

Generating Modals

Ralf Klabunde

Ruhr-Universität Bochum, Department of Linguistics

klabunde@linguistics.rub.de

Introduction

This paper describes our ongoing work on the semantics and pragmatics of modal verbs and modal particles in natural language generation (NLG). We believe that the generation perspective sheds some new light onto the semantics-pragmatics interface from which NL understanding might benefit as well.

Our project aims at the representation of modality during content planning and the lexical choice of modals, i.e. the mapping from modality to corresponding modal expressions. We are developing a system that assists students in their choice of courses for an optimal progression of their studies. The student provides the system with information about his finished courses and his further goals, and the system generates a German text with corresponding recommendations, permissions, or other speech acts.

The starting point of our work is the possible-worlds-semantics proposed in [1]. We will first show how the basic concepts of this semantic theory are integrated into the content planning mechanism of our NLG-system. Since a semantic approach does not result in an unambiguous mapping from modal representations to modals, the pragmatics of the modals must be taken into account as well. Two examples shall illustrate the problems in generating modals:

- (1) Du *musst* den Semantik-Kurs besuchen (You must attend the semantics course)
- (2) Du besuchst *ja/doch* den Semantik-Kurs (You are attending the semantics course (just to bring this information to your mind again/am I right?))

From a semantic perspective, sentence (1) expresses that the addressee's

attendance of the course follows necessarily from some background knowledge, for example the study regulations.

The modal particles in (2) do not have a semantics at all (in a strict, truth-conditional sense). They are used to remind the addressee of information that was introduced by the interlocutors before (example 2 with *ja*), or to indicate that the speaker is not sure whether the proposition expressed by the sentence holds true (example 2 with *doch*) so that the addressee is invited to clarify this issue.¹

Now the problem in generating these expressions is to determine the pre-linguistic conditions for an unambiguous mapping of meaningful representations onto the corresponding modals that express them. We will show that this can be done if we use semantic conditions as a filter for all modal candidates. After that we are able to refine the mapping if we consider the modal expressions as speech act markers.

Modality and the semantics of modals

Modality is an umbrella term that covers different, albeit related subcategories. Most of these subcategories concern the speaker's evaluation of the probability that a certain state of affairs is true or will occur. It is for this reason why the notions of possibility and necessity become the central concepts for any semantic theory of modality.

In her seminal work, Kratzer ([1]) suggests three parameters for the analysis of modal verbs: the *modal force* (i.e. whether the verbs express possibility or necessity), the class of admissible *conversational backgrounds*, and the *ordering source* that induces an ordering of the possible worlds. According to this approach, the different modal verbs express different instantiations of these parameters. For example, German *können* (can) expresses possibility and is not confined to specific conversational backgrounds, while *sollen* (shall) expresses necessity and can only be used with specific backgrounds as, e.g., deontic or teleological ones. The ordering source is a relation between possible worlds that explains why certain worlds do not play a serious role as conversational backgrounds, although they belong to a permitted class. Since ordering sources are irrelevant for our approach, we may ignore them in the following.

Just as in modal logic, in Kratzer's work the notions of possibility and necessity are traced back to quantification: If $R(w)$ denotes the set of accessible worlds, and $[p]$ the set of worlds where p holds, then $[\Box(p)] = \lambda w.(R(w)$

¹These particles can be used with further functions as well. However, for reasons of space we will not go into the polysemy of particles.

$\subseteq [p]$) and $[\diamond(p)] = \lambda w. (R(w) \cap [p] \neq \emptyset)$. As we will outline below, reducing the modal operators to quantifiers allows us to determine the modal force in a non-modal representation.

Conversational backgrounds can be basically everything one can think of, and are determined by the application domain of the respective NLG-system. In our approach, two conversational backgrounds are relevant. The system's knowledge of the preconditions for attending courses and the conditions of study constitute a deontic background. The system's knowledge of the user's prior statements and the content of the previously generated texts form an epistemic conversational background.

Computing the modal force

We are quantifying over the nodes of the plan graph after content planning, and thereby determine the modal force.

The user provides the system with the current state of his studies (e.g., his current semester, and the attended courses so far). Based on the system's background knowledge and the information supplied by the user, a forward planner generates a complex graph where each path in the graph from the starting node to the target node constitutes a possible plan. Quantifying over the nodes results in the modal force. If a course appears in every plan at every semester, it must necessarily be attended in this semester so that a modal verb will be used that expresses necessity as modal force. Otherwise attending the course in that semester is just compatible with the overall plan so that a modal expression should be used that expresses possibility.

This step allows us to reduce the number of modal verbs to that subset that may be used with the respective conversational background and the determined modal force.

Determining pragmatic constraints

However, such a genuine semantic approach is not sufficient in NLG, since it leaves the lexical choice process underdetermined. For example, if we know that a deontic background is relevant, and the modal force is necessity, there are still several modal verbs that may be used to express these two semantic values as, e.g., *müssen* (must) and *sollen* (shall). Additionally, we are just able to separate the necessity-verbs from all other candidates, so that we still do not know w.r.t. possibility as modal force, whether a verb should be used or some particle.

Determining the modal force functions only as a filter for the modal

candidates. In order to receive a unique determination of the modal expressions, we must take into account their communicative function as well. In accordance with [2], we assume that the function of modals is to change the original speech act. For example, the subjunctive form *sollten* (should) modifies the original speech act, an assertion, to a recommendation, and the particle *ja* transforms the initial assertion into a kind of reminder.

The underlying mechanisms for providing the corresponding speech act draw upon content planning as well, as the following exemplary speech act-related procedures show:

Permissions express the system's agreement with the plans of the user. In order to determine this speech act, the system checks whether the user's input can successfully be mapped onto at least one of the generated plans. If this is the case, the modal verb *dürfen* is used.

Recommendations declare a certain state of affairs as advantageous with respect to some goal. In our domain, attending a course in a specific semester is advantageous for the completion of the course of study, if its attendance optimizes the number of semesters that are necessary for that completion. The system checks whether the courses favored by the user can successfully be integrated into the overall plan and computes the corresponding consequences. If attending this course during a specific semester does not increase the number of semesters that are required to achieve the completion within the normal duration of study, but a different course does that is also offered in the same semester, then it is advantageous to attend this course. In this case, the system uses the subjunctive modal form *sollten*.

Reminders (expressed by the particle *ja*) draw on the discourse record as epistemic conversational background. Their function is to remind the user that some propositional content has already been conveyed. For this, the system checks whether the proposition had been inserted into the discourse record some time ago (we use a threshold of four previous utterances).

References

- [1] Kratzer, A. (1981) The Notional Category of Modality. In: H.-J. Eikmeyer & H. Rieser (eds.) *Words, Worlds, and Contexts*. Berlin: de Gruyter; 38–74.
- [2] Zeevat, H. (2003) The syntax semantics interface of speech act markers. In: *Proceedings of Diabrock 03*. 7th Workshop on the Semantics and the Pragmatics of Dialogue.