

# TOWARDS A SYSTEM OF SYNTACTIC DEPENDENCIES OF GERMAN

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A set of syntactic relations in a dependency grammar for German is proposed which can be used for machine translation and other applications. The basis for this set is the formal model of Russian syntax used in the linguistic processor ÈTAP, which is built on the basis of Meaning  $\Leftrightarrow$  Text theory. Using a terminology as close to ÈTAP as possible facilitates a potential computational implementation. At this stage of development the system of German dependency syntax comprises 58 syntactic relations, which were used to analyze manually several hundred German sentences. 18 of them have definitions that are similar to those of their counterparts in Russian syntax. Seven relations have the same definitions as their Russian counterparts except for the concrete German lexemes that are part of the definitions. For another 30 relations identical definitions as for the corresponding Russian relations can be used. Three German relations do not have a Russian counterpart.

**Key words:** surface syntactic relation, dependency, machine translation, Meaning  $\Leftrightarrow$  Text theory, German, Russian

## Introduction

In this paper a first sketch of a set of surface syntactic relations in a dependency grammar for German is proposed, that can be used for machine translation. The basis for this set was the formal model of Russian syntax that was developed by Ju. D. Apresjan, I. M. Boguslavskij, L. L. Iomdin and others for the linguistic processor ÈTAP-3 (cf. Apresjan et al. 2010), which is built on the basis of Meaning  $\Leftrightarrow$  Text theory (cf. Mel'chuk 1974). This model of Russian syntax is an excellent starting point because it is field-tested in the practice of NLP for a long time and still is continued to be refined (cf. Boguslavsky et al. 2011).

An essential part of ÈTAP is the rule-based machine translation from Russian to English and vice versa (cf. Apresjan et al. 1989 and Apresjan et al. 2003). The machine translation from Russian to German is an additional part of ÈTAP which has a prototypical character until now. My aim is to develop further this part and as a first step I want to propose a system of syntactic relations for German. This should be as similar as possible to the system of Russian relations in ÈTAP to have a basis for a computational implementation of Russian-German translation. Apresjan et al. (2010:24–43) describe seventeen actantial relations, 32 attributive, five coordinative and eight auxiliary relations for Russian. For the names and definitions of German relations I followed in a first step, whenever possible, the Russian and English

relations that are used in ÈTAP (cf. Apresjan et al. 2010:24–43 and Apresjan et al. 1989:71–121), and then adapted them to the requirements of German syntax.<sup>1</sup> German linguists, like e. g. Heringer (1996), Engel (2009) or Kunze (1975), often do not use any special labels for syntactic relations,<sup>2</sup> whereas Specht (2003) uses labels that are partially different from ÈTAP's syntactic relations. I, nevertheless, will use a terminology as close to ÈTAP as possible in order to facilitate a computational implementation. In a large part the definitions of Russian and German relations are more or less the same or at least similar. But there are some relations in German that do not exist in Russian, whereas some Russian relations have no counterparts in German,<sup>3</sup> and there are differences, of course, when German lexemes (or Russian lexemes respectively) are part of the definition. Besides the possible practical use, this system of syntactic relations might make a little contribution to the theory of translation.

The syntactic relations presented below were used to analyze manually several hundred German sentences, most of which are translations of Russian sentences that represent a corpus including all the different syntactic relations of Russian.<sup>4</sup> This, of course, is just a start; so, it is possible that one or another additional relation might be needed when a larger corpus with more different German constructions will be analyzed in future work.

The paper is structured as follows: German relations with definitions different from their Russian counterparts are presented in the first part; they are of particular importance for translation: actantial relations in section 1, attributive relations in section 2 and auxiliary relations in section 3 (there are no coordinative relations in this part). Relations with definitions that are more or less the same as those of their Russian counterparts are found in section 4. The paper ends with conclusions in section 5.

## 1. Actantial Syntactic Relations

**1.1. The prädikative syntaktische Relation** 'predicative syntactic relation'<sup>5</sup> connects a personal verb as syntactic governor with the grammatical subject of the

<sup>1</sup> I want to use German names for German relations in order to take into account their language-specific character.

<sup>2</sup> Kunze (1975:19) uses so called *Markierungen* 'marks' to characterize dependent nodes, like e. g. „temporaler Akkusativ“ 'temporal accusative' or „Akkusativobjekt“ 'accusative object'. Heringer (1996:36) uses lexical categories to characterize nodes in dependency trees (stemmas), like e. g. „V“ (for verbs) or „PTL“ (for particles). Engel (2009:305–309) characterizes nodes with labels like „E<sub>sub</sub>“ (for subject) or „Amod“ for (Modifikativangabe 'modifying phrase'), which comes at least near labeling relations.

<sup>3</sup> Seven out of the 62 Russian relations that are described by Apresjan et al. (2010:24–31) do not have a counterparts in German, cf. Zangenfeind (2011:313f.) for considerations in the field of actantial relations.

<sup>4</sup> The Russian sentences were taken from Apresjan et al. (2010), Apresjan et al. (1992) and from <http://www.ruscorpora.ru>; original German sentences were taken from *Süddeutsche Zeitung*.

<sup>5</sup> I will provide English translations for the labels of German relations only where it might be needed.

phrase as dependent. The subject can have one of the following forms: a noun in the nominative case, a preposition (representing a prepositional group), an adverb, an adjective, the particle *zu* 'to' (with an infinitive verb), a conjunction (introducing a relative clause) or a personal verb (representing a relative clause); cf. the following example, where X marks the syntactic governor and Y the dependent:<sup>6</sup>

- (1) *Er [Y] liest [X] ein Buch.* 'He [Y] reads [X] a book'

The definition of this German relation differs from the corresponding Russian relation in some details: the syntactic governor of this relation in Russian can also be a noun, an adjective, the short form of a participle or an adverb in constructions without copula verb, which is not possible in German, unless in elliptical constructions. The dependent, i.e. the subject, in Russian can also be a noun in the genitive or partitive case, the infinitive verb (in those cases where in German the particle *zu* 'to' is the dependent), which, again, is not possible in German; cf. the definition of the Russian predicative relation by Apresjan et al. (2010:25). A further difference between the German *prädikative Relation* and the corresponding Russian relation consists in different requirements of agreement between verb and subject.

**1.2. The agentive SyntRel** connects the predicate (the participle part of a verb in passive voice or an attributive passive participle) as syntactic governor with the preposition *von*, *durch* 'by, from', *seitens* or *von Seiten* 'on the part of', which introduces the semantic subject of an action denoted by the predicate (this subject corresponds to the first semantic actant of the predicate in active voice):

- (2) *Das Ergebnis wurde von [Y] Experten bestätigt [X].* 'The result was confirmed [X] by [Y] experts'

The Russian agentive relation is used both for verbs in passive voice and for nouns as syntactic heads, if the dependent is a noun in the instrumental case, cf. the Russian definition by Apresjan et al. (2010:26); I propose to use the German *quasi-agentive Relation* (cf. section 1.3) in all such cases where a noun is the syntactic head, cf. Zangenfeind (2011:311). The dependent of the Russian agentive relation is always a noun in the instrumental case.

**1.3. The quasi-agentive SyntRel** connects a predicative noun with its first semantic actant, which is a noun in genitive case or a prepositional group that is introduced by the preposition *von*, *durch* 'by, from', *seitens* or *von Seiten* 'on the part of':

- (3) *Das ist ein Bericht [X] von [Y] unserem Kollegen.* 'This is a report [X] by [Y] our colleague'

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<sup>6</sup> Due to lack of space, I will give only one example for each relation.

**1.4. The *kopulative SyntRel*** connects the copula (*sein, bleiben, werden* ‘to be, to stay, to become’) with the nominal part of the complex predicate. The dependent can have one of the following forms: a noun in the nominative case, an adjective or an adverb, a prepositional group or a group that is connected via conjunction:

(4) *Er ist [X] krank [Y].* ‘He is [X] sick [Y]’

In addition to the Russian equivalents of the three German copula verbs, in ÉTAP four more Russian verbs are marked with the syntactic feature ‘СВЯЗ’ as copula verbs, namely *бывать* ‘to be, to visit, to happen, to take place’, *делаться* ‘to become’, *казаться* ‘to seem’, *оказываться* ‘to turn out to be’; they all can be the governor of the corresponding Russian copulative relation, which is not possible in German. The dependent of the Russian relation can also be a word in the instrumental case or in the genitive case.

Another point is the following: in the phrase *Er war [X] in [Y] Bulgarien* ‘He was [X] in [Y] Bulgaria’ (cf. a similar Russian example by Apresjan et al. (2010:27)) *sein* ‘to be’ is used in the meaning of ‘to be located’; so, maybe it should be reconsidered, whether here we don’t have a *kopulative Relation*, but a *1. kompletive*, which connects a full verb with its the first complement.

**1.5. The *kompletiv-appositive SyntRel*** connects a noun that denotes e. g. a parameter with its actant if it is a noun in the nominative case that denotes a quantity:

(5) *Diamant hat die Härte [X] 10 [Y].* ‘Diamond has the hardness [X] 10 [Y]’

The definition of the corresponding Russian relation is very similar; the dependent, however, can also be an adverb with quantitative meaning etc.

**1.6. The *komparative SyntRel*** connects a word with comparative meaning or a verb, a noun or an adverb with a comparative conjunction (e. g. *wie* ‘like’ or *als* ‘as’) that introduces the second part of the comparison:

(6) *Es ist kürzer [X] als [Y] ein Meter.* ‘It is shorter [X] than [Y] one meter’

The definition of the corresponding Russian relation, again, is very similar; but here, in Russian the dependent additionally can be a noun in the genitive case. The concrete conjunctions that are used as a dependent element in the corresponding Russian relation are, of course, different. This also holds for all subsequent relations when concrete German lexemes are part of a definition.

Another point is the following: it might be useful to split this relation into two relations (one for syntactic governors that have a comparative meaning and another for verbs, nouns and other words that don’t have this comparative meaning), because when the syntactic governor is a word without comparative meaning the definition does not match actantial relations but attributive relations, cf. example 7:

(7) *Ich vertraue [X] ihm wie [Y] einem Freund.* ‘I trust [X] him like [Y] a friend’

1.7. The **elektive SyntRel** connects a word that denotes a choice out of a quantity (i. e. a numeral or an ordinal number, an adjective in comparative or superlative degree) with one of the prepositions *von*, *aus*, *unter* ‘of, out of, between’ or a noun in the genitive case:

(8) *Der bessere [X] der beiden Vorträge [Y].* ‘lit. The better-one [X] of-the two talks [Y]’

The syntactic governor of the corresponding Russian relation can also be one of the words that are used to build analytical superlative forms of adjectives.

## 2. Attributive Syntactic Relations

2.1. The **(eigentliche) modifikative SyntRel** ‘modifying relation proper’ connects a noun, an adjective, an ordinal number or a participle that is used as an attribute X with an adjective or the like Y that agrees with X in gender, number, case and definiteness:

(9) *Ein schöner [Y] Baum [X].* ‘A beautiful [Y] tree [X]’

Here, comparing the German and the corresponding Russian relations, we have only different requirements of agreement between syntactic governor and dependent: in Russian, definiteness is no criterion, but on the other hand, animacy is an additional criterion.

2.2. The **determinative SyntRel** connects a noun with its determiner. Heringer (1996:59) lists the following groups of determiners for German: definite: *der, die, das* ‘the’; indefinite: *ein, eine, ...* ‘a’; demonstrative: *diese, jene, ...* ‘these, those’; quantitative: *alle, jeder, ...* ‘any, every’; negative: *kein, keine, ...* ‘no’; possessive: *mein, ihr, ...* ‘my, her’; interrogative: *welche* ‘which’. An example with definite determiner:

(10) *Der [Y] Baum [X].* ‘The [Y] tree [X]’

This is a relation that does not exist in Russian. A corresponding relation, nevertheless, is used for English, cf. Apresjan et al. (1989:99f.).

In the combination determiner + adjective + noun (cf. example 9) Engel (2009:52f.) treats the determiner as syntactic head of the adjective, because the declension of the adjective is dependent on the determiner (which represents morphological dependency), whereas Kunze (1975:65f.) uses different criteria to show that both, adjective and determiner are direct dependents of the noun; Heringer (1996:247) also treats adjective and determiner as direct dependents of the noun. I will follow Kunze's and Heringer's solution because this seems to better represent the syntactic circumstances.

2.3. The **(eigentliche) attributive SyntRel** ‘attributive relation proper’ connects a noun or an adjective with its non-congruent attribute (e. g. a noun in the genitive case, a prepositional group or an adverb):

(11) *Das Haus [X] vorne [Y] ist neu.* 'lit. The house [X] in-front [Y] is new'

The syntactic dependent of the corresponding Russian relation can also be a noun in the instrumental case or an adjective in comparative degree.

**2.4. The (eigentliche) appositive SyntRel** 'appositive relation proper' connects a noun as syntactic governor with an apposition:

(12) *Die Häuser der Stadt [X] Berlin [Y].* 'lit. The houses of the city [X] Berlin [Y]'

In the corresponding Russian relation agreement between syntactic governor and dependent usually is required, which is not the case in German. Another difference between the Russian and the German appositive relations is the following: in Russian personal names the relation is directed from first to second name; in German there is reason to assume it is the other way round, cf. the genitive case of a personal name, which is marked only at the second name:<sup>7</sup>

(13) *Franz [Y] Kafkas [X] Werk.* 'Franz [Y] Kafka's [X] oeuvre'

**2.5. The quantitativ-koprädikative SyntRel** 'quantitative-copredicative relation' connects a verb with a quantitative group (e. g. a numeral) representing a copredicative item. The noun that is described by the co-predicative item and separated from it is not necessarily in the genitive case as it is in the corresponding Russian relation but it is usually in the case that is required by the verb:

(14) *Bücher lieferte [X] man eine ganze Kiste [Y].* 'lit. Books they delivered [X] a whole box [Y]'

**2.6. The (eigentliche) adverbiale SyntRel** 'adverbial relation proper' connects a verb with an adverbial phrase (i. e. an adverb, a noun in the accusative or genitive case, a prepositional group, an adverbial participle, a verb in the infinitive, a subordinate clause introduced by a conjunction):

(15) *Sie liest [X] schnell [Y].* 'She reads [X] fast [Y]'

The syntactic dependent of the corresponding Russian relation can also be e. g. a noun in the instrumental case or an adjective in the genitive case.

**2.7. The durative SyntRel** connects a verb that does not have any valency of duration with an adverbial phrase in the form of a nominal group in the accusative case that has the meaning of a duration:

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<sup>7</sup> cf. also Helbig, Buscha (2001:511) and Heringer (1996:103).

(16) *Er spielt [X] den ganzen Tag [Y] Gitarre.* ‘He plays [X] the guitar all day [Y]’

The syntactic dependent of the corresponding Russian relation can also be a prepositional group.

**2.8. The Distanz-SyntRel** ‘distance relation’ connects a verb with an adverbial phrase of spatial distance that is expressed by a noun in the accusative case:

(17) *Er ging [X] einen Kilometer [Y].* ‘He went [X] one kilometer [Y]’

Here, again, the syntactic dependent of the corresponding Russian relation can also be a prepositional group.

**2.9. The adverbial-tautologische SyntRel** ‘adverbial-tautological relation’ connects a verb with a noun in the accusative case that duplicates part of the meaning of the verb:

(18) *Sie lebte [X] ein kompromissloses Leben [Y].* ‘She lived [X] an all-out life [Y]’

The syntactic dependent of the corresponding Russian relation is a noun in the instrumental case.

**2.10. The Subjekt-koprädikative SyntRel** ‘subject-copredicative relation’ connects a verb with a co-predicative item that characterizes the subject of the verb and that is expressed by a prepositional group or an adverb:

(19) *Meine Schwester kam [X] mit [Y] gebrochenem Bein ins Krankenhaus.* ‘My sister came [X] to the hospital with [Y] a broken leg’

The syntactic dependent of the corresponding Russian relation cannot be an adverb but a noun or an adjective in the nominative or instrumental case, which is in congruency in gender and number with the subject of the verb; (it also can be a prepositional group, as in German).

**2.11. The Objekt-koprädikative SyntRel** ‘object-copredicative relation’ connects a verb with a co-predicative item that characterizes the object of the verb and that is expressed by a prepositional group or an adverb:

(20) *Man lieferte [X] ihn sterbend [Y] ins Krankenhaus ein.* ‘They took [X] him to to the hospital, dying [Y]’

The syntactic dependent of the corresponding Russian relation is a noun or an adjective in the accusative or instrumental case, which is in congruency in gender and number with the object of the verb (or a prepositional group, as in German).

### 3. Auxiliary SyntRel

**3.1.** The **analytische SyntRel** ‘analytical relation’ connects two elements of analytical verb forms (but not of passive voice); the inflected word form is the syntactic governor:

(21) *Wir werden [X] gehen [Y]*. ‘We will [X] go [Y]’

The syntactic dependent of the corresponding Russian relation can be a particle (Russ. *бы*) to build e. g. the subjunctive, which is not the case in German.

**3.2.** The **präfigurative SyntRel** ‘prefigurative relation’ connects a compound verb with its separable prefix:

(22) *Er montierte [X] die Antenne ab [Y]* [infinitive of the verb: *abmontieren*]. ‘lit. He mounted [X] the antenna dis [Y] [= He dismantled the antenna]’

This is a relation that does not exist in Russian. A similar, but in detail different relation is used for English phrasal verbs (phras-junct), cf. Apresjan et al. (1989:115f.).

**3.3.** The **reflexiv-analytische SyntRel** ‘reflexive-analytical relation’ connects a verb with its related reflexive particle *sich* ‘oneself’ and its word forms:

(23) *Sie verstecken [X] sich [Y]*. ‘lit. They hide [X] themselves [Y]’

This is a relation that, too, does not exist in Russian. It is similar to the Russian relation *вспом* ‘auxiliary’ (cf. Apresjan et al. (2010:42)), but differs from it in that the German verb and its related reflexive particle *sich* ‘oneself’ together form a dictionary entry of its own.

### 4. German relations with the same definitions as their Russian counterparts

Some German relations have the same definitions as their Russian counterparts except for the concrete German lexemes that are part of the definitions instead of Russian lexemes in the corresponding Russian relations. In the field of attributive relations these are:<sup>8</sup>

- **verschoben-attributive SyntRel** ‘displaced-attributive relation’: the German preposition *bei* ‘at’ is the syntactic dependent of this relation to connect an external possessor, instead of the equivalent Russian preposition.

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<sup>8</sup> Due to limited space I don’t give the whole definitions here; cf. Apresjan et al. (2010:33, 35, 39, 41, 43). For the same reason no examples are shown.



- **quantitativ-restriktive SyntRel**: the dependent of this relation, that describes an intensity, can be connected via the German preposition *um* ‘at’.
- **distributive SyntRel**: the dependent of this relation, that describes a unit of measure, can be connected via one of the German prepositions *in, pro, auf, je* ‘in, per’ or the like.
- **erklärende SyntRel** ‘explaining relation’: the subordinate clause (whose predicate is the dependent of this relation), that explains a fact of the main clause, is introduced with one of the German relative connectives *weshalb, was, womit, wodurch* ‘which is why, what, with what’ or the like.
- **erläuternde SyntRel** ‘illustrative relation’: the syntactic governor of this relation, whose dependent is a word referring to elements of a generic term, can be e. g. one of the German words *alles, überall* ‘all, everywhere’ etc.

in the field of coordinative relations it is the

- **sequentielle SyntRel** ‘sequential relation’: the syntactic dependent of this relation (a word with the same character as its governor) can be connected via one of the German prepositions *auf, mal, zu, gegen* ‘by, times, versus’.

in the field of auxiliary relations it is the

- **expletive SyntRel**: As a syntactic governor there is a German word like *es, dies, jener, davon, das* ‘it, this, that, of this, what’ etc., that stands for another phrase in the clause, that is the dependent of this relation.

Moreover there are thirty German relations for which the same definitions as for their Russian counterparts can be used as long as no language-specific terms will be part of them. This might undergo a change when more details about these relations can be stated as a result of future work. Due to lack of space they are just listed here without definitions<sup>9</sup> and examples; in the field of actantial relations there are: **Dativ-Subjekt-SyntRel, uneigentliche agentive, erste kompletive etc., erste uneigentliche kompletive etc., nichtaktantisch-kompletive, präpositionale, subordinierend-konjunktionale, komparativ-konjunktionale SyntRel**; in the field of attributive relations: **deskriptiv-modifikative, relative, kompositive, isoliert-appositive, nominativ-appositive, nummerierend-appositive, (eigentliche) quantitative, additive, restriktive, parenthetische, juxtapositionale, präzisierende SyntRel**; in the field of coordinative relations: **koordinierende, sentential-koordinierende, koordinierend-konjunktionale, kommunikativ-koordinierende SyntRel**, and in the field of auxiliary relations: **passiv-analytische, auxiliare, quantitativ-auxiliare, korrelative, proleptische, elliptische SyntRel**.

## 5. Conclusions

At this stage of development the system of German dependency syntax proposed here comprises 58 surface syntactic relations; 18 of them have definitions that are

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<sup>9</sup> cf. Apresjan et al. (2010:25–43).

similar to those of their Russian counterparts and differ from them just in some details. Seven relations have the same definitions as their Russian counterparts except for the concrete German lexemes that are part of the definitions. For another 30 relations identical definitions as for the corresponding Russian relations can be used. Only three German relations do not have a Russian counterpart, namely the *determinative Relation*, the *präfigurative* and the *reflexiv-analytische Relation*. Future work will show whether maybe one or another additional relation will be needed in German when a larger corpus with more different German constructions will have been analyzed.

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