What could mean *interaction* in natural language and how could it be useful ?

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What could mean interaction in natural language. The notion of Interaction, which is central in different fields, from Computer Sciences to Conversational Analysis, seems to be a same term amounting to rather distinct processes. Nevertheless, we think that the same, even if abstract, concept of interaction should underlie its incarnations in different disciplines. In *Ludics*, a logical theory developed by J.Y. Girard (2001), such an abstract concept of interaction is available. We postulate that this formal approach may help us to better understand what is interaction in natural language, and therefore that some language phenomenons may be better grasped and manipulated by means of a modeling based on such conceptual considerations.

In Ludics, there is a unique primitive concept: interaction, acting according to two modes. The *closed* mode is the process of communication itself, the *open* mode accounts for the transformation that this communication process induces on contexts. We may consider that in natural language also, interaction is a common concept subsuming two modes. With the communication mode, elements of language are produced and received by interlocutors during a dialogue. With the composition mode, elements of language are composed together to produce either more elaborated elements of language or to update knowledges and commitments. Therefore, based on the Ludics theoretical frame, we proposed in (Lecomte and Quatrini, 2011; Fouqueré and Quatrini, 2013; Fouqueré and Quatrini, 2012) a dialogue modeling that accounts for both aspects of interaction: communication and computation. Our model of dialogue is organized in two levels. At the first level, called *surface of dialogues*, a dialogue is represented by an interaction between two trees, each of them is the dialogue seen from the viewpoint of one interlocutor. More precisely, each turn of speech is a sequence of dialogue acts, where each dialogue act is represented twice: once positively inside the tree associated to the speaker who produces it, and once negatively inside the tree associated to her addressee. Therefore, each turn of speech gives rise to a part of both trees growing bottom/up. At a second level, knowledges and commitments as well as linguistic elements used to build utterances are stored in two cognitive bases, each one respectively associated to each interlocutor.

Dialogical contributions such as questions, answers and concessions. Even if the types of such speech acts are at first departed by the goals and the intentions of an interlocutor during a dialogue, the inspection that our modeling enables retains more primitive features. Question and negation are not really distinguishable according to their effects on the structure of dialogues, both are particular cases of a general speech act we may call "request for justification". Its main feature, for-

malized at the surface of dialogue, is to be a unique dialogue act creating a unique new address where the addressee is invited to anchor her development. On another side, question and concession are very close according to their effect on cognitive bases. When she asks a question, a speaker not only formulates it, but she is ready to receive and register an answer. In the cognitive base of the speaker, the tree associated with the question contains not only the dialogue act corresponding to the formulation of the question but also the tools to *compute* the reception and the registration of possible answers by means of a copycat strategy. The argument of the function is the answer to the question, also represented by a tree. The application of such a function to its argument gives rise to an execution: an interaction between the two trees. After the interaction, the cognitive base is augmented with the information given by the answer. To sum up, in the cognitive base, the question is associated to a tree which enables an updating. Moreover, we may remark that the effect of concession in cognitive bases is similar: when an interlocutor concedes a position claimed by her addressee, she records this position in her own cognitive base, still using a tree which enables to copy such a position and record it.

Grasping cognitive processes as computation. D. Prawitz (2007) studies the elements that determine the validity of inferences. In particular, he shows that the Modus Ponens rule is insufficient for taking into account the cognitive process at stake when an addressee is convinced by an argumentation. Instead it is the phenomenon of cut elimination which accounts correctly for what is responsible of the conviction. For D. Prawitz, the cognitive process requires a proof of one premise followed by the deductive extraction from this premise towards a conclusion. By this way, the addressee of an argumentation is obliged to accept an inference, if she stays rational. Our dialogue modeling follows and even more goes further Prawitz analysis. According to the theoretical framework on which our modelization is based, a proposition is denoted by the set of its justifications, whereas classically a proposition is formalized as a simple logical formula. In the same way, a "claim", a "thesis", a "belief" on which a protagonist commits herself during a controversy, is denoted by a sequence of arguments in a proof-like style. Such sequences of arguments make explicit the process according to which the protagonist is convinced by the validity of her commitments. It is worth noticing the two following points:

- Such a justification is formally a cut-free proof. It is the trace of the thought process which achieves the conviction about a proposition (close mode).
- Cut-free proofs at stake may interact: This process (open mode) yields a new cut-free proof that represents the new knowledge.

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