Speech Acts, Dialogues and the Common Ground

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Abstract

The formal semantics of speech acts, even in the classical framework of illocutionary logic, requires considerations that go beyond individual speech activity and beyond the interpretation of individual sentences. We show how the formal semantics of speech acts can be extended to take into account the social effects and interactive aspects of *illocutionary activity*. To illustrate our approach, we focus on the semantics of assertions and descriptive discourse, contrasting the individual aspect of speaker's meaning and the epistemic effects of assertion making. The approach presented in this paper generalizes to all other types of illocutionary acts, adding specific content to the *conversational record* that registers the common ground of speakers and hearers as a dialogue unfolds.

Introduction

We presuppose the speech act theory of Searle and Vanderveken (FIL) found in (Searle and Vanderveken 1985). In this framework, the basic units of human communication are speech acts and basic illocutionary acts of the form $F(P)$ consist of an illocutionary force F and a propositional content P. *Illocutionary logic* provides a logico-philosophical analysis of each illocutionary force in terms of six components: an illocutionary point, the mode of achievement of an illocutionary point, propositional content, preparatory and sincerity conditions, and degree of strength. The formal semantics of elementary illocutionary acts is uniquely determined by these components and by the propositional content. It provides an analysis of the logical forms of speech acts. Illocutionary acts have propositional contents without being themselves reducible to sentences and propositions. In this framework, there are three distinct and irreducible semantic values: *truth*, *success* and *satisfaction*.

Vanderveken's approach of pragmatic phenomena is not reductionist. To the contrary, Vanderveken has extended the same strategy to construct a theory of discourse (Vanderveken 2001) that explains the types of possible discursive goals that speakers can attempt to achieve by way of conversing. The framework of this more recent work shows how the conversation types can be defined in terms of previously defined concepts of illocutionary logic. As Searle and others have pointed out, it turns out that the basic uses of language are few in number. In fact they can be separated according to four possible directions of fit between words and the world. Accordingly, there are only four basic types of discourses. These are *descriptive* discourses, *deliberative* discourses, *declarative* discourses and *expressive* discourses. Other discourse types can be generated with Boolean operations on the components of simpler discourse types.[1]

In previous papers, (Paquette 2002), (Paquette 2010), we have contributed to this research program by extending its scope in the direction of strategic interaction. Adding some assumptions and additional requirements to Vanderveken's theory, we formulated a representation of the speech act account of purposeful communication in game theoretical semantics. We have described the basic components of the resulting logic of conversation. We have defined some of the key notions in terms of Stalnaker's and Bonanno's epistemic models for games. More importantly, we have proposed that a dialogue is successful in the sense of the illocutionary account of dialogues if and only if (1) there is a solution to the corresponding dialogue game in the form of a Nash equilibrium (2) the participating agents are efficiency maximizers and (3) the participating agents are rational and cooperative with respect to the internal goal of the dialogue. In our view, this equivalence paves the way that brings us from speech acts to the logic of games.

Speech acts and dialogical interaction

The approach taken in the present paper allows us to answer those critics of speech act theory who claim that this framework is irrevocably individual bound rather than social and sentential rather than dialogical.[2] We argue that these criticisms are no longer relevant. Indeed, we claim that that the speech act approach can meet the challenge of the *interactive turn* which is now dominant in the study of dialogue and

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[1] Vanderveken, (Vanderveken 2001), III.3.

[2] See, for instance, Asher and Lascarides (Asher and Lascarides 2003), p.74.

discourse.[3] In fact, as Baltag pointed out in (Baltag 2001), we must come to realize that the logic of communication must extend beyond individual *speech activity*, and that such is required by the logic of games and the logic of public announcements.

In order to document the shared common ground in a conversational context, we make use of the notion of a conversational record.[4] The conversational record is a public evolving representation of the state of a conversation. The postulated elements of the conversational record complete the clauses required to define the success and satisfaction conditions of coherent and rational discourse.

Assertion: two views

We start by stating the received view. A proposition can be viewed as a way of dividing a set of possible worlds into two parts: the ones that are ruled out by the truth of the proposition and the ones that are not. When an assertion is made by the speaker α the proposition asserted P splits the set of possible worlds in two and the speaker asserts that the actual world of the context of his assertion belongs to the subset of the set of possible worlds in which P is true. The speaker represents a state of affairs as being actual.[5] Under this analysis, assertions are pretty much individual activities. This goes hand in hand with the fact that the distinction between an illocutionary act and its perlocutionary effects is aimed at putting the speaker in command of his own sayings. As is welI-known, perlocutionary effects are cancelable. So we can say "*Don't be offended but it seems to me that what you just said is completely silly*". In speech act theory, the existence of perlocutionary effects is acknowledged but these effects are not relevant to the conditions of success of assertions. A speaker can be successful in making an assertion independently of any effect that his assertion may have on others or on the outside world. The only requirement is that he believes the propositional content, or, in other words, he must have reasons for thinking that the propositional content is true. Assertions are used to represent the world in a certain way, and the possibility of making a successful assertion is independent of any side effects that the assertion may have.

In contradistinction with this semantics of assertions advocated by speech act theory, there is an entirely different approach that has been flourishing in the last decades. According to the interactive and dialogical picture of dialogues and discourses, when people make assertions they are attempting to make other people believe what they say. In a social setting, an assertion can be construed as a kind of update operator with respect to a given conversational record. The idea that the point of a meaningful assertion is the creation of a belief goes back at least to Grice (Grice 1957). According to R. Thomason, this idea can be found in most of the work in which planning is applied to discourse. The view is also a basic tenet in Dynamic Epistemic Logic (DEL)

and Public Announcement Logic (PAL). These approaches have shown that it is fruitful to think of speakers and hearers as interacting systems of beliefs. From the perspective of rational interaction, assertions can be viewed as attempts to induce beliefs in others. Moreover, from a dynamic perspective there is a close connection between assertion and the update operator. This has been developed in DL, DEL and PAL. One goal of asserting a proposition is to update the conversational record with that proposition.[6]

We seem to be confronted with a fundamental incompatibility between the dynamical account of assertions and the semantics of assertions of Searle and Vanderveken. In Searle and Vanderveken assertions have the "words-to-world" direction of fit since the point of assertions is to adjust the words to correspond to the facts of the world. But under the dynamical view mentioned above, the anticipated effect of interacting with other belief systems and changing other people's belief sets is the true purpose of making assertions. Assertions no longer have only the words to world direction of fit, they are also genuine attempts to change the world. It may well be that the simplest countermeasure to this problem is to acknowledge two different kinds of semantic clauses, one semantic clause for the illocutionary act of assertion interpreted in isolation, another semantic kind of semantic clause for the interpretation of assertions in context. Here, we limit ourselves to underlining the difficulty and leave it as an open issue. We come to realize that the extension of speech act theory to dialogical interaction calls into question the usual sharp separation between illocutionary acts and their perlocutionary effects. Even the semantics of assertions needs to be revisited and requires significant adjustments in a dynamic setting.

The logic of games

There are two different ways to connect games and logic. The first way is to use some tools from game theory to interpret logic. This approach goes back at least to C. S. Peirce[7] but is better known is association with a form of model-theoretic technique whereby logical formulas, or more generally structures are interpreted as games (e.g. Ehrenfeucht-Frass, Hintikka's IF-logics). The key idea is that the logic games approach is concerned with the study of games that are played with logic. *Game-theoretic semantics*, for instance, belongs to this lively tradition and this is what is falls under the concept of *logic games*. The other category of work is the study of games *using* logics, usually as a combination of modal, epistemic, temporal and dynamic logics. This approach is what is referred to as *game logics*. This second category of work, entirely different from the first, has been expanding rapidly in the last two decades. It is concerned with the development of logics that are appropriate to express game-theoretic notions and reformulate a large part

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[3] So it turns out that we, *speech activists*, can agree that "one is indeed a lonely number". See J. van Benthem, (van Benthem 2002) and (van Benthem 2010).

[4] We owe this notion to R. Thomason, (Thomason 1992).

[5] See Vanderveken, (Vanderveken 1990 91), p.117.

[6] Alternatively, in van Benthem's logical dynamics, updating is like relativization to a model.

[7] Peirce observed that thinking is a dialogue "with signs as its matter much in the way that the game of chess has the chessmen for its matter". Quoted from Peirce, 1966, MS 298, p.6 quoted by Pietarinen (Pietarinen 2003).

of game theory in terms of modal logics. The survey paper by Wiebe van der Hoek and Marc Pauly (van der Hoek and Pauly 2006) is a good introduction to the field. In the present work, we refer only to logics that belong to the second category, game logics, or, perhaps less confusingly, the logic of games.

New insights in dialogue game theory

In our own earlier attempt to bridge the gap between the speech act theory of dialogues propounded in (Vanderveken 2001), we used as the target formal framework the epistemic logic models proposed by Stalnaker in (Stalnaker 1997) and (Stalnaker 1999). In this setting, we were able to formulate a game-theoretic interpretation of the notion of "intelligent dialogue", distinguish between cooperative and strategic aspects of goal-oriented dialogical activity and establish by way of an informal argument that the notion of success for a dialogue is equivalent to the notion of Nash equilibrium[8]. The role of efficiency and rationality in dialogical interaction came to be highlighted. It was shown that key concepts of game theory could be applied to dialogical interaction. It became apparent that a formal dialogue game could be defined as a (partial) description of a sequence of interdependent Bayesian decision problems. Some critics seem to have understood our earlier efforts (Paquette 2002) and (Paquette 2010) as merely providing an interpretation of game-theoretical concepts in terms of some vague program for building a pragmatics of dialogue. Our complaint is that our critics seem to have entirely missed the point that there really exists a detailed logical account of intelligent dialogue, namely Vanderveken (Vanderveken 2001), that we were trying to extend and represent within the framework of an epistemic logic interpretation of game-theoretic concepts. This crucial fact is what makes the enterprise worthwhile, at once difficult and promising.

There were significant shortcomings in our earlier attempts that needed to be addressed. First, Stalnaker's epistemic models for games are formulated for games in normal (strategic) form. When a game is presented in this form, the payoff matrix is entirely laid out and the sequential nature of the interaction is obliterated. When a game is presented in extensive form, the sequential structure of the moves is revealed. Following Fudenberg and Tirole[9], we believe that game theorists use the concept of game in extensive form to model dynamic situations in which players make sequential choice. On the other hand, it is sometimes said that there is no important theoretical difference between games in normal form and games in extensive forms. Indeed, it is possible to reformulate a game in normal form into a game in extensive form.[10] So, one could argue that the dynamical appearance of a game tree is merely a feature of the presentation of the game and that the difference is merely notational. This, however, definitely ceases to be true when a game in extensive form is interpreted in a multi-modal logic incorporating temporal logic and dynamic operations. Under such an analysis, the sequential nature of a game becomes apparent whereas it is obliterated in the normal form where the game is characterized by its payoff matrix. As Brandenburger has pointed out, with the epistemic interpretation of games, a game can no longer be identified with its payoff matrix. The epistemic program in game theory aims to provide a methodical construction of game theory from its most basic ingredients. These are the concepts of rationality and irrationality, belief and knowledge about such matters, iterated beliefs about beliefs, and iterated knowledge about knowledge. The formal methods of this program rely on epistemic and multi-modal logics. These new approaches have convinced us that there was some gain to be made by building new bridges from the speech act theory of dialogues towards the newer logics of games.

A further reason to go beyond the basic epistemic logic for games is to seek refinements or other solution concepts than Nash equilibrium to represent the notion of success in a dialogue game. A refinement of Nash equilibrium is available in the modal logic interpretation of games proposed by Harrenstein et al. in (Harrenstein et al. 2004). It corresponds to the notion of a Nash equilibrium being *subgame perfect*. This raises the question as to whether this notion is relevant in the analysis of dialogical interaction and if new facts can be systematized in the new framework.

The notion of a subgame can be viewed as the cutting off of some initial segment from a game tree which yields another game in extensive form. This yields the notion of a subgame perfect Nash equilibrium which is an extension of the backwards induction method designed for extensive form games. The notion of a proper subgame is defined as a subset of the nodes of the game starting with an initial node and including all its successors that preserves all information sets of the game and over which a new game is defined by the restriction of the original game elements such as moves, payoffs, information sets, etc. A strategy profile is said to be a *subgame perfect Nash equilibrium* if it is a Nash equilibrium, and for every proper subgame, the restriction of those strategies to the subgame is also a Nash equilibrium. This solution concept is applicable in the case of structured dialogues that contain embedded dialogues.

The third reason to go beyond the basic epistemic models in our investigation has to do with keeping up with recent developments in the field. It has become increasingly clear that we need to reap the benefits of recent developments in dynamic logic to further our own research program on the logic of dialogue. Indeed we need to bring our research closer to the kernel of new logics that have yielded an impressive amount of knowledge linking various kinds of modal logics and numerous concepts of game theory, communication and rational interaction.

The relevance of game theory to the analysis of agent communication can hardly be doubted. Consider the following question, formulated by G. Bonanno in the context of a lecture on the epistemic foundations of game theory : "What

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[8]A comparable account can be found in Parikh (Parikh 2001) and (Parikh 2010). One significant difference is that Parikh's approach is based on situation semantics.

[9](Fudenberg and Tirole 1998), p. 67.

[10]Every extensive-form game has an equivalent normal-form game. But the transformation to normal form may result in an exponential blowup in the size of the representation, making it computationally impractical. ((Shoham and Leyton-Brown 2009), p. 35).

strategies can be chosen by *rational players* who know *the structure of the game* and *the preferences of their opponents* and who recognize each others rationality and knowledge?" It seems clear that this question has immediate resonance and application in the analysis of rational discursive interaction and that it is immediately relevant to the logic analysis of rational verbal interaction. Indeed, Bonanno's question aptly describes the predicament of participants in any type of rational verbal interaction.

Games in extensive form

We consider finite games in extensive form with perfect information. In a game with perfect information, no two nodes have the same information state. That is, whenever a player moves, he knows the past moves of all other players and (and the moves of chance if such a player is included), as well as is own past moves.[11]. As usual, a (pure) strategy for a game consists of a complete plan for a player i that specifies how to play that game. Strategy profiles, denoted by σ, combine strategies, one for each player. A strategy profile determines for each node a unique outcome, though not necessarily for each node the same one.

In order to determine whether a strategy is a best response for a player, the player needs to know the strategies that the other players adopt so best response for a player is relative to a strategy profile. Assuming that play commences at the root node, a strategy profile is said to contain *a best response for player* i_k, if i_k cannot increase his payoff by playing another strategy available to him when the other players stick to their strategies as specified in σ. A strategy profile is a *Nash-equilibrium* if none of the players can increase his payoff by unilaterally playing another strategy. Equivalently, a Nash equilibrium could be characterized as a strategy profile which contains a best response strategy for each player. [12]

Conversational record

The conversational record is a public evolving representation of the state of a conversation. In order to account for the common ground that is being structured as a conversation unfolds, it is necessary to associate with each step in a dialogue game an updated conversational record. An extensive game can be understood as a process in which the history of the game is taken into account. From this perspective, the model must take into account the individual actions of the players and stepwise progression through successive states are part of the definition of the game. Under such a fine grained analysis, we look at more than the set of achievable outcomes which is usually the only aspect that matters in classical game theory. The conversational record registers the successive moves of the participants and the information that these moves make public. It takes the form of a structured set containing shared knowledge at a given moment in a dialogue. The moves in a dialogue are taken to be speech acts that can be simple or complex. Accordingly, the basic layer of the conversational record will contain the

ordered list of speech acts that have been performed up to a given state. In the abstract model, it is convenient to suppose that the participants in a conversation satisfy a condition known as *perfect recall*. This is for the sake of simplicity. Of course, we know that real people often need to be reminded of what was said at an earlier stage of a conversation. From this simplifying assumption arises no conceptual difficulty. In addition to the list of previously performed speech acts, the conversation record must contain a set of propositions encoding the common knowledge of the participants to some of depth of iteration. These propositions are such that player a knows that player b knows that player a knows etc. This scheme is the definition of common knowledge. This component is required in order that the conversational record can be the repository from which the epistemic states of the players can be construed. A third component of the conversational record comprises a fair amount of semantic information that can be derived from the semantics of speech acts. This is the semantic information that the participants must possess in order to understand the type of discourse to which they are participating. Here, the semantic clauses that delineate the conditions of success for a type of discourse play a crucial role in explaining the coordination of the participants to a given dialogue. Following the theory set forth in (Vanderveken 2001), our analysis is restricted to the types of dialogue that possess an internal discursive goal, that is, dialogues that possess reachable endings that can be attained merely by making the appropriate discursive acts. This can only be possible if a shared minimal understanding of the discursive goals and subgoals is shared among the participants. Finally, the theory of success and satisfaction for rational dialogues demands that the most general requirements of coordinated behavior be satisfied. The first of these requirements consists in the common belief in rationality by which participants in a conversation expect of each other that they will attempt to achieve their goals and take the appropriate means to achieve their goals. The second requirement is that there should be common knowledge among the participants of the prevailing norms of efficiency that define cooperation; it must also be common knowledge that the participants are committed to these norms.

Conclusion

The analysis of rational interaction using game theory and modal logics is currently pursued in many different research communities and, accordingly, in many different formal frameworks. Our aim was to show how the classical theory of speech acts could be extended to make a contribution in this research program. Of course, the idea that the moves of players in a game yields a model for interaction in discourse is not new. Our aim was to show in what ways the classical framework of speech act theory might be developed and find its place among the promising new treatments of dialogical interaction.

Acknowledgment

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[11]The definition is taken from (Meyerson 1991), p.45.

[12]A formal treatment of the modal logic of games in extensive forms can be expounded along the lines of (Harrenstein et al. 2002).

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