Indicators of Argument-conclusion Relationships.

An Approach for Argumentation Mining in German Discourses

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[In this paper we present a new methodological approach for the analysis of public discourses aiming at the semi-automated identification of arguments by combining methods from discourse analysis with methods from Natural Language Processing. Discourses evolve over long periods of time and, consequently, form a broad database. Up to now, the analysis of discourses is hitherto performed primarily by hand, i.e., only small corpora or discourse fragments can be analyzed. Inevitably, this leads to lengthy and expensive annotation. Thus, there is a growing interest to overcome these methodological challenges by the use of computer-based methods and tools for the semi-automated analysis.

However, there are only few approaches known that focus on the analysis of discourses and the (semi-)automated identification of arguments therein (e.g. Reed at al., 2008; Liakata et al., 2012; Ashley and Walker, 2013). Particularly, approaches that can be explicitly used for the analysis of German-language discourses exist only in initial stages. Therefore, we suggest a fine-grained semi-automated approach based on multi-level annotation that focuses on linguistic means as indicators of arguments. The aim is to identify regularities, respectively, indicators in the linguistic surface of the discourse (e.g. recurring lexical and typographical characteristics), which indicate the occurrence of certain arguments (e.g. premise). In this paper, we focus on the identification of indicators of argument-conclusion relationship: *conclusive connectors* or *conclusiva,* that are typically adverbs such as *hence, consequently, therefore, thus, because* (Govier, 2013; see example below):

Die Campusbahn werde den Individualverkehr verdrängen, weil die Stadt eng bebaut sei. Schon in den 1970er Jahren sei deshalb das Aus für die Straßenbahn besiegelt worden.

[The campus train will displace the individual traffic because the city is densely built. Therefore, the end for the tram was sealed in the 1970s.]

As an application example, a small corpus consisting of 21 newspaper articles is analyzed. The corpus belongs to the interdisciplinary project *Future Mobility (FuMob)*, which is funded by the Excellent Initiative of the German federal and state governments. The methodological approach consists of three steps, which are performed iteratively: (1) manual discourse-linguistic argumentation analysis, (2) semi-automatic Text Mining (PoS-tagging and linguistic multi-level annotation), and (3) data merge.

(1) *Discourse-linguistic argumentation analysis*: First, the data is manually analyzed. Objectives of the analysis are (i) identifying discourse-relevant arguments, (ii) forming argument classes, and (iii) determining the significance of an argument in the discourse (Niehr 2004). To determine the significance of an argument the use by various discourse participants is analyzed and quantified. The argument-use can be categorized as *argumentative*, *positively cited*, *negatively cited* or *neutrally cited*. In addition, to identify arguments and their use in public discourse, the analysis also aims to detect and characterize discourse participants who use similar arguments. For this purpose, the social *role*, *gender* or *age* of an argument's author are determined on the basis of the information given in the text. This allows comparing the argumentation of different social groups in public discourses.

(2) *Text Mining*: Parallel to the manual discourse analysis, the collected data is processed semi-automatically applying the methodology described in Trevisan (2014/in press). Thereby, post-processing is performed in four successive methodological steps. First, the data is tokenized

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by means of the TreeTagger tokenizer (Schmid 1995). Second, the tokenized data is PoS-tagged using TreeTagger. Third, the automatically tokenized and tagged data is manually corrected. Fourth, the corpus is annotated semi-automatically applying the multi-level annotation model depicted in Trevisan et al. (2014/in press); the annotation is performed using the tool *Auto-Annotator*. Originally, the model was used for the enhancement of automatic *Sentiment Analysis* in German blog comments. The annotation model consists of different annotation levels with various purposes and scopes (token vs. sequence of tokens) of annotation, e.g., the annotation of the morpho-syntactic function of a token vs. the annotation of the polarity (positive, negative, neutral) of a sentence or utterance. Thereby, the fact is taken into account that each token fulfills different grammatical functions, which are also relevant for the constitution of evaluative statements and arguments. The basic idea is, that the interplay and combination of different annotated linguistic means constitutes or indicates an argument and its way of use.

(3) *Data merge:* In a third step, the analysis results from (1) and (2) are merged. By the data merge, it appears, which linguistic means on which linguistic level interplays or often occurs with which kind of argument. The results of the data merge are evaluated regarding the enhancement of automatic argumentation analysis.

The results show that the argument-conclusion relationship is most often indicated by the conjunction *because* followed by *since, therefore* and *so*. In detail, the results show that indicators for argument-conclusion relationship include not only causal conjunctions (e.g. *because, since*), but also concessive (e.g. *although, despite*) or conditional conjunctions (e.g. *if ... then*). Thereby, the conclusiva indicate either the argument (e.g. *because, since, also*) or the conclusions (e.g. *hence, therefore, so*). In the second case, they are still references to arguments that often occur immediately prior to the conclusion. Furthermore, conclusiva occur predominantly as a single token. If they occur as a multi-token they have a reinforcing (e.g. *just because*) respectively limiting or negating function (e.g. *only because*).

The results raise the suspicion that the identified conclusiva are text type-specific phenomenon as the analyzed corpus contains only articles from newspapers. However, we assume that some of the conclusiva may occur across different text types (e.g. *because, therefore*) whereas other (e.g. *for this reason, in the end*) tends to be text type-specific indicators for argument-conclusion relationships.

Moreover, having a closer look at the text data, it is evident that conclusiva only bear evidence *of* argument-conclusion relationships. They do not indicate *where* the argument or conclusion starts or ends or in which sequence (argument-conclusion vs. conclusion-argument) they occur. Regarding the semi-automated analysis of arguments in discourses this constitutes a difficulty. One solution to approach this challenge might be to define the text window, which has to be considered left and right from the conclusiva. In this context, the work of Wellner and Pustejovsky (2007) has to be considered, too.

Future work will focus on the enhancement of the methodological approach and its automation, which includes i.a. the implementation of approaches such as anaphora resolution or pattern recognition. Furthermore, the analysis must be extended to other corpora and text types.

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