April 1982

EXPLORING THE ANALYSIS OF DISCOURSE BY MEANS OF A WORKING MODEL USING FLEXIBLE NATURAL LANGUAGE PARSING

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INTRODUCTION

We have recently been interested in the problem of how to model a communication system with the capability of parsing flexible natural language inputs within a limited task domain. The goals of this paper are to explicate how we are approaching this problem, why we have chosen the approach we are using, and how successful this approach has been so far and promises to be in the future. This paper is organized in terms of the three major parts of the problem statement given above. First, we will explain what we mean by a "model"; next, we will explore the concept of a "communication system"; and finally, we will examine the problem of "parsing flexible natural language inputs" within this system.

2. MODELS

The term "model" is used today in a variety of ways; this section begins by examining various meanings for the term. "Laymen commonly speak of models in reference to airplanes, toy houses, or sets of blueprints. They tend to associate the term with miniatures, objects, and/or plans drawn to scale" (Rosenfield, 1968, p. 66). This naive use of the term provides a valuable starting point, but more social scientific uses exist: "...perhaps the most popular usage of the words 'theory' and 'model' in economics reflects the viewpoint that the two words are synonyms" (McClelland, 1975, p. 29). This is probably the most popular usage in communication research, as well. One communication researcher indicates, "In modelling a process, we may enumerate the components or elements in the system and the structural relationships among those components, or we may specify the activities or functions of those components, or both" (Berlo, 1977, p. 84). Compare this definition of a model with the following: "...theories do not consist entirely of conceptual schemes or typologies but must contain lawlike propositions that interrelate the concepts or variables two or more at a time" (Blalock, 1969, p.2). In discussing communication models, Deutsch (1952) identified 4 purposes served by models: to help organize data, to generate thinking and hypotheses about the system, to provide predictions about the way the system works, and to indicate how to measure various states of the system. These purposes of a model are basically the traditional purposes of theories, i.e., to provide explanations and predictions, if not quite to provide control, of the area under scientific investigation. Indeed, some have gone so far as to claim that "...a model can be drawn from any source that promises to illuminate the phenomenon in question: it may be visual, pictorial, verbal-categorical, symbolic-mathematical, or whatever" (Farrell, 1980, p. 302).

In contrast to these illuminative or explanatory models is the notion we shall refer to as a working model. That is,

> ...there is another type of activity that is different from constructing theories. This other activity is to develop a process that will reproduce the same patterns of empirical data that are found in specific concrete situations. (Reynolds, 1971, p. 111)

One can better appreciate this difference by re-examining the layman's definition of a model that began this discussion. In terms of models as miniatures, there are two types of model airplanes. One type of model airplane is a visually accurate representation that simply sits on one's desk or shelf. Then there is a second type of model airplane that not only looks like a full size airplane, but also acts like one in that the miniature actually flies. It is this second sense of model, the working model, that we mean in the problem statement given above.

Clearly, the choice of a working-model approach provides unique challenges to human communication research. If one is serious about trying to create a model that "will reproduce the same patterns of empirical data" that are found in human communication systems, one must "develop a process" that actually communicates with humans. Only one nonhuman mechanism exists for creating such a working model. Consequently, this paper is a report on the construction of a natural language computer program capable of engaging in communicational dialog with humans. This communication system will be more fully discussed in the next section.

The choice of a working-model approach provides unique opportunities, as well as challenges. The fundamental advantage to this approach is the improved testing procedure it provides. With most communication research, the available method of verifying a theory or model is through statistical hypothesis-testing techniques. In essence, this amounts to arraying a series of studies all of which have a probability of occurring by chance that is less than the arbitrary alpha level of .05. Although many people can probably understand simple statistical procedures like chi-squared and the t-test, much current work uses more sophisticated multivariate methods that are less easily understood or interpreted. In addition, the old maxim that "figures don't lie, but liars figure", underscores the fact that the majority of hypotheses tested in social science research using statistical techniques turn out significant, due to demand characteristics of the procedures used, as well as other aspects of hypothesis testing. In contrast, the working-model approach using a natural language-based computer program does not encounter these problems. No one needs to know anything about experimental design or interpretation of statistics to test such a model. No one even needs to know programming languages or strategies in order to test such a model. One can simply sit down at a computer terminal and engage it in dialog. The extent to which the dialog appears natural and comfortable to the user provides the test of the effectiveness of the model. That is to say, unlike other research efforts that use statistics to test communication models, this approach uses <u>communication</u> to test the communication model.

3. COMMUNICATION SYSTEMS

As just mentioned, the communication system being modelled is a dialogic system. In communication research, the approach most concerned with dialog is termed conversational or discourse analysis (Coulthard, 1977). This research tradition draws upon several related perspectives, including speech act theory (Searle, 1969; Grice, 1975) and the rules approach (Cushman & Whiting, 1972; Pearce, 1976). Both of these traditions make the point that communication is not merely the transfer of information, but also involves an action or behavior in its own right. Speech act theory, for example, emphasizes the locutionary act as the symbolic/linguistic/informational aspect versus the illocutionary act as the actional/intensional/behavioral element of communication (Austin, 1962). The rules approach, on the other hand, emphasizes constitutive rules as those governing the assignment of meaning to symbols versus regulative rules which are those governing the sequential actions of an interaction (Pearce et al., 1980). This is not to say that the distinction between constitutive and regulative rules is the same as the distinction between locutionary and illocutionary acts, just as the constitutive versus regulative dimension is not the same as decoding versus encoding processes. But we do argue that these three dimensions (i.e., locutionary-illocutionary, constitutive-regulative, and decoding-encoding) are obliquely interrelated.

Most of the work done in natural language research has had an extremely limited conception of a communication system in mind. For example, SAM, PAM, and TALE-SPIN (Schank & Riesbeck, 1981) are all natural language programs that analyze stories in one way or another. Telling and listening to stories is certainly a communicative activity (Jefferson, 1978; Ryave, 1978), but hardly the prototypical case of human interpersonal interaction. The exception is a program like PARRY (Faught, Colby, & Parkison, 1974; Faught, 1977), that engages in conversational interaction by modelling the verbal behavior of a paranoid patient while the human user role-plays the psychiatric interviewer. The conversational mode is a more common context for human natural language usage and more in line with the focus of this project, but the rest of the model is far from standard. That is not to say that studying abnormal interactional patterns have no value (Labov & Fanshel, 1977), but that requests made during cooperative conversation are more typical than therapeutic discourse. In addition, all the example natural language models given above focus on the locutionary aspects of communication, largely ignoring the illocutionary.

When one begins to examine the ways computer science compliments social science by providing contexts in which dialog can be modelled, one is struck with the increased use of time-sharing interactive CRT's to conduct computer operations. There is growing interest in providing flexible natural language interfaces for computer systems to make interaction with them more graceful (Hayes & Reddy, 1979). Recent work on such natural language-based interfaces have been done with computer mail systems, checking-account management systems, and library reference systems. Such interfaces provide conversational contexts in which a model of a communication system can be created and tested. The authors chose an airline flight information and reservation system as the task domain with which to work, for three main reasons. First, such an interface involves not only the locutionary but also the illocutionary aspects of communicational dialog. That is, this task domain requires the transfer of information about flights in addition to the behavior of making or cancelling reservations. Second, there is a need for making computerized flight information systems more graceful and robust. We began this project by collecting a number of protocols of people conversing over the telephone with airline reservation agents, in order to assess the use of natural language within this task domain. And third, the task area has a large yet restricted range of potential linguistic inputs, providing a test-bed for the model. By "restricted", we mean limited to the task domain, in this case to the topic of airline flight information. This limitation, along with the maxim of relation identified by Grice (1975), which directs conversational interactants to be relevant in their remarks to the topic of discussion, allows the range of potential linguistic inputs to be defined and consequently parsed.

4. PARSING

We insist that linguistic knowledge is tied to individual words and that world knowledge plays a fundamental role in the parsing process. This is also affirmed by discourse analysts. In a recently published symposium on speech act theory, it was pointed out that "...a number of distinct interpretations can be assigned equally well to the same utterance," and that

> The assignment of interpretations to uttered expressions has been shown to depend on such syntactic factors as the form and structure of constituents and the sequencing of expressions in larger segments of discourse (e.g., conversations and speeches, paragraphs, stanzas, and chapters). It has also been shown to depend on such semantic factors as the denotative and connotative value of the lexical items used, and the knowledge of the world posessed by the author and the interpreter respectively. Finally, the assignment of interpretations to uttered expressions has been shown to depend on such pragmatic factors as the personal relationship and interpersonal beliefs and attitudes of the author and interpreter, and the conventions of utterance in force at the moment. (Sanders, 1981, p. 209)

Pearce and Conklin, when referring to the knowledge brought to bear on the interpretation of utterances within a dialog, say that their approach "...posits the existence of rules as something known by actors, and argues that the phenomena of communication require a model of hierarchical meanings" (1979, p. 76). Their hierarchy of meanings is similar to the one outlined by Sanders above. Our model is an attempt to incorporate more of those "pragmatic factors" into the parsing process.

When one examines the history of natural language modelling, one can recognize that the focus of the models have been gradually moving up the hierarchy. Early natural language programs were models based on "syntactic factors". Current programs, as exemplified by Riesbeck's ELI (1978), focus on "semantic factors" and conceptual world knowledge. The major difficulty in natural language research now is the problem of how to use more "pragmatic factors" in parsing. Specifically, most current models have utilized neither the information on the "relationship" between the interactants, nor on the "conventions of utterance in force" in the interaction. For example, ELI is a system that builds forms referred to as Conceptual Dependencies. Currently, these consist of 11 primitive actions: ATRANS (transfer posession), MTRANS (transfer of mental information), PTRANS (physical transfer), MBUILD (creation of new information from old), SPEAK, ATTEND, MOVE, PROPEL, GRASP, INGEST, and EXPEL. After the forms are produced, they are passed to frame (Minsky, 1975) or script (Schank & Abelson, 1977) interpreters that relate the forms to larger systems of understanding by integrating them into knowledge frames. These larger systems of knowledge, however, have no effect on the initial parsing process itself. The design of our model involves the interaction of a modified system of production rules and sets of knowledge frames, with influence flowing in both directions. Our current model is designed to use knowledge of the "conventions of utterance in force" in the dialog. A future model will incorporate knowledge of the "relationship" between the interactants. The model will be described more fully below.

Before continuing, a more thorough discussion of ELI will help show another way in which computer science research compliments the efforts of discourse analysts. ELI is a system of production rules that builds forms or structures, called Conceptual Dependencies. After the production rules produce these forms, they are passed to frame or script interpreters that relate the forms to larger systems of understanding by integrating them into knowledge frames. SAM, PAM, and TALE-SPIN, mentioned above, are examples of such frame interpreters that have been linked with ELI. Cognitive scientists and discourse analysts, as well as other types of social scientists, are well aware of the computer science concept of a frame or script. But even those studying communication from the rules perspective do not appear aware of the rule-based approach to computer science research using production rules.

A system of production rules, such as ELI, begins with a central processing queue or stack. Each word that the user inputs has an associated word-definition production rule. These rules test and/or modify the status of the stack, as the input words are processed sequentially. In essence, the two subtasks of testing and modifying the stack are directly analogous to the social science concepts of constitutive and regulative rules, although with computer rule-based processing they are incorporated into a single rule structure. That is, the constitutive rules examine the current context of the process in order to determine the relational meaning of the episode (Pearce et al., 1980), in a sense similar to the production rules testing of the stack. And the regulative rules guide sequential actions (Pearce et al., 1980), in a sense similar to the production rules modifying of the stack. Examples of word-definition production rules are given later in the paper.

As mentioned above, research projects are currently underway on flexible natural language interfaces to provide more graceful computer systems. In outlining the qualities of a graceful interface, one group of researchers identified what they considered to be the 7 major components of such a system. One of those is the following:

> Flexible parsing: The ability to deal with naturally used natural language, with all the ellipses, idioms, grammatical errors, and fragmentary utterances it can contain. (Hayes & Reddy, 1979, p. 3)

A problem with most of the current work on flexible parsing for computer interfaces is that they have generally had in mind an extremely limited operational concept of flexibility. One type of limitation imposed by most researchers is to maintain an historically standardized input structure. In every interactive system of which we are aware, there is a highly restricted division of input categories with a rigid structure that matches only one of the "naturally used natural language" structures of English, the imperative sentence.

Generally, inputs are given in the form of a command name followed by any number of required and optional arguments. For example, the VM/SP 1.0 version of the CMS operating system for the IBM VM/370 uses the following format:

COMMAND REQUIRED ARGUMENTS (OPTIONAL ARGUMENTS)

while the 2.4 version of the VMS operating system for the VAX11-780 uses this form:

COMMAND REQUIRED,ARGUMENTS /OPTIONAL/ARGUMENTS

Even those mentioned above who recommend making interfaces more flexible maintain this standard format. As an example, in their latest work on a computer mail system they criticize the following command:

HEADERS FROM "ROBERTSON" INTERSECT SINCE "MAY 15"

in that the command line is neither clearly understandable nor natural. Certainly the punctuation is not natural. This is an improvement over the IBM and VAX punctuation, but still not graceful. Their specific suggestion for improving this command line is the following:

DELETE THE MESSAGES THAT ARRIVED SINCE MAY 15 FROM ROBERTSON

In addition, as they explain, "a variety of terser command language inputs would also be acceptable, e.g., DEL FROM ROBERTSON AFTER 5/15" (Hayes, Ball, & Reddy, 1980, p. 48).

The improved command line is more natural and understandable, but could be more flexible. If they intend the flexibility to come simply from the terser or abbreviated command language, we must argue that this is not the critical sense in which natural language is flexible. Natural language does contain jargon, that provides abbreviations for frequently used concepts in closed task environments. But as mentioned above, all those command lines use probably one of the least often naturally occurring English sentence structures, the imperative. People often request or command action using a declarative or interrogative form (Jacobs & Jackson, 1980). A truly flexible interface should accept not only the suggested command line and its terser version given above, but also the following examples:

WOULD YOU DELETE MESSAGES RECEIVED AFTER 15 MAY FROM ROBERTSON

MESSAGES FROM ROBERTSON AFTER 5/15 SHOULD BE DELETED

This operational concept of flexibility would seem to be needed for a fully graceful system.

The discussion of imperative versus declarative and interrogative structures should not be understood as an attempt to trade one type of flexibility for another. We would not expect all input blocks to be sentences. Therefore, a second type of flexibility sought in our model is the capability to parse words, phrases, clauses, sentences, and paragraphs, i.e., any of a variety of "fragmentary utterances" with "ellipses" that naturally occur in language usage. This paper reports the construction of an interface designed to accept natural language inputs with both types of flexibility just described. In addition, we were concerned about providing the interface with a robust mechanism for word-sense disambiguation. This mechanism will be explained more fully below.

The model handles the problem of ellipsis within flexible inputs by defining a conversational or dialogic context in which ambiguity can be resolved. This conversational context constitutes the knowledge of the "conventions of utterance" mentioned above as being important "pragmatic factors" in the parsing process. This context is defined in the interaction between the system of production rules and the system of knowledge frames. Before one can understand the interaction between two systems, one must understand the structure of each system. Therefore, we begin by showing that the word-definition production rules follow a simple programming format that modifies and evaluates the current values associated with a processing stack. As an example, word-definition rules for the words "TO" and "ATLANTA" could be the following:

```
(TO (NEXT-WORD (TEST (EQUAL *NOUN-TYPE* 'PLACE))
               (ASSIGN airport2 *NOUN-VALUE*)))

(ATLANTA (ASSIGN *NOUN-TYPE* 'PLACE
                 *NOUN-VALUE* 'ATL))
```

If the user types in the phrase "TO ATLANTA", the parser ends by assigning "ATL" to the variable "airport2". By writing rules that allow the command statement to appear at any place in the input block, rather than only in first position, one permits the interface to parse the following input blocks into identical forms:

SAF CHI ATL

SHOW AVAILABLE FLIGHTS FROM CHICAGO TO ATLANTA

WHAT'S AVAILABLE TO ATLANTA FROM CHICAGO

I WANT INFORMATION ON AVAILABLE FLIGHTS LEAVING CHICAGO AND ARRIVING ATLANTA

The knowledge frames embody the interface's knowledge base about its capabilities, options, and response choices to user inputs. The design of the frames will be presented in terms of an example command from the frame that makes flight reservations. One of the first subtasks performed is to check on available flights between two given airports. On several of the currently used computer flight information systems, that command line must correspond with the following example:

A14MARCHIATL1P

in which the command "A" (for "available") is followed by four required arguments: the anticipated date of departure, the departure airport or city code, the arrival airport or city code, and the approximate time of departure desired. In a future model, this command line will have four subnodes associated with it. In our current version, it has two subnodes. First, the command node looks like the following:

```
(SHOW-AVAILABLE-FLIGHTS
     (DEPARTURE-AIRPORT-CODE ?airport1)
     (ARRIVAL-AIRPORT-CODE ?airport2))
```

Then there is one subnode for each of the 2 argument slots. For example, should the user type in the following:

WHAT'S AVAILABLE TO ATLANTA

the word-definition rules parse the input, then the frame interpreter checks the CURRENT-COMMAND's node to be sure all arguments were supplied. Since in this case there is a missing argument, the interface focuses on the following subnode to determine its response to the user's input:

```
(DEPARTURE-AIRPORT-CODE
          (STRATEGY1-IF-MISSING ...)
          (STRATEGY2-IF-MISSING ...))
```

These strategies are communicational in nature. That is, the frame not only stores information about the task domain, but also each subnode embodies the first half of a conversational "adjacency pair" (Jacobs & Jackson, 1980) by storing the model's request strategy designed to elicit a particular user response. The first strategy is generally a single sentence question displayed to the user, while the second strategy generally accesses a more detailed help file. Both of the strategies have the same two subgoals to be performed. The first subgoal is to display a message to the user to explain the problem and request clarification. The second subgoal is to modify the stack used by the production rules to anticipate an answer from the user. For example, in response to the user input given immediately above, the interface responds as follows:

FROM WHICH AIRPORT IS THE CUSTOMER LEAVING?

The user could type in "FROM CHICAGO", that could be easily parsed by analogous word-definition rules to those given above. But because of the question being asked at this point in the dialog, most people would expect to be able to type in simply "CHICAGO" and be understood. Since our knowledge-frame subnode modifies the stack by placing the word-definition of "FROM" on it, this ellipsis is anticipated.

So far, we have been describing the way in which the interaction of the system of production rules and the system of knowledge frames allows the parsing of flexible inputs with ellipsis. But we also briefly mentioned above that we were concerned about providing the interface with a robust mechanism for word-sense disambiguation. For example, one might infer from the inputs given above that the definitional rules for the word "AVAILABLE" would simply build a form saying that the SHOW-AVAILABLE-FLIGHTS command node should be referenced for the frame interpreter as the CURRENT-COMMAND. Were this the case, when the task gets far enough along at making a flight reservation that the user wishes to know the fares associated with available service classes, the following input block will be misunderstood:

WHAT'S AVAILABLE IN 2ND CLASS

We argue that this problem of word-sense disambiguation is closely related to the problem of ellipsis and can be similarly resolved by reference to the dialogic context discussed above. That is, the input "WHAT'S AVAILABLE IN 2ND CLASS" is an elliptical version of "WHAT TICKET PRICES ARE AVAILABLE IN 2ND CLASS", just as "WHAT'S AVAILABLE TO ATLANTA" is an elliptical version of "WHAT FLIGHTS ARE AVAILABLE TO ATLANTA". Normally, the rules of a production system are triggered only by the state of the user's input. By writing production rules that also are triggered by the state of the frame interpreter as it progresses through the nodes of a frame and from one frame to another, the dialogic context of the current block of input can be adequately defined and this dialogic context can be used to resolve the ambiguity.

5. CONCLUSION

At the beginning of this paper we enumerated three goals. The first was to explicate our approach to the study of discourse. In the section labelled "Models" we explained that our working-model approach is a natural language computer program with which a human can communicate. In the "Communication Systems" section we indicated that the program is designed as a model of cooperative, task-directed conversation. And in the "Parsing" section we analyzed the way the model utilizes an hierarchy of meanings to understand the utterances of the human user.

The second goal was to tell why we made those choices in our study of discourse. The first section indicated that the advantage of using a working model is that it allows the use of communication to test our communication model. The second section discussed how our model is more typical of human dialog than storytelling and therapeutic discourse. And the third section explicated the need to expand the knowledge brought to bear on the parsing of natural language, a need recognized by computer scientists and social scientists alike.

The third goal was to evaluate the success of our approach. In a sense this is problematic. As we said, the best way to evaluate its success is to engage the model in communication. Unfortunately, readers of this paper can not easily do this. Therefore, we have provided a transcript of a sample dialog in the Appendix. In terms of modelling a communication system, we have clearly been successful at choosing a more typical example of a human conversational context than past research. And our current parsing strategy is successful in two areas: allowing requests to be in imperative, declarative, or interrogative forms; and effectively handling elliptical inputs. Although predicting is always difficult, we believe our current success portends a promising future for this line of research.

REFERENCES

Austin, J. L. *How to do things with words*. New York: Oxford U. Press, 1962.

Berlo, D. K. Modelling the communication process. In T. M. Steinfatt (Ed.), *Readings in human communication*. Indianapolis: Bobbs-Merrill, 1977.

Blalock, H. M., Jr. *Theory construction*. Englewood Cliffs, N.J.: Prentice-Hall, 1969.

Coulthard, M. *An introduction to discourse analysis*. London: Longman Group Ltd., 1977.

Cushman, D. P. & Whiting, G. C. An approach to communication theory: Toward consensus on rules. *Journal of Communication*, 1972, *22*, 217-238.

Deutsch, K. W. On communication models in the social sciences. *Public Opinion Quarterly*, 1952, *16*, 356-380.

Farrell, T. B. Critical models in the analysis of discourse. *Western Journal of Speech Communication*, 1980, *44*, 300-314.

Faught, B., Colby, K. M., & Parkison, R. C. The interaction of inferences, affects, and intentions in a model of paranoia. AI Memo 253, Stanford, CA: Stanford U., 1974.

Faught, W. S. Motivation and intensionality in a computer simulation model. AI Memo 305, Stanford, CA: Stanford U., 1977.

Grice, H. P. Logic and conversation. In P. Cole & J. L. Morgan (Eds.), *Speech acts*. Vol. 3. *Syntax and semantics*. New York: Academic Press, 1975.

Hayes, P. & Reddy, R. An anatomy of graceful interaction in spoken and written man-machine communication. Pittsburgh, PA: Dept. of Computer Science, Carnegie-Mellon U., 1979.

Hayes, P., Ball, E., & Reddy, R. Computers with natural language skills. In S. Burks (Ed.), *Computer science research review*. Pittsburgh, PA: Dept. of Computer Science, Carnegie-Mellon U., 1980.

Jacobs, S. & Jackson, S. Strategy and structure in conversational influence. Paper presented to the annual meeting of the Speech Communication Association in New York City, Nov., 1980.

Jefferson, G. Sequential aspects of storytelling in conversation. In J. Schenkein (Ed.), *Studies in the organization of conversational interaction*. New York: Academic Press, 1978.

Labov, W. & Fanshel, D. *Therapeutic discourse: Psychotherapy as conversation*. New York: Academic Press, 1977.

McClelland, P. D. *Causal explanation and model building in history, economics, and the new economic history*. Ithaca, N.Y.: Cornell U. Press, 1975.

Minsky, M. A framework for representing knowledge. In P. Winston (Ed.), *The psychology of computer vision*. Hightstown, N.J.: McGraw-Hill, 1975.

Pearce, W. B. The coordinated management of meanings: A rules based theory of interpersonal communication. In G. Miller (Ed.), *Explorations in interpersonal communication*. Beverly Hills, CA: Sage Press, 1976.

Pearce, W. B. & Conklin, F. A model of hierarchical meanings in coherent conversation and a study of "indirect responses". *Communication Monographs*, 1979, *46*, 75-87.

Pearce, W. B., Cronen, V. E., Johnson, K., Jones, G., & Raymond, R. The structure of communication rules and the form of conversation: An experimental simulation. *Western Journal of Speech Communication*, 1980, *44*, 20-34.

Reynolds, P. D. *A primer in theory construction*. Indianapolis: Bobbs-Merrill, 1971.

Riesbeck, C. K. An expectation-driven production system for natural language understanding. In D. A. Waterman & F. Hayes-Roth (Eds.), *Pattern-directed inference systems*. New York: Academic Press, 1978.

Rosenfield, L. W. The anatomy of critical discourse. *Speech Monographs*, 1968, *35*, 50-69.

Ryave, A. L. On the achievement of a series of stories. In J. Schenkein (Ed.), *Studies in the organization of conversational interaction*. New York: Academic Press, 1978.

Sanders, R. E. The interpretation of discourse. *Communication Quarterly*, 1981, *29*, 209-217.

Schank, R. C. & Abelson, R. P. *Scripts, plans, goals, and understanding*. Hillsdale, N.J.: L. Erlbaum Associates, 1977.

Schank, R. C. & Riesbeck, C. K. *Inside computer understanding: Five programs plus miniatures*. Hillsdale, N.J.: L. Erlbaum Associates, 1981.

Searle, J. *Speech acts: An essay in the philosophy of language*. Cambridge: Cambridge U. Press, 1969.

APPENDIX

HELLO
WHAT IS YOUR NAME?

dave

NICE TO MEET YOU, DAVE
WHAT DO WE DO NOW?

i have a customer

WHAT DOES THE CUSTOMER WANT?

what can he want?

```
ON A FULL SYSTEM, YOU COULD:
        DISPLAY AND CHOOSE FLIGHTS
     OR EXAMINE AND CHOOSE SEATS
     OR MAKE A RESERVATION
     OR CHOOSE A PAYMENT METHOD
     OR CANCEL A RESERVATION
RIGHT NOW I ONLY KNOW HOW TO DISPLAY AND CHOOSE FLIGHTS
SO, DOES YOUR CUSTOMER WANT INFORMATION ON AVALIABLE FLIGHTS?
```

yes

TO WHICH AIRPORT IS THE CUSTOMER FLYING?

atlanta, ga.

FROM WHICH AIRPORT IS THE CUSTOMER LEAVING?

chicago, il.

****
ALTERNATIVE FLIGHTS

		ALT1	ALT2	ALT3
LEG TYPE	::	0	0	0
TO AIRPORT	::	ATL	ATL	ATL
FROM AIRPORT	::	ORD	ORD	ORD
FREQUENCY	::	DAILY	DAILY	X6
FROM TIME	::	7:00A	11:35A	2:30P
TO TIME	::	9:37A	2:22P	5:05P
AIRLINE	::	DELTA	EASTERN	REPUBLIC
FLIGHT NUMBER	::	519	249	274
CLASSES	::	FY	FY	Y
CRAFT	::	BOEING 727-200	DC9-S	DC9-50
MEALS	::	BREAKFAST	LUNCH	SNACK
STOPS	::	0	0	0
COMMENTS	::	-	STARTS 1MAY	-

****
WHICH OF THESE ALTERNATIVES IS CHOSEN?

alt1

WHAT DO WE DO NOW?

this is a round trip

****
ALTERNATIVE FLIGHTS

		ALT1	ALT2	ALT3
LFG TYPE	::	0	0	0
TO AIRPORT	::	ORD	ORD	ORD
FROM AIRPORT	::	ATL	ATL	ATL
FREQUENCY	::	DAILY	X6	DAILY
FROM TIME	::	9:27A	11:03A	2:33P
TO TIME	::	10:04A	11:40A	3:10P
AIRLINE	::	DELTA	DELTA	DELTA
FLIGHT NUMBER	::	440	614	540
CLASSES	::	FY	FY	FY
CRAFT	::	BOEING 727-200	BOEING 727-200	BOEING 727-200
MEALS	::	-	-	-
STOPS	::	0	0	0
COMMENTS	::	-	-	-

****
WHICH OF THESE ALTERNATIVES IS CHOSEN?

alt3

WHAT DO WE DO NOW?

show the flights chosen so far

****
LEGS CHOSEN SO FAR

		LEG1	LEG2
LEG TYPE	::	0	0
TO AIRPORT	::	ATL	ORD
FROM AIRPORT	::	ORD	ATL
FREQUENCY	::	DAILY	DAILY
FROM TIME	::	7:00A	2:33P
TO TIME	::	9:37A	3:10P
AIRLINE	::	DELTA	DELTA
FLIGHT NUMBER	::	519	540
CLASSES	::	FY	FY
CRAFT	::	BOEING 727-200	BOEING 727-200
MEALS	::	BREAKFAST	-
STOPS	::	0	0
COMMENTS	::	-	-

****

WHAT DO WE DO NOW?

i have a new customer

WHAT DOES THE CUSTOMER WANT?

show available flights from washington, d.c. to atlanta, ga.

****

ALTERNATIVE FLIGHTS

		ALT1	ALT2	ALT3
LEG TYPE	::	0	0	0
TO AIRPORT	::	ATL	ATL	ATL
FROM AIRPORT	::	DCA	DCA	DCA
FREQUENCY	::	DAILY	X7	DAILY
FROM TIME	::	7:40A	11:40A	4:40P
TO TIME	::	9:26A	1:05P	7:35P
AIRLINE	::	EASTERN	REPUBLIC	PIEDMONT
FLIGHT NUMBER	::	905	159	261
CLASSES	::	FY	FQ	Y
CRAFT	::	BOEING 727-200	DC9	BOEING 737-200
MEALS	::	BREAKFAST	LUNCH	SNACK
STOPS	::	0	0	2
COMMENTS	::	-	-	STOPS 30APR

****

WHICH OF THESE ALTERNATIVES IS CHOSEN?

a new customer wants information on available flights
leaving chicago and arriving washington, d.c.
and back again

****

ALTERNATIVE FLIGHTS

		ALT1	ALT2	ALT3
LEG TYPE	::	0	0	0
TO AIRPORT	::	DCA	DCA	DCA
FROM AIRPORT	::	ORD	ORD	ORD
FREQUENCY	::	DAILY	DAILY	X6
FROM TIME	::	7:22A	12:05A	5:30P
TO TIME	::	10:00A	2:35P	8:13P
AIRLINE	::	UNITED AIRLINES	MIDWAY AIRLINES	TWA
FLIGHT NUMBER	::	272	56	234
CLASSES	::	FY	Q	FY
CRAFT	::	BOEING 727-200	DC9	BOEING 727-200
MEALS	::	BREAKFAST	-	DINNER
STOPS	::	0	0	0
COMMENTS	::	STARTS 27APR	-	-

****

WHICH OF THESE ALTERNATIVES IS CHOSEN?

alt2

```
*****************************************************************
ALTERNATIVE FLIGHTS

                ALT1            ALT2            ALT3

LEG TYPE      :: 0              0               0
TO AIRPORT    :: ORD            ORD             ORD
FROM AIRPORT  :: DCA            DCA             DCA
FREQUENCY     :: X7             DAILY           DAILY
FROM TIME     :: 7:05A          11:00A          4:55P
TO TIME       :: 7:53A          11:50A          6:01P
AIRLINE       :: AMERICAN AIR   UNITED AIRLINES TWA
FLIGHT NUMBER:: 53              865             449
CLASSES       :: FYD            FY              FY
CRAFT         :: BOEING 727     BOEING 727-200  BOEING 727
MEALS         :: BREAKFAST      LUNCH           DINNER
STOPS         :: 0              0               0
COMMENTS      :: -              STOPS 11JUN     -
*****************************************************************
WHICH OF THESE ALTERNATIVES IS CHOSEN?
```

what is the flight chosen already

```
*****************************************************************
LEGS CHOSEN SO FAR

                LEG1

LEG TYPE      :: 0
TO AIRPORT    :: DCA
FROM AIRPORT  :: ORD
FREQUENCY     :: DAILY
FROM TIME     :: 12:05A
TO TIME       :: 2:35P
AIRLINE       :: MIDWAY AIRLINES
FLIGHT NUMBER:: 56
CLASSES       :: Q
CRAFT         :: DC9
MEALS         :: -
STOPS         :: 0
COMMENTS      :: -
*****************************************************************
WHAT DO WE DO NOW?
```

choose alt3 for the second leg and show selected flights

```
******************************************************************
LEGS CHOSEN SO FAR

                LEG1             LEG2

LEG TYPE     :: 0                0
TO AIRPORT   :: DCA              ORD
FROM AIRPORT :: ORD              DCA
FREQUENCY    :: DAILY            DAILY
FROM TIME    :: 12:05A           4:55P
TO TIME      :: 2:35P            6:01P
AIRLINE      :: MIDWAY AIRLINES TWA
FLIGHT NUMBER:: 56               449
CLASSES      :: Q                FY
CRAFT        :: DC9              BOEING 727
MEALS        :: -                DINNER
STOPS        :: 0                0
COMMENTS     :: -                -
******************************************************************
WHAT DO WE DO NOW?

i want to quit now

I ENJOYED WORKING WITH YOU, DAVE
```