

Conversational gameboard and discourse structure

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1 Introduction

This paper tries to bring closer two theories of human communication.

Commitment stores and dialogue games. In his seminal work on dialectical fallacies, Hamblin [Hamblin, 1970] introduced the notion of *commitments stores* whereby dialogue participants can keep track of (public) commitments that arise during the interaction. He also pointed out the rule-governed nature of dialogues, and tried to exhibit set of normative rules (*dialogue games*) which could prevent certain types of fallacies (interestingly, empirical evidence of such norms is given by descriptive conversation analysis). Recently, this line of research proved to be inspiring for the information state-based approach (as illustrated by the TRINDI project [TRINDI, 2001] or Hulstijn work [Hulstijn, 2000]). Clearly, this view challenges the intentional approaches which restrict their attention to mental attitudes and assume strong rational and cooperative principles.

Discourse semantic. Discourse semantics initially ignored dialogue specificities. The primary aim of this approach was to extend Montagovian compositional semantics to account for phenomena observed at the discourse level. This motivated a shift from truth-semantics to an update semantics (that is, sentences are regarded as update functions on possible worlds). In this perspective, the semantic/pragmatic interface becomes the focus of attention —in this paper, we shall mainly investigate how sentences interfere with dialogue structures. Some proposals have explicitly tried to capture dialogue within such a framework [Asher and Lascarides, 2003].

The case for a crossover We are now in a position to provide a justification as to why it would be useful to combine these approaches.

To begin with, one may ask why dialectical models are not enough to model human conversations. Very often, a turn is composed of several basic units. Under the assumption that the speaker obeys coherence principles (e.g. the so-called "right frontier" of discourse structure), it is for instance possible to define those discourse referents that can be used later in the dialogue. This, of course, can prove to be crucial when facing the interpretation of follow-up utterances and dialogue turns. It is clear that current dialectical approaches fall short of being able to account for these aspects, as they are simply not equipped with notions allowing to deal with this level of analysis.

On the other hand, the very same observations can be made at the level of dialogue turns, thus emphasizing the need to take into account dialogue structure (see 1).

(1) —**Dialogue 1.8**—

*F*_{27.2}. alors tu vois pour aller aux Carmes, (*so you see, to go to Carmes Square*)

*F*_{27.3}. tu remontes toute la rue St-Michel. (*you go up St-Michel St.*)

*R*_{28.1}. oui,

*R*_{28.2}. et je continue la rue Pharaon. (*yes, and I follow P. St.*)

*F*_{29.1}. voilà. (*exactly*)

One may wonder why we do not follow the way paved by recent extensions of discourse semantics. Regarding this issue, our response is a rather pragmatic one. Because most of these approaches focus on the modelling of mental attitudes (even though in a "restricted" manner, as in standard SDRT), they have to assume a "perfect" communication (that is, what is said is automatically heard and understood), not to mention maximalist cooperative and rational behaviours. This fails to be the case in natural dialogues, as again exemplified:

(2) —**Dialogue 1.8**—

*F*₅. t'es où ? (*where are you ?*)

*R*₆. euh, chez Y, là (*er, at Y's place*)

*F*₇. où ? (*where ?*)

*R*₈. chez Y. (*at Y's*)

*F*₉. mais je sais pas où c'est moi. (*but I don't know where that is*)

*R*₁₀. ah excuse-moi, (*oh, I'm sorry*)

Considering the previous remarks, our objective in this paper is then to put forward a detailed description of the public aspects of dialogue, as suggested by dialectical approaches. More precisely, we shall analyse interaction on the base of the informations explicitly *grounded*.

2 Formal model

We will detail here our interpretation schema. We try to avoid the explicit reference to mental states to focus on the modelling of social conventions. We propose two different interpretations. The first one handles ideal communications where participants perfectly hear what is said. The second one does not assume this and captures what a *perfect* observer (listening and hearing exactly what is said) can understand the conversation.

2.1 Semantic content, speech acts and rhetorical relations

We take speech acts as conversational basic units, consisting of a propositional content and an illocutionary force. Following proposals in SDRT [Asher and Lascarides, 2003], semantic content is represented as Discourse Representation Structure (K_π), and we augment this by specifying the producer (L_π) and the mood (affirmative, interrogative, imperative) (M_π) of the utterance. In SDRT, assuming the coherence of a discourse means that each utterance has to be related to the context with a rhetorical relation, except the first one. Such relations are defined by their triggering conditions and their semantic effects. Coherence in dialog is modelled in the same way, using specific relations tailored to dialogic phenomena. In discursive approaches, coherence is verified if an utterance can be successfully attached to the context. Likewise, coherence in conventional approaches of dialog correspond to the successful integration of a dialog act in an authorized dialogue game.

2.2 Discourse structure

The following discourse structure definition (2) is suitable for dialog, (cf. [Asher and Lascarides, 2003], section 4.4.1) but according to our second interpretation schema, the structures considered (in fact enriched and structured representations of the dialog's history) can only be built from "perceived" elements of the conversational board.

Def 1 (SDRS Syntax) *section 4.4.1, [Asher and Lascarides, 2003]*

- Let Ψ be a set of dynamic logical formulae (DRS) representing natural language propositions
- Let Π be a set of label (propositional variables)
- Let \mathfrak{R} be a set of binary relations
- The set Φ of well-formed SDRS is defined as follows :
- $\phi ::= \psi | R(\pi, \pi') | \phi \wedge_{dyn} \phi' | \neg \phi$ where $\phi, \phi' \in \Phi$ et $\psi \in \Psi$

SDRS labels correspond to dialog act tokens. The labels can thus differentiate two utterances with the same propositional content but uttered at different times, and can be used to refer to the SDRS themselves.

Def 2 (Discourse structure) *The structure (SD) of a discourse is a tuple $\langle A, \mathcal{F}, \delta \rangle$ such that :*

- $A \subseteq \Pi$ (Π is the set of labels)
- $\delta \in \Pi$ ($\delta \in A$) (the last utterance's label)
- \mathcal{F} is a function assigning to each label in A a SDRS in Φ

2.3 The scoreboard

Def 3 (Conversational scoreboard) *It consists of the discourse structure (SD) and commitment stores (\mathcal{E}_A and \mathcal{E}_B) of speakers A and B over certain elements of SD:*¹

$$\mathcal{TMC} = \langle \mathcal{SD}, \mathcal{E}_A, \mathcal{E}_B \rangle$$

Elements of \mathcal{E}_X are SDRS contents, i.e. either simple DRSs, or complex constituents. Some of these contents received a negative polarity (see below) if speakers are committed to their falsity (linked to an expressed disagreement; this has nothing to do with private beliefs, but reflects public information).

To model establishment processes without assuming a perfect communication, one should distinguish between accepted elements and merely perceived ones. In that case, discourse structures could be different for each speaker. This is a huge complexification, necessary to explain numerous real examples (see [Clark, 1996, Traum, 1994] for these notions, and [Prévet, 2004] for their development in SDRT).

Within a non-perfect communication, the information contained in the conversational board is only known by the ideal observer.

2.4 Interpreting relations and commitment dynamics

We consider here how commitment evolves, and how this can be seen as an interpretation of coherence relations in a dialog, wether we consider "monologic" relations of properly dialogic relations. The following rules can thus be seen as update rules of the board for each recognized act for which a relation with the context can be inferred.

2.4.1 Monologic Relations

The first case to consider is for monologic vericonditional relations, that is relations whose dynamic semantic is of the form (\wedge_{dyn} is dynamic conjunction), cf [Asher and Lascarides, 2003] :

$$(w, f) \llbracket R(\pi_1, \pi_2) \rrbracket_M(w', g) \text{ ssi } (w, f) \llbracket \mathcal{F}(\pi_1) \wedge_{dyn} \mathcal{F}(\pi_2) \wedge_{dyn} \phi_{R(\pi_1, \pi_2)} \rrbracket_M(w', g)$$

Here ϕ stands for semantic effects due to each relation (e.g. *narration*(π_1, π_2) implies a temporal succession of events in π_1 and π_2 , and a common topic for the pair). In a dialogue context, the producer of π_1 and π_2 is then committed to the content of π_1 and π_2 , *and the rhetorical link between them*, because semantic effects can be seen as conventionally implied.

We note \Rightarrow_{π} the update of commitment stores by a constituent π . If both π_1 and π_2 are produced by the same speaker, her commitment store will evolve as follows (in two steps):

$$\mathcal{E}_A \Rightarrow_{\pi_1} \mathcal{E}_A \cup \{\mathcal{F}(\pi_1)\} = \mathcal{E}_{A'} \Rightarrow_{\pi_2} \mathcal{E}_{A'} \cup \{\mathcal{F}(\pi_2), \phi_{narration(\pi_1, \pi_2)}\}$$

The remaining of the board is left unchanged. If it is a monologic relation across speech turns (π_1 is said by A, and π_2 by B), then only the first update applies to A, while the two updates apply to B's commitment store.

Likewise, other relations can be interpreted as commitment updates, with "truth" replaced by the corresponding commitment of a speaker to a proposition.

2.5 Dialogic relations

Given that speaker B utters π_2 , and that π_2 is to be attached to π_1 with the relation R we define commitments for dialogic relations in the following way :

- if $R = relation_q$ (i.e. $relation_q(\pi_1, \pi_2)$ holds)² then B's commitments are not affected but *relation* define the commitments concerning the answer to the question (see next case)
- if $R = QAP$ (Question Answer Pair) then B commits himself to the answer and to the link between the context and the question-answer pair. If $Relation_q(\pi_0, \pi_1)$ then $\mathcal{E}_B \Rightarrow \mathcal{E}_B \cup \{\mathcal{F}(\pi), \phi_{Relation(\pi_0, \pi)}\}$ where π corresponds to the resolved question-answer pair.³

¹This is for two-speaker conversations.

²These relations are interrogative content relation (e.g. *elaboration*, *narration*). The constituent associated with the question answer pair will be attached to the context through the corresponding monologic relation.

³There are different ways of representing such a resolved pair. We do not go further here.

- if $R = \textit{acknowledgement}$, then B commits itself to π_1 content.⁴ This constituent is not always an isolated utterance. It might be the topic of a resolved question-answer pair.

$$\mathcal{E}_B \Rightarrow \mathcal{E}_B \cup \{\mathcal{F}(\pi_1)\}$$

- if $R = \textit{correction}$ then two parts can distinguished in the target and the correction: the background (B) and the focus (F) (see [Asher and Lascarides, 2003] for details). The "background" is an abstraction over both utterances. The target representation is $B(F_1)$ and the correction one is $B(F_2)$. B's commitments evolve in the following way:⁵

$$\mathcal{E}_B \Rightarrow \mathcal{E}_B \cup \{-B(F_1), B(F_2)\}$$

Pursuing our integration of argumentative theories into our approach, we propose now a definition of two major argumentative acts in the SDRT framework.

challenge It corresponds to a justification request as "why p?" (voir [Hamblin, 1970, Maudet, 2001]). This relation can be identified with SDRT relation $\textit{Explanation}_q^*$. As far as we know, this relation has not been investigated in SDRT. The star after its name signals its *meta-relation* status, regarding the utterance level directly and not the content itself. $\textit{Explanation}_q^*$ is a request for explanation of the utterance act of the target.

Following the argumentative tradition, we consider such questions as introducing more constraints on commitments.

Inferring this relation is not easy, loaded or not with an argumentative dimension. In the future we plan to use lexical clues associated with high-level structures (e.g dialogue games).

reject This relation is related to SDRT relation $\textit{Counterevidence}$. However when $\textit{Counterevidence}$ offers a proposition "attacking" the target, *reject* rejects only without proposing anything. *Reject* is illustrated in sequence A1-B2-B3 of the first example of the section (3).

- if $R = \textit{challenge}$ ($\equiv \textit{Explanation}_q^*$) then A is allowed to remove the proposition from his commitment store. B's commitments do not change.

$$\mathcal{E}_A \Rightarrow \mathcal{E}_A \setminus \mathcal{F}(\pi_1)$$

Afterwards if A justifies the proposition with an explanation (satisfying the interrogative content relation) she commits herself to the proposition again. A cannot go further without either withdrawing or justifying the proposition.

- if $R = \textit{reject}$ then B negatively commits himself on π_1 content.

$$\mathcal{E}_B \Rightarrow \mathcal{E}_B \cup \{\neg\mathcal{F}(\pi_1)\}$$

In this first attempt we consider only simple constituent rejection since we did not find any example of a complex turn rejected without an explicit correction on the target.

3 Examples

We give some case studies of management of commitment stores. To make them shorter, commitment on the content of an act $\mathcal{F}(\pi)$ is noted π^+ , and commitment on the opposite is noted π^- . Our first example illustrates a rejection and the second one a correction. In the second example, the correction's target is only the rhetorical relation produced by the first speaker.

A_1 : *Turn left.*

B_2 : *I don't think so!*

B_3 : *there's a river on the left*

A_4 : *well...ok*

| | A_1 | B_2 | B_3 | A_4 |
|-----------------|-------------|-------------|--------------------|--------------------|
| \mathcal{E}_A | π_1^+ | π_1^+ | π_1^+ | π_1^-, π_3^+ |
| \mathcal{E}_B | \emptyset | π_1^- | π_1^-, π_3^+ | π_1^-, π_3^+ |
| \mathcal{E} | \emptyset | \emptyset | \emptyset | π_1^-, π_3^+ |

⁴Acknowledgement is more complex when communication is not taken as "perfect".

⁵Self-correction is different since the speaker has to "uncommit" herself to the self-corrected proposition before committing herself negatively on it.

A_1 : John went to jail.
 A_2 : He was caught embezzling funds.
 $B_{3.1}$: No.
 $B_{3.2}$: He went to jail
 $B_{3.3}$: because he was convicted of tax evasion.
 A_4 : oh... ok.

| | A_1 | A_2 | B_3 | B_4 |
|-----------------|-------------|--|---|--|
| \mathcal{E}_A | π_1^+ | π_1^+, π_2^+ $R_{expl}(\pi_1, \pi_2)$ | π_1^+, π_2^+ $R_{expl}(\pi_1, \pi_2)$ | $\pi_1^+, \pi_2^+, \pi_3^+$ $R_{expl}(\pi_1, \pi_3)$ $\neg R_{expl}(\pi_1, \pi_2)$ |
| \mathcal{E}_B | \emptyset | \emptyset | π_1^+, π_3^+ $R_{expl}(\pi_1, \pi_3)$ $\neg R_{expl}(\pi_1, \pi_2)$ | π_1^+, π_3^+ $R_{expl}(\pi_1, \pi_3)$ $\neg R_{expl}(\pi_1, \pi_2)$ |
| \mathcal{E} | \emptyset | \emptyset | \emptyset | π_1^+, π_3^+ $R_{expl}(\pi_1, \pi_3)$ $\neg R_{expl}(\pi_1, \pi_2)$ |

4 Conclusion and future work

The next step towards the integration of discourse structure approaches and conventional approaches consists in the unification of discourse structure and dialogues games. More precisely, SDRT topics are constituents of the discourse structure which ensure *thematic coherence* of particular sequences such as narrative chains. These constituents are *simple* and correspond to a kind of sum-up of an utterance sequence. Dialogue games are structures taking care of coherence of chain of utterances. These "macro-structures" are dedicated to interaction management but in a broader sense they have the same purposes as topics. In fact, dialogue games definitions include a sequence of specific moves (question/answer/ack) and a topic (or theme)(see [Lewin, 2000, Maudet, 2001]). Topics constituents in "standard" SDRT are used only for some coordinating relations (*Narration*, *Continuation*) but new proposals as [Prévot, 2004] introduce them for any coordinating relation and also for question/answer pairs.

A complete integration of these notions is not easy but their underlying objectives seem too close not to try to bring them together. It might also be a way of simplifying SDRT triggering rules by allowing another parameter (the type of game being played) in the context of application of these rules.

An easier extension is to consider "non-perfect" communication. There is indeed not too much work to be done for integrating different kinds of grounding strategies as proposed in [Traum, 1994, Larsson, 2003].

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