

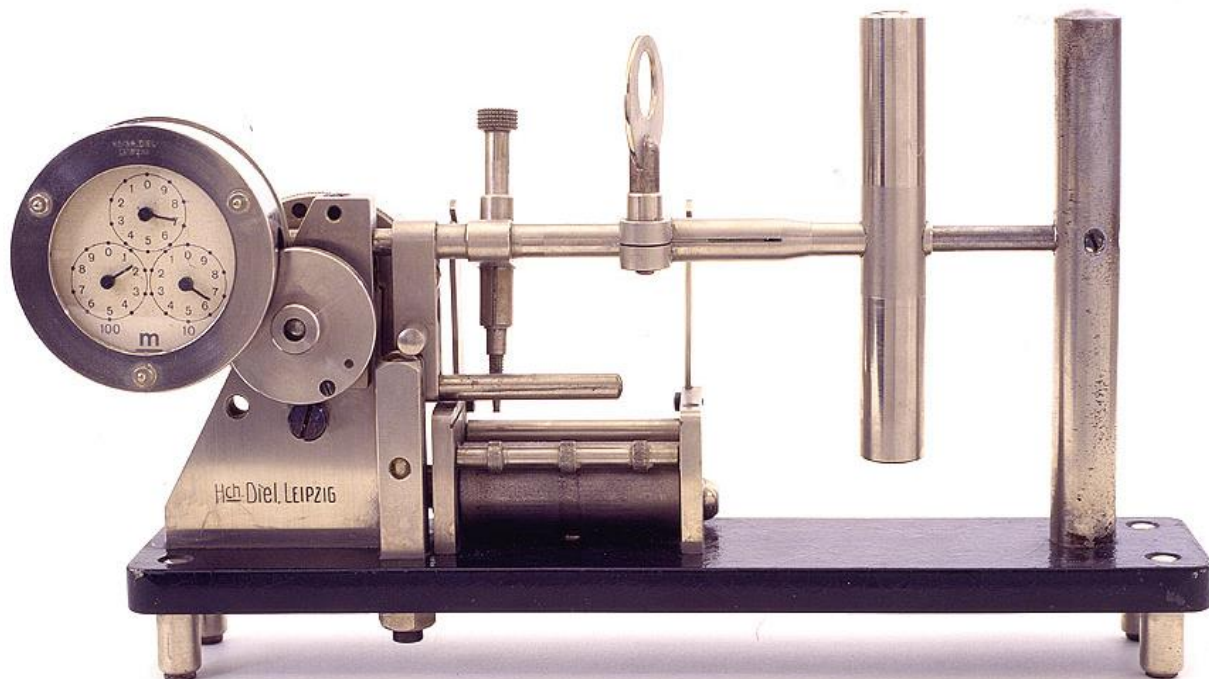
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XXV SCIENTIFIC
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EMPIRICAL STUDIES IN PSYCHOLOGY

MARCH 29TH – 31ST, 2019

FACULTY OF PHILOSOPHY, UNIVERSITY OF BELGRADE



INSTITUTE OF PSYCHOLOGY
LABORATORY FOR EXPERIMENTAL PSYCHOLOGY
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The Effect of Grapheme Size on Processing of Latin and Cyrillic Words

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Abstract

The graphemes are designed to transmit the appropriate information by combining a limited number of terminations as well as straight and curved lines. It was found that visual degradation of words written in lower case letters has a different effect in two alphabet systems. The question is whether such effects will be obtained on upper case letters. Two factors were varied-alphabet (Cyrillic and Latin) and visual availability of information (visible whole word, visible upper part of the word and visible lower part of the word). A significant difference was found between the experimental situations in the RT ($F(5) = 360.2, p < .001$). The results show that processing of Cyrillic words and Latin words with visual accessible upper half of the letter are slower when they are written in capital letters. But, whole Latin words and Latin words which are visible to the bottom half, are processed faster if they are written in capital letters.

Keywords: Latin, Cyrillic, word processing, grapheme size, visual degradation

Introduction

Each alphabet is a set of characters that contain common and specific features which allow a distinction between them. Identification of individual grapheme is necessary for visual recognition of the word. Some authors point out that the grapheme are basic perceptive and functional reading units (Havelka & Frankish, 2010). In Serbian, there is bialphabetism, the phenomenon that one word can be written in two alphabets - Cyrillic and Latin. The specificity of this phenomenon is reflected in the fact that each letter in both alphabets has its phonemic interpretation which does not change (Vejnović & Jovanović, 2012). One group of researchers has focused its attention on identifying structural differences between the two alphabets, suggesting that the isolated letters are specific enough to lead to differences in the processing of Cyrillic and Latin words. In the early 1935s, Ramiro and Zoran Bujas examined the perception of isolated letters in the conditions of a short exposure and found the average readability of both types of letters (Koković-Novosel, 2011). Rohaček (1973) examined the readability of words written in small letters and found better results for the words written in the Latin alphabet. The author assumed that this was due to the large number of upper and lower extensions. In an attempt to study the effect of grapheme characteristics on the word processing speed, Borojević, Dimitrijević and Stančić (2018) carried out an experiment in which they manipulated the visibility of the word. The visual degradation of the words written in lowercase had a different

effect in the Latin and Cyrillic alphabet. In Cyrillic words processing is slower, while in Latin words processing is slower only in the case of degradation of the lower part of the letters. The question is whether such effects will be obtained when the words are written in uppercase. Namely, various studies have shown that processing is different if letters of different sizes are used as stimulus (Smith, Lott, & Cronnel, 1969; Arditi & Cho, 2007). Tinker (1963) was the first who find that the text consists only of capital letters is much more difficult to read than the text in the lower case. So, the aim of this study is to examine the effect of grapheme size on processing Latin and Cyrillic words.

Method

Sample

Sixty-eight undergraduate students participated in this experiment. In the sample were included participants that have met the following criteria:

- Cyrillic was the first learned language;
- They had less than 30% of errors
- They do not have preferred alphabet in reading and writing

All subjects had normal or corrected to normal vision.

Design and Procedure

Two factors were varied: *alphabet* (Cyrillic and Latin) and *visual degradation of word* (degraded in upper part, degraded in lower part, undegraded). By combining varied factors, six experimental conditions were obtained. Stimuli used in this experiment were 60 nouns (masculine, nominative, singular, six character length) and 60 pseudowords of the same length. All stimuli were written in uppercase with Arial font 48.

The lexical decision task was used in experiment. Two dependent variables were measured, the reaction time and the number of errors. Participants were tested individually and received a 120 experimental trials with additional 6 practical trials. Each trial is started with presentation of fixation point for 500ms. After that, a series of letters appeared on the screen. Participants were instructed to press one of two buttons on the keyboard to indicate whether these letters are word or pseudoword. The stimuli (words and pseudowords) were displayed on the screen until the answer was given, with maximum time 3000ms. Experimental session lasted approximately 15-20 minutes per participant.

Results

A significant difference was found between the experimental situations in the reaction time (RT) for word ($F(5) = 360.2$, $p < .001$), whereby the Scheffe post hoc analysis of the average RT was grouped into four groups: (1) (804ms), (2) whole Cyrillic (942ms); (3) visible upper (1521.8ms) and lower part (1553.2ms) of Latin words, and (4) visible lower (1827.8ms) and upper part (1948.8ms) of Cyrillic words. Significant effect was obtained in pseudowords ($F(4) = 586.4$, $p < .001$), but the differences in average RT are not significant among all experimental situations.

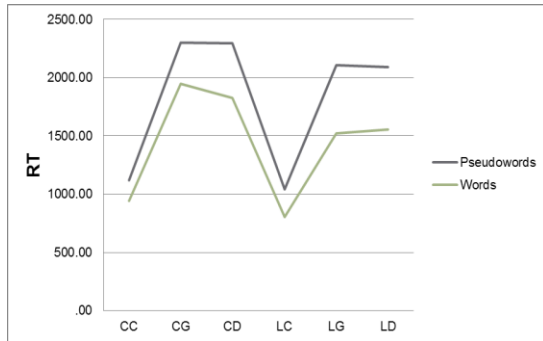


Figure 1. Response latency depending on the *alphabet, lexicality and type of visual word degradation*. Note: *cc* - visible whole Cyrillic words, *cd* - visible upper part of Cyrillic words, *cg* - visible lower part of Cyrillic word; *lc* - visible whole Latin words, *ld* - visible upper part of Latin words.

When the results are compared with the results obtained on the same stimulus in the lower case (Borojević, Dimitrijević, Stančić, 2018), some differences can be noticed (Figure 2). A comparison was not possible for the experimental situation for Latin words in which the lower part was invisible, because in a case of small letters (Borojević, Dimitrijević, & Stančić, 2018) participants have achieved a low accuracy, so this experimental situation in that study was excluded from the analysis. Other comparisons show that reaction time is longer for Cyrillic words (both, degraded and undegraded) when they are written in uppercase.

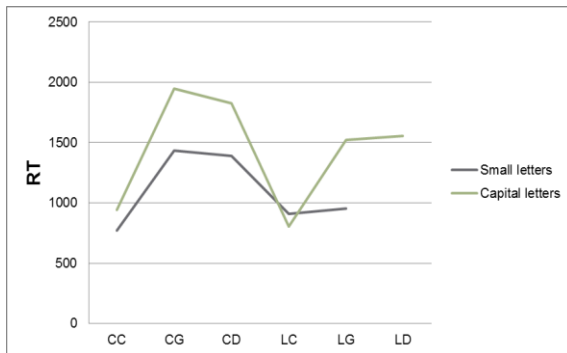


Figure 2: Differences in response latency for word written in small and capital letters among experimental situations

Also, the processing time is longer for Latin words that have degraded the lower part. On the other hand, whole Latin

words are processed slower when they are in lowercase. It could also be concluded for the Latin words that were degraded to the lower part.

Discussion and conclusion

This research is based on the assumption that the difference in processing of two letters Serbian language is based on the structural differences that is, the specific characteristics of individual grapheme. Earlier research (Borojević, Dimitrijević, & Stančić, 2018) has shown that there is an effect of grapheme characteristics on the processing speed of Latin and Cyrillic words, the authors emphasized that the different number of line terminations in the upper or lower part of the letters contributes to different visual complexity, and therefore the differences in recognition. Latin letters also have specific extensions in the upper part that make them different from the Cyrillic letters. When the same experimental manipulation with visual degradation of words is applied to stimulus written in capital letters, somewhat different results are obtained. In Cyrillic words, the response time is longer which implies that processing is more demanding. This is in line with previous research that showed that capital letters are the same height, and they do not contain ascenders and descenders (except the letters Lj and Nj), which would allow a quick distinction (Ardity & Cho, 2007). Ascender is the part of lower-case letter that is taller than the letter. Conversely, descender is the part that is lower than the letter. Slower processing is also observed in Latin words where the lower part is removed. However, the results obtained with the Latin word which has been degraded in the upper part, as well as for the whole word, are inconsistent with previous findings. In attempting to explain such data, we can rely on the researches of the importance of different visual characteristics in the discrimination of letters in different languages. The most important characteristics that are sufficiently perceptive saturated to facilitate the processing of letters and words that create are: vertices (Lanthier, Risko, Stolz, & Besner, 2009), disconnected component (Winsky, 2009) and number of strokes (Tamaoka & Kiyama, 2013). It is possible that the two alphabets of the Serbian language differ in the dominance of the special visual features that are key to recognizing letters and words. It should be systematically checked through experiments in which frequency and frequency should be controlled.

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