Coffee or tea? Yes

Maria Boritchev, Maxime Amblard

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Maria Boritchev
LORIA, Université de Lorraine,
CNRS, INRIA Nancy Grand Est
maria.boritchev@loria.fr

Maxime Amblard
LORIA, Université de Lorraine,
CNRS, INRIA Nancy Grand Est
maxime.amblard@loria.fr

Abstract

In this paper, we present the aim and architecture of our dialogue modeling project. We focus on producing logical representations of questions and answers in dialogue. Our view is to narrow the problem of identifying incomprehension in dialogue to the one of finding logical incoherences in speech acts combinations.

1 Introduction

One of the ways to identify, as a human being, *incomprehension in dialogue* is to see it as a moment when speech acts follow each other in a usual way but their combination doesn't make any sense.

Example 1

$\mathbf{A_1}$ *Do you want coffee or tea?*
$\mathbf{B_2}$ *Yes*

In Example 1, $\mathbf{A_1}$ is a question and $\mathbf{B_2}$ an assertion that could be an answer to $\mathbf{A_1}$, but here doesn't fit. $\mathbf{B_2}$ is in most cases followed by a clarification move $\mathbf{A_3}$ such as *'So you want coffee?'*. The final aim of our project is to be able to quantify this type of phenomena in dialogue. We want to automatically identify moments when speakers don't understand each other throughout a conversation. Among possible applications of our study, one can think in particular about chatbot programming, as our method would allow to generate more fluid automatic answers. When it comes to human-human interaction, we envision further study of specific human dialogues such as ones involving children or psychiatry patients. More generally, incomprehension points in dialogues are singularities where the most complicated human interactions happen, so being able to identify them can lead to improvement of algorithms such as neural networks based ones by focusing the training on these difficult cases.

The following presents our ongoing project. We aim to build a compositional logical model for dialogue, in order to be able to quantify the amount of logical inconsistencies inside a dialogue. Our first approach to dialogue is through question and answer relationship; we can consider that if an answer does not correspond to the question that has been asked, then there has been an incomprehension phenomenon. Yet, it is quite difficult to define the non-correspondence of an answer to a question, especially in an automated way; where does the answer start? what is its span? We chose in our project to bypass those difficulties by restricting the definition of incomprehension to one of its expressions: we only consider here logical incoherence produced by the combination of logical representations of speech acts. Of course, further work on this subject will have to hugely enlarge this definition.

We present the main architecture of our project along with questions and answers mechanisms. We follow by some data consideration by presenting the corpora we work with; finally, we propose to compare our work with other dialogue models.

2 Architecture

The following section first introduces the context and current status of our study, and then presents the focus of our future work. We are currently able to produce a logical representation of sentences

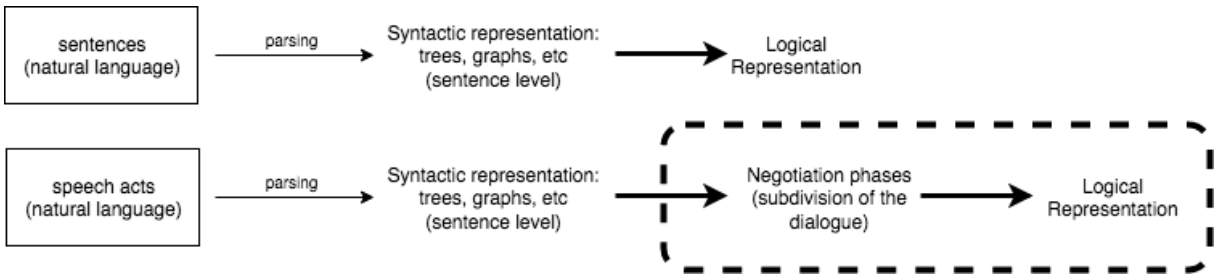

Figure 1: *Architecture of the process.* The upper process has been implemented, our current work focuses on the part inside the dashed-line box.

in natural language following Type Theoretical Dynamic Logic (TTDL) model (de Groote, 2006) and using the Abstract Categorial Grammar toolkit (Pogodalla, 2016); see upper process in Figure 1. Our current goal is to be able to do the same with speech acts. The parsing in the lower process is similar to upper one, as methods developed for general discourse can be applied to dialogue here. Yet, producing logical representations for speech acts is not as straightforward (see Section 3 for further discussion). For now, we simplify the problem by subdivising dialogues in different parts called negotiation phases. The result intuitively corresponds to a division of the dialogue in self-contained sub-dialogues according to the discussed topic. The core of our current work lies in the logical modeling of questions and answers.

3 Questions and Answers in Dialogue

The question-answer relationship is proper to dialogue. Our goal is to produce a logical model for questions and corresponding answers in a compositional way. Several different approaches to logical discourse modeling can be accounted for, starting from Montague (1973) and ending, in our case, with TTDL. Those models are rooted in classical logic, therefore assigning truth values to all sentences. It is thus very difficult to model questions using these methods: *'I want white tea'* might be true or false, but what to say about *'What type of tea do you want?'*?

Questions have then been treated extensively, see in particular Ginzburg and Sag (2000) overview. Among logical models proposed to account for questions, Ciardelli et al. (2012) presents a new, *Inquisitive Logic* that is able to model interrogative exclusive *'or'* in questions such as Example 2.

Example 2

$\mathbf{A_1}$ *Do you want sugar or stevia in your coffee?*

$\mathbf{B_2}$ *Neither.*

$\mathbf{B'_2}$ **Both.*

We suppose here that the answer $\mathbf{B'_2}$ is not acceptable, whereas $\mathbf{B_2}$ is. Inquisitive Logic gives us a handy framework to control how well answers fit the questions. Yet, for now, no systematic way of representing natural language utterances in terms of Inquisitive Logic has been provided. Moreover, as Inquisitive Logic and in particular Inquisitive Semantics has not been particularly developed for Natural Language usage, it is not inherently compositional. Compositionality is central to our project as we want to be able to combine (compose) speech acts logical representations. Therefore, one of the goals of our project is to implement a compositional mapping from Natural Language to Inquisitive Logic.

4 Corpora

We are currently working with a toy handmade corpus in English and French, the Unicorn Corpus (UniC). UniC is composed of 18 sentences in each langage, 9 questions (1 polar + 8, one per *wh*-word) and 9 corresponding assertions (see Example 3 and Appendices).

Example 3

Where-question	*Where is the unicorn?*
	Où est la licorne ?
Where-answer	*The unicorn is at home.*
	La licorne est à la maison.

We use UniC in order to elaborate our theoretical dialogue model. Our mapping is currently being tested on the toy corpus. We intend to run it on a corpus of simple non-controlled human dialogues. To this end, we are currently collecting real-life dialogues among french-speaking players of Settlers of Catan, called Dialogues in Games (DinG). Settlers of Catan is a board game where bargaining over ressources is a major part of the gameplay. Therefore, dialogues during each game are mostly centred on the game, with a small variety of topics. Additionally, studies of online strategic conversations in Settlers of Catan have already been conducted by Afantenos et al. (2015) and it is interesting to compare the observed phenomena.

Testing our model on DinG will allow us to validate structures created for UniC, observe new incomprehension-related phenomena and integrate them into the model. Furthermore, our project can be extended with developments for French grammars and lexicons (Guillaume, 2018).

5 Comparison with Ongoing Projects

When DinG will be constituted, we would like to compare our approach with the one of KoS (see (Aloni and Dekker, 2016) for an extensive presentation), based on Type Theory with Records (Cooper, 2008) and Questions Under Discussion (Ginzburg, 2012). Type Theory with Records (TTR) allows to keep track of the dialogue structure. Using a game board representation, TTR grants a visual way of following the dialogue moves of the participants. However, as TTR is a concept representation (Cooper and Ginzburg, 2015), it directly comes with a higher level of representation than the one we want to work at for now. TTR allocates types to situations as abstractions independent from the descriptions' formulations.

Questions Under Discussion (QUD), Ginzburg (2012), makes direct use of linguistic formulations. QUD brings us insight in the linguistic articulation of mechanisms of question and answer combination. In particular, QUD offers a way to differentiate questions that are currently being discussed, at some point in the dialogue, from those that have been introduced before.

6 Conclusion

We focus our work on the question-answer relationship in dialogue as we think it will give us an entering point for our studies on incomprehension in dialogue. In the previous sections, we presented the core of our project: we work on incomprehension in dialogue towards a method that will allow us to quantify this type of phenomena in conversations. We articulate several logical frameworks in order to fit our task, and we test our models on different corpora. We are now entering the dashed box on Figure 1, and in order to test our model on real-life data, we started collecting the DinG corpus. Working on the DinG corpus will allow us not only to test our model but also to compare our observations with the results obtained by Afantenos et al. (2015). While working on the integration of Inquisitive Logic inside TTDL, we are also considering improving the process of subdivision of the dialogues by adding Dynamic Epistemic Logic mechanisms (Van Ditmarsch et al., 2007).

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Appendices

WH-WORD	QUESTION (ENGLISH)	ASSERTION (ENGLISH)
$\emptyset$	Is Charly a unicorn?	Charly is a unicorn.
What	What colour is the unicorn?	The unicorn is blue.
When	When will the unicorn grow?	The unicorn will grow soon.
Where	Where is the unicorn?	The unicorn is at home.
Who	Who is Charly?	Charly is a unicorn.
Whom	Whom is the unicorn talking to?	The unicorn is talking to Charly.
Which	Which type of unicorn is Charly?	Charly is a blue unicorn.
Whose	Whose unicorn is Charly?	Charly is a free unicorn.
Why	Why is Charly a unicorn?	Because unicorns are great.
How	How big is the unicorn?	The unicorn is small?

Table 1: UniC – English

WH-WORD (ENGLISH)	QUESTION (FRENCH)	ASSERTION (FRENCH)
$\emptyset$	Est-ce que Charlie est une licorne ?	Charlie est une licorne.
What	De quelle couleur est la licorne ?	La licorne est bleue.
When	Quand la licorne grandira-t-elle ?	La licorne grandira bientôt.
Where	Où est la licorne ?	La licorne est à la maison.
Who	Qui est Charlie ?	Charlie est une licorne.
Whom	À qui parle la licorne ?	La licorne parle à Charlie.
Which	Quel type de licorne est Charlie ?	Charlie est une licorne bleue.
Whose	À qui est cette licorne ?	Charlie est une licorne libre.
Why	Pourquoi Charlie est une licorne ?	Parce que les licornes sont géniales.
How	De quelle taille est la licorne ?	La licorne est petite.

Table 2: UniC – French