

A WORD SUPERIORITY EFFECT IN A PHONETICALLY PRECISE ORTHOGRAPHY*

G. LUKATELA, B. LORENC and P. OGNJENović

University of Belgrade

and

M. T. TURVEY

University of Connecticut and Haskins Laboratories

Other things being equal, a letter is identified more accurately and rapidly in the context of a word than in the context of a nonword. This word-superiority effect has been demonstrated many times with materials conforming to English orthography. The present experiment, using the probe letter-recognition procedure, demonstrates the effect in the Serbo-Croatian orthography. In that the English and Serbo-Croatian orthographies distinguish markedly in the level at which they systematically reference the spoken language, it appears that the word-superiority effect is not owing to orthographic idiosyncracies. Analysis of the effect in Serbo-Croatian suggests that it is not completely accountable for in terms of interletter probability structure and that word-specific factors may be involved.

INTRODUCTION

Under the same conditions a letter is identified more rapidly and more accurately in the context of a word than in the context of a nonword. This letter-in-context or word-superiority effect is a now well established fact for fluent readers of the English orthography (Baron, 1978). Arguably, fluent readers of English relate more efficiently to English words than to letter strings with which they have had no experience, because they have learned something about the structure of written English in general and/or the properties of English words in particular. What has been learned to enhance word perception cannot be precisely pinpointed. Nevertheless, a number of knowledge kinds can be proposed as potential candidates; for example, meaning, whole-word familiarity, word-specific associations with sounds, spelling rules and familiarity with spelling patterns (Baron, 1978). Questions as to the aspect or aspects of word-processing that these kinds of knowledge influence are largely unresolved, although most recent evidence appears to rule out the feature analysis of component letters (Krueger and Shapiro, 1979; Massaro, 1979; Staller and Lappin, 1979).

The major focus of the present paper is a simple question: Does the word superiority effect hold for an orthography that differs nontrivially from the orthography of English? Orthographies work as transcriptions of language because the patterning of symbols in written text bears a systematic relationship to some corresponding patterning in the spoken language. The orthography of English is principally (but not exclusively)

* This research was supported in part by NICHD Grant HD-08495 to the University of Belgrade and in part by NICHD Grant HD-01994 to Haskins Laboratories.

systematic with reference to the morphophonemics of the spoken language, while the orthography of Serbo-Croatian is principally (but not exclusively) systematic with reference to the (classically defined) phonemics of the spoken language (see Lukatela and Turvey, 1980; Lukatela, Popadić, Ognjenović and Turvey, 1980). We might expect to find, therefore, differences between the reading-related processes exhibited by fluent readers of English and those exhibited by fluent readers of Serbo-Croatian. For fluent readers of Serbo-Croatian, lexical decision is mediated by phonetic recoding (Lukatela *et al.*, 1980); in contrast, fluent readers of English tend to access the lexicon in non-phonological terms (Coltheart, Besner, Jonasson and Davelaar, 1979). With respect to a distinction drawn by Baron and Strawson (1976), fluent readers of Serbo-Croatian may be disproportionately "Phoenician" (that is, treat the written word as an alphabetic transcription) while fluent readers of English may be disproportionately "Chinese" (that is, treat the written word as a logographic transcription). Though the latter contrast is exaggerated, it makes the point that the phonemically oriented Serbo-Croatian orthography and the morphophonemically oriented English orthography may give emphasis to different aspects of the written form of the word and thus motivate the acquisition of, and a dependency on, different knowledge kinds for word perception. Perhaps the letter-in-context or word-superiority effect is indigenous to the English orthography (and to similar orthographies) and is due to the fact that the processing of written English often demands the use of recoding units larger than the single letter. We doubt that there is such a restriction on the word-superiority effect, but the question of the effect's dependency on the orthography must be asked nevertheless.

The question was addressed through the probe recognition procedure first introduced by Reicher (1969). A horizontally arranged string of letters is briefly exposed and followed immediately by a mask (covering the region of the letter string) together with two letters located above and below the position of a letter in the presented string. The subject's task is simply to choose which of the two letters occupied the probed position. Of interest is how letter recognition varies with the nature of the letter string.

METHOD

Subjects

The subjects were 41 undergraduate students from the Department of Psychology at the University of Belgrade who participated in the experiment as part of a course requirement. The majority of the subjects received their elementary education in eastern Yugoslavia; that is to say, they acquired the Cyrillic alphabet prior to the Roman alphabet (see Lukatela, Savić, Ognjenović and Turvey, 1978).

Materials

The target letter strings and the response alternatives were Roman upper-case (see Lukatela, Savić, Ognjenović and Turvey, 1978), black leterset (Letraset light, 12 pt.) letters pressed onto the glass surface of 36 mm slides. Individual letters maximally sub-

tended 21' x 25' of visual angle, and the visual extent of a five letter string was 2° 17' horizontal to perfectly coincide with the region occupied by the letter string. The response alternative subtended 1° 34' vertically from the top part of the upper letter to the bottom part of the lower letter. The light, background regions of the target and mask fields were equated at 10 cd/m².

There were four kinds of target stimuli: single letters, five-letter words, five-letter nonwords with vowels ("pseudowords") and five-letter nonwords without vowels ("nonwords"). Thirty-two instances of each kind were constructed. Six instances of each kind were used in the preliminaries to the experiment proper, and twenty instances of each kind were used in the experiment proper.

In the fashion of Reicher (1969) and Wheeler (1970), the words and their response alternatives were selected so that the wrong alternative, if substituted for the probed letter, also made a word with a frequency of occurrence roughly equivalent to that of the target word. Frequency equivalence was determined according to the frequency count of Kostić (1965). Thus, if the target word were "TAČKA" (point), and the alternatives for the first letter as the probed letter were T and M, then the substitution of T by M would give "MAČKA" (cat).

The words were of five different consonant(c)-vowel(v) structures (i.e., CVCVC, CCVCV, VCCVC, VCVCV, CVCCV), which were represented in the set of twenty words seven times, seven times, twice, twice and twice respectively. The different consonant-vowel structures were necessitated by the requirements that (1) only consonants were probed in the four kinds of stimuli (the nonwords were composed only of consonants) and (2) each letter position was probed equally often. Table 1 gives the words and pseudowords together with the response alternatives. Each of the twenty pseudowords was constructed from its word mate by changing two letters without altering the consonant-vowel structure. Which two letters were changed depended on the particular consonant-vowel structure of the word as is evident from Table 1. Moreover, the particular letter substitutes were chosen to keep the pronounceability of a word and its pseudoword partner approximately equivalent. This "pronounceability" stricture also determined the selection of the incorrect response alternative. The response alternatives for an individual pseudoword were the same as for its word mate.

The nonwords were constructed by a random drawing of consonants under the constraint that no letter could be repeated within a letter string. The single-letter stimuli were all consonants and they always occurred in the middle of the slide.

Procedure

A subject viewed sequences of slides presented by means of a three-channel tachistoscope (Scientific Prototype, Model GB) and responded to the critical member of a sequence by pressing one of two telegraph keys. The nearer of the two keys indexed "lower" and the further of the two keys indexed "upper." A sequence of slides consisted of the following: Subsequent to a ready signal, a fixation field of 500 msec duration was presented followed by a slide containing one or five letters. The duration of this letter-string or target slide was tailored to the individual subject and therefore variable across

TABLE 1

Words, pseudowords and response alternatives
with target letters specified

WORDS	PSEUDOWORDS	RESPONSE ALTERNATIVES
<u>H</u> RANA	<u>H</u> REKA	H, G
<u>L</u> ITAR	<u>L</u> ETOR	T, M
<u>S</u> REĆA	<u>S</u> RISA	R, V
<u>V</u> RATA	<u>V</u> LITA	T, N
<u>I</u> ZRAZ	<u>I</u> GREZ	R, L
<u>N</u> APAD	<u>N</u> ALID	N, Z
<u>U</u> LICA	<u>U</u> LEZA	L, D
<u>T</u> RAVA	<u>T</u> LEVA	V, K
<u>S</u> AVEZ	<u>S</u> AGIZ	Z, T
<u>M</u> ETA <u>L</u>	<u>M</u> EBOL	L, K
<u>O</u> BRAZ	<u>O</u> BLEZ	B, D
<u>G</u> LAVA	<u>G</u> LOTA	G, S
<u>B</u> OMBA	<u>B</u> UMKA	M, R
<u>K</u> ANA <u>L</u>	<u>K</u> ASOL	L, P
<u>P</u> ONOĆ	<u>P</u> ANUĆ	N, M
<u>O</u> PERA	<u>O</u> PINA	P, V
<u>S</u> VILA	<u>S</u> ROLA	L, T
<u>P</u> OJAM	<u>P</u> ONEM	M, S
<u>B</u> RA <u>D</u> A	<u>B</u> LIDA	D, V
<u>T</u> AČKA	<u>T</u> AZLA	T, M

subjects but constant for a given subject within the sequences of slides. Immediately following the termination of the target slide (that is, at an inter-stimulus interval of 0 msec), a slide containing a random patterning of lines (that overlapped the letters of the target slide) and two letters was presented for a duration of 1.5 sec. One of the two letters was above the masking pattern while the other was below it. These two letters

were aligned vertically and so located as to correspond to the position of one of the letters in the target slide. The subject's task was to press one of the two keys to identify which of the two letters, the upper or the lower, was the letter occurring in that position on the target slide. One of the letter alternatives was always correct.

The dependent measure was the accuracy of the subject's choice between the two response alternatives. A level of performance was sought, therefore, at which a subject recognized the probed-for letters above chance but not perfectly. To this end, the collection of data for analysis was preceded by a practice session during which the subject was familiarized with the task and during which the experimenter determined the duration of the target slide exposure at which the subject's performance was approximately seventy-five percent correct.

The practice session was divided into two phases. During the first phase the exposure time of the target stimuli was held constant at 100 msec, and the subject was given feedback on the accuracy of his or her choice. In the second phase the target stimulus duration was reduced until a duration yielding an accuracy of seventy-five percent was reached. Further sequences were then presented to assess the reliability of the criterial duration with increases or decreases introduced where necessary. Across subjects the duration yielding criterial performance ranged from 30 to 50 msec. The set of target stimuli used for establishing the threshold value was composed in exactly the same way as the set of target stimuli in the experiment proper.

Following the practice session a subject was presented forty sequences with the target exposure at the individually determined duration.

RESULTS AND DISCUSSION

The number of correct responses for each subject for each stimulus type was entered into a two factor analysis of variance (Subject x Stimulus Type) which showed the type of stimulus to be significant, $F(3,123) = 12.69$, $p < 0.001$. The percentages of correct recognition for the four stimulus types were: single letters, 78.10; words, 81.19; pseudowords, 73.81; and nonwords, 64.52. Protected t -tests on the individual comparisons revealed a significant difference between words and nonwords ($p < 0.01$), and words and pseudowords ($p < 0.02$), pseudowords and nonwords ($p < 0.01$) and single letters and nonwords ($p < 0.01$).

Let us consider first why we might *not* have expected a word-superiority effect for the Serbo-Croatian orthography. Suppose that the kind of knowledge which accounted for the effect in English was of the correspondence rules that parse script into the functional units to which phonemes can be systematically assigned. Venezky (1967, 1970) has given a detailed exposition of these rules for English. There are, of course, consistent mappings but they are often abstract, and they generally related graphic symbols to the morphophonemic and not to the phonetic level of the language. Moreover, their application generally involves lexical reference. Thus "sh" in "mishap" is not a single phoneme as it is in "ship" or "smash". To know this the reader must recognize that in "mishap" the two letters are separated by a morpheme boundary. Knowledge of

parts of speech in addition to morpheme identity is necessary for the pronunciation of "ate" at the end of words (compare the verbs "deflate", "integrate" with the nouns "syndicate", "frigate"). A more straightforward rule is that which ascribes the phoneme /s/ to the letter "c" before the letters "e", "i" or "y" plus a consonant or juncture. Because of the opaqueness of English spelling, it is often necessary for a speaker of English to communicate the spelling of a word which another finds perplexing by indicating precisely the identity and order of the alphabetic constituents. In contrast, a speaker of Serbo-Croatian can communicate the spelling in almost all cases by simply speaking the word more slowly. The point is that the fund of orthographic parsing rules required for spelling English has no equivalent in Serbo-Croatian, and thus, if such knowledge were a critical ingredient in the word-superiority effect, then no such effect should be expected in Serbo-Croatian.

Consider a further but related reason which derives from doubts as to the value of reforming the English orthography in the direction of greater phonetic specificity (cf. Gibson and Levin, 1975). Arguably, the efficient recognition of (English) words is principally based on the intra-word redundancies generated by orthographic rules. To increase the phonetic precision of a writing system is to strip away these important clues to a word's nature. The orthography of English allows skilled readers to obtain grammatical and semantic information about words from their orthographic forms (Chomsky, 1970). This is because English preserves the morphological similarity of words (for example, "anxious", "anxiety"), whereas an orthography oriented to phonetics would forego, necessarily, this commitment to meaning and etymology. Thus, in Serbo-Croatian, even declensions of the same word may undergo orthographic modification in the interests of a phonetically precise transcription from the spoken to the written form (for example, "noga", "nozi", the nominative and dative forms respectively, of the word meaning "leg"). Given these considerations one could entertain an argument of the following kind: Meaning is a type of knowledge that determines the word-superiority effect. However, meaning is less directly accessible from the internal structure of Serbo-Croatian words than it is from the internal structure of English words, and at the time of making a choice in the probe recognition procedure a reader of Serbo-Croatian is less likely to have accessed a letter string's meaning. Consequently, under the conditions of the task, the meaning-based word/nonword distinction is less available to the Serbo-Croatian reader, and thus the word-superiority effect is less likely for the Serbo-Croatian orthography.

Of course, the arguments above are straw men. There is little if any reason for believing that the word-superiority effect is owing to a single factor operating in isolation so that the absence of that factor is sufficient to rule out the occurrence of the effect. Nevertheless, the arguments serve the purpose of underscoring differences between the two orthographies and what they entail in processing terms; the arguments suffice to indicate the kinds of rationalization that could be made if the perception of written Serbo-Croatian failed to manifest a superiority of words over nonwords. However, given that fluent readers of Serbo-Croatian did perceive letters in words better than letters in nonwords and pseudowords, let us proceed to consider the reasons that they did so. With regard to the nonsignificant difference between the words and the single letters it suffices to note that when single letter performance is the poorer of the two (e.g., Carr, Lehmkuhle,

Kottas, Astor-Stetson and Arnold, 1976) it is probably due to positional uncertainty (Estes, 1975), and in our experiment the single letters always occurred in the same position of the display.

That the words were perceived better than the nonwords may not require an appeal to word-specific factors, in that the pseudowords were similarly superior. However, the fact that the words were, in turn, perceived better than the pseudowords might mean that an appeal to word-specific factors may be required for a full account. The superiority in the perception of words and pseudowords over nonwords can be considered from two perspectives: One emphasizes general orthographic distinctions, and the other emphasizes general (non-orthographic) figural and conceptual distinctions between the two kinds of letter patterns. Thus the regularities of written Serbo-Croatian (for example, the tendency to alternate consonants and vowels, and the limited number of consonant runs of two and three letters) that were present in the words and pseudowords and not present in the random consonant strings that were the nonwords may be the source of the perceptual distinction. Yet recourse to the regularities of the written language may be unnecessary; there are nonlinguistic factors that would distinguish the words and pseudowords from the nonwords in ways that are potentially exploitable by the perceiver.

Two categories of letters (vowels and consonants) comprised the words and pseudowords. One category of letters (consonants) comprised the nonwords and only one category of letters (consonants) was probed. There is much evidence to show that categorical information facilitates the detection of targets in visual search tasks (Brand, 1971; Ingling, 1972; Jonides and Gleitman, 1972, 1976; Lukatela *et al.*, 1978). Sometimes referred to as a "conceptual" category effect there is accumulating evidence that this may be an ill-chosen label. Denotable physical relations may well support the reliable discrimination of vowels from consonants (Staller and Lappin, 1979; White, 1977). At all events, the enhanced perception of letters in words and in pseudowords with respect to letters in nonwords may have been due to the ability to distinguish the target category (consonants) from the non-target category (vowels), thereby effectively reducing the number of letters to be processed. Staller and Lappin (1979, Experiment 4) provide one significant demonstration that this, indeed, can be the case.

Let us now consider the difference in perceptibility of words and pseudowords. The literature equivocates on the genuineness of word/pseudoword differences. There are a large number of studies reporting that both words and pseudowords are superior to nonwords but do not differ between themselves, and there are a large number of studies showing word/pseudoword differences (see Baron, 1978 for a review). The former suggest that the word-superiority effect is due entirely to general properties of the structure of the written language that are manifest equally in words and pseudowords; while the latter suggest that factors specific to words do exist over and above the general properties common to words and pseudowords. Baron (1978) notes several possible reasons for this equivocality of which the following may speak to the present data. First, current knowledge does not permit a systematic equating of words and pseudowords on the many non-semantic, non-lexical dimensions of potential relevance to perceiving letter strings (for example, the frequencies of letter groups and the frequencies with which letter groupings occur in certain positions within the letter string). Second, methods vary

in their sensitivity to the word-superiority effect, and where the difference between words and nonwords is relatively small, that between words and pseudowords is usually nonexistent. The type of mask (Johnston and McClelland, 1973), visual angle of the display (Purcell, Stanovich and Spector, 1978) and the onset asynchrony between letter string presentation and mask presentation (Michaels and Turvey, 1979) contribute significantly to the magnitude of the word-superiority effect.

The difference between words and pseudowords was significant in the present experiment. Is it a genuine word-specific effect? The answer is not easily given, largely because of the first reason noted above — ignorance of whether all the nonword-specific dimensions were equated between the two sets of stimuli. Nevertheless, when general factors are considered, such as frequency of letter patterns and geometric properties of the letter strings, there remains some reason for believing that specific factors such as meaning, lexical membership or whole-word familiarity (Baron, 1978) may have contributed to the word/pseudoword difference. With respect to geometric properties, Staller and Lappin (1979) have shown that the symmetry and directionality of letters significant to the perceptibility of letters in letter contexts. In the present experiment, where a symmetrical letter (e.g., A, T) in a word was changed in the construction of its pseudoword pair, the letter was changed half of the time into another symmetrical letter and half of the time into a right-facing letter (e.g., G, L). Likewise, right-facing letters were converted into other right-facing letters half of the time and into symmetrical letters the other half of the time. So at least in terms of these two dimensions (the symmetry and directionality of individual letters) the words and pseudowords were numerically equated.

A potentially more significant and more likely source of difference is the conditional probabilities among the letter pairs. Changing two letters of a word to produce a pseudoword may have changed the degree to which letter pairings conformed to the language. Consulting Tomić's (1978) digram frequency analysis of 1,250,000 tokens, the conditional frequencies of letter pairs in the forward direction (that is, the frequency the letter "j" occurs given letter "i" before it) were determined for each letter string. Since the strings were five letters in length there were four conditional frequencies for each letter string; these four were summed for each individual string of letters. For the words of the present experiment, the overall mean of the individual sums was 26,135 compared to an overall mean of 17,863 for the pseudowords. Moreover, of the twenty pairs of words and pseudowords, the word member was of higher summed conditional frequency in seventeen of the pairs. It would seem, therefore, that the word/pseudoword difference in the present experiment is accountable for in terms of differences in the interletter probability structure. A further analysis suggests, however, that interletter probability structure may not be the complete story.

A correlation computed between the summed conditional frequencies of pseudowords and the number of incorrect recognitions proved significant ($r = -0.513$, $p < 0.05$) meaning that the higher the summed digram frequency the fewer the errors. In contrast, a similar correlation computed for the word stimuli proved insignificant ($r = -0.005$). The possibility that interletter probability characteristics may have contributed more significantly to letter recognition in pseudowords than in words is consistent with other

observations in the literature. Thus, Engel (1974) reported that the relationship between interletter probabilities and the accuracy of letter detection was most pronounced for low frequency words, and Rice and Robinson (1975) showed that the influence of mean digram frequency on lexical decision latencies was restricted to rare words. An analysis by Whaley (1978) concurs with these observations: Whereas general factors such as interletter probability structure contribute significantly to the perception of letter strings that are nonwords or pseudowords and perhaps to the perception of relatively new or unfamiliar words, they contribute relatively less significantly to the perception of words. In word perception the general aspects are overridden by the specific aspects such as richness of meaning and familiarity. In the absence of further analysis on general aspects we may, therefore, draw the qualified conclusion that the word-superiority effect of the present experiment is a word-specific effect.

It remains for us to make one final remark by way of reinforcing a point above with regard to the word/nonword data. The Serbo-Croatian language is biased heavily toward open syllables. A perusal of the Tomić (1978) norms reveals that consonant-vowel and vowel-consonant pairs are by far the most frequent with consonant-consonant pairs comparatively rare. A crude comparison suggests that the relative proportion of consonant pairs and consonant triples in English is larger (Baddeley, Conrad and Thompson, 1960; compared with Tomić, 1978). This difference between the interletter structure of the two languages may account for why the word/nonword difference in the present experiment was greater in magnitude than that generally reported for comparable experiments with English materials.

In the present experiment with Serbo-Croatian the difference was roughly 17 percent compared to the difference commonly reported for English which is of the order of 10 percent or less. Nonword letter strings composed solely of randomly selected consonants are considerably more like the internal structure of English words than they are like the internal structure of Serbo-Croatian words. Structurally speaking the difference between words and (all-consonant) nonwords is greater in Serbo-Croatian than it is in English.

To summarize, evidence has been provided for a word-superiority effect in the Serbo-Croatian orthography, an orthography which is markedly different from the English orthography in which the effect is most commonly reported. The Serbo-Croatian orthography is more closely related to (classical) phonemics, while the English orthography is more closely related to morphophonemics. The word-superiority effect, therefore, appears to be indifferent to the linguistic level referenced by the orthography. As with the word-superiority effect demonstrated in English (and see Dutch, 1980), the word-superiority effect demonstrated in Serbo-Croatian may resist explanation solely in terms of general properties of the written language.

REFERENCES

- BADDELEY, A., CONRAD, R. and THOMPSON, W. (1960). Letter structure of the English language. *Nature*, **186**, 414-416.

- BARON, J. (1978). The word superiority effect. In W.K. Estes (ed.) *Handbooks of Learning and Cognitive Processes VI* (Hillsdale, N.J.).
- BARON, J. and STRAWSON, C. (1976). Use of orthographic and word specific knowledge in reading words aloud. *Journal of Experimental Psychology: Human Perception and Performance*, **2**, 386-393.
- BRAND, J. (1971). Classification without identification in visual search. *Quarterly Journal of Experimental Psychology*, **23**, 178-186.
- CARR, T.H., LEHMKUHLE, S.W., KOTTAS, B., ASTOR-STETSON, E.C. and ARNOLD, D. (1976). Target position and practice in the identification of letters in varying contexts: A word superiority effect. *Perception and Psychophysics*, **19**, 412-416.
- CHOMSKY, N. (1970). Phonology and reading. In H. Levin and J.P. Williams (eds.) *Basic Studies on Reading* (New York).
- COLTHEART, M., BESNER, D., JONASSON, J.T. and DAVELAAR, F. (1979). Phonological encoding in the lexical decision task. *Quarterly Journal of Experimental Psychology*, **31**, 489-508.
- DUTCH, S. (1980). Predicting letter search time through words and nonwords: The role of statistical frequency and lexical status in the word-superiority effect. Ph.D. dissertation, University of Connecticut.
- ENGEL, G.R. (1974). On the functional relationship between word identification and letter probability. *Canadian Journal of Psychology*, **28**, 300-309.
- ESTES, W. (1975). The locus of inferential and perceptual processes in letter identification. *Journal of Experimental Psychology: General*, **105**, 122-145.
- GIBSON, E.J. and LEVIN, H. *The Psychology of Reading* (Cambridge, Massachusetts).
- INGLING, N. (1972). Categorization: A mechanism for rapid information processing. *Journal of Experimental Psychology*, **94**, 239-243.
- JOHNSTON, J.C. and MCCLELLAND, J.L. (1972). Visual factors in word recognition. *Perception and Psychophysics*, **14**, 365-393.
- JONIDES, J. and GLEITMAN, H. (1972). A conceptual category effect in visual search: O as a letter or a digit. *Perception and Psychophysics*, **12**, 457-460.
- JONIDES, J. and GLEITMAN, H. (1976). The benefit of categorization in visual search. Target location without identification. *Perception and Psychophysics*, **20**, 289-298.
- KOŠTIĆ, D. (1965). Frequency of occurrence of words in Serbo-Croatian. Unpublished manuscript.
- KRUEGER, L.E. and SHAPIRO, R.G. (1979). Letter detection with rapid serial visual presentation: Evidence against word superiority as feature extraction. *Journal of Experimental Psychology: Human Perception and Performance*, **5**, 657-673.
- LUKATELA, G. and TURVEY, M.T. (1980). Some experiments on the Roman and Cyrillic alphabets of Serbo-Croatian. In J. Kavanagh and R. Venezky (eds) *Orthography, Reading and Dyslexia* (Baltimore).
- LUKATELA, G., POPADIĆ, D., OGNJENOVIĆ, P. and TURVEY, M.T. (1980). Lexical decision in phonologically shallow orthography. *Memory and Cognition*, **8**, 124-132.
- LUKATELA, G., SAVIĆ, M., OGNJENOVIĆ, P. and TURVEY, M.T. (1978). On the relation between processing the Roman and the Cyrillic alphabets: A preliminary analysis with bi-alphabetical readers. *Language and Speech*, **21**, 113-141.
- MASSARO, D.W. (1979). Letter information and orthographic context in word perception. *Journal of Experimental Psychology: Human Perception and Performance*, **5**, 595-609.
- MICHAELS, C.F. and TURVEY, M.T. (1979). Central sources of visual masking: Indexing structures supporting seeing at a single, brief glance. *Psychological Research*, **41**, 1-61.
- PURCELL, D.G., STANOVICH, K.E. and SPECTOR, A. (1978). Visual angle and the word superiority effect. *Memory and Cognition*, **6**, 3-8.
- REICHER, G.M. (1969). Perceptual recognition as a function of meaningfulness of stimulus material. *Journal of Experimental Psychology*, **81**, 275-280.
- RICE, G. and ROBINSON, D. (1975). The role of digram frequency in the perception of words and nonwords. *Memory and Cognition*, **3**, 513-518.
- STALLER, J.D. and LAPPIN, J.S. (1979). Word and nonword superiority effects in a letter detection

task. *Perception and Psychophysics*, **25**, 47-54.

TOMIĆ, T. (1978). Statistička analiza srpskohrvatskog teksta pomoću računara (Statistical analysis of Serbo-Croatian text by computer). *Posebna Izdanja*, **4** (Odeljenje za jezike, Institut za jezike i književnost u Sarajevu), 221-235.

VENEZKY, R. (1967). English orthography: Its graphical structure and its relation to sound. *Reading Research Quarterly*, **2**, 75-105.

VENEZKY, R. (1970). *The structure of English Orthography* (The Hague).

WHALEY, C.P. (1978). Word-nonword classification time. *Journal of Verbal Learning and Verbal Behavior*, **17**, 143-154.

WHEELER, D.D. (1970). Processes in word recognition. *Cognitive Psychology*, **1**, 59-85.

WHITE, M.J. (1977). Identification and categorization in visual search. *Memory and Cognition*, **5**, 648-657.