes the following three types.

1. Basic communication feedback; i.e., whether sender and receiver are willing and able to
   - continue (start or end) communicating
   - perceive message
   - understand message
   - react to message (+ an indication of the nature of this reaction)

2. Turntaking; i.e., mechanisms for distribution of the right to communicate (more properly, for distributing the right to be sender and possibly also the obligation to be receiver). Turntaking functions include: having - not having turn, taking (interrupting) - refusing turn, accepting-giving up turn, keeping-losing turn and assigning a turn. As we can see, turntaking is, thus, conceptually related to the ability and willingness to continue communication.

3. Sequential structuring (of communicative acts, subactivities, topics, etc.); Since this last type of management function concerns, for example, entering or leaving subactivities, it is more often globally than locally determined.

Each interactive communicative expression is assumed to realize one or more positive or negative feedback and turntaking function. The realization can be explicit by special linguistic mechanisms or implicit through communicative acts which presuppose particular feedback and turntaking functions. Some interactive communicative expressions, besides feedback and turntaking, realize global sequential structuring functions.

The requirements of feedback and turntaking are met through the pairing of obligating and obligated aspects of adjacent expressions with regard to the basic communicative functions of feedback, i.e., continuation, perception, understanding and reaction, as well as turntaking.

The options of feedback and turntaking concern:

- whether the information is implicit or explicit
- choice of specific kind of feedback and turntaking information

The corresponding obligations could be restated as the single requirement that each contribution gives and elicits information about feedback and turntaking. Note that a consequence of this view is that also a refusal to communicate will count as giving information, albeit negative information, on feedback and turntaking.

4.3 Obligations and Options Arising from Interactive Requirements of Communicative Acts

Besides obligations related to the interactive management of basic communicative functions, there are obligations related to particular communicative acts. Perhaps the best way of illustrating this is to present a table of these obligations as they are related to the stereotypical expressive and evocative functions of the four moods declarative, interrogative, imperative and exclamative, cf Allwood, Nivre & Ahlsén [6]).

The claim made by the table is that the declarative, *the door is open*, stereotypically is used to express a judgement by the speaker with the evocative intention of getting the listener to share the judgement. Similarly, an interrogative like, *Is the door open*, stereotypically is used to express an act of wonder, connected to a desire for information, with the evocative intention of receiving the desired information from the listener, etc. When communicative expressions realizing the stereotypical combinations of the expressive and evocative functions of the four moods are used for communication in some social activity, certain stereotypical obligations or with a weaker formulation, expectancies are generated.

Table 2. *Mood Functions*

Mood	Expressive	Evocative
Declarative The door is open	Judgement (Belief)	Shared judgement (Belief)
Interrogative Is the door open?	Wonder Desire for info	Answer Giving desired info
Imperative Open the door!	Desire	Satisfaction of desire
Exclamative An open door	Arbitrary other attitudes	Attention

These obligations are the result of the interaction of mood functions with (i) considerations of rational motivated action, ethics and cooperation, (ii) language specification conventions and (iii) activity requirements and conventions.

The obligations are of two types:

1. obligations contracted by the sender through the use of the mood (sender commitments or sender obligations)

2. obligations which the sender attempts to put on the receiver(s) through the use of the mood. These obligations directly correspond to:

   (i) An obligating function generated by the mood carrying expression in a particular context (potential receiver obligations) and

   (ii) the corresponding obligated functions found in an actual response to this expression (response obligations or actual assumed receiver obligations).

If we connect the mood functions with mood obligations that might arise in some particular context, the result generated might, for example, be the one shown in Table 6.3.

In the table, CPU indicates contact, perception and understanding, the three basic feedback functions of AI management. Let us illustrate the way the table is to be read by analyzing an example of a factual information seeking dialogue.

Table 3. *Moods: functions and obligations*

Mood	Expressive	Evocative	Sender related obligations	Receiver related obligations	
				Potential Receiver obligations	Response obligations or Actual assumed receiver obligations
Declarative	Belief	Belief	1. Actual belief 2. Evidence 3. Belief that R can understand and evaluate expressed judgement	1.Accept CPU & evaluate & report 2.Report on evaluation	1. Report on acceptance 2. Report on evaluation
Interrogative	Wonder	Answer	1.Actual wonder 2.Need of info. 3.Belief that R can provide info.	1.Accept CPU and evaluate if possible to provide info.& report 2. Find info. 3. Report	1.Report on acceptance 2.Answer (report on found info.)
Imperative	Desire	Satisfaction of desire	1.Actual desire 2.Need 3.Belief that R can satisfy desire without risk to himself	1.Accept CPU & evaluate if possible to satisfy desire & report 2. Satisfy desire 3. Result or report on result	1.Report on acceptance 2.Desired action (and or report on desired action)
Exclamative	Any attitude	Attention	1.Actual attitude	1. Accept CPU	Optional report on on CPU

(1) U: I would like some information about Korean restaurants

S: Unfortunately, there is no information available. We have no Korean restaurants listed in Göteborg. Would you like information about any other kind of restaurant?

Since we do not have the discourse preceding the user's contribution, we will abstain from commenting on it's obligated aspects. The remainder of the analysis could look like this.

User: I would like some information about Korean restaurants

- Mood: Indicative:Declarative
- Optional:

- Speech Act: Request

- Expressive: Judgement (belief) concerning own likes and desires to the effect that sender has a desire for information

- Evocative: That receiver shares this judgement (belief) and, consequently, tries to satisfy desire for information

· Obligations:

- Sender related obligations:
  1. Sender has the belief expressed
  2. Sender has evidence for this belief, i.e., that sender has a desire for information
  3. Sender has a reasonable need for the information

- Potential receiver obligations:
  1. Accept CPU and evaluate & report
  2. Evaluate whether judgement can be shared & report
  3. Evaluate whether desired information can be provided & report
  4. If possible, provide information

System: Unfortunately, there is no information available. We have no Korean restaurants listed in Göteborg. Would you like information about any other kind of restaurant?

· Mood: Indicative-Indicative-Interrogative: YNQ

· Speech Act: Statement (excuse) Statement (explanation) Question (compensating offer)

· Obligated:
- IA:
  1. Implied CPU & turn acceptance
- CA:
  1 Implied sharing of judgement
2. Explicit negative evaluation of whether information can be provided (cancelling (4) above)

· Optional:
- Speech Act: Explanatory statement-question giving offer
- Expressive:
-

- 1. judgement
  2. desire for information
  3. willingness to provide beneficial action for receiver

- Evocative:
  1.that receiver shares judgement and accepts excuse
  2. that receiver provides desired information
  3. that receiver accepts beneficial action

· Obligations:
  - Sender related obligations:
    1. Sender has beliefs expressed
    2. Sender has evidence for beliefs, i.e., has searched data base
    3. Sender has the desire for information and the willingness to provide beneficial action that he has expressed
    4. Sender has a reason for this desire and willingness, i.e., that it has the role of helpful information provider in a factual information seeking system.
  - Potential receiver related obligations:
    1. Accept CPU and evaluate & report
    2. Evaluate own willingness and ability to accept statement containing excuse as well as question containing offer & report
    3. If evaluation is positive provide information

In section 6,5 below, we will use roughly the categories presented here to analyze an English WOZ dialogue.

After having somewhat lengthily considered the obligations generated by communicative actions, let us now turn to options. The options connected with communicative action concern:

1. whether to engage in communicative action over and above IA management obligations

2. choice of type of communicative action compatible with restrictions given by general and specific, global and local, collective and individual determining factors.

The choice of communicative act is, thus, always regarded as optional, within the degrees of freedom given by the determining factors. This is the reason why the label optional, in the example discussed above, has been used to characterize those of the user's and system's communicative acts which are not bound by the preceding contributions.

4.4 Obligations, options, requirements, assumptions, preferences

Instead of the concepts "obligated", "obligating" and "optional" which make a rather strong assumption about the relations which can hold between utterances in discourse, we could have chosen concepts which would have characterized these relations in a different and often somewhat weaker way. More specifically, we could have spoken about preferences assumptions, expectancies or requirements instead of obligations. For mainly methodological reasons, we have, however, chosen obligations. The methodological reason is that the use of this concept to characterize interutterance relations makes a strong claim about their contractual glue-like character. This claim can subsequently be modified in favor of concepts which characterize the relations in different or weaker terms.

The choice between the concepts mentioned above is, however, not mutually exclusive. Because of their differences, it is relatively easy to point to cases where several of them might be needed, as in the following:

A:could you come here
B: yes (moves towards A)

A possible analysis of the relations between A's and B's utterances is to say that A's utterance is a request couched in the form of a yes/no question, which has an obligated response, a yes or a no, and as a preferred response a yes. If analyzed in this way, we could, thus, for example, make use of the distinction between obligations and preferences.

4.5 Obligations, Options, Backward-Forward Orientation, Boundedness, Novelty of Information and Thematisation

The functional trichotomy obligating-optional-obligated is also related to the distinctions between backward-looking and forwarding-looking bound and free, response and initiative, old and new, topic and comment which have been proposed by different authors to capture various aspects of the way in which each new utterance in a dialogue, both is connected to earlier discourse and unconnected in the sense that it contributes something new. Just as above, we suspect that the mentioned pairs of terms do not cover the same aspects of the interrelatedness of discourse and that, therefore, a very fine-grained analysis could make use of all of them in slightly different ways.

The concepts chosen by us are related to the mentioned concepts roughly in the following way:

With regard to forward and backward orientation, all parts of an utterance can be potentially relevant in both directions, however, the obligated functions are mainly backward-looking and the obligating functions are mainly forward-looking. The optional functions have a lesser bias in either direction but are, if anything, slightly more forward-looking. Concerning the distinction bound-free, the obligated functions are bound by preceding discourse. Similarly, the obligated functions are most responsive and least initiating while the optional and obligating functions are least responsive and most initiating. Finally, the obligated functions of an utterance are perhaps to a greater extent than the optional and obligating functions related to information which is old or in topic or theme position, while the inverse holds for information which is new or in comment or rheme position.

4.6 Possible Rules and Regularities

Let us now turn to a consideration of what kind of regularities have been noted so far and to the question of whether rules could be formulated for these regularities and the supplementary question of the nature of these rules. One way of dividing the regularities observed would be the following:

1. Regularities depending on relations within communicative contributions
2. Regularities depending on relations between communicative contributions
3. Regularities depending on relations between general and specific, global determining factors (e.g., Gricean-like maxims and activity function) and local collective or individual features of communicative contributions.

Rules corresponding to regularities of the first type would be rules of phonology, morphology, syntax and semantic composition applying within and/or between the syntactically and semantically maximal units of a communicative contribution. Rules of this type could also concern the sequencing of pragmatic, semantic or syntactic maximal units within a communicative contribution. Finally, rules of this type regulate the placement of interactive (IA) and own communication (OC) management expressions in relation to non-management oriented expressions. For IA management, what here is involved, is mainly rules of addition and insertion, while OC management, in addition to these, also requires rules of deletion and reordering, (cf also Allwood, Nivre, Ahlsén [5].

Rules corresponding to regularities of the second type, which are the main concern of this paper, could be called rules of expectable exchange obligations and are of two main types:

1. CIAM exchange obligations
2. CA exchange obligations

Rules of the first type - rules of communicative interaction management (CIAM) exchange obligations - are rules which, in a context sensitive way, state correspondences between CIAM functions. Rules of the second type - rules of communicative action (CA) related exchange obligations - are rules which, in a context sensitive way, derive potential receiver obligations from the performed communicative actions and state expectable correspondences between potential receiver obligations and actual assumed receiver obligations.

Rules corresponding to the third type of regularities are also of several kinds:

1. Rules of functional activity specification - these are statements which specify a given function or activity into subfunctions and/or subactivities (cf above).The functional specification rules, thus, feed directly into the rules for CA exchange obligations.

2. Rules for supplementing local sender and receiver obligations by deriving obligations from activity roles and general considerations of rational, motivated (ethical, cooperative) action.

3. Rules stating restrictions and/or requirements on topic development, inference drawing, etc. We will not deal with this type of rules in this paper.

4. Rules stating restrictions and/or requirements on interactive task (communicative or otherwise) accomplishment (cf below).

5. Rules stating restrictions and/or requirements on information update, e.g., co-reference restrictions, nonmonotonicity, etc.

In the next section, we will now proceed to an empirical illustration of phenomena connected with rules and regularities of type 2 and types 3.1, 3.2 and 3.4. In section 6,6, we will discuss some possibilities of formalizing such rules and regularities.

5. Analysis of an English WOZ Dialogue

5.1 Introduction

We will first make some further remarks on the background assumptions for the analysis to be pursued below. The model we are using is roughly depicted in figure 6.1.

The states, which are affected by the discourse, contain the participants 'current belief-sets', as well as their 'current task structures'. (These are regarded as dynamic structures, and kept separate from some presupposed static structures.) Especially important are

the participants beliefs about each others beliefs and goals, since these will be instrumental in their attempts to cooperate, and to their manner of applying Gricean-like maxims. (Being relevant means, among other things, adapting to the others' interests; abstaining from telling what is already known presupposes some opinion on what is known by the other, and so on.)

The task structures consist of a number of tasks related to the activity of which the interaction is a part, as well as to tasks (obligations, reactions to expectancies) deriving from the communicative interaction itself. In the preliminary analysis we have explicitly listed only tasks related to the main activity, and given only a rather course-grained analysis of them at that. As the interaction goes on, the participants generate tasks for each other (and possibly for themselves). A task generated may be refused, but normally accepted. In order to solve a task, a participant may break it down into sub-tasks, some of which may be presented to the other party, who may in turn do likewise, and so on.

The set of tasks and their interrelations form the task structure, and we have given a picture of how this is changing during the interactions, as well as by what "general linguistic means" it is affected.

The *effects* of utterances, thus, correspond to the change of state that they cause/promote. It should, however, be noted that state-changes are affected also by other things than utterances (like, e.g., data base searches, internal planning and reasoning etc.) Thus the solution, and resulting canceling, of a task is normally not brought about by utterances alone.

The *properties*, both internal and relational, of utterances are also recorded in the analyses. As we have seen above, the model used for an analysis of interutterance relations looks roughly like figure 6.2:

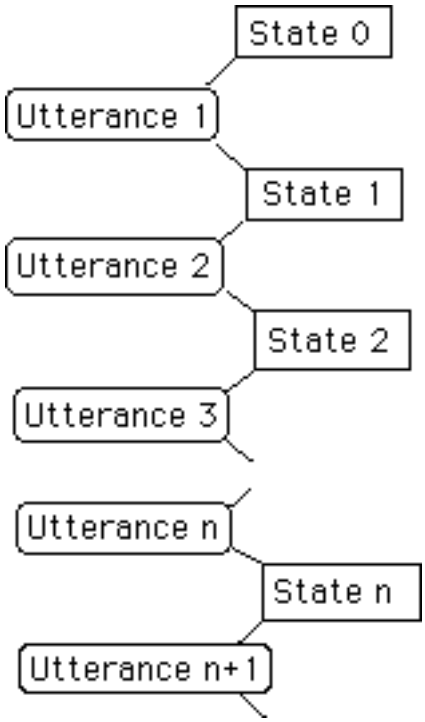

Figure 1: Interutterance relations and state changes

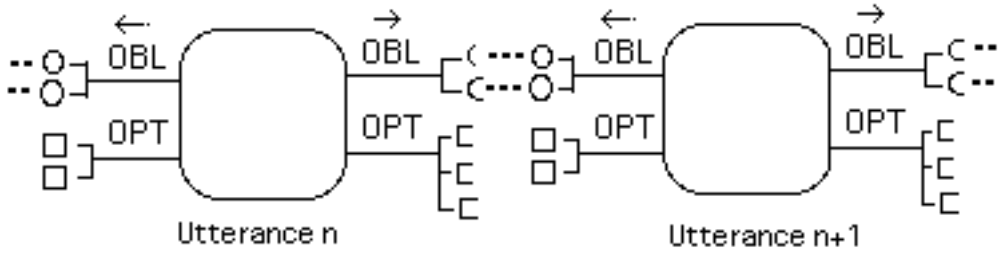

Figure 2: Interutterance relations - obligations and options

To the left we have 'in-coming' obligations and options, and to the right we have 'out-going' obligations/expectancies and options. A sequence of utterances form a 'locally coherent' part of a discourse if the 'in-coming' parts of each utterance in the sequence 'match' the 'out-going' parts of the (immediately) preceding one. Such a sequence forms, so to speak, an interlocked chain, where the locks (or glue) are (is) formed by the matching OBL and OPT parts of the utterances.

Amongst the properties of utterances recorded in the analyses some are 'inherited' from the expression type of the token used in the utterance. (Syntactic category and structure, as well as mode, belong here.) These properties are thus rather context-independent. Other properties are context-dependent, meaning that different tokens of the same expression type could differ regarding these properties.

5.2 Conventions of Analysis and Coding

In what follows we will "utterance-by-utterance" analyze one English WOZ dialogue, attempting in the analysis to make use of the analytical categories introduced above (mainly in section 6.4).

More specifically, the format will be that each utterance (communicative expression) is listed on a separate page with a partially coded analysis following it. The coding categories are, as far as has been possible, structured in the form of attributes and values. Below we now explain the categories with reference to the first "utterance" of the English dialogue. We will later attempt to analyze this dialogue in total.

Example 1:

U1: can i have a list of car hire companies in the Entwistle area.

Mood:Inter:aux.inv.Q:Y/N

<OBL

IA Man :	{TM :Accept turn
	FB : CPU Seq : }
CA Dep :	Follow instruction/accept offer*
	Cont.dep.: classification of SA type of U1 partly given by screen instruction

<>OPT

OC.Man:	
CA:	(Question), Request
	Expr: desire for info, wish
	Evoc: satisfy desire and wish

>OBL

CA Dep:	Sender(U): Have desire, have wish, have motive
	Receiver(S): Evaluate question and request, carry out request
	Cont.dep.: Answer should contain list satisfying predication of U1
IA Man	{FB: CPU}
	TM: Accept turn

Activity Status:	Opening - Query 1
	<opening interaction, presenting Query 1
	>elicit answer to Query 1
System tasks	ST1 = find and present list
User tasks	[UT1 = Enter request]*

*This is based on a guess about how the interaction started. We presume that the screen contained a text which could be interpreted alternatively as an instruction to subjects participating in the experiment or an offer to the users, e.g., something like: Please enter your request.

5.2.2 The contributed communicative expression (utterance)

The contributed communicative expression of example 1 is:

U1: can i have a list of car hire companies in the Entwistle area.

U1 indicates the name of the user's first 'utterance'. The utterance is reproduced without "cleaning up", i.e., uneven spacing, lack of capitals, spelling errors etc. are included.

5.2.3 Mood

Mood: Inter: aux.inv.Q:Y/N

The first coding which is done of an utterance is to assign a mood to it. So far, we have made use of the following moods, where ":" indicates successive values specifying attributes

Indicative (Indic) : Declarative (Decl) : Phrase (Phr) - includes sentences, phrase categories and word class categories
: List

Interrogative (Inter) : Auxiliary inversion (aux.inv.) : Yes-No-question (Y/N)
: Do-supported question (DQ) : Yes-No-question (Y/N)
: Tag question (TQ) : Yes-No-question (Y/N)
: Question word question (WhQ) : Wh-word
: Disjunctive question (DisjQ) :Yes-No-question (Y/N)
: Alternative question (Alt)

Imperative (Imp) :

Exclamative (Excl) :

5.2.4 Obligated functions

<OBL
IA Man : {TM :Accept turn
FB : CPU Seq : }
CA Dep : Follow instruction/accept offer
Cont.dep.: classification of SA type of U1 partly given by screen instruction

This part of the analysis attempts to capture the obligated (<OBL) functions of a contribution (or "utterance", cf above). First we code those functions which are connected with interaction management (IA Man). These are of three types: (i) turn management or turntaking (TM), (ii) feed-back (FB) and (iii) global sequential structure (Seq). As values of turn management we use turn taking - turn rejecting, turn accepting - turn giving, turn keeping - turn loosing - turn returning. As values of feedback we use contact (C), perception (P), understanding (U) and reaction (R). Usually R is left out since it's most important aspects are elaborated by the communicative act dependent (CA Dep) functions. Values of global sequential structuring (Seq) are, for example, opening, closing, summarization (of subactivities or topics). Seq is only used when there is an explicit linguistic indication of sequential structuring. When the structuring is implicit and concerns the relation between activity and subactivities, relevant information is given under the heading Activity Status.

"CA Dep" and "Cont.dep", as already mentioned, concern obligated functions and content features dependent on the content and type of communicative act of the preceding "utterance". Examples of values of Cont.dep are coreferential repetition (Co-ref:Rep), Coreferential anaphor (Co-ref : Anaph), coreferential ellipsis (Co-ref : Ellips). For both CA Dep and Cont.dep it is still an open question what a more extensive list of values might look like. In our analysis, as will be seen, we experiment with many different values.

Curly brackets ("{"and"}")" are used to indicate that functions are present (or filled) implicitly. Thus in example 1 the TM, FB and Seq obligations are met implicitly.

5.2.5 Optional functions

<>OPT

Own C.Man:
CA: (Question), Request
Expr: desire for info, wish
Evoc: satisfy desire and wish

Two types of functions are coded as optional:

1. Own communication management (OC.Man)
2. Communicative act (CA)

These functions are regarded as optional in the sense that they are not obligated by the preceding utterance. They are, however, as has been mentioned above, constrained by global determining factors.

OC.Man refers to mechanisms for planning and changing one's own contribution on-line, while communicating. Values of this attribute are, for example, change, choice and process.

CA refers to the communicative acts performed in the contribution. If there are several acts, they are listed as concatenated, e.g., statement-statement-request. As values of this attribute we allow most verbs and nouns that could be used to describe aspects of the act of communicating, including, of course, basic communicative acts such as statement, question, request and exclamation. Sometimes we use ordinary brackets (i.e."(" and ")") to surround communicative act labels we believe to be less important for the following interaction. Thus we believe that, from an interactive point of view, it is more important to classify USER 1 as a request than as a question.

Each communicative act is characterized by the attributes expressive (Expr) and evocative (Evoc). The values of "Expr" are the attitudes which are expressed by the communicative act, e.g., *statements* express belief, *questions* express desire for information, *requests* express wish and *exclamations* express any attitude. The values of "Evoc" are the evocative intentions which are connected to a communicative act, e.g., *statement* —evoke belief, *question* — evoke answer (providing desired information), *request* — evoke a desired action and *exclamation* - evoke attention. For concatenated communicative acts expressed attitudes and evocative intentions are enumerated in the sequential order of the respective communicative acts.

5.2.6 Obligating functions

>OBL

CA Dep:	Sender(U): Have desire, have wish, have motive
	Receiver(S): Evaluate question and request, carry out request
	Cont.dep.: Answer should contain list satisfying prediction in U1
IA Man	{FB: CPU}
	TM: Accept turn

Just as we have assumed that each contribution has two kinds of obligated functions, we assume that it also has two kinds of obligating functions:

1. Communicative act dependent (CA Dep)
2. Interactive management dependent (IA Man)

"CA Dep" has two values, sender related obligations, i.e., commitments made by the sender through the use of a certain communicative act, and receiver related obligations, which the sender tries to get the receiver to assume, and which, in fact, need the receivers acceptance in order to become operational. It is not the sender or receiver role per se, which is obligated through the use of a particular communicative act, but rather the persons taking these roles at a given moment. We have indicated this by putting U

for user and S for system in brackets after sender and receiver. This enables us, in a cumulative way, to keep track of the ways in which user and system become obligated through the interaction.

We have assumed two basic types of sender incurred obligations: (i) sincerity related obligations, whereby the sender commits him/herself to have the attitude expressed by the communicative act, and (ii) reasonableness related obligations, whereby a sender is committed to have reasons for his/her expressed attitude; e.g., a belief requires evidence etc.

With regard to potential receiver obligations, we have also assumed that:

1. The receiver should always evaluate willingness and ability to attend to the evocative intentions connected to the preceding communicative act and report if willingness or ability is not present.

2. If willingness and ability are present, he/she should attempt to realize the goals of the evocative intentions (i.e., believe statements, carry out requests, attend to exclamations etc) and if the result of such attempts is not evident through performed actions, report on the realization and

3. evaluate whether the communicative act activates other obligations he/she might have through activity role or as a motivated rational agent.

The values of the attribute "Cont.dep" are supposed to be obligating features which arise as the result of an interaction between the expressive and evocative aspects of the present communicative act and its content. For example, a which-question does not only expect an answer but, by content dependency, it expects an answer which gives an enumeration (which could contain 0 or more elements) of items satisfying the predication used in the question. This is also true of example 1, where there is even an explicit question about a list.

The attributes "IA Man", "FB", "TM" and "Seq" and their values "CPU", "Accept turn", etc. have the same meanings as discussed above. The only difference is that they are seen as obligating rather than obligated here. In our analysis we have left out "Seq" as an obligating attribute, except in the last contribution, since it is only relevant there.

The curly brackets ("{" and "}"), indicating that functions are implicit, have in our analysis been used to show that FB functions but not TM functions are implicit. The reason for this is that we assume that each contribution is terminated by, eg., pressing the 'return key' which is assumed to show up as, e.g., a prompt appearing on the receivers screen. This would then mean that turn giving obligating turn acceptance is explicit in the system, at hand, even if this can not be seen in the log.

5.2.7 Activity Status

Activity Status: Opening - Query 1
<opening interaction, presenting Query 1
>elicit answer to Query 1

This coding concerns the function of a contribution in relation to activity and local subactivity. "Activity Status" has as values the local subactivity or subactivities. (If several subactivities are superposed the names of the subactivities are given separated by hyphen ("—") as in example 1. Each contribution is then specified as to whether it is an obligated (<) or obligating (>) part of a subactivity and a further attempt is made of specifying what type of obligated or obligating activity/subactivity function it is. In example 1, we have guessed that U1, simultaneously, concludes a request to open interaction and a request to present a query, both of which have been elicited by the screen text. These two functions, in turn, create an obligation for the system to answer the query.

5.2.8 Task Structure

System.tasks ST1 = find and present list

User tasks [UT1 = Enter request]*

These codings represent an attempt to combine CA dependent obligations with local (sub)activity obligations, separately for system and user. The tasks represent a kind of 'discourse model' for system and user. When a task is first introduced in the analysis, it is, for convenience, given an informal description. When a task has been completed its designating expression (e.g, first user task: UT1) is enclosed in square brackets (e.g., [UT1]). If a task is abandoned or left uncompleted, its designating expression is enclosed in ordinary brackets (e.g., (UT1)). The tasks are numbered according to the order in which they are introduced in the interaction. We can also see that there is a correspondence between the task structure and the activity status of an expression. U1 concludes subactivities 1 and 2, which have both been introduced by the system. Simultaneously U1, thus, provides the actual query which it is the systems main task to answer.

It should also be noted that the record of task structures for user and system form part of the description of the 'state-boxes' of fig. 6.1, rather than of the utterances. Thus what is coded is an aspect of the state immediately "after" the utterance under which the code is found.

5.3 An English Factual Information Seeking Dialogue

On the pages that follow, we now present an 'utterance-by-utterance' analysis of an English dialogue from the UMIST corpus.

U1: can i have a list of car hire companies in the Entwistle area.

Mood:Inter:aux.inv.Q:Y/N

<OBL

IA Man :	{TM :Accept turn
	FB : CPU Seq : }
CA Dep :	Follow instruction/accept offer*
	Cont.dep.: classification of Sa type of U1 partly given by screen instructions

<>OPT

OC.Man:	
CA:	(Question), Request
	Expr: desire for info, wish
	Evoc: satisfy desire and wish

>OBL

CA Dep:	Sender(U): Have desire, have wish, have motive
	Receiver(S): Evaluate question and request, carry out request
	Cont.dep.: Answer should contain list satisfying predication of U1
IA Man :	{FB: CPU}
	TM: Accept turn

Activity Status :	Query —Query 1
	< opening interaction, presenting Query 1
	> elicit answer to Query n1
System tasks	ST1 = find and present list
User tasks	[UT1 = Enter request]*

S1: Where's Entwistle?

Mood: Inter:WhQ:where

<OBL
IA Man: {FB: CPU
TM: Accept turn
Seq: }
CA Dep: {Neg eval of ability to carry out request}
Cont.dep.: co-ref repetition of name in U1
<>OPT
Own C.Man:
CA: Question of clarification/specification
Expr: desire for info
Evoc: satisfy desire by presenting info
>OBL
CA Dep: Sender (S): have desire, have motive*
Receiver (U): evaluate, satisfy desire
Cont.dep.: Answer must concern location of named referent
IA Man: {FB: CPU}
TM: Accept turn

Activity Status: Specification (Query)
<Evaluate ability to answer query, Elicit specification
>Give specification

System.tasks ST1

User tasks [UT1], UT2 = provide system with info about location of Entwistle

* An acceptable motive for the user but not for the system is plain curiosity. Acceptable motives for the system are only such that are related to being robust and cooperative.

U2: Entwistle is outside Bolton.

Mood:Indic:Decl

<OBL

IA Man:	{FB: CPU TM: Accept turn Seq: }
CA Dep:	satisfy desire by answering question Cont.dep.: co-ref repetition of name in S1, Answer concerns location

<>OPT

OC.Man:	
CA:	Statement: answer Expr: belief Evoc: belief

>OBL

CA Dep:	Sender(U): have belief and evidence Receiver(S): evaluate, make use of IC for carrying out request in U1 Cont.dep.: Answer to U1 included in list for Bolton area
IA Man:	{FB: CPU} TM: Accept turn

Activity Status:	Specification (Query) <Presentation of specification >Evaluate specification and answer query
System .tasks	ST1
User tasks	[UT1], [UT2]

S2: There are a fair number of companies in Bolton - about three pages worth.

Mood: Indic:Decl

<OBL

IA Man:	{FB: CPU TM: Accept turn Seq: }
CA Dep:	{Pos eval of statement in U2, Neg eval of ability to carry out request in U1} Cont.dep.: co-ref rep of name in U2

<>OPT

Own C.Man:	
CA:	Statement {Explanation of why request in USER 1 is not carried out} {Indirect request for further specification} Expr: belief Evoc: belief, inference that system needs further spec

>OBL

CA dep:	Sender(S): have belief, have evidence Receiver(U): evaluate and react Cont.dep.:
IA Man:	{FB: CPU} TM: Accept turn

Activity Status:	specification 2 (specification 1 (query)) <Negative evaluation of sufficiency of specification in U2. Indirect elicitation of further specification. >Give specification 2
System tasks	ST1
User tasks	[UT1], [UT2], UT3 = react adequately on info given

U3:
<OBL
IA Man: TM: Accept turn
>OBL
IA Man: TM: Loose turn

S3:

<OBL
IA Man: TM: Accept turn
>OBL
IA Man: TM: Accept turn

(Probably unintended turngiving by user, and intended giving back of turn by system)

U4: Which companies do not have to have the car returned to the same as

S4:

<OBL
IA Man: TM: Accept turn—Return turn
>OBL
IA Man: TM: Accept turn

U5: address as hired from.

Mood:Inter:WhQ:which

<OBL

IA Man:	{FB: CPU TM: Accept turn (twice) Seq: }
CA Dep	evaluation of & reaction to WIZARD 2 (which serves as further spec of info task) Cont.dep.: co-ref with common noun (topic of query 1), presupposed: location of referent of queried topic the same as in USER 1 and USER 2

<>OPT

Own C.Man:	user has probably intended to correct message, but instead given turn over to system, who immediately has given it back ?? Probably incomplete deletion of "as".
CA:	Question, Expr: desire for info Evoc: find and present info

>OBL

CA Dep:	Sender(U): have desire for info, have motive Receiver(S): evaluate and satisfy desire for info Cont.dep.: Answer must provide equivalent of listing satisfying pred in U4-5
IA Man:	{FB: CPU} TM: (Return mistakenly given turn), Accept turn

Activity Status:	Specification 2 (Specification 1 (Query 1)) <Give Specification 2 (replace Query 1 by more specific Query 2) >Initiate answer of Query 2
System tasks	(ST1), replaced by the more confined ST2 = find and present list of companies in Bolton with one way rental service
User tasks	[UT1], [UT2], [UT3]

S 5:
Budget Rent-a-Car
Bradford House
287-289 Manchester Road
Bolton
0204 391611
One way rentals available
EuroDollar Rent-a-Car
Bridgeman Street
Bolton
0204 365373
Unlimited mileage, one way rentals available, all cars have radios
Hertz
Manchester North branch
061-273 8884
One way rentals, delivery/collection service, cheap local rates,
unlimited mileage

Just those three are in my list here.

Mood:Indic:List-Indic:Decl

<OBL
IA Man: {FB: CPU
TM: Accept turn
Seq: }
CA Dep: satisfy desire by answering question in U4-5
Cont.dep.: enumeration in form of list satisfying pred in U4-5
<>OPT
OC.Man:
CA: Statement(answer) of list-statement (comment on previous statement)
Expr: belief-belief
Evoc: belief-belief

>OBL
CA Dep: Sender(S): have beliefs, have evidence
Receiver(U): evaluate (esp. first statement)
Cont.dep.:
IA Man: {FB: CPU}
TM: Accept turn

Activity Status: Query 2
<Answer Query 2
>Evaluate answer & terminate or continue with new query

System tasks (ST1), [ST2]

User tasks [UT1], [UT2], [UT3]

U6: Can I have a price list for the cheapest cars for hire for 1 day from the listed companies?

Mood:Inter:aux.inv.Q:Y/N

<OBL
IA Man: {FB: CPU
TM: Accept turn
Seq: }
CA Dep:
Cont.dep.: presupposed: query topic restricted by U1, U2 and U4-5
<>OPT
OC.Man:
CA: request for info
Expr; wish for info
Evoc: find and present info

>OBL
CA Dep; Sender(U): wish for info
Receiver(S): evaluate and satisfy wish for info (answer question)
Cont.dep.: Answer should contain list of referents of query topic restricted by predication and properties given in U1, U2 and U4-5
IA Man: {FB: CPU}
TM: Accept turn

Activity Status: Supplementary specifying query 3
<Evaluation & specifying query
>Evaluate and answer query 3

System tasks (ST1), [ST2], ST3 = find info on prices and present cheapest cars from listed companies

User tasks [UT1], [UT2], [UT3]

S6: I'm sorry I've only got the Yellow pages here, they don't give any prices.

Mood:Indic:Decl-Indic:Decl-Indic:Decl

<OBL

IA Man:	{FB: CPU
	TM: Accept turn
	Seq: }
CA Dep:	explanation why answer can't be given
	Cont.dep.: YP presupposed as source of info for query topic

<>OPT

OC.Man:	
CA:	Exclamation & Excuse-Explanation-Explanation
	Expr: regret, belief
	Evoc: belief, excuse

>OBL

CA Dep:	Sender(S): has attitude of regret, has belief, has evidence
	Receiver(U): evaluate and react
	Cont.dep.: reaction should accept link between presupposed info source and query topic
IA Man:	{FB: CPU}
	TM: Accept turn

Activity Status:	Query 3
	<Neg evaluation of ability to answer Query 3
	>Evaluate response and terminate or continue
System tasks	(ST1), [ST2], (ST3)
User tasks	[UT1], [UT2], [UT3], UT4 = react on info by closing or by presenting new task for system.

USER 7: Can the car be delivered to me home?

Mood:Inter:aux.inv.Q:Y/N

<OBL

IA Man:	{FB: CPU
	TM: Accept turn
	Seq: }
CA Dep:	(Neg eval) suppl. spec. question
	Cont.dep.: presupposed ownership link between car and company, co-ref. me = user

<>OPT

OC.Man:	
CA:	Question
	Expr: want of info
	Evoc: find and present info

>OBL

	Sender(U): has want of info, has motive for want
	Receiver(S): evaluate and carry out request by more than minimal info
CA Dep:	(answer question), meeting request
	Cont.dep.: ref of car owned by company restricted by properties in U1, U2, U4-5, U6. Answer also restricted by pred in U7. Answer should explicitly or implicitly affirm (yes) or reject (no) the queried proposition
IA Man:	{FB: CPU}
	TM: Accept turn

Activity Status:	Query 4
	<(Neg eval of answer), suppl spec of Query 4
	>evaluate and answer Query 4
System tasks	(ST1), [ST2], (ST3), ST4 = find and present info on delivery at home
User tasks	[UT1], [UT2], [UT3], [UT4]

S7:
Hertz
Manchester North branch
061-273 8884
One way rentals, delivery/collection service, cheap local rates,
unlimited mileage
say they do that, most other big companies do it if you ask.

Mood:Indic:Decl

<OBL
IA Man: {FB: CPU
TM: Accept turn
Seq: }
CA Dep: Answer to WIZARD 7
Cont.dep.: Hertz instance of company owning car restricted to pred of U7.
Pro-predicates"do that","do it" co-ref pred of U7.
<>OPT
Own C.Man:
CA: Statement
Expr: belief
Evoc: belief
>OBL
CA Dep: Sender(S): has belief, has evidence
Receiver(U): evaluate and react
Cont.dep.:
IA Man: {FB: CPU}
TM: Accept turn

Activity Status: Query 4
<Answer to Query 4
>Evaluate answer to Query 4 and terminate or continue

System tasks (ST1), [ST2], (ST3), [ST4]

User tasks [UT1], [UT2], [UT3], [UT4], UT5 = react on info by closing or by presenting new task for system

U8: Does Hertz have a 24 Hr. service/

Mood:Inter:aDQ:Y/N

<OBL

IA Man:	{FB: CPU
	TM: Accept turn
	Seq: }
CA Dep:	{Neg eval of sufficiency of answer}
	Cont.dep.: Co-ref repetition of "Hertz"

<>OPT

OC.Man:	
CA:	Question
	Expr: want of info
	Evoc: find and present info

>OBL

CA Dep:	Sender(U): has want of info, has motive for want
	Receiver(S): evaluate and satisfy want of info
	Cont.dep.: Answer should affirm or reject queried proposition
IA Man:	{FB: CPU}
	TM: Accept turn

Activity Status:	Query 5
	<Neg eval of sufficiency of answer to Query 4
	>Answer Query 5
System.tasks	(ST1), [ST2], (ST3), [ST4], ST5 = find and present info on Hertz 24 h service
User tasks	[UT1], [UT2], [UT3], [UT4], [UT5]

S 8: I don't know I'm afraid. It's not specified in their advert, but then it isn't in anyone else's either.

Mood:Indic:Decl-Indic:Decl-Indic:Decl

<OBL

IA Man:	{FB: CPU TM: Accept turn Seq: }
CA Dep:	Neg eval of ability to answer-Excuse-Explanation Cont.dep.: Knowledge object given by implied proposition in U8. Pron "it" bound by abstraction over pred in this proposition. "Their" co-ref with Hertz in U8.

<>OPT

OC.Man:	
CA:	Admission-.Explanation Expr: belief (and regret) Evoc: belief (and excuse)

>OBL

CA Dep:	Sender(S): has belief, has evidence Receiver(U): evaluate and react Cont.dep.:
IA Manag:	{FB: CPU} TM: Accept turn

Activity Status:	Response to Query 5 <Neg eval of ability to answer >Eval answer, terminate or continue
Sysem.tasks	(ST1), [ST2], (ST3), [ST4], (ST5)
User tasks	[UT1], [UT2], [UT3], [UT4], [UT5], UT6 = react on info by closing or by presenting new task for syst.

U9: Thank you. quit

Mood:Excl:VP-Indic:V alt. Excl:VP-Imp:V

<OBL

IA Man:	{FB: CPU
	TM: Accept turn}
	Seq: closing
CA Dep:	(Evaluate response) and thank
	Cont.dep.: Object of thank S1-8, (esp S8),
	"quit" linked to screen instruction?

<>OPT

OC.Man:	
CA:	Thank and request
	Expr: gratitude-belief motivated by wish (to end interaction)
	alt. Gratitude-wish (to end interaction)
	Evoc: share belief and help realize wish,
	alt. satisfy wish by ending interaction

>OBL

CA Dep:	Sender(U): be satisfied, have belief, have wish to end, have motive for these
	Receiver(S): evaluate and satisfy wish to end
	Cont.dep.: "quit" bound to interaction as a whole
IA Man:	{FB: CPU}
	TM: terminate

Activity Status:	Closing
	<Evaluation of answer and dialogue
	>Elicit closing
System tasks	(ST1), [ST2], (ST3), [ST4], (ST5), ST6 = end interaction
User tasks	[UT1], [UT2], [UT3], [UT4], [UT5], [UT6]

S9: You'll need to type quit on a separate line to get off.

Mood:Indic:Decl:Cond
<OBL
IA Man: {FB: CPU
TM: Accept turn
Seq: }
CA Dep: {Neg eval of wish to satisfy users wish (to end)}
Cont.dep.: presupposed link between typing "quit" and termination instruction given on screen
<>OPT
OC.Man:
CA: Statement (instruction)
Expr: belief
Evoc: shared belief
>OBL
CA Dep: Sender(S): have belief
Receiver(U): evaluate and react
Cont.dep.:
IA Man: {FB: CPU}
TM: Accept turn

Activity Status: Closing
<Neg eval of closing attempt
>Evaluate and terminate or continue

System.tasks (ST1), [ST2], (ST3), [ST4], (ST5), (ST6)
User tasks [UT1], [UT2], [UT3], [UT4], [UT5], [UT6], UT7 = type "quit" on a separate line

U 10: quit

Mood:Indic:V alt. Imp:V

<OBL

IA Man:	{FB: CPU TM: Accept turn} Seq: closing
CA Dep:	Accept and follow instruction Cont.dep.: effect of typing "quit" given in S9, (and screen message?)

<>OPT

OC.Man:	
CA:	Request (instruction) Expr: belief, wish to stop alt. desire to stop Evoc: evaluate and satisfy wish alt. follow instruction

>OBL

CA Dep:	Sender(U): have belief, have wish to stop and motive for wish Receiver(S): satisfy wish* Cont.dep.: responsive action should be the object of wish (i.e. stop interaction)
IA Man:	{FB: CPU} TM: terminate seq: closing of interaction

Activity Status:	Closing <Acceptance of closing instruction >Evaluate and terminate
System tasks	(ST1), [ST2], (ST3), [ST4], (ST5), (ST6)
User tasks	[UT1], [UT2], [UT3], [UT4], [UT5], [UT6], [UT7]

* The systems obligation and/or right to evaluate the request to quit is diminished by the asymmetric relation between the user and system roles, in this type of dialogue.

6. On the Possibilities of Formalizing the Regularities and Functional Dependencies Found in the Dialogues

6.1 What should be formalized

It is not necessarily desirable to formalize the Communicative Activity Theory (CAT), at least not as a whole, since it is not the case that the system, as opposed to its designers, should use this theory. The system should behave in a certain way (helpful, robust, cooperative etc), but not necessarily by having access to, and reason from, an explicit theory of helpful, robust, cooperative etc. behaviour.

A similar remark can be made concerning some of the factors which, according to CAT, determines certain features of the dialogues. Thus that the system's purpose is to help the user to find information that the system has access to in some database is a global factor that is constant and therefore not one that necessarily must be explicitly stored in the system. The balance between what should be explicitly stored and used by means of inference processes, and what should be implemented as procedural features of the system is a difficult design issue.

Roughly the same goes for Gricean type maxims. Whether these should be formalized and explicitly stored in full generality, or if one should settle for the "relevant special cases" depends on how general a system one is aiming for. To take an example., how should the system treat the opening

U1: "I need a hire car for tomorrow afternoon"?

If uttered to an employee of a car hire company or to a psychiatrist or to a YP-information system, it would, in all probability, require quite different responses. A fully general, pragmatically competent, system should of course be able to decide on an appropriate response in these (and innumerably many other) cases. It could then look in some internal storage to find that it should enact a YP-information service system, and at some other place that it should be helpful etc. A less general, but still pragmatically competent, system could be designed to "automatically" exploit constraints valid in all its intended applications.

Exactly what level of generality should be aimed for has, of course, to be decided sooner or later (preferably sooner), and then it will be easier to tell precisely what aspects of conversation rules, global constraints etc that will have to be explicitly coded. Still, it is important to have a general theory, amongst other things in order to know what the special cases are to he special cases of, and to be able to show that they really are special cases.

6.2 Rules Of Communicative Analysis for the Analyze Dialogues

In this section we will discuss the possibilities of formulating give rules that cover the communicative activity occurring in factual information seeking dialogues of the analyzed type. We will concentrate on rules covering the activity from the systems point of view, and we will also here exploit the fact that we are dealing with a rather

specialized type of dialogue, in which one participant (the system) has the purpose of helping the other participant to obtain information from the Yellow Pages data base (YPDB). This means, inter alia, that the systems "interests" are subordinated to those of the user, and, thus, that the systems initiatives are restricted to those motivated by its purpose to serve the user's (expressed or inferred) interests. The resulting asymmetry in rights and obligations of the participants is an important source of simplifying constraints in comparison to those that might hold in an arbitrary type of dialogue.

The perspective chosen in this section is the following: the cooperative activity is carried out by means of a series (or, more accurately, a partially time-ordered set of) actions performed by the system and user. These actions gradually change, among other things, the informational and motivational states of the participants. The general goal of the system is, if possible, to provide the user with information (from the YPDB) that satisfies his/her desires for knowledge. In the paper we have so far concentrated on those phenomena of the activity that concern its communicative aspects. But besides overt communicative expressions, we will in this section also consider other types of actions, especially those performed by the system, like data base searches, acts of interpretation which are implied by or required for the use of communicative expressions.

A few words on activity status and task structure. These notions belong to different dimensions of analysis. Activity status pertains to the activity (in the case at hand a species of factual information seeking dialogue between a "client" and a "server") as such, whereas the task structure pertains to the participants in the activity. Especially the task structure is rather superficially described in the manuscript, and only partially coded in the analysis. So let's say something more. First, a task structure consists of more than a (list of the) tasks for the participants, namely relations between and properties of these. Such relations are, e.g., "replaces", "overrides", "interrupts", "is a sub-task of", "has precedence over" and so on, and some properties axe "is completed", "is in progress", "is temporarily stacked" etc. (Such properties and relations are not recorded in the presented analysis.) The idea is, of course, that the verbal exchange between the participants is partly aimed at regulating, controlling and reporting on the task structure and the work done on the tasks. (In cooperative activities a task of one participant may well be a sub-task of a task of another participant. In our type of activity, the ultimate control over the general task structure lies, of course, in the hands of the user.) The carrying out of tasks is however only partly done on the dialogue level. (To complete its tasks the system has, e.g., to make database searches etc.) The point of including at least some aspects of task structures in analyses is to make explicit what effects certain features of the dialogue has on some important nonverbal aspects of the activity and how these, conversely, influence aspects of the dialogue. Thus all aspects of a dialogue can't be captured by a description of the verbal intercourse alone. Not all regularities in a set of dialogues (corpus) can, consequently, be captured in a dialogue grammar dealing with only verbal aspects of the dialogues.

A 'typical sequence of actions' performed by the system in a phase of a dialogue might, at a rather coarse level of description, look something like this:

```
1. receive a string from the user
2. interpret the string as a 'message'
3. if the message is a request for information about some matter
        then: store the information that the user wants information about the particular
        matter
            transform the message to a YPDB search query
            search the YPDB for the desired information
            if the information is found
               then:  store this information internally
                      evaluate whether the info matches the users wants
                      evaluate whether the info is suitable to present to user
                      if so
                              then   transform it into a NL answer
                                     send the answer to user
                              else   (e.g. if there are too many YPDB-hits)
                                     decide on a suitable request for specification
                                     transform request into NL expression
                                     send the expression to the user and 'stack'
                                           the present task
                      else   construct an NL statement with the content that no
                                     information on the matter is available
                             send statement to user
               else if the message is a statement about the users wants or desires ....
and so on.
```

Obviously the above example is both grossly oversimplified and incomplete, but it points to a method for pursuing the goal of formulating action rules (including rules pertaining to a "dialogue grammar" etc) and deciding on what aspects of the dialogue history and the informational and motivational states of system and user that have to be represented.

As a matter of fact, we believe that all functional aspects of utterances covered in this paper have to be represented if the system is to be able to pursue a reasonably natural dialogue with a user. Thus actions like 'interpret string' and 'transform into NL response' have to be broken down into much more detailed action sequences, and given explicit preconditions and result requirements.

6.3 Production Systems

Production systems, or rewrite systems, are computational devices, well known from the theory of automata, mathematical linguistics, and recursion theory. Their mathematical properties have been extensively studied and are in many respects well known. Their computational power is, e.g., that of Turing machines (cf Post [18]). Production systems have also been used in modelling of psychological and cognitive systems (cf. Newell and Simon [17]; Buchanan and Feigenbaum [81), and they are nowadays a standard tool in expert systems technology (cf McDermott and Forgy [16]; Brownston et al [7]; Jackson [14]). A traditional production system has three

components: a set of productions, a work-space and a control system. The productions consist of condition- action-pairs. The workspace contains symbolic expressions which can satisfy (or fail to satisfy) conditions in productions. If a condition in a production is satisfied by an expression in the workspace, the control system may activate the production, which means that the action specified in the action part of the production is carried out. Usually this means that the content of the workspace is altered, possibly to the effect that the conditions of other productions become satisfied (or cease to be satisfied). The most important function of the control system is to handle so called conflict resolution in cases where two or more productions have satisfied conditions, and where the respective actions are incompatible, or where the carrying out of the action of one of the productions has the effect that the condition of another no longer is satisfied.

Production systems form a very flexible tool for modelling monotonic as well as nonmonotonic, inferences, deterministic as well as indeterministic dynamic systems, sequential as well as parallel calculations, and so on. They are also fairly easy to implement in, e.g., logic programming languages, which makes it possible to test rule systems at an early stage of construction. For many types of production systems, there exist well developed theories. This is the case for systems with monotonically growing workspace content, systems with strong restrictions on the expressions used in the workspace (and the productions), and systems which use fixed linear precedence orderings of productions as conflict resolution strategy. Also for other types of system there are theories and knowledge gained from numerous applications.

Some of the popularity of production systems as a theoretical tool in many areas no doubt derives from the rather intuitive character of the production rule form, which makes it possible to "understand" each rule in isolation, as it were. This, rather than the universality of the format, is the main reason for choosing a production rule format for early stage specification and development of complex systems.

We thus propose that, at least for a start, rules are given in the form of production rules, i.e., as pairs of conditions and actions (to be obligated or permitted if the condition is satisfied). The conditions concern primarily states of the dynamic records, like the user model, the task structure, the activity status, the discourse history (and especially the preceding utterance) and the actions pertain to the behaviour of the system. (It would be making our task too simple to already at this stage try to externally 'regulate' as opposed to 'predict' the behaviour of the user.)

Some examples of rather generic rules might be:

1. if the user has expressed a desire for information about a particular matter, then the system should construct a task structure containing at least the tasks to search the YPDB for that information, and to report to the user on the result of this search in a way that respects all the obligating functions of the utterance by which the user expressed the desire

2. if the user has expressed a belief with the content that the user has a desire for information about a particular matter, then the system should conclude that the user has thereby also expressed that desire, and

3. the user has expressed a desire for information on whether the system has information about a particular matter, then the system should conclude that the user has thereby expressed a desire for information about that particular matter

Together these rules should make user utterances of the types:

> "Which Indian restaurants are there in Gothenburg?",
> "I want to know which Indian restaurants there are in Gothenburg.", and
> "Do you know what Indian restaurants there are in Gothenburg?"

on the whole functionally equivalent with regard to the task of finding and reporting on YPDB information. However, a response beginning like "Yes, there are ..." would be odd as a reply to the first (and maybe the second) type of user utterance, and one beginning "Certainly, there are ..." would be even more odd as a response to the first type of user utterance, which shows that communicative functions over and above those pertaining to communicative act and content are important for, e.g., response planning. In this case, we see that the specified mood of the information request is important. A yes or a no (and equivalents like certainly) are expected (or weakly obligated) after a Y/N-Q, tolerated after a Declarative but odd after a Wh-Q.

7. Relation of the Proposed Analysis to a PLUS-like system

7.1 The Natural Language Engine

In terms of the analyses we have presented above and the architecture so far given for the PLUS system, the NL engine could be supposed to deliver a parsed analysis of a communicative expression which had as prominent features

(i) A structure separating OCM, IACM and MM parts of an expression (cf. Allwood, Nivre, Ahlsén 1990)

(ii) A mode (mainly for the MM parts)

(iii) A syncategorematic structure, especially a predication structure (mainly for the MM parts)

Scope and reference resolution as well as determination of categorematic predicates are deliberately left out. This kind of structure is then supposed to serve as an input to the cognitive analyzer and as an output from the response planner.

7.2 The Cognitive Analyzer

The cognitive analyzer takes as an input a string of the kind described in 6.7.1 and, in the terminology introduced above, it produces the following six types of analysis (we will mainly be concerned with the perspective of the system):

1. An analysis of OCM and IACM parts. Roughly speaking, in the dialogues at hand, unless there are explicit OCM and IACM parts, it can be assumed that there is no OCM and that IACM functions are implicitly positive, i.e., each contribution except the first and last, implies obligated and obligating "turn accept".

2. An analysis of the obligated communicative act dependent functions of the (user) expression. These can probably only be got through a matching procedure between (i) the obligating CA dependent (including content dependent) requirements of the preceding (system) contribution and (ii) the presently relevant obligations (on the user) arising from taking part in rational, ethical cooperative interaction, having a particular role in a particular subactivity of an activity, and (iii) the features of the parsed utterances which are compatible with these obligations.

3. An analysis of the optional functions of the expression, in particular what (optional) communicative acts it is used for. The mood of the expression, in combination with a consideration of requirements derived from a consideration of MRA (motivated rational action), role, activity and subactivity are probably very relevant for this kind of analysis. The analysis of communicative acts should also include an analysis of the expressed attitudes and evocative intentions of the

communicative act. This analysis can probably most profitably be done once the communicative acts have been determined.

4. An analysis of the epistemic and attitudinal commitments made in using the expression. These commitments are, in fact, the expression relevant expressive and evocative sender obligations discussed above, and are derived, more or less directly, from the attitudes given by 3, above, in combination with a consideration of the user's sender obligations (sincerity and reasonableness commitments).

5. An analysis of the obligating functions of the user's contribution. These can, together with considerations of the system's obligations as an ethically motivated rational cooperating agent, in a particular subactivity of the activity provide a major part of the input to the goal formulator.

6. An analysis of the presently relevant activity status and task structure. The results of such an analysis, possibly in combination with an analysis of topic structure and content dependencies, could then provide a major part of what has been called the "discourse model".

7.3 The Goal Formulator

Given an input to the goal formulator as described in 6.7.1 above, the output of the goal formulator could be expected to specify the following functions of the planned expression (functional goal plan):

1. Obligated functions
    (a): IA management
        (i) FB
        (ii) TM
        (iii) Seq
    (b): CA dependent
        (i) report on evaluation of preceding CA
        (ii) carrying out functions

2. Optional functions
    (a): Expressive & evocative
    (b): Communicative acts (compatible with 2A,1A and 1B above, and other determining constraints)

3. Obligating functions
    (a): IA management (i) FB
        (ii) TM
        (iii) Seq
    (b): CA dependent (compatible with 2A, 2B and other determining constraints)

4. Sender commitments
    (a): sincerity
    (b): rational motivation (reasonableness)

7.4 The Response Planner

In the response planner, the functions given by the goal planner have to be explicitly or implicitly, sequentially or simultaneously realized in a plan for a communicative expression specified down to roughly the following level:

1. OCM - IA - MM structure
2. Mood specification of mainly MM
3. A determinate syncategorematic structure, especially a predication structure of mainly MM
4. Determinate scope and coreference relations
5. Determinate aspects of categorematic predicates

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