TGermaCorp – A (Digital) Humanities Resource for (Computational) Linguistics

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Abstract

TGermaCorp is a German text corpus whose primary sources are collected from German literature texts which date from the sixteenth century to the present. The corpus is intended to represent its target language (German) in syntactic, lexical, stylistic and chronological diversity. For this purpose, it is hand-annotated on several linguistic layers, including POS, lemma, named entities, multiword expressions, clauses, sentences and paragraphs. In order to introduce TGermaCorp in comparison to more homogeneous corpora of contemporary everyday language, quantitative assessments of syntactic and lexical diversity are provided. In this respect, TGermaCorp contributes to establishing characterising features for resource descriptions, which is needed for keeping track of a meaningful comparison of the ever-growing number of natural language resources. The assessments confirm the special role of proper names, whose propagation in text may influence lexical and syntactic diversity measures in rather trivial ways. TGermaCorp will be made available via hucompute.org.

Keywords: German literature resource, language diversity, corpus characteristics, linguistic annotation

1. Introduction

TGermaCorp is a digital humanities resource build around German literature texts from several centuries. The primary texts are annotated on four levels: Firstly, the parts of speech are tagged according to the STTS (Schiller et al., 1999). Secondly, each token is assigned to its lemma. Thirdly, proper names are classified according to the kind of their referent (e.g., person or institution). Fourthly, clauses, sentences, paragraphs and headings are explicitly marked. Fifthly, multiword expressions are identified. All annotations have been carried out by linguistically trained annotators.

One characteristic of TGermaCorp is the composition of its primary sources: TGermaCorp is designed in view of capturing the lexical and morpho-syntactic varieties of written German as exhibited in German-speaking literature. Thus, TGermaCorp complements corpora that address the homogeneous style of mainly contemporary German (e.g., news- 

2. Qualifying TGermaCorp

What are the primary sources of TGermaCorp and in which way have they been collected? What is the size of TG? Are the POS annotations of TGermaCorp reliable? These questions are addressed subsequently.

2http://zs.gbv.de/motive/index.html
3https://de.wikipedia.org/wiki/Genetik, accessed multiply between May and December 2013
4https://www.gutenberg.org/
5https://de.wikisource.org/
6www.deutschestextarchiv.de/
7http://de.wikipedia.org/wiki/Genetik, accessed on 8th November 2012.
Table 1: Summary of concatenated POS.

| POS       | freq |
|-----------|------|
| ADV/ART   | 1    |
| APPR/ART  | 25   |
| APPR/PPER | 1    |
| ART/PPER  | 1    |
| KOKOM/ART | 1    |
| KOUS/PPER | 6    |
| NN/ADJA   | 2    |
| PIS/PPER  | 3    |
| PPER/PPER | 29   |
| PRF/PPER  | 5    |
| PW A V/ART| 2    |
| PW A V/PPER| 2  |
| PW A V/PRF| 2    |
| VAFIN/ART | 1    |
| VAFIN/PPER| 38   |
| VMFIN/PPER| 13   |
| VFFIN/PPER| 30   |
| VVIMP/PPER| 1    |

Table 2: Frequencies of POS.

| Rank | POS       | freq |
|------|-----------|------|
| 3    | S.        | 10164|
| 8    | S.        | 7167 |
| 13   | S(        | 2533 |
| 9    | ADJA      | 6095 |
| 11   | ADJD      | 3890 |
| 5    | ADV       | 7619 |
| 43   | APPO      | 55   |
| 7    | APPR      | 7420 |
| 19   | APPRART   | 1346 |
| 47   | APZR      | 55   |
| 2    | ART       | 10641|
| 32   | CARD      | 385  |
| 38   | FM        | 181  |
| 36   | ITJ       | 250  |
| 28   | KOKOM     | 706  |
| 10   | KON       | 4645 |
| 41   | KOUI      | 105  |
| 18   | KOUS      | 1526 |

| Rank | POS       | freq |
|------|-----------|------|
| 14   | NE        | 2205 |
| 1    | NN        | 20444|
| 34   | PAV       | 358  |
| 29   | PDAT      | 527  |
| 33   | PDS       | 369  |
| 24   | PLAT      | 949  |
| 25   | PIS       | 942  |
| 6    | PPER      | 7499 |
| 15   | PPOSAT    | 2137 |
| 51   | PPOSS     | 23   |
| 44   | PRELAT    | 72   |
| 22   | PRELS     | 1027 |
| 20   | PRF       | 1237 |
| 54   | PROAV     | 1    |
| 45   | PTKA      | 59   |
| 42   | PTKANT    | 104  |
| 26   | PTKNEG    | 930  |
| 21   | PTKVZ     | 1057 |
| 27   | PTKZU     | 828  |
| 49   | PWAT      | 42   |
| 30   | PAV       | 435  |
| 31   | PWS       | 413  |
| 50   | TRUNC     | 29   |
| 12   | VAFIN     | 3283 |
| 53   | VAIMP     | 14   |
| 37   | VAINF     | 232  |
| 40   | VAPP      | 122  |
| 23   | VMFIN     | 967  |
| 48   | VMINF     | 47   |
| 52   | VMPP      | 18   |
| 4    | VVFIN     | 7771 |
| 35   | VVIMP     | 347  |
| 16   | VVFIN     | 2093 |
| 39   | VVIZU     | 167  |
| 17   | VVPP      | 1621 |
| 46   | XY        | 56   |

Table 2: Frequencies of POS.

In order to provide a simple lexical example: the German noun *door*, *Tür*, is spelled “Thür” in Immermann’s Muenchhausen; likewise the adverb *freilich* (certainly) is spelled “freylich” in von Schubert’s Ansichten von der Nachtseite der Naturwissenschaft. Such spelling variations are only the tip of the iceberg – these and many more complications need to be addressed.

2.2. Some Facts and Figures

TGermaCorp comprises 122,902 word tokens. The average token length (excluding punctuations) is 4.59 characters, with a range of 1 to 39.\(^8\) Tokens are assigned their parts of speech (POS) in terms of the Stuttgart-Tübingen TagSet (STTS) (Schiller et al., 1999). Note that we follow a “concatenation” approach to POS, based on the model of the APPRART tag. That is, word tokens that are contractions of two lexical units\(^9\) are tagged with the concatenation of the POS involved. For instance, the token “kanns”, which is a contraction of the modal verb “kann” (can) and the pronoun “es” (it), is tagged with VMFIN/PPER (we use a slash ‘/’ as concatenation operator). In total there are 163 contractions in TGermaCorp, which are summarized in Table 1. However, since we do not assume that concatenated POS constitute proper parts of speech, we bifurcate them and use the split, “atomic” categories for analyses. The summary of the split POS is given in Table 2.

With regard to named entities, we basically followed the three classes Person, Location and Organisation used in the CoNLL 2003 training data set, which set a practical standard for named entity recognition.\(^10\) However, since we didn’t expect many organisations to be mentioned in literary texts and since the CoNLL threefold distinction ignores many further kinds of names, we distinguished between names of persons (“nepers”), names of locations (“neloc”), and other kinds of names (“nemisc”) in the annotation of TGermaCorp. The latter are then assigned their specific kind, for instance, “chrononym” or “institutionyn”. The list of admissible kinds of names has been compiled from several resources (viz. Brendler (2004); Debus (2012); Kamianets (2000); Nagel (2008); Vasil’eva (2011), the Urban Dictionary (Urban Dictionary LLC, 1999), and Wiktionary (Wikimedia Foundation, Inc., 2009), giving rise to a rather detailed inventory of proper name classifications. In sum, there are 1,586 names of persons, 347 names of locations, and 104 other kinds of names. The latter are mainly used to refer to mythological (Mythonym) or theological entities (Theonym), or to name rivers (Potamonym) or art objects (Artionym) – see Table 3 for the complete classification of other kinds of names.

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\(^8\) One-character tokens may result from interjections (“A!”) or abbreviations – both are separated from their punctuation in the process of tokenisation.

\(^9\) We found no token that consists of more than two items.

\(^10\) See [http://www.cnts.ua.ac.be/conll2003/ner](http://www.cnts.ua.ac.be/conll2003/ner); see also [http://nlp.stanford.edu/software/CRF-NER.shtml](http://nlp.stanford.edu/software/CRF-NER.shtml).
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sults (i.e., agreement coefficient

Krippendorff’s (Krippendorff, 1980) level of credible re-

results are collected in Table 4. The reliability results reach

1971), and Gwet’s AC1 (Gwet, 2001). The respective re-

the STTS annotation has been mapped onto the 12 tags of

Der Tod in Venedig

Thomas Mann’s novel

annotators’ STTS annotations of an extract of 555 words of

Table 3: Classification of other kinds of names.

| Tagset      | PercAgree | Kappa | AC1     | AC1 Conf.     |
|-------------|-----------|-------|---------|--------------|
| STTS        | 77.12     | 0.87  | 0.87    | (0.85 – 0.89) |
| UT          | 84.68     | 0.92  | 0.92    | (0.91 – 0.94) |

2.3. Reliability

In order to assess the reliability (Carmines and Zeller, 1979) of the part-of-speech annotation of TGermaCorp we calculated the interrater agreement of several annotators and different data. The main agreement study comprises five annotators’ STTS annotations of an extract of 555 words of Thomas Mann’s novel Der Tod in Venedig. Additionally, the STTS annotation has been mapped onto the 12 tags of the Universal Tagset (UT) (Petrov et al., 2012). Agreement has been measured by means of three coefficients: raw percentage agreement ("PercAgree"), Fleiss’ Kappa (Fleiss, 1971), and Gwet’s AC1 (Gwet, 2001). The respective results are collected in Table 4. The reliability results reach Krippendorff’s (Krippendorff, 1980) level of credible results (i.e., agreement coefficient > 0.80), which, according to (Rietveld and van Hout, 1993) can even be regarded as “almost perfect”. We used the R environment for statistical computing (R Core Team, 2013) for all analyses and calculations.

3. Assessing the Lexical and Syntactic Range of TGermaCorp

How does TGermaCorp diverge from related German corpora? To answer this question, we compute a number of diversity measures to compare TGermaCorp with two “reference corpora”, that is, TigerSmall and WikiMimikry, sampled for this purpose.

3.1. TigerSmall and WikiMimikry

In order to obtain reference corpora of comparable size, we randomly sampled texts of equal size as texts in TGermaCorp starting from two third-party sources. The first comparison corpus is called Wikipedia-based Mimikry Corpus (WikiMimikry). It has been built by extracting the plain text of Wikipedia articles out of the German dump from 30th April 2015 using the WikiExtractor11. The second comparison corpus consists of sentences sampled from the Tiger Treebank (TIGER project, 2003).

For the purpose of comparing the corpora in a fair way, their plain texts have been POS tagged and lemmatized using one and the same preprocessing tool. We used the TreeTagger (Schmid, 1994) to this end, for which Griesbrecht and Evert (2009) report an overall accuracy of 95.82 on the TIGER treebank (given their specific application conditions). For syntactical analysis, we converted the TreeTagger output of the corpora to the CoNLL 2009 format12 and parsed the result using the latest version of the MALT parser13. Thus, if there is some noise induced by the preprocessing procedure utilising the specific tools mentioned, all corpora should be affected in a similar way.

3.2. Lexical diversity

In order to assess the lexical diversity of the corpora, we computed their coverage with respect to the German release of Wiktionary14 of 1st September 2015. This has been done on the level of wordforms and lemmas, excluding punctuations. On the level of wordforms, Wiktionary covers 87.00% of TGermaCorp, 86.00% of TigerSmall, and 82.00% of WikiMimikry. On the level of lemmas, 60.49% of TGermaCorp, 54.36% of TigerSmall, and 48.50% of WikiMimikry are covered.

Following Baayen (1992), quoted after Evert and Baroni (2007), we additionally calculated the “measure of productivity”, viz. the portion of hapax legomena, as a further indicator of lexical diversity. The results are shown in Table 5. Finally, we computed measures of type-token ratio (TTR) for both tokens vs. types (i.e., unique wordforms) and tokens vs. lemmas (classified for their POS). The results are summarized in Table 6.

Since the TTR is known to be dependent on contingent features like text length, we looked for other expressive measures for lexical richness (despite our three corpora being of approximately the same length). Following Covington and McFall (2010), we calculated MATTR (moving average TTR) as the average of TTR values observed in sliding windows of 500 tokens. This measure of lexical diversity does not depend on text length. The MATTR values are 0.72 for TigerSmall, 0.64 for the TGermaCorp and 0.62 for WikiMimikry.

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11http://medialab.di.unipi.it/wiki/Wikipedia_Extractor
12See http://ufal.mff.cuni.cz/conll2009-st/task-description.html
13http://www.maltparser.org/
14https://de.wiktionary.org
3.3. Sentence Similarity and Syntactic Complexity

In order to assess corpus-internal similarity of sentences we perform a Monte-Carlo simulation on the comparison corpora. We start with randomly sampling 1000 sentences from each corpus. Then, we compute the Jaccard coefficient for each pair of these sentences, where each sentence is represented by the multiset of its wordforms. This procedure is iterated 1000 times for each corpus. Finally, the resulting similarity distributions are averaged and ranked per corpus. The results are shown in Figure 1(a).

Secondly, we adopt the method of measuring tree-like structures in social ontologies developed by Mehler (2011) for comparing parse trees of sentences generated by the MALT parser. We used, for example, the measure $D_m$ of Altmann and Lehfeldt (1973), which recursively assesses the complexity of subtrees as a ratio of their widths and depths (Abramov and Mehler, 2011). We mapped each sentence of each sample of each corpus on a vector of 13 such measures of tree-like structuring (including $D_m$ and 12 measures taken from Mehler (2011, chap. 3.4.1)). By a Monte-Carlo simulation (of 1000 iterations) we draw 1000 sentences from each corpus and computed for each sample the distances of these vectors. The resulting averaged rank distribution obtained by applying the Euclidean distance are shown in Figure 1(b). According to Euclidean distance, the Tiger Corpus seems to contain the least similar sentences. However, using a different distance measure, viz. the Mahalanobis distance, results are far more leveled – see Figure 1(c).

3.4. Choice of Measures

In general, comparability with external resources requires measures which are more general or widely used, such as the Euclidian distance. At the same time, different measures emphasize different aspects of the data. For instance, the Mahalanobis distance is the only distance of the three measures used that takes covariance into account. Whilst the other distances are thus insensitive to the context of the other vectors, the Mahalanobis distance compares each pair of sentences with respect to their position in the overall space of the sample, which in turn gives rise to a more leveled output. Using the Wilcoxon test (R library MASS (Venables and Ripley, 2002)), which consistently deals with ties for statistical significance on the distribution of all distances from the Monte Carlo simulations, we find that all pairwise distances are highly significant for the Jaccard similarities and the Euclidian distances. However, for the Mahalanobis distance between TGermaCorp and WikiMimikry, there was no significant difference. Since the distance measure determines the basis for further statistical and ultimately interpretative assessments, it is favorable to chose a number of different measures and/or to motivate the choice of measure carefully. The question for the effect of measure has been raised with respect to various subfields various times, see for instance Cha (2007) on density functions providing a dendrogram of distance measures, Salleh et al. (2012) on geometrical shapes, Cerequeira-Silva et al. (2009) on molecular markers. The latter reported a highly significant Spearman correlation of 0.58 between the Mahalanobis distance and the Euclidian distance, making them the most distant measures for their data and distance set. In computational linguistics, Rama and Kolachina (2012) worked on typological distances. Jin and Barrière (2005) found in a preliminary study, that the Dice coefficient, most similar to the Jaccard index, correlated best with human similarity judgments. Given these considerations, the choice of the three applied measures allows for the assessment of different aspects of the data and allows generalisability on the other hand.

4. Discussion

Given the different genres underlying TGermaCorp and the two comparison corpora, the quite similar results of the diversity measures applied above come as a surprise. However, those measures focus on the respective span of the feature in question within a target corpus while ignoring mutual overlap. This line of reasoning is fostered by observing that the Wiki articles that make up the WikiMimikry comparison corpus contain a lot of named entities (which are furthermore written in a vast variety of typescripts, including Greek, Chinese, and so on) which are not part of the vocabulary of the other resources – see Table 7 for respective figures.

With this in mind, we also calculated a simple mutual lexical overlap between the comparison corpora on the level of lemmas as identified by the TreeTagger. As can be
Table 7: Frequency of NEs within the comparison corpora based on TreeTagger outcome.

| Resource      | Number of NEs |
|---------------|---------------|
| TGermaCorp    | 2410          |
| TigerSmall    | 6159          |
| WikiMimikry   | 9208          |

Table 8: Lexical overlap (lemma).

|        | TGermaCorp | TigerSmall | WikiMimikry |
|--------|------------|------------|-------------|
| TGermaCorp | —          | 4586       | 4548        |
| TigerSmall | —          | —          | 6778        |
| WikiMimikry| —          | —          | —           |

Table 9: Lexical overlap (lemma) excluding NEs.

|        | TGermaCorp | TigerSmall | WikiMimikry |
|--------|------------|------------|-------------|
| TGermaCorp | —          | 4383       | 4306        |
| TigerSmall | —          | —          | 6159        |
| WikiMimikry| —          | —          | —           |

5. Conclusion

This paper introduced TGermaCorp as a novel resource especially devoted to the computational analysis of literary data. We described the sampling and annotation of the texts of TGermaCorp and provided a quantitative comparison regarding two reference corpora – drawn from Wikipedia and from the Tiger treebank. TGermaCorp can be used to train NLP tools that are better adapted to literary data (not being addressed by Tiger). Our assessment shows that in terms of lexical similarity of sentences and their complexity the TGermaCorp and the Tiger treebank are comparable. However, part of the diversity is due to the influence of proper names, which occur with different frequencies in various resources. Accordingly, assessing lexical overlap provides quantitative evidence for the fact that TGermaCorp contains historical texts whose vocabulary is not in the focus of present-day language resources like Wiktionary. Furthermore, given the proliferation of natural language resources, quantitative assessments of the kind employed in order to...
characterize TGERmaCorp are useful for comparing corpora and eventually pinpoint their specific features.

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