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P. Falzon, René Amalberti, Noëlle Carbonell

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# INRIA

UNITÉ DE RECHERCHE  
INRIA-ROCQUENCOURT

Institut National  
de Recherche  
en Informatique  
et en Automatique

Domaine de Voluceau  
Rocquencourt  
B.P. 105  
78153 Le Chesnay Cedex  
France

Tél. (1) 39 63 55 11

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### DIALOGUE CONTROL STRATEGIES IN ORAL COMMUNICATION

Pierre FALZON  
René AMALBERTI  
Noëlle CARBONELL

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**DIALOGUE CONTROL STRATEGIES  
IN ORAL  
COMMUNICATION**

Pierre FALZON  
René AMALBERTI  
Noëlle CARBONELL

This work is the result of a collaboration between INRIA (P. Falzon), the Division Psychophysiology of the CERMA (R. Amalberti) and CRIN (N. Carbonell).

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## SUMMARY

An important issue in the conception of computer interfaces concerns the elaboration of efficient and acceptable dialogue systems. A design methodology is proposed, based on the study of human-human communication. When the prospective user population is to be composed of infrequent users, the analysis should focus on the strategies used by experts in a domain when interacting with domain-naïve interlocutors.

In these situations, there are at least two domains of expertise: expertise in the knowledge domain and expertise in operative communication. Only this last expertise is considered in the work reported here. The strategies of two subjects have been studied: both subjects have a long experience in the domain, but only one of them is an experienced (telephone) operator.

The dialogue control strategies differ. The strategy used by the experienced operator has two main characteristics: very early interpretations of the queries, based on a strong model of the client, and immediate proposal of a solution. This strategy is economical and well adapted to the standard situations (i.e. the situations corresponding to the model of the client). Even when the interpretation is erroneous or the model inadequate, the strategy remains efficient, allowing rapid shifts of focus towards the points of disagreement, thus facilitating the elaboration of a solution.

As a conclusion, the study proposes the design of systems functioning according to two different modes: an economical mode for the standard situations, a more powerful mode in case of a failure of the economical strategy. The main rules of the economical strategy are described.

Key-words: Communication strategy - dialogue design

## RESUME

Un point important dans la conception des interfaces homme-calculateur concerne l'élaboration de systèmes de dialogue efficaces et acceptables par l'utilisateur. Une méthodologie de conception est proposée, fondée sur l'étude de la communication homme-homme. Dans les cas où la population des usagers futurs doit être composée d'usagers occasionnels, l'analyse doit être centrée sur les stratégies utilisées par les experts d'un domaine lorsqu'ils interagissent avec des interlocuteurs naïfs.

Dans ces situations, deux domaines d'expertise peuvent être distingués: l'expertise dans le domaine de connaissance, et l'expertise dans la communication opérative. Seule cette dernière est considérée dans cette étude. Les stratégies de deux sujets ont été étudiées: tous deux ont une longue expérience du domaine, mais un seul est expérimenté du point de vue de l'interaction avec les usagers.

Les stratégies de contrôle du dialogue diffèrent. La stratégie de l'opératrice expérimentée se caractérise d'une part par des interprétations très précoces des requêtes, fondées sur un modèle du client prototypique, d'autre part par une proposition immédiate de solution. Cette stratégie est économique et bien adaptée aux situations standards (i.e. les situations où le client correspond au modèle). Même dans les cas où le modèle est erroné ou inadéquat, la stratégie reste efficace, permettant un recentrage rapide sur les points problématiques, et donc facilitant l'élaboration d'une solution.

En conclusion, on propose la conception de systèmes fonctionnant selon deux modes: un mode économique pour les situations standards, un mode plus puissant en cas d'échec de la stratégie économique. Les règles principales de la stratégie économique sont décrites.

Mots clés: Conception des dialogues, stratégie de communication

## 1. A FRAMEWORK FOR DIALOGUE DESIGN

An important issue in the conception of computer interfaces concerns the elaboration of efficient and acceptable dialogue systems. This design process, most of the time, is not made upon very solid ground. Designers' manuals only give very vague and 'common sense' guidelines (of the 'be friendly' style), which are of little help. Empiricism still tends to be the rule.

However, there is a growing need for design guidelines: more and more systems are built and put into use, for a variety of potential users, with different needs, education, training, and familiarity with and tolerance to the computer domain.

We would like to propose a specific methodology for dialogue design, based upon the following principles:

Principle 1: the fundamental criterion to take into account in dialogue design is the expected user population and the frequency with which this population will interact with the computer.

Principle 2: dialogue design must be based on the analysis of human-human communication. Although this may seem obvious to some readers, it certainly deserves some justification for many others, who may argue for instance that one cannot compare human-human communication to human-computer interaction, that one can wonder whether human-human communication is such a desirable model, that users do not wish the computer to behave like a human, but rather like an obedient, easy to use and ever ready machine. Nevertheless, we believe that, even though human dialogues may have some flaws, they are still the only model of a working communication system we dispose of.

Principle 3: dialogue design must be based on the analysis of human-human communication in situations analogous to those to be computer-assisted. This

implies that the design process must not be based on general linguistics (or on linguistics of the 'general' language) but rather on the study of the language used in similar contexts. As Argyle et al (1981) point out, in goal-oriented situations, it is not only each individual speech act that is goal-oriented, but the whole speech system. Research should then focus on these dedicated speech systems used in comparable situations. Knowledge of the general use of language is, to say the least, not sufficient for dialogue design.

Principle 4: if the prospective population is composed of professionals who will have to interact frequently with the system, the best strategy is to study the professional language of this population: this study will allow the choice of appropriate vocabularies and modes of expression (Falzon, 1983a and b; Kelly and Chapanis, 1977; Mathiassen and Andersen, 1984) and the design of systems adapted to the planning activity of the users (Sebillotte, 1983).

This strategy has two advantages. The first one has to do with the fact that natural language cannot be considered as a natural command language in work contexts (Falzon, 1984). In fact, professional languages are often restricted subsets of natural language (Kittredge, 1979). These restrictions, which are spontaneously created by the professionals, can be used in the design of computer command languages. As a consequence, this strategy avoids the use of natural language as an interactive medium, and thus avoids its major drawback: its need for a large amount of computer memory and processing power.

The second advantage of this strategy is the fact that the computer command language elaborated on the basis of an existing professional language can be used to introduce computer concepts into a profession. Nygaard (1984), who advocates this point of view, stresses that "professional

languages have always been reflecting changing technologies and social structures by changes in these languages" and that "the strategy of a profession should be to enrich in a carefully considered way its professional language with concepts related to information processing".

Principle 5: if the prospective population is to be composed of infrequent users, the best strategy is to study dialogues between prospective users and experienced professionals. For instance, if the projected application concerns airlines timetables, the dialogues between clients and airlines employees should be studied. Moreover, the emphasis should be put on what is said by the employees (and not so much on what is said by the clients). Experimenters have tended to focus on the users' utterances, thinking that these were what the system will have to understand, without taking into account the fact that these utterances are, for a large part, the consequence of the use of a specific dialogue strategy by the professional. We believe that dialogues between professionals and naive users are very much under the control of the experts, who, through their interactions with a number of different speakers, have become experts not only in their domain but also in communication in their domain. It is this expertise in operative communication that we need to study and to use as a model for elaborating computer dialogue strategies. In summary, if the system is to be used by novices, the dialogue should be guided by the system (cf Benbasat and Wand (1984) for a discussion of this point), and system guidance should be based on human dialogue control strategies.

This last point is probably the most controversial. The following text will try to give it some support through the presentation of some related experimental findings and through the analysis of a specific human-human communication situation, involving different 'users' (clients of a medical center) and 'communication experts' (telephone operators of that center, in charge, among other

things, of taking appointments for some services).

### Modelling the conversation partner

Psychologists have studied the regulation processes affecting language. Some of them have concentrated on a specific human linguistic ability: the ability to adapt language to the (supposed) knowledge of the conversation partner, and, consequently, the influence of a model of the interlocutor on language production.

Adaptive language behaviors can be found first at the lexical level. Anglin (1977) points out, for instance, that adults do not use the same denominations when they speak to children or to other adults. Moscovici (1967) notices that the vocabulary used by subjects in a given context (describing an engine problem) varies according to the supposed knowledge of the interlocutor.

The volume and type of dialogue vary with the level of knowledge. This point has been stressed by Deutsch (1974), in a study of dialogues between expert and apprentices with varying degrees of skill. Dialogues with novices are filled with word definitions and procedural explanations, dialogues with skilled students are shorter and composed mostly of accounts (by the apprentices) of the actions being performed.

Krauss and Glucksberg (1977) have devised a clever experimental situation in which the experimenter was asking passers-by his way to some point in town. The typical answer is brief, direct, and gives a minimal amount of information, in the sense that it supposes much knowledge on the interlocutor's side. In a second situation, the experimenter, before asking his way, mentioned that he was from out-of-town. In that case, passers-by gave longer and more explicit explanations, indicating different landmarks on the way and details on the procedure. The same effect is obtained if the experimenter adopts a strong accent. This experiment clearly shows how a model of the interlocutor directly structures the communication content and strategy.



The accuracy of this model has a direct effect on communicative performances. Harris et al (1980) have studied the consequences of erroneous representations of the interlocutor's level of knowledge. The results indicate first that communication is optimal when the knowledge expectation is correct, second that both errors (attributing too much or too little knowledge) are detrimental to communication efficiency. These results are in agreement with the conclusion of a study by Thomas (1976). In his experiment subjects interacted with an 'intelligent' computer (simulated by another experimenter). Thomas observes that the interactions vary according to the level of knowledge of the subjects in the application domain and/or in the computer domain. This variation is so important that the author concludes that, in order to achieve a truly intelligent communication, future systems should be able to identify the type of user they are interacting with. Thus, intelligent dialogue depends on the elaboration of an accurate representation of the partner's knowledge.

#### Dialogue strategies

In the field of computer ergonomics, there is in fact very little experimental research conducted in the perspective described in Principle 5. As we have mentioned earlier, most research on expert-naive dialogues has been focused on what was said by the novices. It is difficult to find studies of the language of experts, and of the way they use language in order to cope with the requests of their interlocutors.

A very relevant work is reported by Evans (1976). This author has studied conversations between medical doctors and patients. These conversations can be considered as perfect examples of the situations that we think should be studied. Doctors are specialists of a domain (medicine) in which patients are naive. But, more important, doctors can be considered as experts in a specific type of dialogue: the medical interview. Evans gives the following results:

- although doctors find it difficult to describe the procedure they use to interview their patients, they do use dialogue strategies, that can be represented by "quite simple" flow diagrams;
- the patients' responses use a very restricted vocabulary, and, very often, are limited to answers like 'yes', 'no', 'I don't know', etc. Even when the responses are longer, they are invariably coded by the doctors under the form of a simple statement. When responses are verbose or inconsequential, the doctor asks the patient an answer with yes or no.

The dialogue is thus strongly influenced by the strategy of the expert. The consequences of these results are very interesting in terms of system design. One goal of this study was the elaboration of an input interface for an interviewing machine to be used by patients in an hospital. The keyboard that was developed had only three keys: 'yes', 'no' and '?'.

One may consider that this is an extreme example of the dialogue limitations introduced by an expert strategy, and that the users should not be restricted to this extent. However, this study exemplifies very well our point, i.e. the fact that dialogue design can benefit from the analysis of the strategies used in human-human communication.

## 2. THE EXPERIMENT

### 2.1. Environment and task description

The experiment was conducted in a medical centre in which patients can get appointments to see different specialists. The secretaries of the centre act partly as telephone operators, transferring the calls to the departments, but they are also in charge of taking appointments for the medical specialties for which no specific information is needed, the other appointments being processed by the personnel of the concerned department.

For one hundred calls they receive:

- 30% concern the taking or modification of an appointment that secretaries process themselves;
- 30% concern appointments that they cannot process; these calls are transferred to the appropriate department;

- 40% concern requests to the services, personal calls, etc.

Two sources of information are used by the secretaries:

- external representations: different data bases are used: appointment agendas, clients card-indexes;
- internal representations, that can be divided into domain-related knowledge (functioning of the centre, basic medical information, related institutions, etc) and function-related knowledge (model of the client, model of the typical telephone caller, etc).

## 2.2. Subjects

The subjects were two secretaries, who will be considered approximately equal in secretarial experience, the first one having worked for two years as a secretary in the centre, the second one one year. The subjects differ sharply in experience in telephone communication: 10 years of experience for the first one vs 1 year for the second one. In the following text, the more experienced telephone operator will be referred to as Mrs V., the other one as Mrs C.

## 2.3. Data

We have focused on those telephone dialogues (between secretaries and clients) in which the conversation topic is the taking, or modification of an appointment. In all, 30 conversations belonging to that category have been studied.

Interviews with both subjects have been conducted on the following themes:

- How do you see your job?
- In your opinion, how do you process the calls relative to appointments? Do you use specific procedures? If yes, describe them.
- Are there other possible procedures, and why don't you use them?

We have thus been able to correlate our analysis of the telephone conversations with the views of the subjects.

## 3. RESULTS

We will begin by describing the general dialogue structure, without differen-

tiating too much between our two subjects. These differences will be analyzed in chapter 3.2., focusing on dialogue control strategies.

### 3.1. Dialogue phases

#### 3.1.1. General structure

All the conversations studied can be divided in three phases, the relative length of which is irregular:

- a phase of QUERY FORMULATION: this phase initiates the dialogue. The client formulates a request (or part of a request);
- a phase of NEGOTIATION. This is the second phase of dialogue, consisting, after a first interpretation of the query by the secretary, in agreeing on a date and time of appointment.
- a phase of AGENDA MODIFICATION for both speakers. The client and the secretary take note of the result of the preceding phase and add it to their respective data bases.

Here is an example of these three phases on a simple dialogue (in this example, and in subsequent examples, S stands for secretary, U for user. Examples are translated from French into English).

<1>

#### QUERY FORMULATION

S. Medical centre, good morning.  
U. I'd like to see Dr. X this afternoon

#### NEGOTIATION

S. Yes Madam, at a quarter past three?  
U. A quarter past three?  
S. Yes  
U. Allright.

#### AGENDA MODIFICATION

S. This is Mrs X?  
U. Yes.  
S. X, allright, I took it down.  
U. Thank you, goodbye.  
S. Goodbye Madam.

Conversation 1 exemplifies the standard pattern of dialogue: Formulation - Negotiation - Modification (the FNM pattern). However, conversations can have more complicated structures, as we will see later.

The word 'communication' will often be used in this text to refer to each of

the successive interventions of the participants in a conversation. Conversation <1>, for instance, is composed of 11 communications.

### 3.1.2. The query formulation phase

Query formulations vary in length, both in terms of number of communications and in terms of length of each communication.

For 12 queries, the clients formulate their requests in a single communication. 3 of these 12 queries are incomplete, in the sense that they do not provide the secretary with all the necessary information. A first client omits to mention that she is asking an appointment not for herself, but for someone else, absent at the time of the call. A second client requests an appointment with a specialist, but does not tell the secretary the very specific examination that is needed. The third client should have asked, before taking an appointment to discuss the results of a previous examination, whether these results are available.

These three examples indicate that the client does not always dispose of a correct representation of the secretary's information needs or of the order in which elements of information should be provided. These incomplete queries will give rise to dialogue incidents, related to the fact that the secretary, in the absence of indication about the specificity of the requests, uses her knowledge about the typical client to infer the elements that have not been stated. Let us consider for example the case of the client who does not mention that the appointment is taken for someone else, who will not be able to come before a few weeks. The secretary does not systematically verify these points: on the contrary, she refers to a model of the prototypical client, which assumes that, unless otherwise specified, the appointment concerns the person speaking on the telephone, and that clients want to get their appointments as soon as possible.

This model of the client is elaborated through numerous interactions between the secretary and the clients, and allows the secretary to limit the length of the conversations by using a set of default values instead of asking for more

information.

In 14 cases, the clients use several communications to formulate their queries. This does not mean that these requests are more complicated than those which are formulated in a single communication; they are, on the contrary, similar to those mentioned above. The question is then: how is it that the number of communications is greater in those cases?

Three factors seem to be responsible for this fact:

- understanding problems related to difficulties with the communication channel;
- desire of the client to keep in control of the conversation without taking into account the secretary's utterances;
- on the contrary, unwillingness of the secretary to take control of the conversation: this is particularly frequent in the case of Mrs. C, the less experienced telephone operator.

In most cases, the secretary improves the quality of the dialogue if, instead of passively following the course of conversation, she attempts to take control of the dialogue and to interpret the requests, even on the basis of incomplete information. Her first goal is to classify the request, and, in this purpose, she will choose the more plausible interpretation, sometimes asking for a confirmation, more often assuming the interpretation to be true and processing it immediately.

A second point must be stressed here: in order to classify the request, the secretary need not process extensively the client's words: a limited analysis of the linguistic 'input' is enough.

Consequently, a characteristic of this phase of query formulation, in which the secretary elaborates a representation of the client's request, is a partial understanding of the request. 'Partial', as Bisseret (1980) points out, should be understood in both senses of the word: the understanding is selective and biased. This partial understanding is supported by a large body of extra-linguistic knowledge: domain knowledge (about the medical centre, etc) and knowledge about the clients (their most frequent requests, the way the requests

are formulated in general, the most frequent errors, etc). The secretary's expertise in operative communication is modelled by this knowledge.

### 3.1.3. The negotiation phase

This phase begins as soon as the secretary has elaborated a first representation of the client's request, and, when things go well, ends when both speakers have agreed on a date and time of appointment. Different factors influence the progress of this phase, in particular the correctness and comprehensiveness of the secretary's interpretation, and the dialogue strategy she uses.

There are three possible situations.

#### Situation 1

The interpretation of the query is correct and comprehensive, and an appointment is decided.

Most calls belong to this category. Conversations can be extremely short (cf <1>). The secretary proposes an acceptable time of appointment, the client agrees and the negotiation phase is ended.

This ideal case is not general. Negotiation may give rise to a longer dialogue. In one case, ten exchanges are needed, only to reach a temporary date of appointment, to be modified if cancellations occur.

#### Situation 2

The interpretation of the query is correct and comprehensive, but no appointment is taken. Two conversations belong to this category, but for different reasons.

In conversation <2>, negotiation is impossible on the basis of the first interpretation of the query. The secretary then suggests an alternative possibility (see a general practitioner), and proposes to check the feasibility of this solution by asking the nurses of the department. Conversation is thus ended at this point, with no scheduled appointment, but, it can hardly be considered as a failure of the communication process: the secretary has done her best to satisfy

the client.

<2>

S. Medical centre, good morning.

U. My daughter, uh, she would like an appointment, well I don't know if it will be possible, today, she has a wart that should be removed on her knee.

S. Uh, well, in any case, the, well, the dermatologist will not be here before monday or tuesday.

U. Oh no, this is too far away...

S. Well, you should see a general doctor.

U. Well yes, but the doctor, he won't be able to do much, uh, it is a wart, it is rather big...

S. Do you want me to transfer you to the nurses?

U. Well yes, this is kind of you.

The second conversation of this category (conversation <6>; see below) is a real failure of the negotiation phase, for reasons that are related to the strategy used by the less experienced operator.

### Situation 3

This category concerns three conversations, which have ended by the taking of an appointment, but which have followed a pattern of dialogue which differs from the standard pattern FNM (query Formulation, Negotiation, agenda Modification). The following patterns are observed: F-N-M-F-N, F-N-M-N-F-N, F-N-F-N-M.

The first case begins with a standard pattern FNM. An appointment is scheduled, but the client raises a problem (she does not know whether she will get the results of a previous examination in time for the appointment). This new problem provokes a second phase of negotiation, ending successfully, without changing the appointment already scheduled (the physician will manage to get the results).

The second case (FNMNFN) begins also with a FNM pattern. Conversation could then stop here, but the client tries to get an earlier appointment. The operator indicate that this is not possible. The client then gives a new formulation to her query: she has fainted, and it is urgent for her to see a doctor. The operator accepts to consider the case as an emergency and proposes an immediate appointment. The client finally prefers to stick to the date previously agreed



upon. There is then no final phase of agenda modification.

The third case (FNFM) develops in the following way: the operator and the client have agreed on a date of appointment, and are about to begin the modification phase, when the client incidentally mentions a point that changes the operator's interpretation of the query. A second phase of formulation occurs, followed by a negotiation phase and a modification phase.

The interest of these three cases is to stress the fact that, although most conversations follow a standard FNM pattern, some are more complex: speakers return to prior phases, change the problem definition, challenge the agreed solutions. It is in fact during the negotiation phase that the interpretation of the queries are tested and that errors and missing elements are spotted.

#### Some particular cases

Two conversations deserve some special attention. These two dialogues are cases of standard FNM patterns.

The first one is characterized by long and emotional interventions of the caller. The operator attempts to stop the client discourse several times, by proposing, very early in the conversation, a possible appointment. The client, as it seems, does not even hear the repeated proposal, absorbed by her problem. In that case, the operator waits until the client has given her a definite positive answer before initiating the agenda modification phase, and she asks her several confirmations of the schedule.

The second case (conversation <4>; see below) shows the strong influence on dialogue of a model of the client, and some characteristics of this model. The model becomes apparent because the call is very untypical, for three reasons:

- the appointment is wanted for a rather distant date;
- the client is not calling for herself, nor for someone of her family, but for someone else;
- the person for whom an appointment is wanted is not covered by the Social Security.

The model of the prototypical client postulates that the callers want an ap-

pointment for themselves or for someone of their family, that they are covered by the Social Security, and that they want their appointment as soon as possible. The differences between the model and the actual case are obstacles in the dialogue that the operator has to overcome. The model facilitates the interactions in the standard cases as much as it provokes clarification dialogues in the unusual situations.

#### 3.1.4. The agenda modification phase

The agenda modification phase begins as soon as an appointment has been agreed upon. This phase can be presented as the filling in of a frame in which all the information necessary to the centre appear: name and surname, file number if known, in case of a first appointment information on the documents needed. This phase may not occur at all if no appointment is taken. The modification phase is longer and give rise to more control messages when the preceding phases have been long and difficult.

In the majority of cases, the operator has the initiative in this phase. She requests information in a sequential way, repeats it and concludes with a recall of the scheduled appointment. In some cases, the situation is different: some clients are old customers of the centre and know the pieces of information usually requested. These clients provide the information before being asked (e.g. their file number). In the same way as the operator disposes of a model of the client, these clients have built a model of the operator, allowing them to anticipate the secretary's requests.

But this is a particular case: the general case is that only the secretary knows the rules of this type of conversation. Old customers have acquired part of these rules. It is striking to notice that the conversations with these clients are among the shortest of our sample.

## 3.2. Dialogue control strategies

### 3.2.1. Description

The description of the strategies is based both on the interviews of the operators and on the analysis of their interventions in the telephone dialogues.

#### The experienced operator: Mrs V.

Mrs V. has worked for eight years as a telephone operator before her present job. For her, the most important part of her work as an operator is dialogue control. She must manage to avoid the production, by the client, of long, muddled and sometimes emotional interventions, which are useless for the comprehension of the request. She considers that asking the client all the information that could be relevant to give an appropriate response is too long and dangerous, because it could encourage the client to make unwanted digressions. Consequently, as soon as she thinks the formulation of the problem is sufficient for making an interpretation, she tries to propose a solution.

A model of Mrs V.'s behavior in these situations can be described as follows:

- 'I pick up the phone and say 'Medical centre, good morning'' This takes care of the possible errors and initiates the dialogue.
- "I listen to the first sentence, and I try to categorize immediately the call. My goal is to detect at once the calls that shall be transferred (in which case my work is over)."
- If the call concerns an appointment, the operator then applies the algorithm presented in figure 1.

The analysis of the conversations shows that Mrs V. really uses this algorithm. It was the case for example in <1>. It is also the case in <3>, in which an appointment is proposed without asking the client the name of the doctor she wishes to see (several physicians are available).

<3>

S. Medical centre, good morning.

U. Yes, good morning Madam, could I have an appointment this morning with the generalist?

S. Oh yes Madam, yes, hold on, at half past nine?

U. Yes, alright....

The name of the physician will not be given, the client will discover it when she comes.

Conversation <4> shows that this strategy may not be satisfying for the client, to whom the operator proposes, after an incomplete interpretation, an inadequate schedule.

<4>

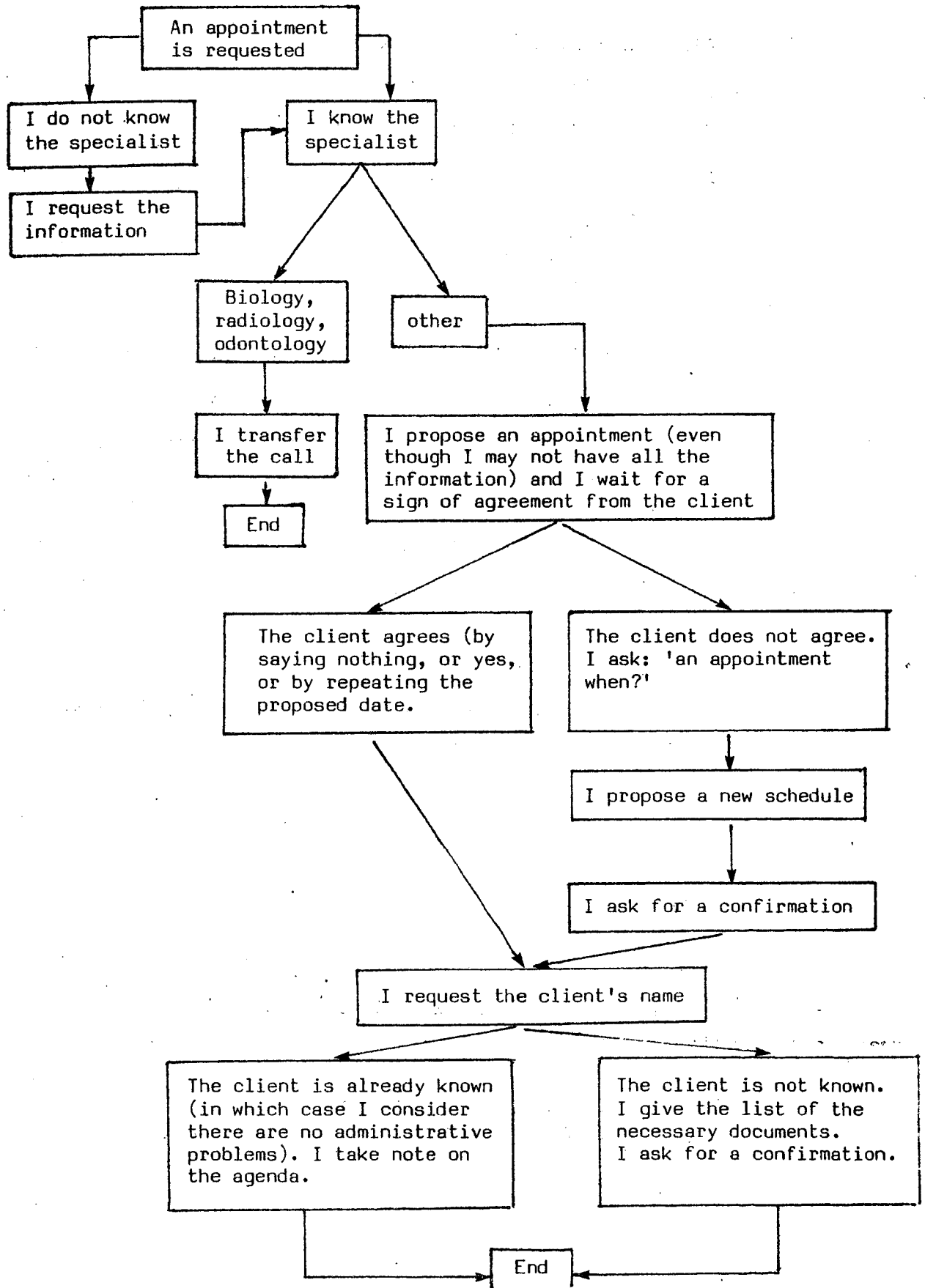
- S. Medical centre.
- U. Good morning Madam.
- S. Good morning Madam.
- U. I would like an appointment with the eye physician.
- S. Yes, the ophtalmologist.
- U. Yes.
- S. I am going to give you ... this afternoon, I still have a possibility, will that do?
- U. No.
- S. At a quarter past four.
- U. No, no, it's not for this month, it's for April, April the 16th.
- S. Monday morning?
- U. April the 16th.
- S. Yes.
- U. Monday morning.
- S. Yes, then at what time? Nine o'clock?
- U. At ten I prefer ten ...

A second characteristic of Mrs V.'s strategy clearly shows in this last example: the use of conflicts. In fact, Mrs V. knows that, by taking control of the dialogue, she may be proposing solutions which are in conflict with the request, because they may have been elaborated from an incomplete interpretation of the query. But she also knows that the client facing a conflict will formulate his request again, giving more precisions on the conflictive points.

Conflicts thus allow rapid, clear, precise reformulations, and should not be considered as "bugs" in the strategy. Communication efficiency seems to benefit from the secretary's early interpretations of the queries, even though they might be erroneous, since questioning an interpretation will help the client focus on the decisive elements.

When the number of possible interpretations is limited, the operator's performance will get even better if, instead of trying to get the confirmation of her interpretation, she tries to propose the corresponding solution. The

Figure 1: The dialogue algorithm of the experienced operator



client's answer will give her an evaluation of her hypothesis.

The less experienced operator: Mrs C.

Mrs C. is far less talkative about her job. She does not really see how to explain her method on the phone: "I must try and keep the lines free as much as possible... You know it's sometimes difficult to understand what people want... I wait until the client has completely formulated his request to give an answer. In any case, when I do not know the answer, I transfer the call."

As it appears in Mrs C.'s explanations, her strategy is very different from Mrs V.'s. The analysis of her interventions on the telephone confirm her statement. She tends to punctuate the dialogue with answers like "yes", or with repetitions of the client's last emitted message, encouraging them into giving complete requests.

<5>

S. Medical centre, good morning.

U. Good morning Madam, I would like to know if there is an ophtalmologist today?

S. Yes.

U. This afternoon, there will be one?

S. Yes.

U. Uh, could I have an appointment at eighteen, eighteen fifteen?

S. No, at sixteen.

U. Yes...

S. Uh...

U. Later is not possible?

S. Not later.

U. Well, never mind.

S. Goodbye.

U. Goodbye.

Mrs C. never takes control of the dialogue; she lets the client ask questions, and merely answers these. In some cases, this method sounds surprising, and one can really wonder whether the client has been satisfied or not. Conversation <6> is one of these cases. One can suppose that the initial intention of the client was to take an appointment, but nothing is proposed by the operator, and this intention cannot be verified.

<6>

- S. Medical centre, good morning.  
U. Good morning Madam, I would like some information: I would like to know who is the consulting gynecologist today?  
S. No one today.  
U. No one today?  
S. No.  
U. And tomorrow?  
S. No one, only on Friday now.  
U. Friday morning or afternoon?  
S. Afternoon.  
U. Is it Dr. X?  
S. It's her.  
U. Alright, thank you.  
S. Goodbye.  
U. Goodbye.

### 3.2.2. Strategy and efficiency

Five conversations of the sample we studied clearly show the influence of the strategy on the efficiency of the dialogue. In three of these conversations, the passivity of the operator leads to long phases of query formulation. Instead of letting the initiative to the client, the operator should have taken control right after the first message, either because the client has difficulties in explaining a rather complex problem, or because all the important elements of information are mentioned in the first utterance.

In conversation <5>, the query formulation phase would have been shortened if the operator (Mrs C.) had, immediately after the first intervention of the client, begun the negotiation phase by proposing an appointment.

Conversation <7> is characterized by difficulties of a different kind. At first, the operator understands the first communication as a request for an appointment. Discovering her error, she switches to an interpretation in terms of request for modification of the schedule. Consequently, she begins to ask information about the appointment to be cancelled. The fourth intervention of the client finally make her understand the request.

<7>

- U. Good morning Madam, I have an appointment with Dr. X, please, I took it one week ago.  
S. You want an appointment?  
U. No, I have an appointment.

S. Today?

U. Yes.

S. At what time?

U. At half past nine and I'm waiting for the bus, it's late, may I still come or ...?

These difficulties in understanding must not be interpreted as defects of the strategy. They are the results of the use of a model of the client that does not fit that non-standard case, but which is very well adapted to more usual situations.

In fact, the operator is much more efficient in usual cases if, instead of listening and memorizing the whole initial utterance of the client, she simply tries to detect in it some clues (linguistic or not), sufficient to categorize the situation. In other words, instead of aiming at a total understanding of what is said, she should attempt to class it as a familiar request. This enables her to use, in order to process the request, representations and schemata that are already known, including information such as:

- the number and nature of the pieces of information required to process each class of request;
- the algorithms that are applicable in order to understand and answer the request;
- the strategies that can be used in order to gain control of the dialogue in different contexts, to help the clients give relevant information about their requests, and to lead the negotiation.

The use of these representations and schemata explain:

- on one hand, the efficiency of the experienced operator, especially in standard cases; her absence of hesitation, her methodical questions, her skill in making up for the missing information, in interpreting correctly ambiguous formulations and implicit requests;
- on another hand, her lack of attention and her errors in understanding, in the cases when the requests are obviously too unusual to belong to an established category, even if similar cases have already occurred.

Conversation <8> presents a total failure of the expert strategy, and allows to describe it more fully. It is a very unusual request.

<8>

U. It is because my son took an appointment on the 25th of May at eighteen



thirty with...

S. With whom?

U. With the ophthalmologist and his file number is xxxx.

S. Oh... This is kind of you... Very kind of you Madam.

U. Well, that's not it, but we did not have the number this morning.

S. Well yes... hold on... wait until I can find it.

U. Excuse me, on the 24th... Laurent X

S. The 24th of June... No, it's a Sunday.

U. No...no...Not the 24th of June, the 24th of May.

S. We only are the 7th today... No we are on the 7th of June.

U. Yes but there it was on the 24th of May.

S. He had an appointment?

U. Yes

S. Yes... Oh yes... and then he did not come.

U. I would like to know whether he came or not.

The first utterance of the client mentions a date of appointment: the immediate inference of Mrs V. is that the caller requests an appointment. To reach this interpretation, the operator totally ignores one element of information (the date, May the 25th) provided by the client. This element contradicts her hypothesis, since the client cannot be requesting an appointment for a date that is already past (the conversation takes place on June the 7th). What happened is that the word "appointment" has triggered one interpretation among the possible request schemata. This interpretation has been built after a very superficial and partial analysis of the client's message. Conversation then goes on until the operator is faced with a complete impossibility: the appointment cannot be on a Sunday. At this point, the cognitive routine she is applying reaches a dead end, and she has to dismiss her hypothesis, which she does with some difficulty.

#### 4. CONCLUSION

The following remarks concern essentially the dialogue strategies to be implemented in systems when their future users are to be more or less naive in the domain. The possible applications that can be considered should be of a complexity comparable to the complexity of the application we have studied, for instance information and bookings in travel agencies, data base interrogation and updating, etc.

Two very different strategies have been presented: the first one attempts to gain control of the dialogue, to give focus to the user's interventions, the second one leaves the initiative to the users.

The question is then to evaluate the two strategies, their performances, and the comfort they provide. The discussion will consider separately the standpoint of the operators and the standpoint of the user.

Both operators are considered equal in secretarial experience; only their expertise in telephone communication will be discussed here. The years of experience of Mrs V. and the fact that other experienced operators (who have been interviewed) adopt the same attitude tend to prove that Mrs V.'s strategy is indeed an expert one. This strategy leads to acceptable results (for both speakers) in all the cases that have been analyzed. It may prove very quick and efficient in a number of situations. At worst, it allows clear reformulations of the requests, focused on the elements of misunderstanding. It avoids, through successive focalizations and dialogue control, the emission of irrelevant or emotional discourse which is useless, and sometimes harmful, for the satisfaction of the request.

In the case of the less experienced operator, observations are not numerous enough to demonstrate that her situation is not as comfortable as Mrs V.'s. From the standpoint of communication efficiency, her strategy seems less effective (cf for example conversation <5>).

For both operators, the operators tend to stick to their strategy, whatever the client and the type of situation. Unless a problem occurs, the strategy remains stable.

On the users' side, we do not have indications as to the strategy that is the most comfortable. Only a laboratory study could answer this question. However, in some cases, we can wonder whether the clients have had satisfaction when interacting with the less experienced operator.

From the standpoint of computer dialogue design, a first conclusion concerns the initialization of the conversation. Leaving the initiative to the user at the beginning of the dialogue (instead of, for example, presenting a menu) does not complicate the situation, since the computer will be able to gain control of the conversation with little difficulty after the first utterance without bothering the user, except in cases when the user wishes to keep in control of the dialogue.

The strategy of the experienced operator can be summarized as follows:

- in all cases, take control of the dialogue as soon as possible by asking precise questions relative to the relevant information; do not ask "open" questions that may give the initiative back to the user;
- if the object of the request is unclear:
  - \* just after the first utterance of the user, try and infer a possible interpretation, using for this purpose information about the prototypical users and their goals;
  - \* try and confirm the hypothesis, either by beginning a negotiation phase (i.e. by proposing a solution), or by asking for a confirmation; this second possibility is not to be used normally, but only in case of serious incomprehension or misunderstandings. In general, it is more effective to act as if the interpretation is correct; if the hypothesis happens to be wrong, it will provoke a reaction of the user, who will both reject the solution and correct the interpretation.

In order to improve their efficiency, systems should then be provided:

- with a knowledge not only in the application domain, but also about the prototypical users and their behaviors;
- with strategies analogous to Mrs V's strategy, instead of attempting to implement sophisticated linguistic parsers.

The superiority of this approach seems difficult to deny, when one thinks of the difficulties met by the understanding of natural language by computers. It seems at the moment more realistic to reduce the process of language understanding to the selection, in a finite set of possible interpretations, of the interpretation that fits best the request of the user, because this process can be based on a partial understanding of the user's utterance. Of course, this approach would be totally inadequate if applied to non-goal-oriented dialogues,

the content of which is unpredictable, by definition.

However, the expert strategy faces some problems when requests are unusual. In many cases, several interactions are necessary to the operator in order to understand the queries. But of course these non standard case are relatively rare.

A possible solution to this problem is the design of systems functioning at two levels of complexity:

- these systems would first attempt to process the requests by using an economical strategy, well suited to the standard situations;
- in the case of failure of this standard strategy, they would switch to a "debug" mode, which would call for higher level strategies (based in particular on models of the typical causes of failures, on models of the more efficient recovery algorithms, etc).

That second level of complexity is still to be studied. The very limited amount of data of this experiment is certainly insufficient to allow a description of the strategies used when the standard strategy fails. In this purpose, recordings should focus on the unusual, or strangely formulated, requests.

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