Under the magnifying glass. Dimensions of variation in the contemporary Timok variety

Documentation

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Contents

Introduction

The present document is appendix to the manuscript Under the magnifying glass. Dimensions of variation in the contemporary Timok variety.

The manuscript deals with morphosyntactic and socio-geographic variation in a South Slavic Timok variety spoken in Southeast Serbia. Four linguistic features are analysed in the context of variation between East South Slavic/Standard Serbian on the one side, and Balkan Slavic/non-standard on the other. The features selected for the analysis are:

- marking of indirect object and possessor
- post-positive demonstratives
- dative reflexive *si* as a particle
- auxiliary omission in the perfect tense

The present document follows the analysis presented in the paper and provides data and methodological processes used. It thus orderly refers to the sections and subsections from the manuscript.

For the purposes of the present paper, corpus files were searched using Python. The published online version of the corpus might provide different search options. Should the search be repeated on the uploaded version of the corpus, due to potential fine-grained changes in the data, the tendencies presented in the paper will not change, but the absolute numbers might, as well as the overall number of examples.

Note that in the present document, some pieces of code have been hidden to make it more readable. The entire code is available in the source script with the .Rmd extension.

3. Facets of variation

3.1 The analysis of morphosyntactic factors

3.1.1 Marking of indirect object and possessor

The analysis is based on the following variables:

- Dependent variable: type of marking (*na* + general oblique case vs. inflectional dative)
- Independent variables: function (indirect object, possessor), part-of-speech (nouns, pronouns, 'other'), nominal categories (proper/common nouns, grammatical number, grammatical gender, animacy)

The data used in the analysis is stored in the file 1_data.xlsx. The data was extracted from the corpus semi-automatically. Firstly Python script was used to extract all the instances of dative or *na* + noun/pronoun patterns.

00_IO_na_search.py

00_IO_dative_search.py

Noun forms were approximated using word endings for inflected and non-inflected forms. For pronouns, a list of all pronominal forms was used (see in scripts). The list of verbs was added as an additional means to enable better search and ensure that particular verbs will be retrieved (see in scripts). The obtained examples of IO are not just based on the pre-defined list of verbs, other contexts were included as well.

This data was then filtered manually example, by example. The final list of examples was labelled manually for the perametres included in the analysis. The filtered data was further segmented by focusing on particular criteria for each analysis. The overall number of examples is 895.

Frequencies of *na* 'on' + general oblique case and inflectional dative are normalized with regard to the overall number of relevant parts of speech and nominal categories retrieved from the corpus and multiplied with 10,000 in case of the PoS, gender and number, but with 1,000 in case of type of noun and animacy.

The file 1_marking_examples.xlsx is organized in sheets as follows:

1. Case, PoS, Function - rows contain examples extracted from the corpus. Columns contain information about Case, Function, PoS for each example (manually annotated)
2. IO PoS RAW - data from Case, PoS, Function, only for IO. It contains also a summary table with absolute frequencies regarding PoS.
3. POSS PoS RAW - data from Case, PoS, Function, only for POSS. It contains also a summary table with absolute frequencies regarding PoS.
4. Freq PoS tabele - repeated summary tables from 2. IO PoS RAW and 3. POSS PoS RAW, with calculated percentages, normalized per total number of the respective category.
5. Nominal categories RAW data - (for nouns only!) rows contain examples extracted from the corpus. Columns contain informtaion about nominal categories: Type of Noun (proper, common), Gender (masculine, feminine, neuter), Number (singular, plural), Animacy (animate, inanimate).
6. % for Nominal categories - Summary table based on data from 5. Nominal categories RAW data, with percentages and normalized frequencies per total number of nouns of each type/gender/number/animacy. The data for Type of Nouns is marked in yellow. The final table used for Figure 3 is highlited in red.
7. corpus_PoS_frequencies - frequencies extracted from the corpus for each PoS and nominal categories. The last row shows total frequency for each column.

In what follows analyses are presented as they appear in the paper.

Chi square test is used to compare analysed observations of analytic vs. inflectional marking in the whole sample. The test is performed using the data in the file 1_analytic_synthetic_marking.csv' which contains all examples of IO and POSS extracted from the corpus, labelled for the type of marking: analytic=0, inflectional=1 (from the file 1_data.xlsx, sheet 1. Case, PoS, Function, column Case). The values were relabelled below 0="NA+OBL", 1="DAT" here for clearer representation.

```r
head(analytic_synthetic_marking)
```

```
##                Informant Case
## 1 TOR_C_0001_tagged.txt    0
## 2 TOR_C_0001_tagged.txt    0
## 3 TOR_C_0001_tagged.txt    0
## 4 TOR_C_0001_tagged.txt    0
## 5 TOR_C_0001_tagged.txt    1
## 6 TOR_C_0001_tagged.txt    0
```

The sum of each category is used as input for Chi-square test.

```r
head(analytic_synthetic_marking_chisq)
```

```
##
##   0   1
## 763 132
```

```r
chisq.test(analytic_synthetic_marking_chisq)
```

```
##
##  Chi-squared test for given probabilities
##
## data:  analytic_synthetic_marking_chisq
## X-squared = 444.87, df = 1, p-value < 2.2e-16
```

Chi-square test is used to compare frequencies of analytic and inflectional type of marking with regard to their function (indirect object, possessive).

```r
head(marking_function_chisq)
```

```
##      analytic synthetic
## IO        480       112
## POSS      283        20
```

```r
chisq.test(marking_function_chisq, simulate.p.value = TRUE)
```

```
##
##  Pearson's Chi-squared test with simulated p-value (based on 2000
##  replicates)
##
## data:  marking_function_chisq
## X-squared = 24.187, df = NA, p-value = 0.0004998
```

The percentage of each category is visualised in Figure 1, based on the data from the file 1_marking_type_function.csv. The data was obtained by categorizing each example based on the type of marking and function (see 1_data.xlsx, 1. Case, PoS, Function, columns Case and funciton).

```r
marking_type_function
```

```
##   X marking_type marking_function marking_count marking_percent X.1
## 1 1       NA+OBL      IO (66.14%)           480           53.63  NA
## 2 2       NA+OBL    POSS (33.86%)           283           31.62  NA
## 3 3       DATIVE      IO (66.14%)           112           12.51  NA
## 4 4       DATIVE    POSS (33.86%)            20            2.23  NA
```

```r
Figure1
```

The data for analytic and inflectional marking was sorted based on part-of-speech categories. Frequencies were extracted from the 1_data.xlsx file and presented in the file 1_marking_function_pos.csv.

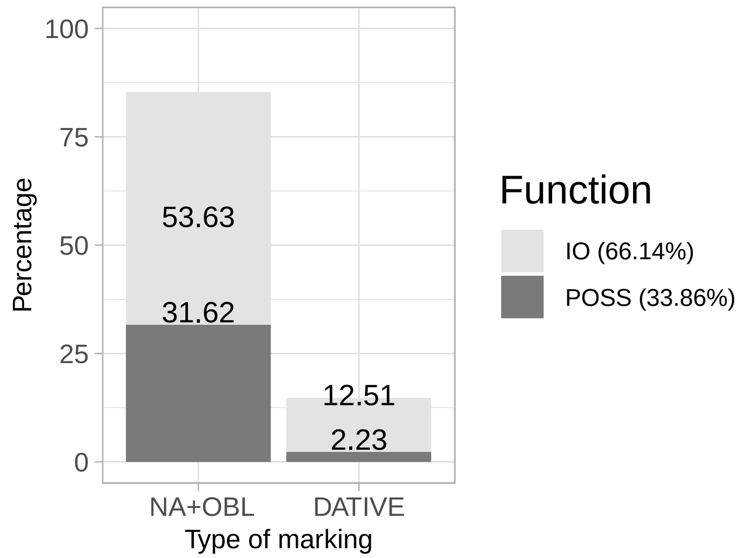


Figure 1 - Type of marking: overall and per functions

```
head(marking_function_pos)
```

```
##   X Function Type_of_marking     POS Values
## 1 1       IO          NA+OBL    Noun  43.61
## 2 2       IO          NA+OBL Pronoun  14.83
## 3 3       IO          NA+OBL   Other   8.57
## 4 4       IO             DAT    Noun   4.10
## 5 5       IO             DAT Pronoun   9.01
## 6 6       IO             DAT   Other   0.86
```

The values for indirect oblect and possessive function with respect to PoS categories are presented in Figure 2.

```
Figure2
```

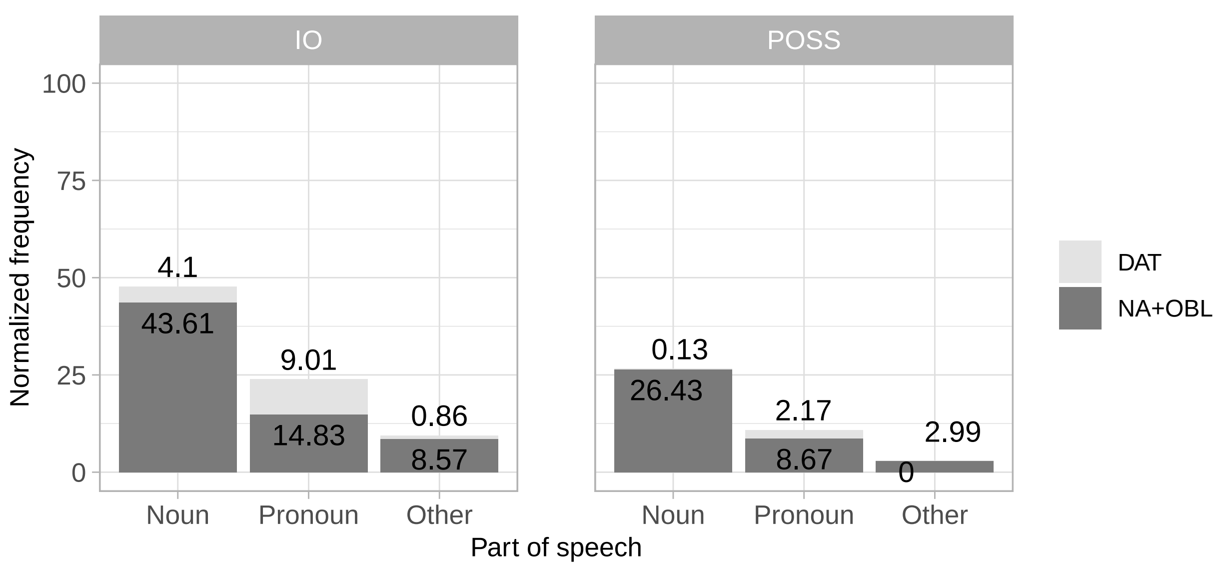


Figure 2: Marking of case in IO and POSS function with respect to PoS

Data for IO was categorized based on nominal categories (type of noun, gender, number animacy) and stored in the file 1_marking_nominal_category.csv. It is visualised in Figure 3.

```
Figure3
```

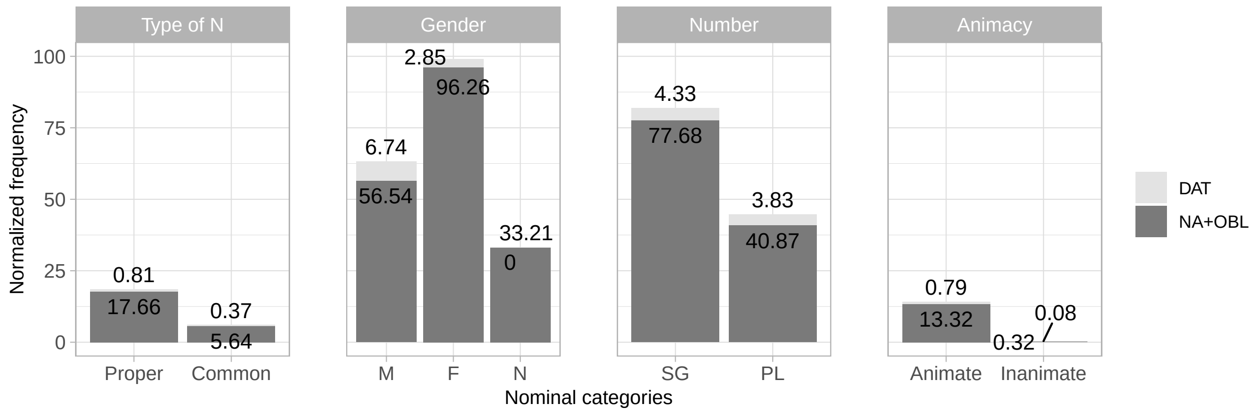


Figure 3: Case marking with regard to nominal categories

3.1.2 Post-positive demonstratives

In order to identify the distribution of different forms of PPD (nominative/unmarked vs. accusative/oblique, as well based on gender), nouns containing PPD were compared against bare nouns. The comparison regarding gender includes all nouns, while the comparison concerning case takes into account only nouns of the grammatical feminine gender ending in -a and masculine animate nouns ending in a consonant (regardless of the syntactic position). The following variables were used:

- Dependent variable: frequency of the nouns containing PPD and bare nouns (absolute and normalized per 10,000 nouns)
- Independent variables: gender of nouns (masculine ending in consonant, feminine ending in -a, neuter), case of nouns (nominative/unmarked and oblique/accusative singular)

Words with PPD were extracted from the corpus based on their form. The analysis in the present study involved nouns only, as explained in the manuscript. The resulting list of nouns carrying a PPD contains 1,182 tokens (in the corpus there is a total of 1,131 words of all PoS categories carrying a PPD). These words were manually annotated for PoS categories for the purposes of the analysis, because some PoS labels retreived from the corpus had been initially wrong. The examples of words containing PPD are stored in the file 2_PPD__examples.xlsx.

For the analysis of nouns based on gender genders, the data was categorized using PoS tags.

For the analysis of gender and case inflection, the extraction of nouns of different genders was done by using lists of lemmas from each of the categories: - grammatical feminine gender (feminine and masculine nouns ending in -a) - animate masculine nouns ending in consonant The lists were made by first automatically extracting all nouns of each gender from the corpus by using PoS tags and forms, and then manually selecting only correct instances. The feminine group includes the first 1337 correct lemmas, sorted by frequency. Both masculine groups contain all lemmas retreived from the corpus fitting the criteria. The lists of lemmas are available in files 2_PPD__masculine__nouns__in__a.txt, 2_PPD__masculine__animate__nouns__in__consonant.txt, 2_PPD__feminine__nouns__in__a.txt. The number of elements in each list is shown below (not included in the manuscript).

```
lists_of_lemmas_gender
```

```
##                          Category List_size
## 1 Masculine animate in consonant       336
```

```
## 2                 Feminine in -a      1337
## 3                Masculine in -a       109
```

All nouns were compared for gender, categorized based on gender and the presence of PPD. The total number of bare nouns of all genders is 74,769. The total number of nouns with PPD is 1,182. The data used in the analysis is presented in the file 2_PPD_gender_absfreq.csv.

Absolute frequencies of each gender in bare nouns and nouns containing a PPD are presented in the file 2_PPD_gender_prop.csv.

```
PPD_gen_all
```

```
##   Bare_nouns Nouns_with_PPD
## F      31549            612
## M      34100            413
## N       9120            157
```

Proportions of each gender in bare nouns and nouns containing a PPD is shown in Figure 4.

```
Figure4
```

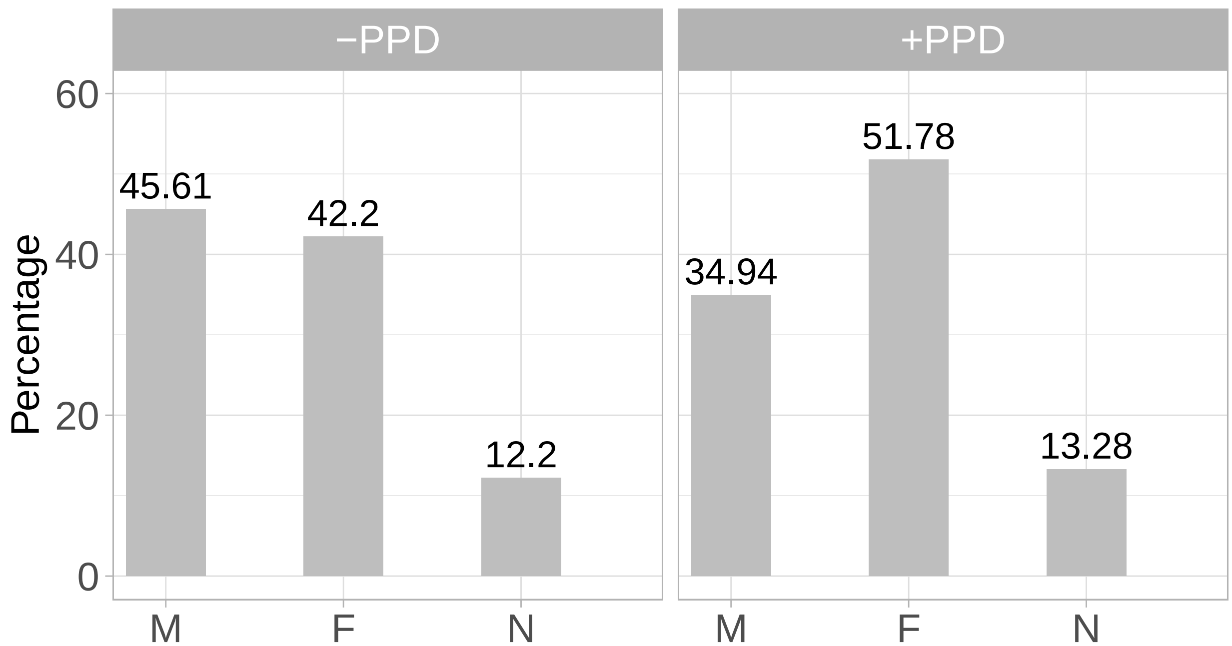


Figure 4: PPD and gender of nouns

Chi-square test shows that there is a significant difference in distribution of gender in bare nouns and nouns carrying a PPD.

```
chisq.test(PPD_gen_all)
```

```
##
##  Pearson's Chi-squared test
##
## data:  PPD_gen_all
## X-squared = 55.482, df = 2, p-value = 8.96e-13
```

Data used for the analysis of the distribution of case marking has been categorized based on the presence of PPD (bare vs. with PPD) and case inflections. The same categorization was performed for masculine and feminine nouns separately.

```r
ppd_case_gender
```

```
##   X Case  PPD All_nouns Masculine_animate Feminine
## 1 1  NOM -PPD     50.29             68.51    46.24
## 2 2  OBL -PPD     49.71             31.49    53.76
## 3 3  NOM +PPD     59.31             79.27    56.63
## 4 4  OBL +PPD     40.69             20.73    43.37
```

Mosaic plots presenting the proportion of nouns marked and unmarked for case (all nouns, masculine, feminine nouns) is displayed in Figure 5. Figure 5: Proportions of nominative/unmarked and oblique/accusative case forms in nouns with and without PPD

```r
Figure5 = grid.arrange(ppd_mosaic_all, ppd_mosaic_masc, ppd_mosaic_fem, nrow = 1)
```

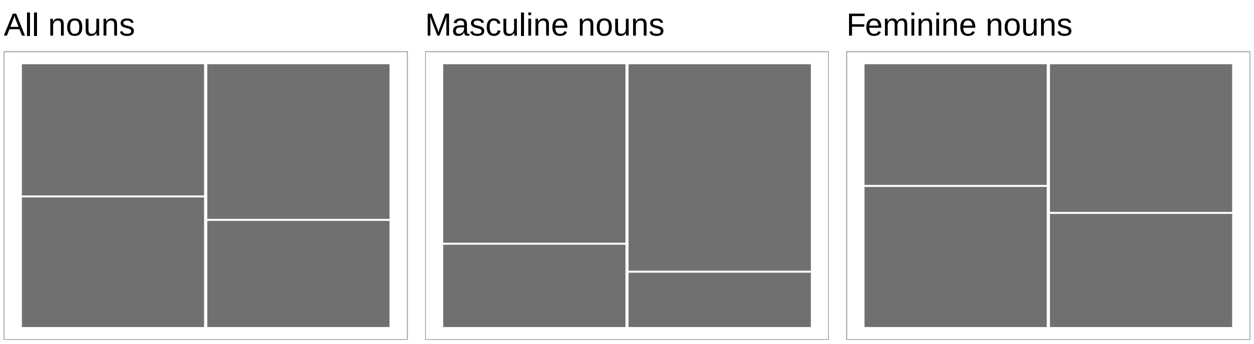


Figure 5: Proportions of nominative/unmarked and oblique/accusative case forms in nouns with and without PPD

3.1.3 Particle SI

The analysis is based on the following variables:

- Dependent variable: absolute and normalized frequency of the particle *si* used non-pronominally (per 1,000 verbs)
- Independent variables: properties of the verb (person and number, animacy, reflexivity, lexical type), variation in the syntactic patterns in the contact position between *si* and the verb

The search was done semi-automatically. A python script was used to search for all the occurences of the word 'si' and some unwanted results were excluded (such as the forms of the 2nd person auxiliary, e.g. Ti *si* gledal. 'You were watching.'). The rest was removed manually, by checking each example. Each example was annotated manually for the criteria described in the manuscript. The 1,375 examples of the use of si were extracted from the corpus. Manually annotated data used in the analysis is shown in the file 3_si_examples.xlsx

The frequency of particle *si* categorized based on person and number is shown below (see file 3_si_person.csv).

```r
si_person
```

```
##   X si_person_pers si_person_labels si_person_value
## 1 1             SG              1SG           19.13
## 2 2             SG              2SG            0.80
## 3 3             SG              3SG           44.22
## 4 4             PL              1PL           16.15
## 5 5             PL              2PL            3.56
## 6 6             PL              3PL           16.15
```

```
Figure6
```

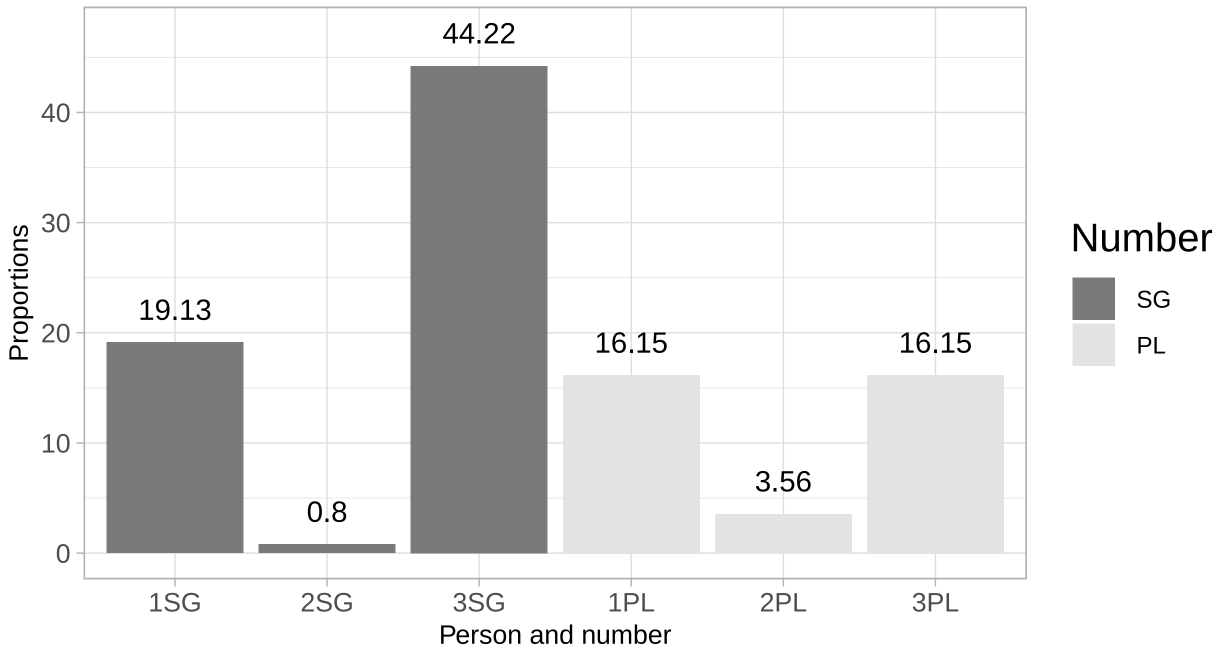


Figure 6: *Si* particle frequency: Person and number of the verb

Frequency of the particle *si* is compared on the basis of grammatical categories: animacy of the subject, reflexivity of the predicate, voice of the predicate.

Animacy (see file 4_si_animacy.csv):

```
si_animacy
```

```
##   X si_animacy_label si_animacy_value
## 1 1          Animate            83.35
## 2 2        Inanimate            16.65
```

Reflexivity (see file 4_si_refl.csv):

```
si_refl
```

```
##   X si_refl_label si_refl_value
## 1 1 Non-reflexive         91.78
## 2 2     Reflexive          8.22
```

Voice (see file 4_si_voice.csv):

```
si_voice
```

```
##   X si_voice_label si_voice_value
## 1 1         Active          96.15
## 2 2        Passive           3.85
```

Figure 7 shows the frequencies of the occurrences of the particle ‘si’ categorized based om the three linguistic features: animacy, reflexivity, voice.

```
Figure7 = grid.arrange(si_animacy_plot, si_refl_plot, si_voice_plot, nrow = 1)
```

The data presenting the analysis of the order of particle ‘si’ and the verb is shown in Figure 8 (see file 4_si_order_csv).

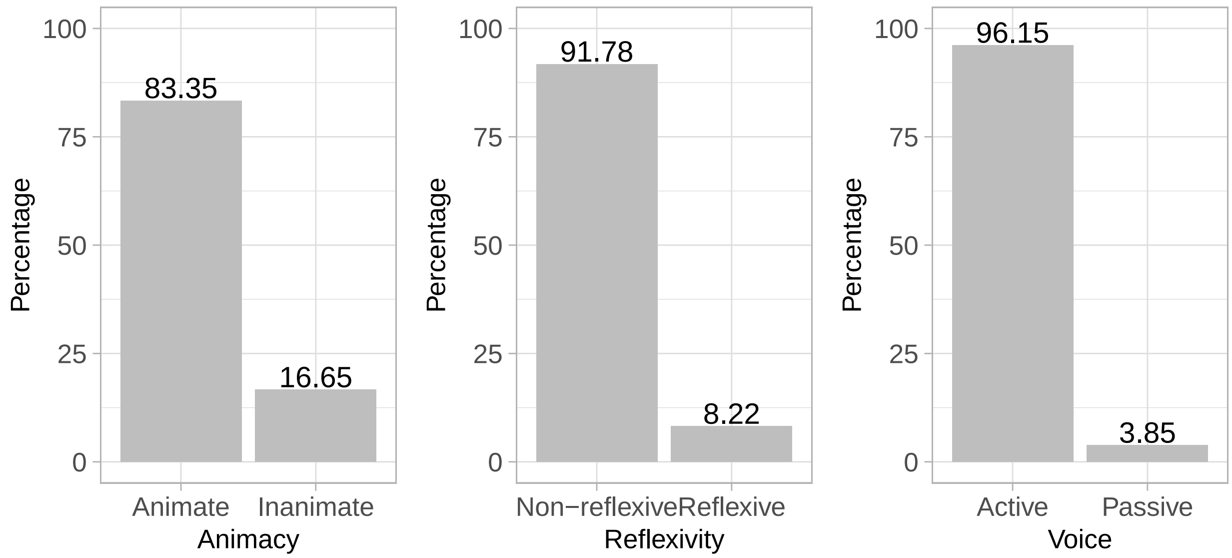


Figure 7: *si* particle frequency: Animacy, reflexivity, voice

```
Figure8
```

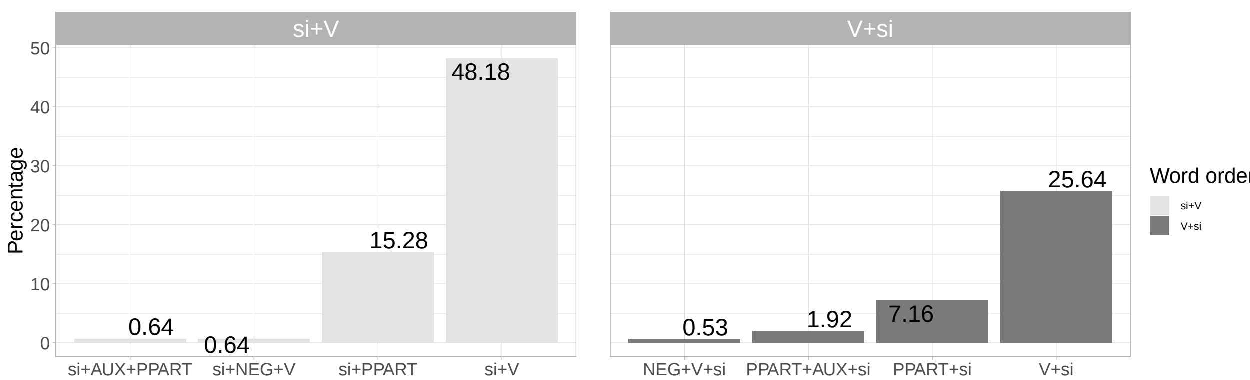


Figure 8: The proportions of contact patterns between *si* and the verb

3.1.4 Auxiliary omission in perfect tense

The quantitative analysis of the use of the -AUX forms is based on the following variables:

- Dependant variable: normalized (to the total number of the examples of the use of the perfect tense) frequency of the −AUX and +AUX forms per location.
- Independant variables: gender, several categorical linguistic variables: aspect, transitivity, lexical group.

The automatic search for relevant examples in the Timok corpus made with a user Python scriptrequired all the clauses where perfect participle tense is used. These examples were automatically divided into three groups: clauses with −AUX perfect forms, clauses with +AUX perfect forms and clauses with potential mood (the latter group was subsequently excluded from the analysis). From the total number of 13,233 examples of perfect tense, 8,343 (63.05%) are −AUX forms, 4,890 (36.95%) are +AUX forms.

The file 4_overall_freq.csv shows the frequency of analysed examples of the perfect tense that display +AUX (total_aux) and -AUX (no_aux) pattern per transcript (normalized per 1,000 occurrences of the perfect tense).

```
aux_overall = read.table('4_aux_overall_freq.csv', sep = '\t', header = TRUE, row.names = "ID")
```

```
head(aux_overall)
```

```
##             total_aux no_aux
## TOR_C_0001        547    453
## TOR_C_0002        382    608
## TOR_C_0003        342    658
## TOR_C_0004        483    517
## TOR_C_0005        523    471
## TOR_C_0006        526    474
```

The distribution of +AUX/-AUX patterns in the overall sample is shown in Figure 9.

Figure 9: +AUX and -AUX frequencies in the overall sample

```
Figure9
```

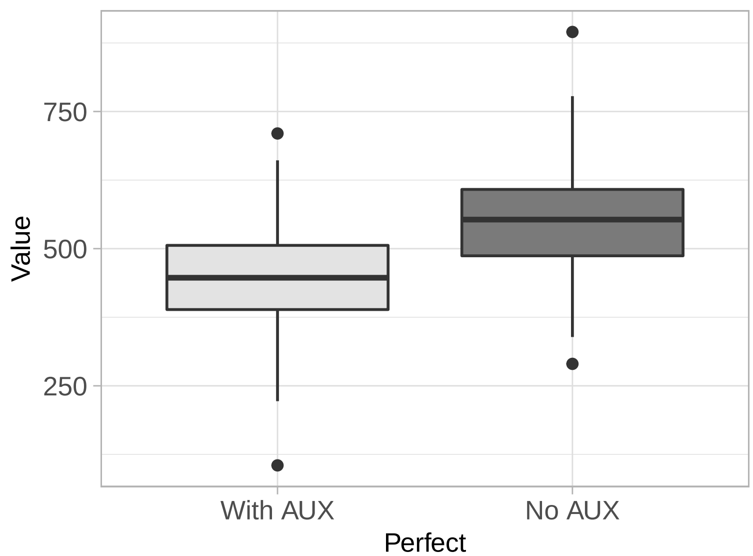


Figure 9: +AUX and -AUX frequencies in the overall sample

The total frequency of +AUX and -AUX pattern is presented below (see 4_aux_overall_chisq.csv):

```
head(aux_overall_chisq)
```

```
##   total_no_aux total_with_aux
## 1        35844          28849
```

Chi-squared test is used to compare the total frequencies of +AUX and -AUX.

```
chisq.test(aux_overall_chisq)
```

```
##
##  Chi-squared test for given probabilities
##
## data:  aux_overall_chisq
## X-squared = 756.34, df = 1, p-value < 2.2e-16
```

The data used in the analysis of verb categories on the use of AUX is kept in the file 4_gramm.csv.

```r
aux_gramm
```

```
##    Perfect Perfective Imperfective Transitive Intransitive Modal Non.Modal
## 1   No_AUX         84         1290        201         1173   996       378
## 2 With_AUX        332          979        539          772   546       765
```

The proportions of the linguistic properties through the -AUX and +AUX forms are displayed in Figure 10.

```r
Figure10
```

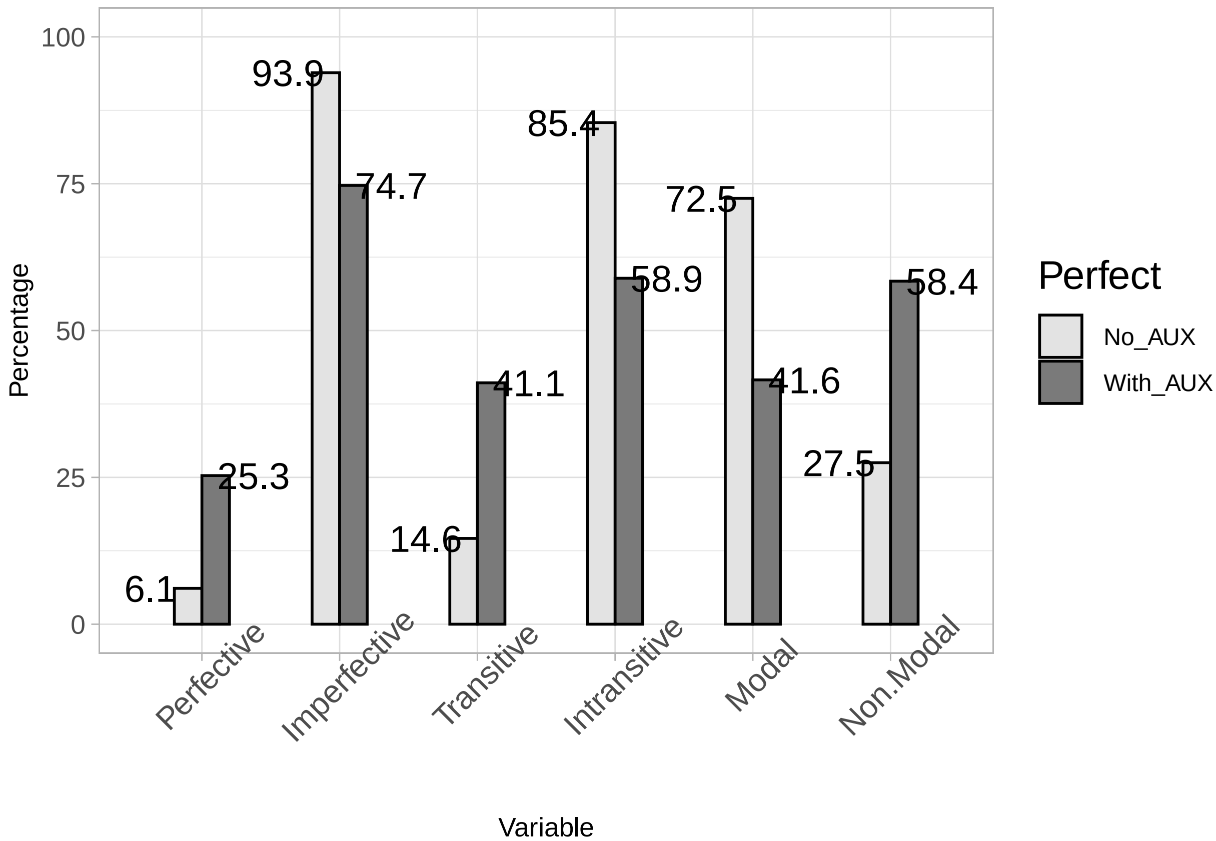


Figure 10: Linguistic properties of -AUX and +AUX forms in Timok corpus (proportions)

Chi-squared tests are performed for each verb category separately: aspect, transitivity, lexical group (+/- modal).

Aspect:

```r
gramm_table_aspect
```

```
##          Perfective imperfective
## No_AUX           84         1290
## With_AUX        332          979
```

```r
chisq.test(gramm_table_aspect)
```

```
##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  gramm_table_aspect
## X-squared = 187.63, df = 1, p-value < 2.2e-16
```

Transitivity:

```r
gramm_table_trans
```

```
##          Transitive Intransitive
## No_AUX          201         1173
## With_AUX        539          772
```

```r
chisq.test(gramm_table_trans)
```

```
##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  gramm_table_trans
## X-squared = 234.38, df = 1, p-value < 2.2e-16
```

Lexical group (+/-modal):

```r
gramm_table_lex
```

```
##          Modal Not modal
## No_AUX     996       378
## With_AUX   546       765
```

```r
chisq.test(gramm_table_lex)
```

```
##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  gramm_table_lex
## X-squared = 259.76, df = 1, p-value < 2.2e-16
```

3.2 Analysis of the socio-geographic factors

Analysis of social and geographic factors involved the dependent variables:

- proportion of the analytic marking of the indirect object and the possessive per total examples analysed per location
- normalized frequency of PPD per 1,000 nouns per location
- normalized frequency of particle *si* per 1,000 verbs
- normalized frequency of AUX omission per 1,000 cases of perfect tense

The independent variables regarding geographic distribution are:

- geographic longitude
- geographic latitude
- altitude
- distance from the city of Knjaževac

The independent variables regarding socio-demographic distribution are:

- age
- gender

Analysis of the geographic factors

We firstly present the comparison of the linguistic frequencies with geographic vairiables (longitude, latitude, altitude, distance from the city). For the analysis of the geographic variables, frequency values have been aggregated for each location. The dependant variables and the geographic variables are continuous. The dependant variable in all 4 analyses does not have normal distribution, so Kendall's correlation test was used. Geographic distribution of frequencies of each feature is presented on maps. (not included in the manuscript)

Marking of indirect object and possessor:

```r
head(marking_geo)
```

```
##            LOCATION N.of.NA.Oblq N.of.DAT ALL..IO.POSS. Freq.NA...ALL
## 1           Žukovac            3        0             3           100
## 2              Žlne            3        0             3           100
## 3  Gornja Bela Reka            1        0             1           100
## 4 Gornja Sokolovica           15        0            15           100
## 5            Drvnik           27        0            27           100
## 6        Mali Izvor           20        0            20           100
##   Freq.DAT...ALL LATITUDE LONGITUDE Location Altitude DIST_Bul DIST_city
## 1              0 43.53035  22.28190        4      274    15.57      5.89
## 2              0 43.52175  22.23101        5      320    20.28      5.10
## 3              0 43.76383  22.16492        7      235    38.61     14.82
## 4              0 43.52082  22.31761        9      305    13.23      8.34
## 5              0 43.53809  22.37374       10      597     7.92     11.96
## 6              0 43.73677  22.33321       11      205     5.99     18.24
```

Kendall's rank correlation between analytic case marking frequencies and geographic variables.

```r
cor.test(marking_geo$Freq.NA...ALL,marking_geo$LONGITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  marking_geo$Freq.NA...ALL and marking_geo$LONGITUDE
## z = 1.0804, p-value = 0.28
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##       tau
## 0.1017915
```

```r
cor.test(marking_geo$Freq.NA...ALL,marking_geo$LATITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  marking_geo$Freq.NA...ALL and marking_geo$LATITUDE
## z = 0.41866, p-value = 0.6755
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## 0.03944419
```

```r
cor.test(marking_geo$Freq.NA...ALL,marking_geo$Altitude, method = c("kendall"))
```

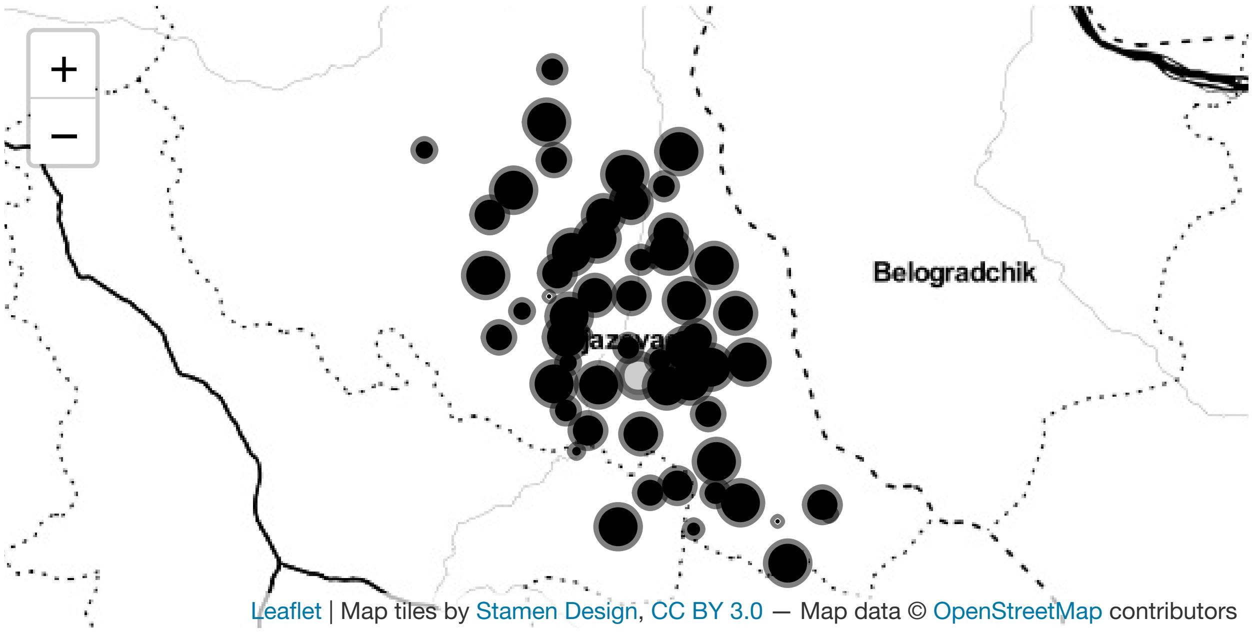
```
##
##  Kendall's rank correlation tau
##
## data:  marking_geo$Freq.NA...ALL and marking_geo$Altitude
## z = 0.013506, p-value = 0.9892
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## 0.00127351
```

```r
cor.test(marking_geo$Freq.NA...ALL,marking_geo$DIST_city, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  marking_geo$Freq.NA...ALL and marking_geo$DIST_city
## z = -0.29037, p-value = 0.7715
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##         tau
## -0.02736446
```

The map presenting the areal distribution of the analytic case marking in IO and POSS:

```r
marking_map
```



Post-positive demonstratives:

```r
head(ppd_geo)
```

```
##   X        LOCATION art_freq LATITUDE LONGITUDE Altitude DIST_city X.1 X.2  X.3
## 1 1         Aldinac       10 43.54287  22.41992      623     16.44  NA  NA <NA>
## 2 2       Balanovac       12 43.58993  22.13367      327      7.04  NA  NA <NA>
## 3 3         Balinac       70 43.56462  22.35576      605     11.58  NA  NA <NA>
## 4 4 Balta Berilovac       20 43.39568  22.45872      419     27.00  NA  NA <NA>
## 5 5         Borovac        2 43.73822  22.00940      199     18.68  NA  NA <NA>
## 6 6           Bučje       38 43.67853  22.09256      514     16.05  NA  NA <NA>
```

Kendall's rank correlation between post-positive demonstatives frequencies and geographic variables.

```r
cor.test(ppd_geo$art_freq, ppd_geo$LONGITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  ppd_geo$art_freq and ppd_geo$LONGITUDE
```

```
## z = 3.7682, p-value = 0.0001644
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##       tau
## 0.3320316
```

```
cor.test(ppd_geo$art_freq, ppd_geo$LATITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  ppd_geo$art_freq and ppd_geo$LATITUDE
## z = -2.3157, p-value = 0.02058
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## -0.2040447
```

```
cor.test(ppd_geo$art_freq, ppd_geo$Altitude, method = c("kendall"))
```

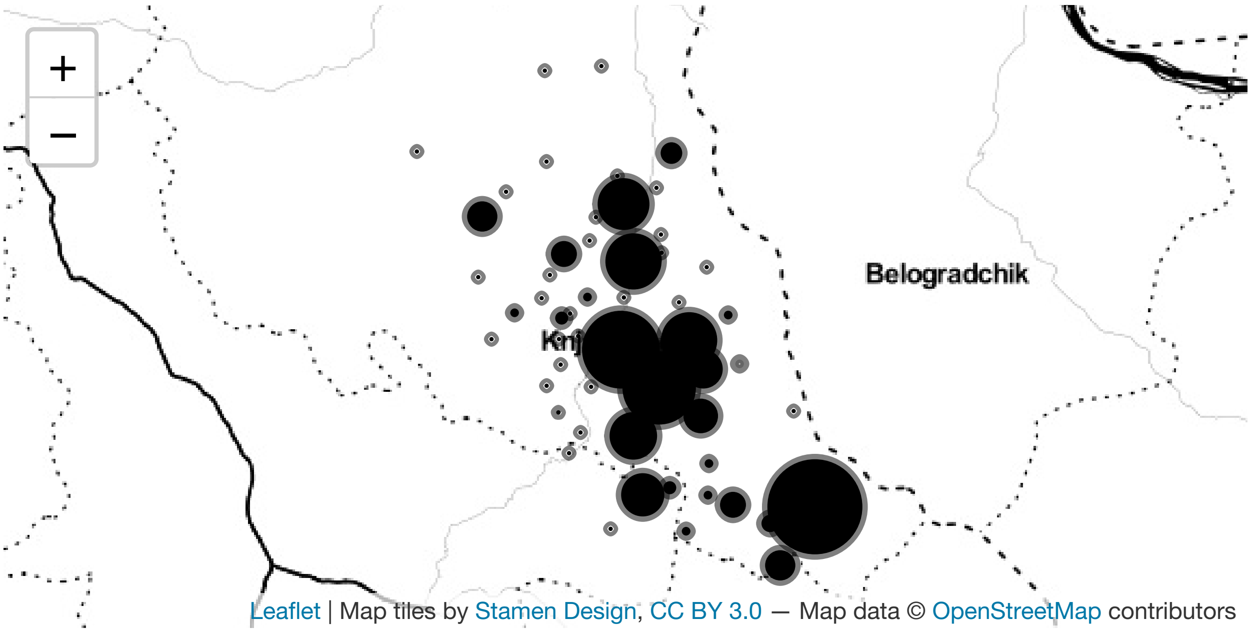
```
##
##  Kendall's rank correlation tau
##
## data:  ppd_geo$art_freq and ppd_geo$Altitude
## z = 1.649, p-value = 0.09915
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##       tau
## 0.1453711
```

```
cor.test(ppd_geo$art_freq, ppd_geo$DIST_city, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  ppd_geo$art_freq and ppd_geo$DIST_city
## z = 1.774, p-value = 0.07606
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##       tau
## 0.1563519
```

The map presenting the areal distribution of the post-positive demonstatives:

```
ppd_map
```



Particle SI:

```
head(si_geo)
```

```
##     LOCATION Number.of..si. Number.of.verbs Normalized.FREQ.of..SI. LATITUDE
## 1    Ošljane             48             996               4.8192771 43.66194
## 2     Lepena             91            5005               1.8181818 43.58023
## 3 Trgovište             28            1938               1.4447884 43.55598
## 4    Žukovac             31            1717               1.8054747 43.53035
## 5       Žlne              7             734               0.9536785 43.52175
## 6     Vasilj             16            2648               0.6042296 43.56564
##   LONGITUDE Altitude DIST_Bul DIST_city
## 1  22.31988      520     3.06     16.11
## 2  22.16977      315    17.35      9.05
## 3  22.26894      230    16.56      2.62
## 4  22.28190      274    15.57      5.89
## 5  22.23101      320    20.28      5.10
## 6  22.10432      415    26.75      7.51
```

Kendall’s rank correlation between particle ‘si’ frequencies and geographic variables.

```
cor.test(si_geo$Normalized.FREQ.of..SI., si_geo$LONGITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  si_geo$Normalized.FREQ.of..SI. and si_geo$LONGITUDE
## z = 0.2482, p-value = 0.804
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## 0.02238355
```

```
cor.test(si_geo$Normalized.FREQ.of..SI., si_geo$LATITUDE, method = c("kendall"))
```

```
##
```

```
##  Kendall's rank correlation tau
##
## data:  si_geo$Normalized.FREQ.of..SI. and si_geo$LATITUDE
## z = -0.32869, p-value = 0.7424
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##         tau
## -0.02964307
```

```r
cor.test(si_geo$Normalized.FREQ.of..SI., si_geo$Altitude, method = c("kendall"))
```

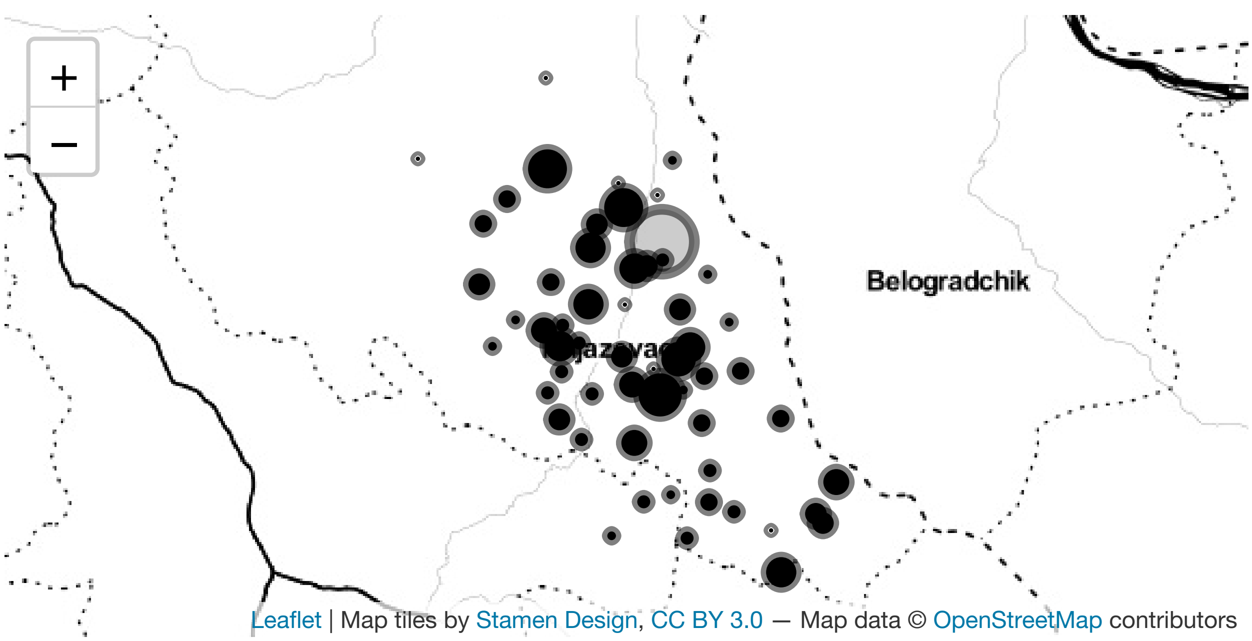
```
##
##  Kendall's rank correlation tau
##
## data:  si_geo$Normalized.FREQ.of..SI. and si_geo$Altitude
## z = 0.98612, p-value = 0.3241
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## 0.08898307
```

```r
cor.test(si_geo$Normalized.FREQ.of..SI., si_geo$DIST_city, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  si_geo$Normalized.FREQ.of..SI. and si_geo$DIST_city
## z = -0.17441, p-value = 0.8615
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##         tau
## -0.01573374
```

The map presenting the areal distribution of the particle ‘si’:

```r
si_map
```



Auxiliary omission in the perfect tense:

```r
head(aux_geo)
```

```
##   X      LOCATION total total_aux no_aux LATITUDE LONGITUDE Altitude DIST_city
## 1 1       Ošljane    95        52     43 43.66194  22.31988      520     16.11
## 2 2        Drvnik   204        78    124 43.53809  22.37374      597     11.96
## 3 3       Balinac   184        63    121 43.56462  22.35576      605     11.58
## 4 4       Ćuštica    89        43     46 43.35698  22.47159      794     33.74
## 5 5 Gornje Zuniče   155        81     73 43.60401  22.27268      235      4.13
## 6 6   Novo Korito    19        10      9 43.63191  22.37807      423     17.68
```

Kendall's rank correlation between Auxiliary omission in the perfect tense frequencies and geographic variables.

```r
cor.test(aux_geo$no_aux, aux_geo$LONGITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  aux_geo$no_aux and aux_geo$LONGITUDE
## z = -0.046358, p-value = 0.963
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##         tau
## -0.00397912
```

```r
cor.test(aux_geo$no_aux, aux_geo$LATITUDE, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  aux_geo$no_aux and aux_geo$LATITUDE
## z = 0.16805, p-value = 0.8665
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## 0.01442789
```

```r
cor.test(aux_geo$no_aux, aux_geo$Altitude, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  aux_geo$no_aux and aux_geo$Altitude
## z = -0.81136, p-value = 0.4172
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##        tau
## -0.0697385
```

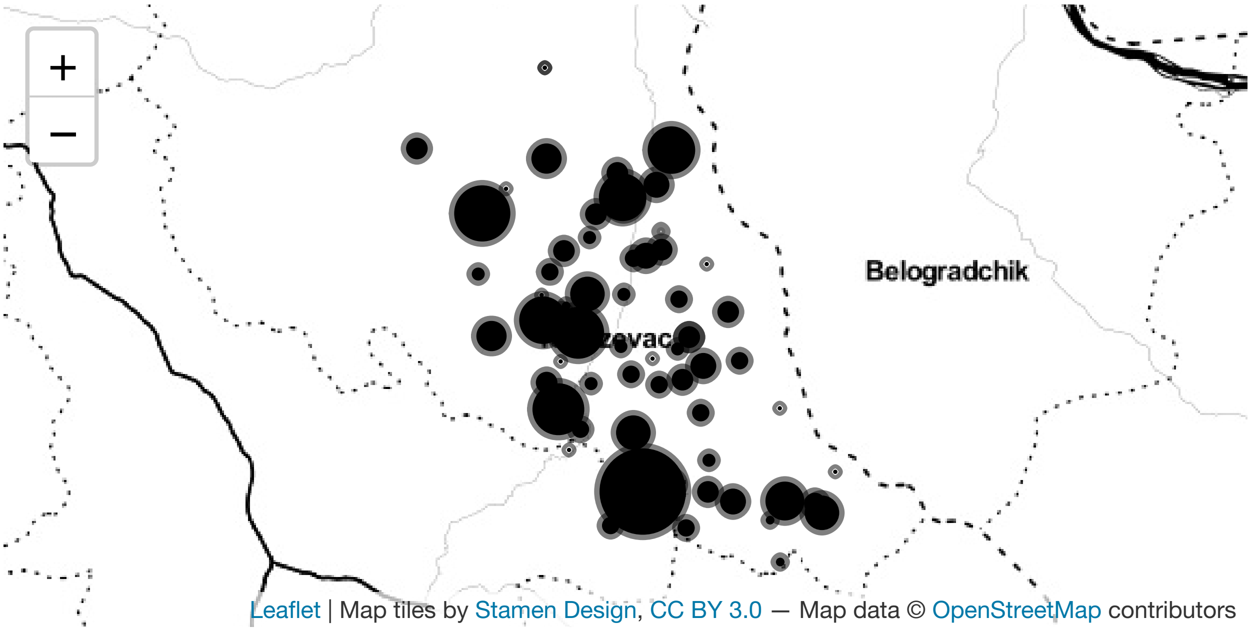
```r
cor.test(aux_geo$no_aux, aux_geo$DIST_city, method = c("kendall"))
```

```
##
##  Kendall's rank correlation tau
##
## data:  aux_geo$no_aux and aux_geo$DIST_city
## z = 0.41725, p-value = 0.6765
## alternative hypothesis: true tau is not equal to 0
```

```
## sample estimates:
##        tau
## 0.03584768
```

The map presenting the areal distribution of the auxiliary omission in the perfect tense:

```
aux_map
```



Analysis of the socio-demographic factors

What follows is the correlation of the linguistic frequencies with socio-demographic variables (age, gender). For the analysis of the geographic variables, frequency values have been aggregated for each location. The dependant variables is coninuous, while the geographic variables are binary. The dependant variables in all analyses except PPD do not have normal distribution, so Wilcoxon Rank Sum test was used, while for PPD, we used Pearson's rank correlation.

Marking of indirect object and possessor:

(see file 1_marking_socio_all.csv)

Analytic marking and age:

```
head(marking_age)
```

```
##                Informant N.of.NA.Oblq N.of.DAT ALL..IO.POSS. Freq.NA...ALL
## 1  TOR_C_0001_tagged.txt            6        1             7      85.71429
## 2 TOR_C_00010_tagged.txt           17        0            17     100.00000
## 3 TOR_C_00011_tagged.txt            0        1             1       0.00000
## 4 TOR_C_00013_tagged.txt            3        0             3     100.00000
## 7 TOR_C_00017_tagged.txt            1        0             1     100.00000
## 9 TOR_C_00019_tagged.txt           15        0            15     100.00000
##   Freq.DAT...ALL AGE
## 1       14.28571 OLD
## 2        0.00000 OLD
## 3      100.00000 OLD
## 4        0.00000 OLD
## 7        0.00000 OLD
```

```
## 9        0.00000 OLD
```

Wilcoxon Rank Sum test used to compare the distribution accross OLD and YOUNG speakers.

```
wilcox.test(Freq.NA...ALL ~ AGE, data = marking_age)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  Freq.NA...ALL by AGE
## W = 145, p-value = 0.0006728
## alternative hypothesis: true location shift is not equal to 0
```

Analytic marking and gender:

```
head(marking_gender)
```

```
##                Informant N.of.NA.Oblq N.of.DAT ALL..IO.POSS. Freq.NA...ALL
## 1  TOR_C_0001_tagged.txt            6        1             7      85.71429
## 2 TOR_C_00010_tagged.txt           17        0            17     100.00000
## 3 TOR_C_00011_tagged.txt            0        1             1       0.00000
## 4 TOR_C_00013_tagged.txt            3        0             3     100.00000
## 5 TOR_C_00015_tagged.txt            3        0             3     100.00000
## 6 TOR_C_00016_tagged.txt           24        5            29      82.75862
##   Freq.DAT...ALL Gender
## 1       14.28571 FEMALE
## 2        0.00000 FEMALE
## 3      100.00000 FEMALE
## 4        0.00000 FEMALE
## 5        0.00000 FEMALE
## 6       17.24138 FEMALE
```

Wilcoxon Rank Sum test used to compare the distribution accross MALE and FEMALE speakers.

```
wilcox.test(Freq.NA...ALL ~ Gender, data = marking_gender)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  Freq.NA...ALL by Gender
## W = 734.5, p-value = 0.0003797
## alternative hypothesis: true location shift is not equal to 0
```

Post-positive demonstratives:

(see files 2_PPD_age.csv and 2_PPD_gender.csv)

Post-positive demonstratives and age:

```
head(ppd_age)
```

```
##             ID NORM_ART YEAR_OF_BIRTH AGE OLD
## 1 TIM_SPK_0001    59.64          1925 OLD   1
## 2 TIM_SPK_0003   147.87          1930 OLD   1
## 3 TIM_SPK_0004     0.00          1954 OLD   1
## 4 TIM_SPK_0005   587.30          1957 OLD   1
## 5 TIM_SPK_0006     0.00          1957 OLD   1
## 6 TIM_SPK_0007    61.16          1927 OLD   1
```

Wilcoxon Rank Sum test used to compare the distribution accross OLD and YOUNG speakers.

```r
wilcox.test(NORM_ART ~ OLD, data = ppd_age)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  NORM_ART by OLD
## W = 185, p-value = 0.002198
## alternative hypothesis: true location shift is not equal to 0
```

Post-positive demonstratives and gender:

```r
head(ppd_gender)
```

```
##             ID ART NOUN TOKEN FEMALE GENDER NORM_ART
## 1 TIM_SPK_0161   0  149  1062      0   MALE     0.00
## 2 TIM_SPK_0164   0  136  1111      0   MALE     0.00
## 3 TIM_SPK_0014   6  191  1155      0   MALE   314.14
## 4 TIM_SPK_0163   0  210  1312      0   MALE     0.00
## 5 TIM_SPK_0162   0  200  1357      0   MALE     0.00
## 6 TIM_SPK_0134   0  149  1366      0   MALE     0.00
```

Wilcoxon Rank Sum test used to compare the distribution accross MALE and FEMALE speakers.

```r
wilcox.test(NORM_ART ~ FEMALE, data = ppd_gender)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  NORM_ART by FEMALE
## W = 340, p-value = 0.003727
## alternative hypothesis: true location shift is not equal to 0
```

Particle SI:

(see file 3_si_socio.csv)

Particle 'si' and age:

```r
head(si_age)
```

```
##                Informant Age Normalized.FREQ.of..SI.
## 1  TOR_C_0001_tagged.txt OLD                4.819277
## 2 TOR_C_00019_tagged.txt OLD                3.082395
## 3  TOR_C_0046_tagged.txt OLD                2.949062
## 4 TOR_C_00033_tagged.txt OLD                2.944444
## 5 TOR_C_00013_tagged.txt OLD                2.815534
## 8  TOR_C_0050_tagged.txt OLD                2.367628
```

Wilcoxon Rank Sum test used to compare the distribution accross OLD and YOUNG speakers.

```r
wilcox.test(Normalized.FREQ.of..SI. ~ Age, data = si_age)
```

```
##
##  Wilcoxon rank sum test
##
## data:  Normalized.FREQ.of..SI. by Age
## W = 74, p-value = 0.7236
## alternative hypothesis: true location shift is not equal to 0
```

Particle 'si' and gender:

```r
head(si_gender)
```

```
##                  Informant Gender Normalized.FREQ.of..SI.
## 1  TOR_C_0001_tagged.txt FEMALE                4.819277
## 2 TOR_C_00019_tagged.txt FEMALE                3.082395
## 3  TOR_C_0046_tagged.txt FEMALE                2.949062
## 4 TOR_C_00033_tagged.txt FEMALE                2.944444
## 5 TOR_C_00013_tagged.txt FEMALE                2.815534
## 6  TOR_C_0038_tagged.txt FEMALE                2.647059
```

Wilcoxon Rank Sum test used to compare the distribution accross MALE and FEMALE speakers.

```r
wilcox.test(Normalized.FREQ.of..SI. ~ Gender, data = si_gender)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  Normalized.FREQ.of..SI. by Gender
## W = 475, p-value = 0.001399
## alternative hypothesis: true location shift is not equal to 0
```

Auxiliary omission in the perfect tense:

(see files 4_aux_age.csv and 4_aux_gender.csv)

Auxiliary omission in the perfect tense and age:

```r
head(aux_age)
```

```
##           ID      LOCATION LONGITUDE LATITUDE total total_aux no_aux Year AGE
## 1 TOR_C_0001       Oöljane  43.66194 22.31988    95        52     43 1925 OLD
## 3 TOR_C_0003       Balinac  43.56462 22.35576   184        63    121 1952 OLD
## 4 TOR_C_0004       ?uötica  43.35698 22.47159    89        43     46 1955 OLD
## 5 TOR_C_0005 Gornje Zuni?e  43.60401 22.27268   155        81     73 1934 OLD
## 6 TOR_C_0006   Novo Korito  43.63191 22.37807    19        10      9 2005 OLD
## 7 TOR_C_0007       Trnovac  43.67783 22.23714   123        57     65 1941 OLD
```

Wilcoxon Rank Sum test used to compare the distribution accross OLD and YOUNF speakers.

```r
wilcox.test(no_aux ~ AGE, data = aux_age)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  no_aux by AGE
## W = 222, p-value = 0.0332
## alternative hypothesis: true location shift is not equal to 0
```

Auxiliary omission in the perfect tense and gender:

```r
head(aux_gender)
```

```
##           ID      LOCATION LONGITUDE LATITUDE total total_aux no_aux    GEN
## 1 TOR_C_0001       Oöljane  43.66194 22.31988    95        52     43 FEMALE
## 2 TOR_C_0002        Drvnik  43.53809 22.37374   204        78    124 FEMALE
## 3 TOR_C_0003       Balinac  43.56462 22.35576   184        63    121 FEMALE
## 4 TOR_C_0004       ?uötica  43.35698 22.47159    89        43     46 FEMALE
## 5 TOR_C_0005 Gornje Zuni?e  43.60401 22.27268   155        81     73 FEMALE
```

```
## 6 TOR_C_0006    Novo Korito  43.63191 22.37807    19        10      9 FEMALE
```

Wilcoxon Rank Sum test used to compare the distribution accross MALE and FEMALE speakers.

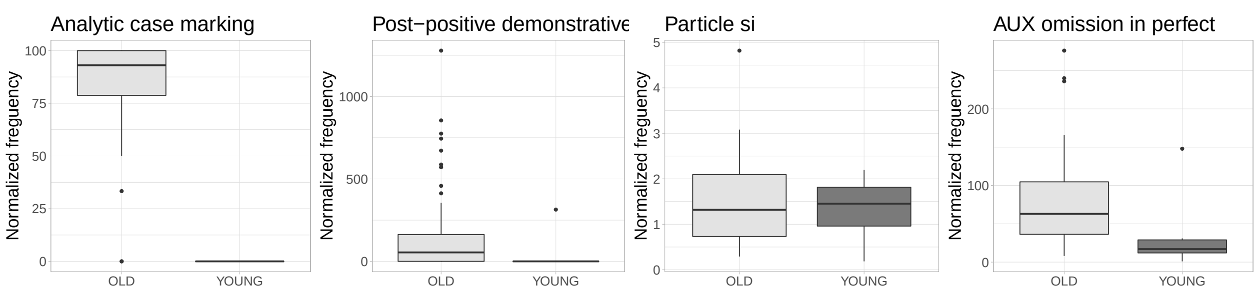
```r
wilcox.test(no_aux ~ GEN, data = aux_gender)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  no_aux by GEN
## W = 541.5, p-value = 0.02942
## alternative hypothesis: true location shift is not equal to 0
```

The ranges of values of the lingustic frequencies categorized according to age are shown in Figure 11.

Figure 11: Age

```r
Figure11 = grid.arrange(marking_age_plot, ppd_age_plot, si_age_plot, aux_age_plot, nrow = 1)
```



The ranges of values of the lingustic frequencies categorized according to gender are shown in Figure 12.

Figure 12: Gender

```r
Figure12 = grid.arrange(marking_gender_plot, ppd_gender_plot, si_gender_plot, aux_gender_plot, nrow = 1
```