# Dialogue Games: Conventions of Human Interaction

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ABSTRACT: Natural dialogue does not proceed haphazardly; it has an easily recognized "episodic" structure and coherence which conform to a well developed set of conventions. This paper represents these conventions formally in terms related to speech act theory and to a theory of action.

The major formal unit, the dialogue game, specifies aspects of the communication of both participants in a dialogue. We define the formal notion of dialogue games, and describe some of the important games of English. Dialogue games are conventions of interactive goal pursuit. Using them, each participant pursues his own goals in a way which sometimes serves the goals of the other. The idea of dialogue games can thus be seen as a part of a broader theoretical perspective which characterizes virtually all communication as goal pursuit activity.

We also define and exemplify the property of Motivational Coherence of dialogues. Motivational Coherence can be used as an interpretive principle in explaining language comprehension.

Actual dialogue games have a kind of causal connectedness which is not a consequence of their formal properties. This is explained in terms of a theory of action, which is also seen to explain a similar attribute of speech acts.

KEY WORDS: Dialogue game, dialogue, speech act theory, theory of action, convention, coherence.

## 1. INTRODUCTION

Dialogue games are abstract elements of a theory of the discourse structure of human dialogue. They are bilateral, in the sense that each dialogue game refers to and accounts for aspects of the speech of both parties to a dialogue.[1, 2, 3, 4]

A dialogue text reflects intentions and goal pursuit activity on the part of each participant. Dialogue proceeds in a manner which not only leaves traces of this goal pursuit, but also exhibits it to the participants. That is, each speaker provides suitable information so that the hearer can have tacit knowledge of a plausible set of goals which the speaker can be seen as pursuing. Some goals are pursued merely because achieving them contributes to achieving some other goal(s); goals which are subordinated

in this way are referred to as subgoals. Other goals are not subordinated. The subordination relationships between a speaker's goals and their subgoals are part of the hearer's tacit knowledge.

The particular goals which a speaker exhibits in dialogue are consequential over the period in which he is evidently pursuing them. They can conveniently be regarded as having scopes, intervals over which they prevail in particular ways. Without reviewing the evidence, it is clear that the consequences include effects on pronoun resolution and related syntactic consequences, semantic effects including certain kinds of restriction of generic terms, and pragmatic effects such as the creation or prohibition of certain indirect speech act interpretations of utterances, and also creation of topic boundaries which are perceived by hearers but not overtly signaled in the dialogue.[5] It is also clear that the effects of exhibited goals are a significant component of what is often vaguely called "context."

Although some speakers' goals are formed and evidenced in novel ways, *there are also conventions of goal use*. In particular, there are conventional combinations of goals and related propositions which are used repeatedly by dialogue participants. The ability to recognize and employ these conventions is part of a person's ability to communicate.

Dialogue games are abstract technical descriptions of these conventions. The conventions are described formally in the next two sections, the first devoted to propositional knowledge and the second to the active use of that knowledge.

## 2. ELEMENTS OF DIALOGUE GAMES

### 2.1. *Dialogues and Turns*

For the purposes of this definition, we consider only the case of alternating dialogue, dialogue which (in the views of the participants, if not in fact) can be represented by a sequence of two or more intervals of language use produced alternately by the participants, without significant overlap in time. Each element of such a sequence is produced by a single speaker and bounded either by the other speaker's language use, or by the beginning or end of the sequence.[6]

Each such element is called a *turn*, and the sequence is called a *dialogue*.

This definition is meant to apply only to communication which takes place through media which do not impose significant delays between turns. Thus face-to-face dialogue, radio conversations and linked typewriter dialogues are included, but exchanges of letters are not.

## 2.2. *Participants*

One participant is designated I (for Initiator) and the other R (for Responder); participants are also designated without regard to these roles as A and B.

## 2.3. *Goals*

Each participant has a view or model of the world, and in this view the world may assume various states. States and sets of states of the world are subject to description. Let DA be such a description in the view of A. Then "A wants DA" is a goal. (For present purposes, it is convenient to regard "wants" as a binary predicate; for other purposes one would prefer more than two possible values.)

The describable world of A includes participant B, whose state may be described in various ways. Goals of A can therefore contemplate descriptions of states of B which A desires to prevail, including goals to be held and pursued by B, knowledge for B to possess or actions for B to perform.

## 2.4. *Formal Definition of Dialogue Games*

A dialogue game is a triple, (IP, GR, CC), consisting of

IP:      A goal in the view of I called the *illocutionary point* of the game.
GR:     A non-empty set of goals called *goals-of-R*.
CC:     A set of state descriptions in the view of I called the *conventional conditions* of the game.

## 2.5. *Examples of Dialogue Games*

Table 1 below represents some of the dialogue games of American English. (The table could be extended, say, with definitions of an information offering game or others.)

## 2.6. *Standard Conventional Conditions*

The representations of dialogue games in Table 1 have been abbreviated by omission of certain conventional conditions which are common to all dialogue games. These conditions, called *standard conventional conditions*, are expansions of the following expressions:

1. I is pursuing the illocutionary point as a goal.
2. I believes that achieving the illocutionary point is feasible.

3. I believes that R's achieving the goals-of-R is feasible.
4. I has the right to achieve the illocutionary point.
5. I has the right to use the dialogue game.
6. The illocutionary point has not already been achieved.
7. R is willing to pursue the goals-of-R.


3. USES OF DIALOGUE GAMES

The simple synthetic example in Figure 1 below is representative of the domain of discourses to which dialogue game theory should apply. The participants are a mother M and child C.

What kinds of knowledge about this dialogue do we account for? Whatever phenomena there are, in whatever description, they must be defined relative to human judgments about the text. Some of the judgments which have been made about this text appear in the right hand column of the figure. Many more could be made, but these particular judgments are ones which dialogue games are helpful in explaining.


4. ENTERING AND LEAVING DIALOGUE GAMES


4.1. *Entering Dialogue Games*

We notice in the example in Figure 1 an "episode" starting with turn 11 and ending with turn 14, devoted to getting permission to eat. We account for this episode as the speaker C initiating use of the Permission Seeking game, with the game remaining in use until the illocutionary point was achieved in turn 14.

The duration of use of the Permission Seeking game, (and all other games) varies. Each participant may perform many different speech acts, in the sense of Searle and others, in the course of the game's use. (Austin (1962), Searle (1969), Searle (1975) and Davison (1975)). However, no explanation of the individual speech acts accounts for the fact that the participants recognize and take advantage of such episodic structure, so that, for example, both are responsive to the fact that the issue raised in turn 11 is still open at the end of turn 13. Similarly, no account which restricts attention to adjacent pairs of turns can account for this fact, since turn 11 is not adjacent to either turn 13 or turn 14.[7] (Ferrara (1980a, b), but there is as yet no widely-accepted approach to such extensions.)
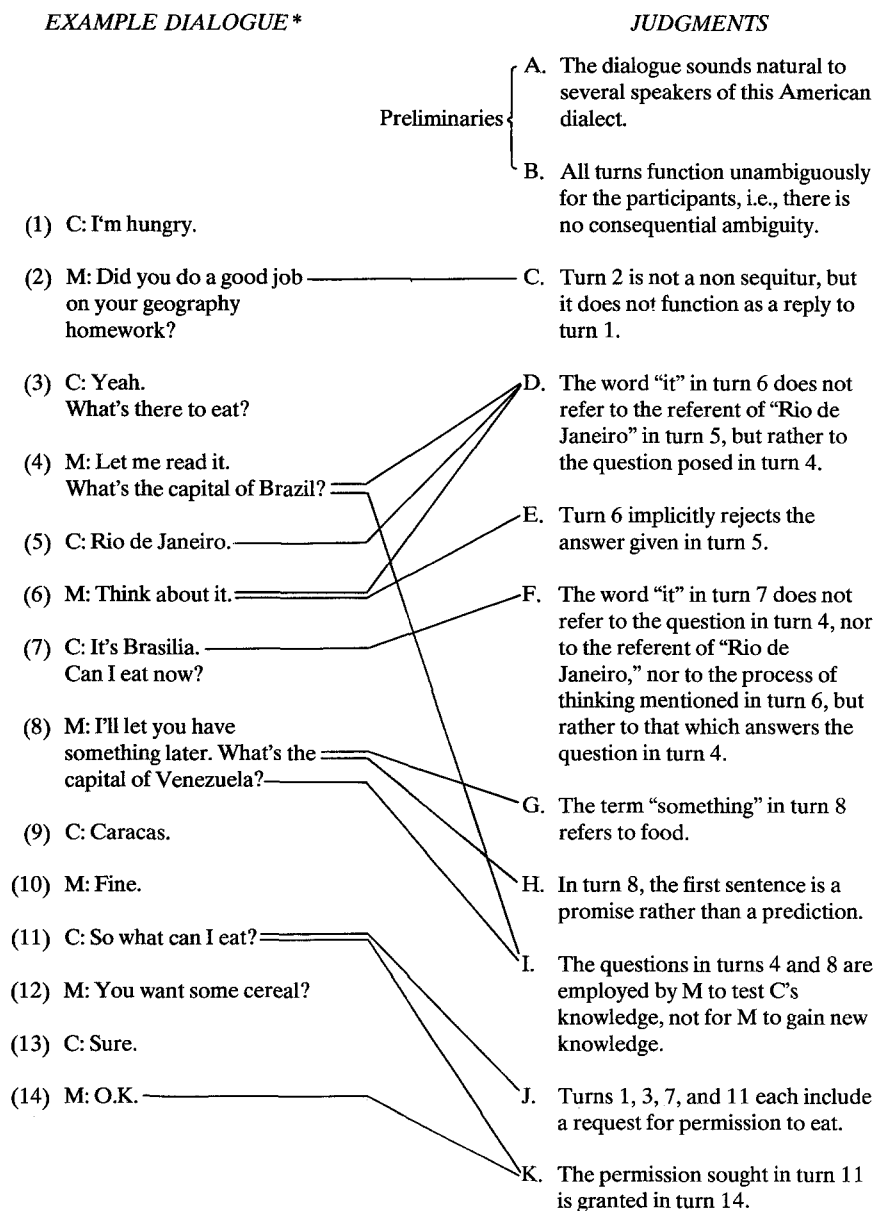
To account for entry, we posit a speech act called a *bid of a game*. The participant who bids a game is identified with I in the game specifications, and the other with R. Bidding a game is, among other things,

TABLE 1
Some dialogue games*

| Game | Illocutionary Point | Goals-of-R | Conventional Conditions |
|---|---|---|---|
| Information Probing | I knows whether R knows Q.* | R informs I of R's knowledge of Q. | I knows Q. |
| Helping | I is able to perform A. | I is able to perform A. | R is able to cause I to be able to perform A; I has the right to perform A. |
| Information Seeking | I knows Q. | I knows Q. | R knows Q. |
| Dispute | R believes P. | R justifies that R might not believe P. | I believes P; R does not believe P.** |
| Permission Seeking | I knows that R approves that I performs A. | (R chooses whether to approve that I performs A) and (I knows this choice). | I wants to perform A sometime; I does not have the right to perform A without the permission of R. |
| Action Seeking | R causes A to be performed. | R causes A to be performed. | R might not cause A to be performed in the normal course of events. |
| Information Offering | R knows P. | R knows P. | I knows P; R's knowledge and P can be reconcilled. |

* In these game specifications A represents an action, Q represents an information specification, and P represents a proposition. They are unspecified in the game definitions, but must be made suitably definite when the game is used.
** Although the Dispute Game carries the assumption that I believes the proposition which he defends, he can explicitly deny that he believes it. Such a denial does not destroy an ongoing dispute, but rather alters its working hypotheses, making it more like a debate. In some circumstances, (e.g., debates, academic discussions or "devil's advocate" defenses) such a denial would be wholly redundant. The assumption is therefore optional, a convention rather than a consequence of other facts about the communication situations of disputes.

*EXAMPLE DIALOGUE**                                    *JUDGMENTS*

Preliminaries

A. The dialogue sounds natural to several speakers of this American dialect.

B. All turns function unambiguously for the participants, i.e., there is no consequential ambiguity.

(1)  C: I'm hungry.

(2)  M: Did you do a good job on your geography homework?

C. Turn 2 is not a non sequitur, but it does not function as a reply to turn 1.

(3)  C: Yeah.
     What's there to eat?

(4)  M: Let me read it.
     What's the capital of Brazil?

D. The word "it" in turn 6 does not refer to the referent of "Rio de Janeiro" in turn 5, but rather to the question posed in turn 4.

(5)  C: Rio de Janeiro.

(6)  M: Think about it.

E. Turn 6 implicitly rejects the answer given in turn 5.

(7)  C: It's Brasilia.
     Can I eat now?

F. The word "it" in turn 7 does not refer to the question in turn 4, nor to the referent of "Rio de Janeiro," nor to the process of thinking mentioned in turn 6, but rather to that which answers the question in turn 4.

(8)  M: I'll let you have something later. What's the capital of Venezuela?

(9)  C: Caracas.

G. The term "something" in turn 8 refers to food.

(10)  M: Fine.

H. In turn 8, the first sentence is a promise rather than a prediction.

(11)  C: So what can I eat?

(12)  M: You want some cereal?

I. The questions in turns 4 and 8 are employed by M to test C's knowledge, not for M to gain new knowledge.

(13)  C: Sure.

(14)  M: O.K.

J. Turns 1, 3, 7, and 11 each include a request for permission to eat.

K. The permission sought in turn 11 is granted in turn 14.

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* This is a synthetic dialogue which has been composed to illustrate the operations and structures discussed in this paper. However, use of such dialogue is not representative of our usual methods of inquiry. Synthetic dialogues (including plays and dialogues which people produce while pretending) usually differ from natural dialogues under dialogue game analysis. Results established only on the basis of nonnatural dialogues are suspect.

Fig. 1.  Example dialogue and judgements.

1. to consent to pursue the *illocutionary point* of the game.
2. to request that R begin to pursue the goals-of-R in the game specification. (The illocutionary point and the goals-of-R must be made suitably definite in the bid. In all of the specified games, this is accomplished by simply making the illocutionary point definite.)
3. to offer to adopt the conventional conditions of the game as working hypotheses for the duration of the game's use (or until some other hypotheses replace them). Adopting the conventional conditions as working hypotheses is very much like asserting them, and so they function like felicity conditions of standard speech act theory, but over the entire interval of the game's use rather than just on a single utterance.

Bidding a dialogue game prompts for a response, just as do requests, queries and certain other speech acts. As part of the account of this response, we recognize a speech act of *acceptance of a bid*, performed of course by R. To be performed felicitously, there must be a corresponding prior bid by I which has not already received a response. If I felicitously bids a game, and R felicitously accepts the bid, then the game has been entered, and both parties are free to rely on the conventional conditions which have been thus established as working hypotheses. The goals of I and R are regarded as being actively pursued for the duration of the game. Other games may be entered without leaving the game just entered, and no limit is imposed on the duration of the game.

Why have the speech acts of *bid of a game* and *acceptance of a bid* not been included in previous speech act theory? Obviously it was necessary first to recognize the games and also to identify the fact that entering and leaving their scopes were actions. Identification of these speech acts has also surely been hampered by the fact that *the bidding of games and acceptance of them are usually performed implicitly, as indirect speech acts.* For example, consider a dialogue which begins with a factual statement,

(15)    A: I can't start my car.

In this position it not only functions as a statement about the speaker and the car, but may also perform a bid of the helping game. Notice that it does not mention help explicitly, nor request the other party's participation. But without the possibility of cooperative response, it would be unmotivated. In many ordinary circumstances R, in ascribing motivation (goals) to A, should readily recognize (15) as a request for help. Notice that this method of bidding resembles the recognized method for performing indirect speech acts in which an action is requested by asserting one of its preconditions (Heringer (1972)). Here, one of the conventional conditions (from number 6 of the standard conventional conditions) is asserted, namely:

I is not able to perform A.

In general, any part of a game definition can be used to create a bid. Further discussion of the great diversity of ways to bid games is found in the previous work on the subject. (Mann (1975), Mann (1977), Levin and Moore (1977), Mann, Moore and Levin (1978)).

The act of acceptance of the bid can likewise be performed implicitly, as in the following reply to (15):

(16)    B: Did you buy gas at Cheapgas?

This is an act of acceptance of the bid because by initiating diagnosis of the problem, B begins to pursue the goal offered. It is recognizable as acceptance because it obviously can contribute to satisfaction of the illocutionary point of the game, namely, to become able to start the car. The act of acceptance of a bid of a game is distinguished from acts of acceptance of other offers in two ways:

1. Acceptance of a bid of a game has immediate consequences for both parties in extending the dialogue, whereas other acceptances may have only delayed effects.
2. The most frequent kind of act of acceptance, beginning pursuit of certain goals, has not been given theoretical status in speech act theory as an act of acceptance for the other offers.

However, it may be that theories of discourse will assimilate these acceptances to others.

Acceptance of a bid is like acts of acceptance of offers in general, in that both sorts of acts lead to an expectation that the offer will be fulfilled. Acceptance of a bid is to be distinguished from "uptake" (as described in Stalnaker (1978) and Rogers (1978)); this can be seen in the following variant of the previous dialogue:

(17)    A: I can't get my car started.
(18)    B: I'm very busy right now. Ask me again tomorrow if you need to.

In (17), the Helping game is bid, and there is no objection in (18) to any aspect of its validity as a bid. Thus full uptake of the bid is achieved; however, the bid is not accepted. The turn in (18) rejects the bid, and so the Helping game is not entered.


4.2. *Leaving Dialogue Games*

Somewhat parallel to the acts of entering, we posit an act for leaving, called *bidding termination of a game*. Bidding termination is also often done implicitly. If a particular utterance makes it evident that the illocutionary point is unpursuable, then that utterance functions as a bid for

termination. The illocutionary point may become unpursuable by satisfaction, as when requested information is supplied, or it may become unpursuable by infeasibility, as for example by exhausting the available methods which address that goal.

When several games are ongoing, it is possible (and frequent) that a bid of termination addresses a game which is not the one most recently entered. For example, the illocutionary point of the most recently entered game may be a subgoal of some higher goal which itself is the illocutionary point of an ongoing game. If an utterance shows the higher goal to be satisfied or unpursuable, then termination of that higher game, along with termination of all of the games which were entered after entering that higher game, is being bid.

The previously defined act of acceptance of a bid seems adequate for use both to enter and to leave a game. Acceptance of a bid of termination terminates the particular use of the game, and has the additional effect of terminating all of the other ongoing dialogue game uses which began within the scope of the game being terminated. This ensures *strict nesting of game uses*, an arrangement which has been found in all but a few extremely bizarre examples.

## 4.3.  *Refusal of a Bid*

Finally, we posit a speech act of *refusal of a bid*. This act typically occurs in the turn which immediately follows a bid. Like bidding and accepting, refusing a bid is often performed implicitly, sometimes by pursuing a goal unrelated to the illocutionary point of the game being bid, or in the case of refusal of a bid of termination, by continuing to pursue the illocutionary point of the game.

Although all of the game-related speech acts are often performed implicitly, they may all be performed explicitly as well. It is conceivable that bids will be neither immediately accepted nor immediately refused, but rather that some negotiation will take place leading to acceptance or refusal. However, I am reluctant to synthesize such an example, since (after examining hundreds of natural dialogues) I have no natural examples of this.

Bids of games which are accepted are called *successful bids*, and bids which are refused are called *unsuccessful bids*.

## 4.4.  *Scopes of Use of Games*

For a dialogue game G, a *scope of use* of G (or simply a use of G) is a sequence of utterances which

1.  begins with a successful bid of G, and

2. is immediately followed by either an acceptance of a bid of termination or the end of the dialogue.

Two features of this definition are noteworthy. First, requiring that the bid be successful forces every scope of use to include turns by both participants. Second, by defining scope of use so that the acceptance of a bid of termination is *outside* of the scope, the scopes so defined closely match scopes assigned by readers who are asked to mark the intervals in dialogue where particular topics are being discussed. (Mann et al. (1975), Mann et al. (1977)). Scopes of use almost always coincide with the major "episodic" structures which people recognize intuitively in dialogue. They are also closely related to the distribution of "focus spaces" (Grosz (1977)).

The illocutionary point of a particular scope of use is the one established in the bid of the game which begins that scope of use, and the bid which begins the scope of use is called the *opening bid* of that scope. A scope of use is *open* at turn T if no successful bid of termination of that scope has been performed prior to T.

Note that dialogue game uses can be recursive, and in fact we often find a scope of use of the information seeking game which includes one or more other scopes of use of the same game.

## 5. MOTIVATIONAL COHERENCE OF DIALOGUES

To the above descriptions of dialogue games and their uses we add a principle which governs the relationship between uses of dialogue games.

A bid of a game B in turn T *bears on* a scope of use S provided that:

1. S is open at T, and
2. T does not bid termination of S.

A bid of a game B is *Motivationally Compatible* with its context iff, for each scope of use $S_i$ such that B bears on $S_i$, the illocutionary point of B *serves* the illocutionary point of $S_i$.[8]

Note that with a suitable (predictive) notion of "serves," the hearer can immediately judge whether a bid is Motivationally Compatible with the context in which it occurs. His judgment can be made as soon as he knows the illocutionary point of the bid.

A dialogue is *motivationally coherent* if every bid of a game which it contains is Motivationally Compatible with its context.

We have found nearly all of the natural dialogues which we have examined in detail to be motivationally coherent. There is also a preference for Motivationally Compatible interpretations, so that, given two interpretations of a particular turn in a dialogue, one of which is Motiva-

tionally Compatible with its context and one of which is not, people select the compatible interpretation as the correct one. A turn which can be interpreted only in ways which are not Motivationally Compatible with its context is seen as a *non sequitur*. People are frequently willing to create very imaginative explanations in order to preserve Motivational Coherence.

We can therefore use the notion of Motivational Coherence as part of an explanation of language comprehension. It provides a system of constraints on acceptable interpretations, in some ways directly analogous to familiar kinds of semantic and syntactic constraints. Like other kinds of constraints, Motivational Coherence has a great deal of explanatory power, in spite of the fact that it is occasionally violated in practice.[9]

Figure 2 summarizes our analysis of the example dialogue. There are four scopes of use which we can judge for Motivational Compatibility. We judge all of them to be compatible, and so the dialogue as a whole is Motivationally Coherent. (Notice that the scope of use beginning in turn 7 is Motivationally Compatible with its context even though the goal of eating does not serve the goal of knowing whether C did a good job on the Geography homework, because termination of the open scope is bid in the same turn.)

The dialogue contains examples of nested use of dialogue games (turns 2 through 10 and turns 11 through 14), implicit acceptance of bids (turns 5 and 12), refusal of game bids (turn 2), refusal of a bid of termination of a game (turns 4, 6), and disambiguation of game bids (as Information Probing rather than Information Seeking in turns 4 and 9, vice versa in turn 11) by the principle of Motivational Coherence. It also contains an example of semantic specification of a generic term ("something") based on a current goal introduced through use of a game.

## 6. RELATING DIALOGUE GAMES TO OTHER THEORIES

### 6.1. *Speech Acts*

We have made direct use of speech act theory in this formulation of dialogue game theory. The representation of bidding, acceptance and rejection of bids, and the choice of the term illocutionary point are intended to suggest some of the close relationships between dialogue game theory and speech act theory.

Speech acts are *unilateral*. They are performed in their entirety in contiguous speech by a single speaker. In contrast, Dialogue Games are *inherently bilateral*. Scopes of use of dialogue games must include turns by both participants. Dialogue games are in a sense the *lowest level bilateral construct*, since they rely entirely on unilateral constructs. Whereas a speech act specification accounts for an action by a single speaker, along

| SCOPES OF USE | EXAMPLE DIALOGUE | ENTRY | | | TERMINATION | | |
|---|---|---|---|---|---|---|---|
| | | BIDS OF GAMES | REFUSALS OF BIDS | ACCEPT-ANCES OF BIDS | BIDS OF TERMIN-ATION | REFUSALS OF BIDS | ACCEPT-ANCES OF BIDS |
| | (1) I'm hungry. | Permission seek | | | | | |
| | (2) M: Did you do a good job on your geography homework? | Information seek | | | | | |
| | (3) C: Yeah. | | | | | | |
| | What's there to eat? | Permission seek | | | | | |
| | (4) M: Let me read it. | | | | | | |
| | What's the capital of Brazil? | Information probe | | | | | |
| | (5) C: Rio de Janeiro. | | | | | | |
| | (6) M: Think about it. | | | | | | |
| | (7) C: It's Brasilia. | | | | | | |
| | Can I eat now? | Permission seek | | | | | |
| | (8) M: I'll let you have something later. | | | | | | |
| | What's the capital of Venezuela? | Information probe | | | | | |
| | (9) C: Caracas. | | | | | | |
| | (10) M: Fine. | | | | | | |
| | (11) C: So what can I eat? | Permission seek | | | | | |
| | (12) M: You want some cereal? | Information seek | | | | | |
| | (13) C: Sure. | | | | | | |
| | (14) M: O.K. | | | | | | |

Fig. 2. Annotated mother and child dialogue.

with its conditions, dialogue games account for particular actual effects of a speaker's words on a hearer. So, for example, as a hearer is moved to accept or reject a bid, he utters words which reveal the effect of the bid, including the particular effect of the prior utterance having been recognized as a bid. Thus we see dialogue game theory is a theory of communication in a way not shared by speech act theory. It accounts for actual effects of speech on hearers, changes of state brought about by exchange of symbols. Since dialogue games are the lowest level bilateral construct in this definitional hierarchy, they are in a sense a minimal theory of communication. The principle of Motivational Coherence, on the other hand, is defined relative to the illocutionary points of dialogue games and so is not minimal in the same sense.

## 6.2.  *Special Status of Questions*

Unlike most game bids, questions (interrogatives) in their most common interactive use are *direct* speech acts. They bid various games, notably Information Seeking and Information Probing. In other words, we identify the act of questioning and the bidding of a particular game as the same act. What counts as a suitable answer clearly varies with the dialogue game, so identification of the particular game being bid is consequential. For example, in the Information Probing game the goal of the tester (I) cannot be satisfied by having the testee (R) read the correct answer from a reference book. In general, what counts as an appropriate goal for I is constrained by situation and the prior text of the dialogue, making the bid unambiguous in most cases.

The familiar question-answer pair is often a particularly abbreviated case of use of the information seeking game. In the dialogue

(19)     A: Where's the towel?
(20)     B: Behind you.

A bids the information seeking game in (19). In (20) B begins to pursue the proffered goal (that A knows where the towel is) and thereby accepts the bid. If B satisfies the goal, as in this case, he thereby bids termination of the game. Then unless A appears to continue to pursue his goal as in

(21)     A: I don't see it.

or objects, as in

(22)     A: I didn't hear you.

or

(23)     A: No, the other one.

then, he has performed an acceptance of the bid of termination, and the game is thereby terminated.

Questions differ from imperatives in that when an imperative is given, there is often no goal which R can pursue by speaking, and in such cases no game is bid. There are also many other roles for questions for which there is no corresponding goal which R can pursue by speaking, and such questions do not bid games.

## 6.3.  *Theory of Action*

Dialogue game theory depends on a general theory of actions, in more ways than speech act theory does. Such a theory must provide for states and state descriptions, goals of agents, and plans (i.e., goal subordination relationship, and goal/action relationship). Some of these, and certain

problems of goal recognition and plan recognition, have been specified in detail by others (Allen (1978), Perrault and Cohen (1978), Cohen and Perrault (1977), Brown (1979), Moore (1980), Cohen and Perrault (1979)). In this theory of actions it must be possible to state what counts as pursuit of a particular goal, and what counts as an unpursuable goal. This theory of pursuit as the source of the "serves" relation which we have relied upon.

The principle of Motivational Coherence is seen above as a selective basis on which some interpretations of utterances are rejected. But how selective is it? To reject an interpretation of an utterance on the basis of Motivational Coherence, the goals which the utterance can serve must not include the goals already revealed by prior text. If Goal1 is served by an utterance U (according to a particular interpretation), and Goal2 is a prevailing goal already revealed by S, then we must be able to deny that Goal1 serves Goal2 if we are ever to reject this interpretation of U on the basis of lack of Motivational Coherence. Occurrence of pairs such as Goal1 and Goal2 will of course be a feature of some theories of action and not others. Since our experience indicates that some sort of Motivational Coherence does prevail in communication, we require that the theory of action provide for it. The theory *must not* contain ways to rationalize from any goal to any other, so that one would find that Goal1 serves Goal2 for any pair of goals whatever. We prefer theories of action in which the "serves" relation is quite sparse, since such theories agree with our observation that one must in fact act very selectively in order to pursue ordinary human goals.

While some portions of natural dialogue games are clearly arbitrary, other parts are simply consequences of the active nature of communication. We should expect to see various theories of action, differing in details, which are empirically adequate for explaining human communication actions.

Any adequate theory would be expected to explain several features of dialogue games as a matter of course. For example, it should explain why bidding a game always carries the working hypothesis that the illocutionary point has not already been achieved, and also the hypothesis that achieving the illocutionary point is feasible (standard conventional conditions 6 and 2 respectively.)

Such a theory need not be complex or obscure. There are straightforward theories of action in artificial intelligence and elsewhere which embody explicit formal concepts of acts, goals, preconditions, well-formed-plans and other constructs. Even without attempting to assess the adequacy of any of them, it is clear that there is a good prospect for finding a satisfactory one.

Part of the theory of actions will necessarily be psychological, accounting for the goals, plans, self-perceptions etc. the people may hold. De

Beaugrande has suggested ways to interpret actions in dialogue in terms of more or less permanent psychological goals (de Beaugrande (1978)).

## 6.4. *Relation to Scripts and Frames*

Scripts and frames, in Artificial Intelligence, are loosely defined kinds of knowledge structures which contain collections of associated ideas, facts or propositions. The terms were popularized by Schank (Schank and Abelson (1975)) and Minsky (Minsky 1975)) respectively. Winograd has pointed out that few if any explicit claims have been made about general consequences of their use, and that whether a knowledge structure is a script or a frame is not a formal issue (Winograd (1975)).

It would be inappropriate to call dialogue games "scripts" or "frames" because there are significant differences between the concept of a dialogue game as defined above and the prevailing usage of the latter terms. The terms have been used most often to describe collections of knowledge about conditional sequences of events or collections of objects in the world, related by likelihood or frequency of occurrences, unlike dialogue games which bear knowledge about conditions and consequences in inter-personal communication. Unlike typical scripts or frames, dialogue games do not embody knowledge about particular topics of conversation or expertise. The independence of dialogue game knowledge from so-called "domain knowledge" is an important factor since it is useful in explaining how people can converse freely on new subjects.

## 7. IS THIS CONSTRUCT NECESSARY?

Dialogue games are convenient thoretical constructs, but there is an issue of whether such collections of knowledge need to be given any theoretical status at all. Could some other combination of constructs, perhaps already recognized ones, account for the same phenomena? In particular, is it the case that a combination of a theory of action, a speech act theory and some knowledge of the circumstances of dialogue will be sufficient to predict or reconstruct in context of all the knowledge that dialogue games hold (or should hold)?

One kind of evidence concerns arbitrary, implicit communication which arises from the conventional conditions. Consider

(24)     A: Who is the Secretary of Agriculture now?
(25)     B: Why do you assume I would know that?

B's reply is an ordinary, legitimate response to A in many situations. The proposition: B knows the identity of the present Secretary of Agriculture, is neither expressed nor presupposed by (24). It is an arbitrary

convention of the Information Seeking game, represented by the proposition: R knows Q, in its conventional conditions.

Notice that we cannot associate the condition R knows Q with the direct speech act of the question in (24) since, for example, if the situation is an oral quiz, then in

(26)    Teacher: Who is the Secretary of Agriculture now?
(27)    Student: *Why do you assume I would know that?

the reply is unacceptable. The Information Probing game is being bid in (26) rather than the Information Seeking game, and the Information Probing game has no such conventional condition.

There are ways of using dialogue games in an altered form which also illustrate the arbitrary character of conventional conditions. One may say

(28)    Excuse me, I don't know whether you know the answer to this, but I'd like to ask you who is Secretary of Agriculture now?

in which the Information Seeking game is bid in an altered form. Such preparatory remarks are inappropriate if the question is bidding the Information Probing game since its very point is to come to know whether the hearer knows the answer.

One can obviously seek information by engaging in dialogue; one can do so without ever using, as a working hypothesis, that the other participant knows the information being sought, i.e. without using any hypothesis like R knows Q. The occurrence of this conventional condition in the Information Seeking game (and its consequences in our experience) is an arbitrary element, not dependent on the action being performed, the speech acts used, or communication circumstances. Therefore it is not derivable from the corresponding theories of action, speech acts or circumstances. One must find another locus for this knowledge. The dialogue game seems to be the appropriate level of abstraction for representing the hypothesis.

## 8. WHAT KINDS OF GAMES OCCUR?

Dialogue games are not simply arbitrary collections of labeled goals and other propositions. While it would be possible, for example, to select and permute the elements of the games in Table 1 to define new games, the resulting games would not resemble the conventions of actual language use.

What attributes distinguish the games that occur from those which do not?

Actual games have a kind of causal connectedness which arbitrarily composed games lack. In particular, the conventional conditions of actual games are such that if any of them does not hold, then achieving the

illocutionary point of the game is prevented, made unlikely or rendered irrelevant. Similarly, the goals-of-R are such that if R does not pursue those goals, achieving the illocutionary point is prevented or made unlikely.

This causal connectedness makes it appropriate for a speaker to use a dialogue game to achieve some purpose for which a simple speech act would be inadequate. Because bidding of the game invokes its conventional conditions, and because the hearer can refuse or object on the basis of these conditions, games which are likely to fail are made likely to fail immediately. Games which can succeed can do so without explicitly mentioning the working hypotheses to be used while the game is in progress. These advantages of rapid failure and brevity in success can be used in explaining why only a few of the possible games occur, and in explaining why these games rather than others occur.[10]

Notice also that games such as the Dispute game and the Permission Seeking game are typically useful in adversary situations, whereas others such as the Information Seeking and Helping games, are typically useful in cooperative situations. This is reflected formally in that the illocutionary point and the goals-of-R differ in adversary games, but are identical in cooperative games.

For example, the Action Seeking game has the following eight conventional conditions, derived from the standard conventional conditions and the special conditions of the game:

1. I wants R to cause A to be performed.
2. I believes that it is feasible for R to cause A to be performed.[11]
5. I has the right to ask R to cause A to be performed.
6. R has not already caused A to be performed.
7. R is willing to cause A to be performed.
8. R might not cause A to be performed in the normal course of events.

Clearly, in any use of the Action Seeking Game, brevity is achieved by not explicitly stating conditions 1 through 5; they are conveyed implicitly because they are conventional conditions of the Action Seeking Game. And rapid termination is achieved because if R is unable or unwilling to do A, has already done A or is surely going to do A in any case, then the game can be terminated immediately by revealing that fact (conditions 3, 6, 7 and 8).

On the other hand, consider including in the Action Seeking game the condition of the Permission Seeking game which states that I does not have the right to perform A without the permission of R. This condition would be irrelevant and extremely inconvenient as a working hypothesis for the Action Seeking game. If it were expressed implicitly by bidding Action Seeking, it would often be necessary to explicitly deny it, a loss of brevity. If the condition did not hold, the illocutionary point could still be achieved, so rapid termination would not be facilitated. Such games do not occur.

## 9. SUMMARY

We have defined Dialogue Games as conventions of communication which can be used to account for the "episodic" structure of natural dialogue. Dialogue is two-party goal pursuit in which the parties choose to interact by communicating. The definition of Dialogue Games is based on an extension of speech act theory; several new speech acts are posited, including the act of bidding a dialogue game, an attempt to begin active use of a particular set of conventions.

The Conventional Conditions, which are part of every dialogue game, function in a way which somewhat resembles the function of sincerity conditions of a speech act: they are implicitly conveyed propositions which are invoked by use of the game. They differ from sincerity conditions in that their scopes of application include utterances by both participants, not just the single utterance by which they are invoked.

The principle of Motivational Coherence, which is a predicate applicable to whole dialogues, is based on relations between scopes of use of dialogue games. Motivational Coherence, with the more local notion of Motivational Compatibility, gives a principled basis for identifying certain utterances as nonsequiturs, and for selecting the intended interpretation of an utterance from a set of meaningful candidates. Dialogue game theory can also be useful in accounting for speech act disambiguation, semantic range of generic terms, pronominal reference and perceived topic structure.

Bilateral conventions of interaction must be given theoretical status, since they contain relevant and otherwise unavailable information about how dialogue takes place. The dialogue games which are used most frequently have a causal connectedness which helps a speaker to satisfy his goals quickly.[12]

NOTES

[1] The generalization of dialogue game theory to multilogue appears to be straightforward. There are also some interesting ways to use dialogue games to account for monologue structures. However, both of these are outside of the scope of this paper.

[2] This paper was written in mid-1978 and submitted for inclusion in an edited book, which did not appear. This work should be distinguished from the subsequent line of work begun by Lauri Carlson and represented in his book, *Dialogue Games*: (Carlson (1983)). See the final footnote for a discussion of how the paper relates to subsequent developments.

[3] Constructs called dialogue games were defined as part of the design of a comprehension system called DMS. (Levin and Moore (1977), Mann (1975), Mann et al. (1975), Mann et al. (1977), Mann (1977a, b), Moore et al. (1977)).

> It is worthwhile to restate the theory of dialogue games for several reasons. It needs to be clarified, partly because previous descriptions of dialogue games were intermixed with computer system design descriptions and discussion of other concepts, but more

because we can now make the relationship of dialogue game theory to speech act theory very explicit; however, it is also possible to redefine these concepts in a way that is independent of speech act theory. We also wish to correct an unfortunate tendency to confuse dialogue games with certain other notions, especially scripts and frames.

Dialogue game theory arose during attempts to create a thoroughly explicit theoretical framework for accounting for natural language comprehension. Explicitness was to be enforced by representing all of the claims of the theory by computational processes, and relevance was to be enhanced by choosing natural dialogues as data. Creation of such a framework clearly has not been achieved, but the general research strategy is still being pursued.

The use of the term "games" here was inspired by certain resemblances to Wittgenstein's language games but its use here does not conform to his.

[4] We gratefully acknowledge support from the National Science Foundation, grants MCS78-07410 and MCS76-07332, and from ARPA contract N00014-75-C-0710. We also gratefully acknowledge the important contributions that Levin and Moore have made to this development.

[5] Previous studies have defined methods by which people can identify intervals in dialogue over which particular topics (subject matter) prevails (Mann et al. (1975)), and have established that they can identify such intervals with high levels of agreement and reliability (Mann et al. (1977)). The intervals identified in this way are closely related to the focus spaces defined by Grosz (Grosz (1977)) as well as this work.

[6] The terms speaker and hearer are used regardless of whether the media of communication include an auditory one.

[7] Various other workers have also advocated extending speech act theory so that larger scopes of text are accounted for (Van Eemeren and Grootendorst (1982), Ferrara (1980a, b)), but there is as yet no widely-accepted approach to such extensions.

[8] See the section on theory of action, 6.2, for a discussion of "serves."

[9] There are comparable principles of Motivational Coherence which could be applied to the non-bidding utterances in dialogue, and also to monologue text. These are anticipated less formally in some methods of exegesis and text criticism; the discussion of these is of course outside the scope of this paper.

[10] There is a corresponding explanation needed in speech act theory, of why certain sincerity conditions arise with certain illocutionary forces. For example, the act of S asserting P cannot have as a sincerity condition that S wants to know whether P is true, but a sincerity condition that S believes P is suitable. Notice that the same explanation can be used: the condition that S believes P has a direct causal connection to the illocutionary point that S wants H to know that S believes P, but the condition that S wants to know whether P is true does not.

[11] For this particular game, standard conventional condition 3 turns out to be identical to 2, and condition 4 is vacuous.

[12] As indicated above, this paper was written in mid-1978 and submitted for inclusion in an edited book, which did not appear. The paper subsequently was circulated informally as an Information Sciences Institute report (Mann (1979)), and shortly afterward was in use for instructional purposes, including a Stanford course on computational models of discourse. Since then it has been subjected to a variety of delays in the course of publication. Its appearance now reflects the conviction that it remains relevant to the kinds of concerns and enterprises that originally prompted it. The central topic, bilateral conventions of goals and goal pursuit, remains an important one worthy of much further study.

To avoid yet further delay, the paper has not been updated to reflect the current status of speech act theory, nor even to take a position on the somewhat confused status that the theory previously had.

This work should be distinguished from the line of work begun by Lauri Carlson and represented in his book, *Dialogue Games*: (Carlson (1983)). Our use of the term "Dialogue Games" predates his, and is represented in an early paper by coworkers of mine (Levin and Moore (1977)). The current paper is a regularization and reformulation of the prior work, specifically relating it to a theoretical notion of action, using proposed extensions of speech act theory as a vehicle.

Several lines of subsequent work in Artificial Intelligence have employed notions of goals held by speakers and hearers as an organizing notion for the formation and interpretation of dialogue. A recent paper, (Grosz and Sidner (1986)), is an excellent representative.

Recent discussion by Grosz and Sidner, along with a line of work begun by Phil Cohen (Cohen (1985)), suggest that higher level constructs such as speech acts and dialogue games can be deduced or derived from more elementary constructs. While such derivations may help to account for the origins of the higher level constructs, we believe that these constructs have been subject to conventionalization, which involves addition of arbitrary elements at the higher level. (The conventionalization may include understandings about personal roles, and may also include lexical conventions, such as the meaning of the word "request.") Any such conventionalization of a higher level construct makes it necessary to include that construct in accounts of the formation and interpretation of dialogue.

[13] In these game specifications A represents an action, Q represents an information specification and P represents a proposition. They are unspecified in the game definitions, but must be made suitably definite when the game is used.

[14] Although the Dispute Game carries the assumption that I believes the proposition which he defends, he can explicitly deny that he believes it. Such a denial does not destroy an ongoing dispute, but rather alters its working hypotheses, making it more like a debate. In some circumstances, (e.g. debates, academic discussions or "devil's advocate" defenses) such a denial would be wholly redundant. The assumption is therefore optional, a convention rather than a consequence of other facts about the communication situations of disputes.

[15] This is a synthetic dialogue which has been composed to illustrate the operations and structures discussed in this paper. However, use of such dialogues is not representative of our usual methods of inquiry. Synthetic dialogues (including plays and dialogues which people produce while pretending) usually differ from natural dialogues under dialogue game analysis. Results which can be established only on the basis of non-natural dialogues are suspect.

REFERENCES

Allen, James, 1978: 'Recognizing Intention in Dialogue', Ph.D. Thesis, University of Toronto.
Austin, J. L.: 1962, *How to Do Things with Words*, Harvard University Press, Cambridge.
Brown, Gretchen P.: 1979, 'Towards a Computational Theory of Indirect Speech Acts', Massachusetts Institute of Technology, Technical Report, MIT/LCS/TR-223.
Carlson, Lauri: 1983, *Dialogue Games: An Approach to Discourse Analysis*, Reidel, Dordrecht, Holland.
Cohen, Philip R. and Hector J. Levesque: 1985, 'Speech Acts and Rationality', in *Proceedings of the 23rd Annual Meeting of the Association for Computational Linguistics*, Association for Computational Linguistics, pp. 49—59.
Cohen, Philip R. and C. Raymond Perrault: 1977, 'Overview of Planning Speech Acts', in *Proceedings of the Fifth International Joint Conference on Artificial Intelligence*, Massachusetts Institute of Technology.

Cohen, Philip R. and C. Raymond Perrault: 1979, 'Elements of a Plan-Based Theory of Speech Acts', *Cognitive Science* 3.

Davison, Alice: 1975, 'Indirect Speech Acts and What to Do with Them', in P. Cole and J. L. Morgan (eds.), *Syntax and Semantics*, Vol. 3, Speech Acts, Academic Press, New York, pp. 143—185.

De Beaugrande, Robert: 1978, 'Text and Sentence in Discourse Planning', in J. S. Petofi (ed.), *Text vs. Sentence: Basic Questions of Text Linguistics*, Buske, Hamburg, pp. 467—494.

Eemeren, F. van and R. Grootendorst: 1982, 'The Speech Acts of Arguing and Convincing in Externalized Discussions', *Journal of Pragmatics* 6, 1—24.

Ferrara, A.: 1980a, 'An Extended Theory of Speech Acts: Appropriateness Conditions for Subordinate Acts in Sequences', *Journal of Pragmatics* 4, 233—252.

Ferrara, A.: 1980b, 'Appropriateness conditions for entire sequences of speech acts', *Journal of Pragmatics* 4, 321—340.

Grosz, Barbara J.: 1977, 'The Representation and Use of Focus in Dialog Understanding', Ph.D. Thesis, University of California, Berkeley.

Grosz, Barbara J. and Candace L. Sidner: 1986, 'Attention, Intentions and the Structure of Discourse', *Computational Linguistics* 12, 3, 175—204.

Heringer, James: 1972, 'Some Grammatical Correlates of Felicity Conditions and Presuppositions', in *Working Papers in Linguistics* 11, The Ohio State University Department of Linguistics, Columbus.

Levin, James, A. and James A. Moore: 1977, 'Dialogue-Games: Meta-Communication Structures for Natural Language Interaction', *Cognitive Science* 1, 4.

Mann, William C.: 1975, 'Dialogue Based Research in Man-machine Communication', USC/Information Sciences Institute, Technical Report, ISI/RR-75-41, Marina del Rey, CA.

Mann, William C.: 1977a, 'Man-Machine Communication Research', USC/Information Sciences Institute, Final Report, ISI/RR-77-57, Marina del Rey, CA.

Mann, William C., James A. Moore and James A. Levin: 1977b, 'A Comprehension Model for Human Dialogue', in *Proceedings of the Fifth International Joint Conference on Artificial Intelligence*, Massachusetts Institute of Technology, pp. 77—87.

Mann, William C.: 1979, 'Dialogue Games', USC/Informationa Sciences Institute, Technical Report, ISI/RR-79-77, Marina del Rey, CA.

Mann, William C., James A. Moore, James A. Levin and James H. Carlisle: 1975, 'Observation Methods for Human Dialogue', USC/Information Sciences Institute, Technical Report, ISI/RR-75-33. Marina del Rey, CA.

Mann, William C., James H. Carlisle, James A. Moore and James A. Levin: 1977, 'An Assessment of Reliability of Dialogue-Annotation Instructions', USC/Information Sciences Institute, Technical Report, ISI/RR-77-54. Marina del Rey, CA.

Minsky, Marvin A.: 1975, 'A Framework for Representing Knowledge', in P. H. Winston (ed.), *The Psychology of Computer Vision*, McGraw-Hill, New York.

Moore, James A., James A. Levin and William C. Mann: 1977, 'A Goal-Oriented Model of Human Dialogue', *American Journal of Computational Lingustics*, Microfiche 67.

Moore, Robert: 1980, 'Reasoning About Knowledge and Action', SRI International Artificial Intelligence Center, Technical Note 191, Menlo Park, CA.

Perrault, C. Raymond and Philip R. Cohen: 1978, 'Planning Speech Acts', University of Toronto Department of Computer Science, Technical Report.

Rogers, Andy: 1978, 'Remarks on the Analysis of Assertion and the Conversational Role of Speech Acts', in *Proceedings of the Fourth Annual Meeting of the Berkeley Linguistics Society*, Berkeley, CA.

Schank, Roger C. and Robert P. Abelson: 1975, 'Scripts, Plans and Knowledge', in *Proceedings of the Fourth International Joint Conference on Artificial Intelligence*, Tbilisi, Georgia, U.S.S.R., pp. 151—157.

Searle, John R.: 1969, *Speech Acts: An Essay in the Philosophy of Language*, Cambridge University Press, Cambridge, England.
Searle, John R.: 1975, 'Indirect Speech Acts', in P. Cole and J. L. Morgan (eds.), *Syntax and Semantics*, Vol. 3, Speech Acts, Academic Press, New York, pp. 59—82.
Stalnaker, Robert C.: 1978, 'Assertion', in P. Cole ed., *Syntax and Semantics*, Vol. 9, Pragmatics, Academic Press, New York, pp. 315—332.
Winograd, Terry: 1975, 'Representing Knowledge: Frames, 'Oral Presentation at the Conference on Theoretical Issues in Natural Language Processing', Cambridge, MA.