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The Processing of Process and Result Deverbal Nominals in Serbian and English*

Isidora Gatarić[1**], Sanja Srdanović[2], and Anja Kovač[2]

[1]Computing in Social Sciences, University of Belgrade, Serbia
[2]Department of Linguistics, Goethe University Frankfurt, Germany

Process and result deverbal nominals are two types of nouns derived from related verbs. These two types of deverbal nominals exhibit different behavior in a number of aspects. The aim of this study was to test the differences of process and result deverbal nominals, in both Serbian and English, with respect to their cognitive processing. Two self-paced reading experiments were conducted. Experiment 1 was conducted in Serbian, with target constructions, process and result deverbal nominals (e.g., *drhtaj/drhtanje* [EN *trembling*]), embedded in the sentence contexts, whereas Experiment 2 dealt with the equivalent constructions in English. Data were analyzed with the Generalized Additive Mixed Models – GAMMs (Wood, 2006, 2011) measuring reading times (RTs) at the word level (deverbal nouns) and the sentence level (the whole sentence, including the deverbal nominal) in both languages. The final results in general suggested that result deverbal nominals were processed faster than process deverbal nominals. It was assumed that these differences were obtained because process deverbal nominals are syntactically more complex than result deverbal nominals.

Keywords: Deverbal nominals, Derivational morphology, Syntax, Cognitive processing

Highlights:

- The paper looks into cognitive processing of two main types of deverbal nominals in Serbian and English.
- Two self-paced reading tasks were designed as experimental tasks.
- Generalized Additive Mixed Models (GAMMs) were used for data modeling.
- Results indicate that result deverbal nominals were processed faster than process deverbal nominals.

Corresponding author: gataric.isidora@gmail.com

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** https://orcid.org/0000-0001-5092-0356

- Findings from this study provide support for the claim that syntactic complexity plays one of the major roles in the lexical processing of deverbal nominals in both languages.

Deverbal nominalization is a linguistic phenomenon whereby a noun is derived from its related verb. The newly formed noun denotes a result or a process of the activity portrayed by the verb it is derived from (Grimshaw, 1990). The peculiar behavior of deverbal nominals, which is mixed between nouns and verbs, has been a topic of discussion for years among theoretical linguists dealing with derivational morphology. In the transformational grammar, deverbal nominals were assumed to be transformed from their corresponding verbs (Lees, 1960). The lexicalists, on the other hand, claimed that the nature of deverbal nominals was more related to derivational nouns than to related verbs (Chomsky, 1970; Giorgi & Longobardi, 1991; Rozwadowska, 1988). Although verbal and deverbal nominals have been considered as one and the same phenomenon, in the lexicalist period, these two were separated: the former were related to inflectional nouns only, while the latter were related exclusively to derivational nouns. This division was followed by all subsequent research that dealt with this topic.

Types of Deverbal Nominals in Serbian and English

Given the complexity of this phenomenon, it is not surprising that deverbal nominals have received much attention in the linguistics literature. One of the most detailed divisions of deverbal nominals in English was proposed by Grimshaw (1990). She divides deverbal nominals into: 1) *complex event nominals – process nominals*, which have an argument structure and take obligatory complements (e.g., deverbal nominal *examination* in the example *The examination of the students by the teacher*); 2) *result nominals*, which do not take obligatory complements, and therefore do not have an argument structure (e.g., deverbal nominal *exam* in the example *The exam was on the table*); 3) *simple event nominals*, which also do not take obligatory complements, and do not have an argument structure (e.g., deverbal nominal *examination* in the example *The examination lasted two hours*). Thus, one of the crucial differences between process and result deverbal nominals is argument structure: only process deverbal nominals have an argument structure, result deverbal nominals do not (Alexiadou, 2010; Anderson, 1983; Grimshaw, 1990; Higginbotham, 1983; Kayne, 2008). Hence, the absence of the argument structure makes result deverbal nominals syntactically less complex. Moreover, simple event nominals fall into a category in-between process and result nominals, as they share features of both of these categories (Grimshaw, 1990). However, the presented division of deverbal nominals seems to hold for English only. Previous empirical and theoretical studies dealing with deverbal nominals in Serbian suggest that only a two-way distinction can be made with respect to their behavior in this language:

1) *result deverbal nominals* (e.g., deverbal nominal *drhtaj* [EN *tremble*] in the example *Snežanin drhtaj je nagoveštavao dolazak zime.* [EN *Snežana's tremble signaled the arrival of winter.*]); and 2) *process or complex event nominals* (e.g., deverbal nominal *drhtanje* [EN *trembling*] in the example *Snežanino drhtanje ruku je nagoveštavalo dolazak zime.* [EN *Snežana's trembling of hands signaled the arrival of winter.*]) (Gatarić et al., 2019; Radman, 2015; Srdanović et al., 2018). In other words, simple event nominals do not form a separate category in Serbian, as they do not satisfy any conditions for a category or sub-category formation in this language. Specifically, they do not possess distinctive features which would set them aside from the rest of deverbal nominals (Srdanović et al., 2018).

Although the basic distinctions between process and result deverbal nominals have been mentioned previously, a more detailed review of their syntactic, semantic and morphological differences is needed for a better understanding of the present study. Process and result deverbal nominals exhibit similar differences in both English and Serbian with respect to syntax. In sentential contexts, process deverbal nominals cannot occur without an argument structure, whereas result deverbal nominals can (Mrazović & Vukadinović, 1990). Unlike result deverbal nominals, process deverbal nominals cannot take the indefinite article in English (Partee, 1987). When it comes to semantics, a fundamental difference between these two types of deverbal nominals in both languages is, naturally, their meaning. Specifically, process deverbal nominals denote a process of an activity, while result deverbal nominals, as their names suggests, denote a result of the same activity. Morphologically, process deverbal nominals in Serbian are mainly formed by adding the derivational suffix *–nje* to the imperfective verbal stem (e.g., *rešavanje* [EN *solving*]). Result deverbal nominals are formed by a number of different derivational suffixes added to the perfective verbal stem. Some examples of suffixes used for the formation of result deverbal nominals in Serbian are the following: *–ija* (e.g., *donacija* [EN *donation*]), *–aj* (e.g., *pokušaj* [EN *attempt*]), *–ba* (e.g., *borba* [EN *fight*]), *–idba* (e.g., *krunidba* [EN *coronation*]), *–nja* (e.g., *šetnja* [EN *walk*]), and *–ak* (e.g., *gubitak* [EN *loss*]) (Mrazović & Vukadinović, 1990). Similarly, in English, a derivational suffix *–ing*, equivalent to the Serbian suffix *–nje*, is used mainly in formation of process deverbal nominals, while other derivational suffixes are mostly used for formation of result deverbal nominals (Alexiadou & Rathert, 2010; San Martin, 2009). For instance, suffixes *–ation* and *–er* are used for creation of result deverbal nominals in English, as can be seen in nouns such as *examination* or *worker*.

Cognitive Processing of Deverbal Nominals in Serbian and English

One of the first empirical studies dealing with the effects of syntactic complexity of deverbal nominals on their cognitive processing was conducted in English (Kennison, 1999). This eye-tracking experiment was designed to track the reading patterns of sentences containing different deverbal nominals.

However, the stimuli were not categorized into two main types of deverbal nominals (process and result). Instead, authors used all types and subtypes of deverbal nominals as stimuli. The final results suggested that stimuli with more complex syntactic structures were processed more slowly than stimuli with simpler structures (Kennison, 1999). This was in line with the very extensive theoretical review that argues that syntactic complexity plays a major role in the cognitive processing of words, phrases or sentences (Gibson, 1998). Similar empirical study was conducted in Greek (Manouilidou, 2006), with the final results speaking in favor of the role of syntactic complexity in the lexical processing of deverbal nominals (Kennison, 1999). Furthermore, a methodologically different empirical study looking into the comprehension of deverbal nominals was designed in English (Smirnova, 2015). Although this study was mainly concerned with the comprehension domain of deverbal nominals, the obtained results supported all previously mentioned findings advocating for the major role of syntactic complexity in the comprehension of deverbal nominals (Smirnova, 2015).

Following these findings, the first study in Serbian was designed to test the lexical processing of process and result deverbal nominals (Radman, 2015). The stimuli were presented to participants isolated (i.e., without a sentence context) in a visual lexical decision task. However, the stimuli for this experiment consisted of a small set of data, and their syntactic features were not controlled in a strict way, which is one of the main flaws of this study (Radman, 2015). Although there are numerous empirical studies looking into the effects of the syntactic complexity of deverbal nominals and their natural interference with semantics in different languages, only a small number of them considered the morphological features of this class of nominals. An empirical study that followed Radman's (2015) was designed to look into the role of morphology in Serbian. The aim of that study was to examine the morphological effects on the cognitive processing of process and result deverbal nominals (Gatarić et al., 2019). The results of this study suggested that when syntactic effects were strictly controlled, there were no differences in the cognitive processing of deverbal nominals that differ in certain morphological characteristics. In other words, the obtained results fully support the idea that morphological features of deverbal nominals do not affect their lexical processing. Still, the importance of syntactic differences was not sufficiently explored in this research. More experimental studies were needed in order to get a better understanding of the effects of syntactic variation in the lexical processing of deverbal nominals in Serbian.

The Present Study

The aim of the present study was to investigate the differences in the cognitive processing of process and result deverbal nominals in Serbian and English. Target constructions, i.e., deverbal nominals, were presented to the participants in sentence contexts within a self-paced reading task. Serbian and English were selected for this study because deverbal nominals in these languages share a similar morpho-syntactic and semantic structure (Zlatić,

1997). Additionally, in both Serbian and English, the results of previous studies suggest that process deverbal nominals are syntactically more complex than result nominals. The present study differs from all former studies conducted in English and Serbian in a number of aspects. Firstly, the study at hand focuses on only two main types of deverbal nominals in both languages, i.e., process and result. Secondly, stimuli in both experiments were larger than data sets used in most previous research. And thirdly, the identical design of the two experiments allowed for the obtained results to be analyzed simultaneously and in the same manner in both languages (Serbian and English). When it comes to research methodology, all previous studies used questionnaires or eye-tracking experiments (Kennison, 1999; Manouilidou, 2006; Smirnova, 2015). However, for this research a self-paced reading task was used, as this type of experimental task is primarily aimed at looking into the cognitive processing of different morpho-syntactic features. Having proved that in Serbian (Experiment 1) there are only two different types of deverbal nominals – process and result (Srdanović et al., 2018), a comparable study in English was needed (Experiment 2), where stimuli would consist of the same two types of deverbal nominals – process and result. Finally, as all previous studies in Serbian were conducted on small sets of stimuli, and without controlling for syntactic effects (Radman, 2015; Gatarić et al., 2019), a new study was needed in order to obtain more reliable results.

Experiment 1

The aim of the present experiment was to investigate the differences in the cognitive processing of two different types of deverbal nominals in Serbian, i.e., process and result deverbal nominals. The experimental task was a self-paced reading task consisting of 120 stimuli sentences, half of which (60) were test sentences containing the deverbal nominals, while the other half (60) were fillers (i.e., without the deverbal nominals).

Method

Participants

Fifty-four native speakers of Serbian with normal or corrected-to-normal vision participated in the experiment. All participants were undergraduate students at the University of Novi Sad, Serbia and received course credits for their participation. The experiment was carried out according to the ethical rules specified in the Helsinki declaration. Hence, each participant signed a consent form, previously approved by the Ethical Committee of the Faculty of Philosophy, University of Novi Sad, Serbia.

Design

A two-level factor was manipulated in this experiment: *the type of the deverbal nominal*, i.e., process or result, with two dependent variables being measured: (1) *reading times of deverbal nominals*; and (2) *reading times of the entire sentences*, including the

deverbal nominal. Both of these were measured in milliseconds. Three additional numeric predictors were included in the experimental design as covariates: (1) *length of the deverbal nominal* (measured in letters); (2) *length of the sentence containing the deverbal nominal* (measured in the number of words); and (3) *lemma frequency* (retrieved from the Serbian web corpus – srWac) (Ljubešić & Klubička, 2016).

Stimuli

The stimuli consisted of 120 sentences, 60 of which were test sentences containing a deverbal nominal, and 60 of which were filler sentences without a deverbal nominal. The stimuli sentences were randomly divided among the experimental groups with the Latin square design. Out of the total of 60 test sentences containing a deverbal nominal, 30 sentences included a result deverbal nominal, while the other 30 included a process deverbal nominal. Each test sentence with a result deverbal nominal had its counterpart with the process deverbal nominal. Both sentences had identical syntactic structures. The only difference between a pair of sentences was the deverbal nominal itself, i.e. in one sentence a result nominal was used, and the other sentence contained a corresponding process nominal (Table 1). In that respect, the total of 60 test sentences was actually 30 pairs of sentences, which differed in the type of the deverbal nominal only, but were otherwise identical. All test sentences followed the same syntactic pattern: possessive form + deverbal nominal + (argument) + verb + object and/or adjectival clause. Unlike the test sentences with result nominals (1_a), the test sentences with process nominals (1_b) had to include an overt argument due to their nature and behavior in Serbian.

Table 1
A pair of stimuli from the experiment in Serbian

The sentences (type of deverbal nominals)
1_a *Snežanin drhtaj je nagoveštavao dolazak zime.* (result) (EN *Snežana's tremble signaled the arrival of winter.*)
1_b *Snežanino drhtanje ruku je nagoveštavalo dolazak zime.* (process) (EN *Snežana's trembling of hands signaled the arrival of winter.*)

Procedure

The stimuli were presented within a self-paced reading task (stationary window paradigm). This type of self-paced reading task was chosen for this experiment because of its high correlation with measures obtained in eye-movement studies (Just, Carpenter, & Woolley, 1982). As such, it is considered to be a reliable procedure for data collection in behavioral experiments involving reading times on isolated words, as well as on entire sentences (Vejnović & Jovanović, 2012). The task was performed in the open-source software *OpenSesame* (Mathôt et al., 2012), on a standard PC configuration (Pentium(R) Dual-Core CPU E6600 processor/3.06 GHz/2.00 GB RAM, with monitor set to 75Hz vertical refresh rate and 1600_x1200 pixels resolution). The stimuli sentences were presented as a series of isolated capitalized words (color white, font mono, size 40), one-by-one in the center of a black screen. The participants' task was to read individual words appearing on the screen as quickly and as accurately as possible, and to press the button ENTER on the keyboard once they have read the displayed word, after which the next word would appear. The presentation of each individual word was preceded by a 500 ms fixation dot. The experiment was designed in such a way that if the participant did not press ENTER within the time frame of 1500 ms, the word would automatically disappear, and the next

word would appear. The experimental stimuli loop was preceded by a four practice trial sentences loop, which were excluded from the data analysis. The presentation sequence was randomized for each participant.

Results

The first step in the preparation of the data was to exclude 1% of the collected data from the statistical analysis due to invalid data values (e.g., outliers, NAs, etc.). None of the participants had more than 10% of errors, which was set as the threshold for the exclusion of a subject from further statistical analysis. Data analysis was performed in an open-source software for statistical computing *R* (R Core Team, 2017) with the following packages: *mgcv* (Wood, 2006, 2011) and *itsadu*g (van Rij et al., 2016). Reading times (RTs) of both single words and entire sentences, together with deverbal nominal length, sentence length and lemma frequency were log transformed in accordance with Baayen and Milin (2010). All numeric predictors were standardized by centering on zero and dividing by the standard deviation (Gelman & Hill, 2007). The collinearity between covariates was tested with the Cohen's kappa coefficient (Belsley et al., 1980), with the results suggesting a high collinearity between numeric predictors ($\kappa = 46.36$). Bearing in mind that the least collinearity (Cohen's kappa coefficient) was present when the predictor sentence length was excluded from the model, the analysis was continued without it. Consequently, Cohen's kappa coefficient decreased significantly ($\kappa = 24.44$). Although this predictor was excluded from further analysis, it was important to point out that this predictor itself did not have a statistically significant effect on the processing of process and result deverbal nominals in Serbian (Table 2; Table 3). As the collinearity was still rather close to high, log RTs were fitted with the *Generalized Additive Mixed Model – GAMMs* (Wood, 2006, 2011), a statistical technique least sensitive to collinearity between predictors. Ultimately, two separate data analyses were performed from this data set: (1) the single-word data analysis, and (2) the entire-sentence data analysis.

The Single-word Data Analysis

The first statistical analysis included RTs on deverbal nominals only. In addition, to test the significance of the fixed effects, two random effects were controlled – the random effect of stimuli, as well as the random effect of participants. The random effect of participants was included within by-participant factorial smooths over trials (Table 2), which increased the level of control of the effects that could arise from some trial-specific characteristics. Standardized residuals which exceeded the range of –2.5/+2.5 standard units were excluded from further analysis, after which the final GAMMs model was refitted (Table 2). Ultimately, the model showed to be robust, as there were no differences between the models' suggested results before and after the residual values have been removed.

Table 2
Coefficients from the GAMMs analysis on single-word reading times in Serbian

Parametric coefficients	*Estimate*	*Std. Error*	*t value*	*Pr(>|t|)*
Intercept	5.85	.04	146.02	.00 ***
Trial order (order of presentation)	-.13	.01	-7.06	.00 ***
Deverbal nominals = result	-.01	.01	-.69	.49
Sentence length[1]	.01	.00	1.47	.14
Smooth terms	***edf***	***Ref.df***	***F***	***p-value***
te(Noun length, Lemma frequency)	8.028e+00	9.83	3.63	.00 **
s(Stimuli)	3.041e-05	1.00	0.00	.70
s(Trial order, Subject)	2.431e+02	485.00	8.05	.00 ***

Note. te = tensor product smoot; s = thin plate regression spline smooth; ** $p < .001$; *** $p < .0001$.

The final GAMMs model suggested that the main effect of deverbal nominals type (process vs. result) was not statistically significant (Table 2), although the results revealed that there was a tendency for the result deverbal nominals (M_{RT} = 375.32; *SD* = 188.19; *SE* = 7.72) to be processed slightly faster than process deverbal nominals (M_{RT} = 392.01; *SD* = 200.23; *SE* = 8.22). However, the effect of the trial order covariate was statistically significant, which suggests that the stimuli presented later during the experiment were processed faster than those ones presented earlier to the participants. Moreover, the interaction between deverbal nominal lengths and lemma frequencies proved to be statistically significant. This suggests that shorter deverbal nominals have in general more frequent lemmas than the longer ones in Serbian (Table 2).

The Entire-sentence Data Analysis

The second data analysis included RTs on entire sentences. Data preparation for analysis was identical to that of the single-word analysis.

Table 3
Coefficients from the GAMMs analysis on entire-sentence reading times in Serbian

Parametric coefficients	*Estimate*	*Std. Error*	*t value*	*Pr(>|t|)*
Intercept	7.63	.06	118.12	.00 ***
Trial order (order of presentation)	-.09	.01	-7.25	.00 ***
Deverbal nominals = result	-.14	.01	-7.57	.00 ***
Sentence length	.01	.01	1.22	.22
Smooth terms	***edf***	***Ref.df***	***F***	***p-value***
te(Noun length, Lemma frequency)	20.26	20.89	21.52	.00 ***
s(Stimuli)	.93	1.00	14.14	.00 ***
s(Trial order, Subject)	181.17	485	3.87	.00 ***

Note. te = tensor product smoot; s = thin plate regression spline smooth; ** $p < .001$; *** $p < .0001$.

1 The predictor *sentence length* was not included in any of the final GAMMs models (it was excluded due to a very high collinearity), but based on the reviewers' suggestions, the absence of its effect on the processing is shown in the tables interpreting the final GAMMs models results (Tables 2; Table 3; Table 5; Table 6).

Unlike the results of RTs of result and process nominals presented in isolation, the final GAMMs model for the analysis of entire sentences gave different results; i.e., the main effect of the type of deverbal nominals was statistically significant. More specifically, sentences containing result deverbal nominals (M_{RT} = 2334.67; *SD* = 895.99; *SE* = 36.76) were processed faster than sentences containing process deverbal nominals (M_{RT} = 2803.05; *SD* = 1020.80; *SE* = 41.48). The effect of the trial order, as well as the interaction between nominal length and lemma frequencies were again statistically significant in the same direction as in Experiment 1 (Table 3).

Experiment 2

Experiment 2 was designed as an English counterpart to the Experiment 1. The main aim of Experiment 2 was to test the differences in the cognitive processing patterns of process and result deverbal nominals in English. Following the procedure from the Experiment 1, the same number of stimuli was included in a self-paced reading task.

Method

Participants

Thirty-eight undergraduate students from the University of Alberta participated in this experiment, and received course credits for their participation. All participants were native speakers of English, with normal or corrected-to-normal vision. The experiment was carried out according to ethical rules specified in the Helsinki declaration, and this research was approved by the Ethical Committee of the Faculty of Arts, University of Alberta, Canada.

Design

The research design was identical to the design from the Experiment 1, with lemma frequencies retrieved from *The Corpus of Contemporary American English* (Davies, 2008).

Stimuli

The stimuli consisted of a total of 120 sentences in English, out of which 60 sentences were filler items without deverbal nominals. The remaining 60 sentences were created as 30 pairs of sentences, with uniform syntactic structures, differing only in the type of deverbal nominals used. All sentences were structured in the following way: possessive + deverbal nominal (with additional obligatory adjective for process deverbal nominals) + (argument) + verb + object and/or adjective clause. Any change in the last part of the sentence is made due to the obligatory grammatical rules in English (as in the examples shown in Table 4) (Grimshaw, 1990; Zlatić, 1997), but care was taken that sentences were uniform in length as much as possible. The stimuli were randomly assigned to experimental groups with the Latin square design.

Table 4
An example of a pair of stimuli from the experiment in English

The sentences (type of deverbal nominals)
1_a *Her job refusal was final and very steadfast.* (result)
1_b *Her instant refusal of the job surprised the employer.* (process)

Procedure

The entire procedure of the Experiment 2 was exactly the same as in the Experiment 1.

Results

The preparation of data for the statistical analysis was equivalent to the data preparation in Experiment 1, with the following differences. The total amount of excluded data was 4% from the entire data set (errors), and none of the participants reached the 10% exclusion threshold. Similaras in Experiment 1, the collinearity between covariates was extremely high (κ = 68.91). Following the procedure of the collinearity reduction explained for the Experiment 1, the same covariate (sentence length) was excluded from further statistical analysis, after which the Cohen's kappa noticeably decreased (κ = 25.53). As in Experiment 1, Table 5 and Table 6 include statistical metrics that confirm that the sentence length had no effect on the cognitive processing of process and result deverbal nominals in English. All other steps for data preparation were the same as in Experiment 1.

The Single-word Data Analysis

The pre-processing of single-word data from Experiment 2 was identical to that of Experiment 1. The final GAMMs model suggested that the main effect of the type of the deverbal nominal was statistically significant. Specifically, result deverbal nominals (M_{RT} = 538.44; *SD* = 367.27; *SE* = 15.38) were processed faster than the process deverbal nominals (M_{RT} = 587.55; *SD* = 444.96; *SE* = 18.64). On the other hand, none of the covariates were statistically significant (Table 5).

Table 5
Coefficients from the GAMMs analysis of single-word reading times in English

Parametric coefficients	*Estimate*	*Std. Error*	*t value*	*Pr(>|t|)*
Intercept	6.14	.07	78.47	.00 ***
Trial order (order of presentation)	.02	.01	1.93	.05
Deverbal nominals = result	-.06	.02	-3.13	.00 **
Noun length	.03	.02	1.39	.16
Sentence length	.00	.02	.44	.66
Lemma frequency	-.02	.02	-.81	.41
Smooth terms	***edf***	***Ref.df***	***F***	***p-value***
s(Stimuli)	24.90	32	4.39	.00 ***
s(Trial order, Subject)	49.19	335	5.88	.00 ***

Note. s = thin plate regression spline smooth; ** $p < .001$; *** $p < .0001$.

The Entire-sentence Data Analysis

The data pre-processing procedure for entire-sentence data was the same as for the single-word data for Experiment 2.

Table 6
Coefficients from the GAMMs analysis of entire-sentence reading times in English

Parametric coefficients	*Estimate*	*Std. Error*	*t value*	*Pr(>|t|)*
Intercept	8.26	.06	137.70	.00 ***
Trial order (order of presentation)	-.00	.00	-.26	.79
Deverbal nominals = result	-.11	.01	-9.32	.00 **
Noun length	.00	.01	.27	.78
Sentence length	.00	.01	.42	.68
Smooth terms	***edf***	***Ref.df***	***F***	***p-value***
s(Lemma frequency)	3.27	3.50	1.52	.29
s(Stimuli)	24.12	32	5.02	.00 ***
s(Trial order, Subject)	53.18	335	9.50	.00 ***

Note. s = thin plate regression spline smooth; ** $p < .001$; *** $p < .0001$.

The results of the final GAMMs model were similar to the results of the single-word data from the same experiment. The main effect of the deverbal nominal type was statistically significant, with the identical direction: result deverbal nominals (M_{RT} = 3869.09; *SD* = 1738.97; *SE* = 72.84) were generally processed faster than process deverbal nominals (M_{RT} = 4289.61; *SD* = 1973.76; *SE* = 82.67). The covariates, much like with the single-word data, have not reached significance in the entire-sentence data analysis (Table 6).

Discussion

The aim of the present study was to investigate the cognitive processing of process and result deverbal nominals in two languages: Serbian and English. Two self-paced reading experiments were conducted, one in Serbian (Experiment 1) and one in English (Experiment 2). The stimuli in both experiments were pairs of sentences with process and result deverbal nominals embedded within them. Reading times (RTs) were measured on deverbal nominals (The Single-word Data Analysis) and on entire sentences (The Entire-sentence Data Analysis). The results of the first statistical analysis ran on the single-word data from the Experiment 1 suggested that there were no statistically significant differences in the cognitive processing of process and result deverbal nominals in Serbian. However, the analysis ran on the RTs of entire sentences from Experiment 1 revealed significant results. Namely, sentences with result deverbal nominals were processed faster than sentences with process deverbal nominals. Likewise, the results of the experiment conducted in English (Experiment 2) confirmed these findings. In English, like in Serbian, sentences containing a result deverbal nominal were processed faster than their equivalents with process deverbal nominals.

However, the fact that the single-word data analysis for Serbian (Experiment 1) did not reach significance requires an explanation. Even though the differences in RTs between process and result deverbal nominals in Serbian did not show statistically significant differences when presented in isolation, it is important to note that the direction of the effect was in line with the results from the entire sentence analysis. In other words, the same trend was observed – result deverbal nominals were indeed processed faster than process deverbal nominals. A possible reason for the absence of a significant difference between result and process deverbal nominals, presented in isolation, might as well be due to their peculiar nature in Serbian, which in turn limited the number of stimuli that were used in this study. Another explanation of such results could be the lack of an adequate language (sentence) context. In other words, in natural language, people are rarely presented with words devoid of any context, i.e., without being embedded into larger phrases or sentences. Moreover, the results of Radman's (2015) research in Serbian suggest the same conclusion. In Radman (2015) the results of two experimental tasks, one involving the analysis of deverbal nominals in isolation, and the other one analyzing entire sentences, showed inconsistencies. This goes to show that a broader context is indeed necessary for a more precise observation of the processing effects of deverbal nominals. This is probably of an even greater importance in morpho-syntactically rich languages such as Serbian. Finally, these inconsistencies once again showed how important context is for psycholinguistic studies looking at lexical processing (Bertram, 2011; Jones et al., 2017; Rayner, 1998).

When it comes to the processing of entire sentences, the statistical analysis performed on RTs revealed that sentences with result deverbal nominals were processed faster than those with process deverbal nominals. These results are in line with those from previous theoretical and empirical studies. All previous research, regardless of the language, highlights the syntactic complexity of process deverbal nominals as the reason for their slower processing in comparison to result deverbal nominals, which are syntactically less complex, and as such faster to process (Anderson, 1983; Alexiadou, 2010; Gibson, 1998; Grimshaw, 1990; Kennison, 1999; Manouilidou, 2006; Radman, 2015; Smirnova, 2015). The results of the experiment in Serbian (Experiment 1) were confirmed by the experiment conducted in English (Experiment 2). English result deverbal nominals were processed faster than process deverbal nominals, regardless of whether they were presented in isolation or in a sentence context. The results obtained in Experiment 2 were also supported by the findings from previous empirical and theoretical studies (Anderson, 1983; Alexiadou, 2010; Grimshaw, 1990; Kennison, 1999; Manouilidou, 2006; Radman, 2015; Smirnova, 2015), together with the findings from the second analysis in Experiment 1. The conclusion that language complexity could influence the instability of the

effects observed in isolated words (single-word analysis) and contextually rich environments (entire-sentence analysis) was further supported with the results of Experiment 2. In other words, the effect was robust in English, as differences in the processing of result and process deverbal nominals reached significance in both isolated words and in context environments. Note that this was not the case for Serbian, given that despite the differences observed in processing times at the single-word analysis, no statistically significant effect was obtained. It could thus be concluded that in languages with simpler morpho-syntactic structures these inconsistent effects do not arise. The obtained results unanimously show that, in English, syntactic complexity causes longer processing times of process deverbal nominals.

Although the present study has tried to overcome certain drawbacks noted for the previous research on this topic, nevertheless, more research is needed in order for this phenomenon to be understood better. First, studying deverbal nominal in other languages than English and Serbian is crucial for a better insight into the nature of this phenomenon. Specifically, studies in other Slavic languages, with rich morpho-syntax would provide an invaluable insight into the effects of the syntactic complexity of deverbal nominals, and cognitive processing patterns caused by this complexity. Furthermore, using advanced research methodology techniques (e.g., EEG, ERP etc.) could shed more light on the neurocognitive processing of deverbal nominals in different languages. This kind of data would give us a better understanding of the processing patterns of result and process deverbal nominals.

Conclusions

The results of experiments conducted in this study suggested that result deverbal nominals were processed faster than process deverbal nominals in both Serbian and English. This is due to process deverbal nominals' higher syntactic complexity. However, the results from the two statistical analyses in Serbian were not consistent. The statistical analysis on single-word RTs did not reveal significant differences between the processing of result and process deverbal nominals. On the other hand, the statistical analysis on entire sentence RTs suggested that result deverbal nominals were processed faster than process deverbal nominals. The observed inconsistency goes to show that context is an important component of lexical processing, especially in morphologically rich languages such as Serbian. In the experiment conducted in English, results of both statistical analyses gave significant results: result deverbal nominals were processed faster than process deverbal nominals. Overall, results of both experiments support previous findings that syntactic complexity has a dominant role in the cognitive processing of deverbal nominals. In other words, the more syntactically complex a deverbal nominal is, the longer it takes for it to be processed.

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Obrada procesnih i rezultativnih deverbalnih imenica u srpskom i engleskom

Isidora Gatarić[1], Sanja Srdanović[2,] i Anja Kovač[2]

[1]Računarstvo u društvenim naukama, Univerzitet u Beogradu, Srbija
[2]Department of Linguistics, Goethe University Frankfurt, Germany

Deverbalne imenice, koje označavaju proces i rezultat neke radnje, su dve vrste imenskih reči koje su izvedene od odgovarajućih glagola. Ove dve vrste deverbalnih imenica razlikuju se u pogledu brojnih aspekata. Cilj ovog istraživanja bio je da se ispita postojanje razlika u kognitivnoj obradi deverbalnih imenica koje označavaju proces, odnosno rezultat neke radnje na srpskom i engleskom. Sprovedena su dva eksperimenta sa zadatkom čitanja slobodnim tempom. Prvi eksperiment je sproveden na srpskom jeziku sa deverbalnim imenicama koje označavaju proces, odnosno rezultat (npr. *drhtaj/drhtanje*), koje su dodatno bile umetnute u rečenice. Drugi eksperiment sadržao je ekvivalentne rečenične konstrukcije na engleskom.

Podaci su analizirani korišćenjem generalizovanih aditivnih mešovitih modela (eng. Generalized Additive Mixed Models – GAMMs [Wood, 2006, 2011]), pri čemu je mereno i analizirano vreme čitanja na nivou reči (samo deverbalne imenice) i na nivou rečenice (cela rečenica uključujući i deverbalne imenice), na oba jezika. Rezultati generalno ukazuju na to da se rezultativne deverbalne imenice obrađuju brže nego procesne deverbalne imenice. Pretpostavlja se da su ove razlike dobijene kao posledica uticaja sintaksičke kompleksnosti deverbalnih imenica, koja je znatno izraženija kod procesnih deverbalnih imenica u odnosu na rezultativne deverbalne imenice.

Ključne reči: deverbalne imenice, derivaciona morfologija, sintaksa, kognitivna obrada

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