

# Rapid naming is affected by association but not by syntax

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Three experiments are reported that focused on the grammatical and associative relationship between a single-word context and a to-be-named target in the Serbo-Croatian language. Unlike in studies using the English language, word class need not be violated in order to obtain grammatical incongruity: all word pairs, therefore, can be semantically plausible. Experiment 1 contrasted naming with lexical decision using associative and grammatical priming, a replication of Seidenberg, Waters, Sanders, and Langer's (1984) study. With associative priming, both lexical decision and naming were facilitated significantly, but with grammatical priming, only lexical decision was affected significantly. Heeding observations of West and Stanovich (1986), in Experiment 2 we used stimuli known to produce a robust grammatical congruency effect on lexical decision (130 msec) and a procedure designed to slow naming latencies. Again, no grammatical congruency effect for naming was obtained. Finally, because Experiment 1, which used a row of Xs as the neutral context, showed an associative priming effect on naming pseudowords, Experiment 3 used a neutral context that was linguistic. An associative priming effect was found for words but not for pseudowords. Results were discussed in terms of pre- and postlexical loci of contextual effects.

The influence of contextual information on visual word processing tasks has been found to depend on both the kind of context and the nature of the task. Two tasks—lexical decision and naming—have emerged as necessary converging operations to be considered in any evaluation of context effects, because they appear to be differentially sensitive to pre- and postlexical influences (Forster, 1979; Seidenberg, Waters, Sanders, & Langer, 1984; Stanovich & West, 1983; West & Stanovich, 1982, 1986). This differential sensitivity has important implications for theories of language processing, especially those that assert the modularity of the lexicon. In this regard, Forster's (1979, 1981) can be considered the archetypal model. We provide its details here because they are important to understanding both what is the nature of contextual information that might influence word processing and where that influence will occur.

Forster (1979, 1981) proposed three autonomous levels of processing—lexical, syntactic, and message—arranged

hierarchically. The message processor, which receives input from lexical and syntactic levels, evaluates whether or not a particular letter string (or message) is semantically plausible. The syntactic processor, which receives input only from the lexical level and not from the message processor, assigns a grammatical structure to a message. The lexical processor, which receives input only from feature analysis and not from the other levels, finds meanings (lexical entries) for individual words in the message. In this model, higher level information cannot influence lower order processing. For example, while associative contexts can affect lexical access, syntactic or semantic contexts cannot. Insofar as such contexts have an effect, that effect must be postlexical. Postlexical effects have been construed as coherence checks that bias (positively or negatively) a general problem solver (de Groot, Thomassen, & Hudson, 1982; Forster, 1981; Gurjanov, Lukatela, Moskovljević, Savić, & Turvey, 1985; West & Stanovich, 1986) or a "softly" assembled special-purpose decision making device (Lukatela, Carello, Kostić, & Turvey, 1988; Lukatela, Kostić, Todorović, Carello, & Turvey, 1987).

An interesting feature of syntactic- and message-level context effects is that they seem unavoidable, even when syntactic and message information is seemingly irrelevant to the task. In lexical decision, the decision making device

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needs to know only whether or not a letter string has a lexical entry, yet it is biased by syntactic (Goodman, McClelland, & Gibbs, 1981; Gurjanov, Lukatela, Lukatela, Savić, & Turvey, 1985; Gurjanov, Lukatela, Moskovljević, et al., 1985; Katz, Boyce, Goldstein, & Lukatela, 1987; Lukatela, Kostić, Feldman, & Turvey, 1983; Lukatela et al., 1982; Seidenberg et al., 1984; West & Stanovich, 1986; Wright & Garrett, 1984) and semantic coherence (Forster, 1981; Lukatela et al., 1988; Schwanenflugel & Shoben, 1985; Stanovich & West, 1983; West & Stanovich, 1982).

Returning to the contrast between the two word processing tasks, it has been argued that effects obtained with lexical decision but not naming are postlexical effects and that those obtained with both tasks are lexical effects (Balota & Chumbley, 1985; Seidenberg et al., 1984; West & Stanovich, 1982). It has been argued further that the difference arises because of the logic of the two tasks. In signal detection terminology, lexical decision involves sensitivity and bias; naming—because there is said to be no decision in need of criteria—involves only sensitivity (Seidenberg et al., 1984).

With respect to this conjecture, results from investigations of syntactic influences on lexical decision and naming are not straightforward. A comparison of associative and syntactic priming in lexical decision and naming produced the expected pattern: Associative priming occurred with both tasks, but syntactic priming was observed only in lexical decision (Seidenberg et al., 1984). Targets were preceded by semantically plausible single-word contexts, situations that produce a small syntactic congruency effect (13 msec) in lexical decision (Goodman et al., 1981). In contrast, semantically implausible sentence fragment contexts produce a robust syntactic congruency effect on lexical decision (Wright & Garrett, 1984) and a comparable effect on naming (West & Stanovich, 1986). The effect on naming is diminished and significantly less than the effect on lexical decision, however, when pronunciation latencies are especially fast (West & Stanovich, 1986).

The differences between conditions that have given rise to a grammaticality effect on naming and those that have not include (1) one-word versus sentence fragment contexts, (2) small versus large grammaticality effect on lexical decision, (3) slow versus fast response latencies in naming, and (4) semantically plausible versus implausible situations.

West and Stanovich (1986) implied that differences 1 and 2 are the important ones: syntactic effects with single-word contexts are weak and unstable. However, this is not necessarily the case, as experiments that exploit the inflectional nature of Serbo-Croatian have shown (with grammatical congruency effects of 30 msec to over 100 msec in lexical decision). We suspect that difference 4 is the important one, because it suggests that putative syntactic effects actually may be semantic effects. There are hints of this in the original data of Wright and Garrett (1984). Inspection of their Appendix A (the

stimuli used by West and Stanovich, 1986, as well) reveals sentences that seem reasonable (“In modern Japan elegance is sought in simple things, and this should CONTINUE”) as well as those that are, as intended, “horrendous pragmatically” (“When you buy a car, the owner’s manual will BELIEVE”). These contrasting types of sentence forms were separated by having four independent observers rate each syntactically congruent sentence for how difficult it was to interpret on a scale from 1 to 7. The syntactic effect on lexical decision is substantial with pragmatically implausible sentences (for those rated higher than 3, syntactically congruent sentences averaged 653 msec, and syntactically incongruent sentences averaged 750 msec); however, the effect disappears in relatively plausible (though, perhaps, incomplete) sentences (for those rated 3 or less, syntactically congruent sentences averaged 681 msec and syntactically incongruent sentences averaged 687 msec). Indeed, the small syntactic effect on lexical decision in Seidenberg et al. (1984) may also reflect the combined negative biases from syntactic and message processors (“men-planet” and “whose-swear” are semantically implausible, not simply syntactically incongruent).

This confounding of syntactic and message levels implies that no purely syntactic effects (on lexical decision or naming) have yet been found using English language materials. The experiments to be reported here explored associative and grammatical priming in lexical decision and naming using Serbo-Croatian materials. This inflectional language has an advantage over English in that it does not require that word class be violated in order to obtain grammatical incongruency. For example, possessive adjectives and nouns must agree in gender (masculine, feminine, or neuter), case (e.g., nominative, dative, accusative), and number (singular or plural). When a context and target agree on these dimensions, lexical decision is about 50 msec faster than when they disagree on, say, gender (Gurjanov, Lukatela, Lukatela, et al., 1985). But the syntactic violation does not affect the plausibility of the message (MOJ DOKTOR and MOJA DOKTOR both mean “my doctor,” although the feminine possessive adjective is inappropriate).

If the robustness of the syntactic effect on lexical decision is an indication of the relative likelihood of finding a syntactic effect on naming, then we should replicate the findings of West and Stanovich (1986). If, in contrast, the confounding of syntactic and message manipulations produced the syntactic effects found by Wright and Garrett (1984) and West and Stanovich (1986), and if naming is not sensitive to postlexical effects, then we should expect no effect of syntax on naming. But, in agreement with Seidenberg et al.’s (1984) findings, the lexical effect of associative priming should occur with both tasks.

It should be noted that earlier investigations of lexical priming of naming in Serbo-Croatian are mixed. Two that used university students in Belgrade as subjects failed to find a difference as a function of related and/or unrelated prime words (Frost, Katz, & Bentin, 1987; Katz & Feld-

man, 1983). In contrast, Seidenberg and Vidanović (1985) reported finding a priming effect on naming in Serbo-Croatian using less well educated Yugoslav workers living in Montreal. A more critical difference than education level may be found in the nature of the context-target relationship: Katz and his colleagues used primes and targets that were semantically related (category types and tokens), whereas Seidenberg and Vidanović used those that were associatively related. Lupker (1984) pointed out that semantic priming effects are diminished greatly if the relationship between context and target is strictly semantic and not associative as well. These observations suggest that a strong associative relationship between contexts and targets leads to the most reliable effect on naming. Therefore, we used associative priming.

### EXPERIMENT 1

Seidenberg et al. (1984) intended to identify the loci of associative and syntactic effects by comparing lexical decision and naming. Because their syntactic effect on lexical decision was small and their syntactic manipulation influenced the message level as well, their conclusions must be viewed cautiously. Experiment 1 was a replication of Seidenberg et al.'s (1984) study in that it used a syntactic manipulation that is known to be robust without introducing differences at the message level. Masculine (M) and feminine (F) nouns were preceded by possessive adjectives that either agreed or disagreed in gender (e.g., MOJ DOKTOR, "my doctor," is M-M; MOJA BLUZA, "my blouse," is F-F; MOJ BLUZA is M-F; and MOJA DOKTOR is F-M). The congruous-incongruous comparison was intended to enhance the likelihood that a grammatical effect would be detected (XXX contexts fall in between these extremes [Lukatela et al., 1988]). Associative priming used the same targets preceded by associatively related context words (e.g., BOLNICA-DOKTOR, "hospital-doctor"; KOSTIM-BLUZA, "costume-blouse") or a neutral row of three Xs. The related-XXX comparison has been found to exaggerate associative effects (unrelated word or neutral word contexts fall between these extremes [de Groot et al., 1982; Neely, 1976]). In other words, although grammatically incongruent word contexts and XXX contexts are superficially different, they are similar in that they contribute to large context effects.

#### Method

**Subjects.** One hundred eight high school seniors from the Fifth Belgrade Gymnasium served voluntarily as subjects. None had previous experience with visual processing experiments. For the first 48 subjects, each student was assigned to one of eight subgroups (two counterbalancing groups in each of four experimental conditions) according to his/her order of appearance at the laboratory. The remaining subjects were assigned randomly to one of the two naming conditions.

**Materials.** Eighty nouns of four to seven letters were chosen. Half were masculine and half were feminine. Eighty pseudonouns were generated by changing one letter in the root morpheme of the

words in this set. The replacement was an orthotactically and phonotactically legal letter. For grammatical priming, congruent situations were created by pairing masculine nouns with masculine possessive adjectives (MOJ=my, TVOJ=your [familiar], VAS=your [polite], NJEN=her, NAS=our) and feminine nouns with corresponding feminine possessive adjectives (MOJA, TOVJA, VASA, NJENA, NASA). Incongruent situations were created by exchanging the gender of the possessive adjectives. Sixteen other congruent pairs (8 words and 8 pseudowords) were used for preliminary training of subjects.

For associative priming, associatively related contexts were selected on the basis of a pretest in which a list of 120 words was presented to a group of 25 students enrolled in psychology at the University of Belgrade and 28 high school seniors at the Fifth Belgrade Gymnasium. For each word in the list, the students were asked to write the first 5 words that came to mind. First-, second-, and third-order associates were then presented to another group of 50 subjects from the same population, who also were asked to write the first 5 words that came to mind. Response sheets from both tasks were inspected for symmetrical associates regardless of rank differences (e.g., first-order and third-order, third-order and second-order), and 80 of these were used as the associatively related situations. The pseudowords were paired with associates of the words from which they were derived. An equal number of baseline trials were created by preceding the noun and pseudonoun targets with XXX. Again, 16 other pairs (8 words and 8 pseudowords) were used in training.

**Design.** The major constraint on the design of the experiment was that a given subject never encountered a given word or pseudoword in any of the pairs more than once, but each target word appeared in every condition. This was achieved by using two counterbalancing groups in each of the four experimental conditions: associative context/lexical decision, associative context/naming, grammatical context/lexical decision, and grammatical context/naming. For the first group in each condition, half of the pairs were related and half were not. For the second group, these halves were interchanged.

In the naming conditions, each subject saw 88 words and their derived pseudowords, ordered pseudorandomly (words and corresponding pseudowords were separated by one-half of the list, counterbalanced with respect to which was encountered first). In the lexical decision conditions, each subject saw 84 words and 84 pseudowords, also ordered pseudorandomly. The difference in number arose because 2 of the words were in the Croatian dialect and were uniformly considered nonwords by the Belgrade (Serbian) students. Two other words and corresponding pseudowords were eliminated randomly to balance the groups of stimuli. (These 8 items did not change the pattern of results in the naming condition.) In all, a given subject in the naming conditions saw 44 words with related contexts, 44 words with unrelated contexts, 44 pseudowords with related contexts, and 44 pseudowords with unrelated contexts. A given subject in the lexical decision conditions saw 42 situations of each type.

**Procedure.** A subject sat before the CRT of an Apple IIe computer in a dimly lit room. A fixation point was centered on the screen. On each trial, the subject heard a brief warning signal, after which a context (possessive adjective, associate, or XXX, depending on the condition) appeared for 500 msec centered above the fixation point. After an interstimulus interval of 100 msec, a noun or pseudonoun appeared below the fixation point for 300 msec. All letter strings appeared in uppercase Roman. Intertrial intervals were 2,500 msec. The subjects in the lexical decision conditions were instructed to decide as rapidly as possible whether or not the second stimulus was a word. Decisions were indicated by depressing a telegraph key with both thumbs for a "No" response or by depressing a key slightly further away with both forefingers for a

"Yes" response. In the naming conditions, the subjects were required to pronounce each word or pseudoword as quickly and as distinctly as possible. Pronunciation errors included not initiating the response within the cutoff latency, hesitations after beginning the name, and pronunciations that included a phoneme not specified by the characters in the letter string (because the Serbo-Croatian orthography is shallow [e.g., Frost et al., 1987], only one pronunciation is acceptable for each of the letter strings used). In all conditions, latencies were measured from the onset of the target (in naming, this was accomplished by a voice-operated trigger relay constructed by M. Gurjanov of the Faculty of Electrical Engineering at the University of Belgrade). If the response latency was longer than 1,400 msec, a message appeared on the screen requesting that the subject respond more quickly. That trial was then repeated, but only the first result was included in the analysis. To ensure that subjects were reading the contexts, a message appeared on the screen (every 10 to 20 trials) asking them to report the prime item after the response had been made.

## Results

Latencies in excess of 1,400 msec and less than 250 msec were dropped from the reaction time analysis and included in the error analyses. Each of the four conditions was analyzed separately in a 2 (context)  $\times$  2 (lexicality) analysis of variance (ANOVA) on latencies and errors, using both subjects and stimuli as the error term. Latencies and errors for words and pseudowords are shown in Table 1.

In the subject analysis of lexical decision with associative priming, there was an effect of context [ $F(1,11) = 26.22$ ,  $MSe = 1705.08$ ,  $p < .001$ ], indicating that word primes facilitated lexical decision relative to XXX contexts (785 msec vs. 846 msec). The effect of lexicality [ $F(1,11) = 58.64$ ,  $MSe = 957.36$ ,  $p < .001$ ] indicates that words were accepted faster (782 msec) than pseudowords were rejected (850 msec). The context  $\times$  lexicality interaction [ $F(1,11) = 13.78$ ,  $MSe = 829.93$ ,  $p < .004$ ] indicates that the context effect was larger for word targets (91 msec) than pseudoword targets (30 msec). All of these findings were corroborated in the stimulus analysis: context,  $F(1,150) = 59.37$ ,  $MSe = 4722$ ,  $p < .001$ ; lexicality  $F(1,150) = 79.53$ ,  $MSe = 4829$ ,  $p < .001$ ; and

context  $\times$  lexicality,  $F(1,150) = 15.52$ ,  $MSe = 4722$ ,  $p < .001$ . There were no significant effects in the error analyses.

The subjects analysis of lexical decision with grammatical priming yielded similar effects: Context approached significance [ $F(1,11) = 4.43$ ,  $MSe = 1284.43$ ,  $p < .06$ ], with a difference between grammatically congruent (861 msec) and grammatically incongruent (883 msec) situations (averaged over word and pseudoword targets). Lexicality [ $F(1,11) = 17.26$ ,  $MSe = 2363.48$ ,  $p < .002$ ] again showed acceptance latencies (843 msec) to be shorter than rejection latencies (901 msec). The context  $\times$  lexicality interaction [ $F(1,11) = 16.54$ ,  $MSe = 367.34$ ,  $p < .002$ ] shows a strong grammatical congruency effect on words (44 msec) but none on pseudowords (-1 msec). This difference was confirmed with protected  $t$  tests (Cohen & Cohen, 1975; the error term from the ANOVA is used as the estimate of the variance). The effect for words was significant [ $t(11) = 32.01$ ,  $p < .001$ ], but the effect for pseudowords was not ( $t < 1$ ). Again, these effects were corroborated by the stimulus analysis, where context [ $F(1,150) = 5.67$ ,  $MSe = 5612$ ,  $p < .02$ ] and lexicality [ $F(1,150) = 39.41$ ,  $MSe = 6690$ ,  $p < .001$ ] were both significant, as was the context  $\times$  lexicality interaction [ $F(1,150) = 6.58$ ,  $MSe = 5612$ ,  $p < .01$ ]. Again, the congruency effect was significant for words [ $t(150) = 12.24$ ,  $p < .01$ ], but not for pseudowords ( $t < 1$ ). No main effects were significant in the error analyses. The interaction was significant for subjects [ $F(1,11) = 5.5$ ,  $MSe = 6.72$ ,  $p < .04$ ] and marginal for stimuli [ $F(1,150) = 3.15$ ,  $MSe = 74.15$ ,  $p < .08$ ]. Both subjects and stimuli analyses revealed more errors on word targets in grammatically incongruent contexts [ $t(11) = 5.2$ ,  $p < .04$ ].

In the subjects analysis of naming with associative priming, there was an effect of context [ $F(1,41) = 17.82$ ,  $MSe = 316.84$ ,  $p < .001$ ], indicating that word primes facilitated naming relative to XXX contexts (499 msec vs. 511 msec). The effect of lexicality [ $F(1,41) = 150.93$ ,  $MSe = 339.08$ ,  $p < .001$ ] indicates that words were named faster (487 msec) than pseudowords (522 msec). Their interaction was not significant ( $F < 1$ ). The same results were obtained in the stimulus analysis: context,  $F(1,158) = 7.39$ ,  $MSe = 1482$ ,  $p < .007$ ; lexicality,  $F(1,158) = 50.32$ ,  $MSe = 1957$ ,  $p < .001$ ; and no interaction,  $F < 1$ . There does appear to be a speed-accuracy trade-off with pseudowords, but there were no significant differences in the error analyses.

The subjects analysis of naming with grammatical priming yielded only one significant effect: lexicality [ $F(1,41) = 102.68$ ,  $MSe = 403.5$ ,  $p < .001$ ], with words again being named faster (491 msec) than pseudowords (523 msec). Neither context ( $F < 1$ ) nor the interaction [ $F(1,41) = 1.55$ ,  $MSe = 210.37$ ,  $p > .20$ ] was significant. This was true in the stimulus analysis as well: lexicality was significant [ $F(1,158) = 27.61$ ,  $MSe = 2778$ ,

Table 1  
Mean Response Latencies (RT in msec) and Percent Errors (PE)  
for Lexical Decision and Naming in Experiment 1

Context	Word Targets				Pseudoword Targets			
	Lexical Decision		Naming		Lexical Decision		Naming	
	RT	PE	RT	PE	RT	PE	RT	PE
Associative Priming Condition								
Related	736	2.6	481	2.7	835	3.5	517	3.1
XXX	827	4.2	494	2.5	865	4.8	528	2.3
Grammatical Priming Condition								
Congruous	821	3.7	489	3.2	902	4.6	524	4.0
Incongruous	865	6.1	493	3.5	901	3.5	522	3.3

\*For pseudoword targets, context is related to the word from which the pseudoword was derived.

$p < .001$ ], but context and the interaction were not (both  $F_s < 1$ ). There were no significant differences in the error analysis.

### Discussion

Experiment 1 eliminated two problems engendered by the stimuli used by Seidenberg et al. (1984). Our grammatical congruency effect on lexical decision for word targets was large (44 msec), and none of our situations was implausible at the message level. Nonetheless, the task differences between lexical decision and naming with respect to associative and grammatical priming were replicated. Both tasks showed facilitation with an associative context. This effect was larger in lexical decision (91 msec for words, 30 msec for pseudowords) than naming (13 msec for words, 11 msec for pseudowords), as would be expected with our high proportion of related trials (50%), an aspect that exacerbates this effect in lexical decision (cf. Seidenberg et al., 1984, Experiment 2). Only lexical decision showed an effect of grammatical congruence, even though the sensitivity of the naming condition was increased by having 3.5 times more subjects than the lexical decision condition.

A closer examination of the naming stimuli and data suggest three possibilities for exploration. First, target selection was not restricted with respect to frequency of occurrence. If we contrast the congruency effect for high-frequency (greater than 150 according to Lukić, 1983) and low-frequency (less than 30) words, there is a numerical difference. The congruency effect is 3 msec for 26 low-frequency targets and 11 msec for 26 high-frequency targets. Although the ANOVA on this subset of the data revealed no significant differences, grammaticality approached significance: grammatical congruence,  $F(1,50) = 3.20$ ,  $MSe = 391$ ,  $p < .10$ ; frequency,  $F < 1$ ; frequency  $\times$  congruence,  $F(1,50) = 1.12$ ,  $MSe = 391$ ,  $p < .25$ .

Second, recall that West and Stanovich (1986) found a diminished syntactic effect when naming responses were especially fast. Our subjects averaged less than 500 msec in naming words, whereas those investigators' fast experiments produced an average of 525 msec. However, a comparison of our fastest 14 subjects (a grammatical congruency effect of 6 msec, with an average response of 432 msec) and our slowest 14 subjects (a grammatical congruency effect of 2 msec, with an average response of 561 msec) reveals no difference in support of that contention. Nonetheless, even our slowest subjects named congruent targets at close to 500 msec.

Finally, although the syntactic effect on lexical decision is large relative to that of Seidenberg et al. (1984), it is not large relative to other experiments in the Serbo-Croatian language. In particular, a grammatical congruency effect of 130 msec has been reported using pronouns and inflected verb forms in a lexical decision task (Lukatela et al., 1982). Moreover, in that experiment, a 27-msec grammatical congruency effect was reported on

pseudoverbs (i.e., letter strings created by replacing one letter in the root morpheme, leaving a legal inflected ending): Contexts that were grammatically congruent with the inflection retarded pseudoword rejection relative to contexts that were grammatically incongruent with the inflection (Lukatela et al., 1982). The existence of any grammaticality effect on legally inflected pseudowords, which was not obtained in the present experiment, underscores just how robust the grammatical manipulation can be. It also reinforces the assertion that this is a purely syntactic effect because it is defined over inflections, not semantically loaded systems.<sup>1</sup>

In order to maximize the likelihood of a syntactic effect on naming, these three observations will be used to constrain the stimulus choice and procedure of Experiment 2.

## EXPERIMENT 2

The lexical decision experiment of Lukatela et al. (1982) has the features we needed for our naming experiment. A large syntactic effect was obtained with mid- to high-frequency targets, and the procedure required subjects to lexically evaluate the context as well as the target, which has the effect of slowing the second response. The stimuli and procedure of that experiment were duplicated, therefore, except that the target was named rather than lexically evaluated.

### Method

**Subjects.** Forty psychology students from the University of Belgrade participated in the experiment as one way of fulfilling a course requirement. All had experience with visual processing experiments. A subject was assigned to one of two subgroups according to his/her order of appearance at the laboratory.

**Materials.** The materials and design were identical to those of Lukatela et al. (1982). Briefly, 80 singular verbs (of five or six letters) were selected from the middle-frequency range (Kostić, 1965). These were conjugated in first and second person to produce 160 inflected verbs. A second set of 80 comparable verbs was used to generate 160 legally inflected pseudowords (first and second person) by changing one letter in the stem (e.g., PEVAM, "I sing," and PEVAS, "you sing," were changed to JEVAM and JEVAS, respectively).

Verbs and pseudoverbs (in first or second person) were preceded by the first-person singular pronoun JA, the second-person singular pronoun TI, or a monosyllabic pseudopronoun derived from each of these (essentially first- and second-person pseudopronouns), counterbalanced over lexicality and person of the targets. In total there were 320 pairs, 20 of each combination of 4 context types and 4 target types. A given subject saw 160.

**Design.** A given subject never saw a given verb or pseudoverb (in either inflected form) more than once, but every subject encountered every type of combination. Put differently, each subject saw the same verbs and pseudoverbs as did every other subject, but not necessarily in the same inflected form or preceded by the same pronoun or pseudopronoun type.

**Procedure.** The procedure was the same as in the grammatical priming of naming condition of Experiment 1, with the following exceptions: (1) the subjects made a lexical decision about the pronoun or pseudopronoun context, and this response terminated

its exposure and initiated the presentation of the verb or pseudoverb to be named; (2) if the lexical decision exceeded 1,300 msec, the targets were initiated automatically; and (3) target duration was fixed at 1,300 msec. The remaining data collection techniques and cutoffs were the same. (The original lexical decision experiment of Lukatela et al., 1982, presented stimuli tachistoscopically. In other respects, its procedure was as described here [with lexical decision to the targets]).

## Results

Latencies in excess of 1,300 msec were dropped from the reaction time analysis and included in the error analysis. A 2 (person of target)  $\times$  2 (person of context)  $\times$  2 (lexicality of context) ANOVA was performed on latencies and errors for words and pseudowords. Means are shown in Table 2.

There were no significant differences in the latencies. The important interaction between context person and target person was not even close. For words,  $F(1,39) = 1.42$ ,  $MSe = 1018$ ,  $p > .20$ , and for pseudowords,  $F < 1$ . This interaction also was not apparent in the error analysis (both  $F$ s  $< 1$ ). On words, lexicality of context affected the error rate [ $F(1,39) = 8.48$ ,  $MSe = 318.84$ ,  $p < .01$ ], with more errors on targets preceded by a pseudopronoun (2.7%) than on those preceded by a pronoun (1.9%). This was true of pseudowords as well [ $F(1,39) = 23.64$ ,  $MSe 325.89$ ,  $p < .001$  (pseudopronoun contexts 3.6%, pronoun contexts 2.4%)]. In addition, pseudoword error rates showed an interaction between lexicality of context and person of target [ $F(1,39) = 4.53$ ,  $MSe = 165.7$ ,  $p < .04$ ]; with pronoun contexts, there were more errors on first-person targets (2.6%) than second-person targets (2.2%), but for pseudopronoun contexts, the opposite pattern was found (3.5% and 3.8% for first- and second-person targets, respectively).

## Discussion

Conditions that have produced one of the largest grammatical congruency effects on lexical decision latencies have no influence on naming latencies. Even though naming latencies in Experiment 2 were, on average, 20 msec longer than the fast responses of West and Stanovich's (1986) Experiments 3 and 4 (which showed a grammaticality effect on naming), this extra time still did not promote postlexical grammaticality checks by our subjects. Eliminating low-frequency targets also had no effect.

Before concluding that (1) naming and lexical decision are affected differently by associative and grammatical contexts and (2) the difference is attributable to the dif-

ferential postlexical sensitivity of the two tasks, two puzzling results from Experiment 1 remain to be addressed. First, if naming is not susceptible to postlexical influences, then why would pseudowords be primed by a related context? Associative priming of pseudowords in lexical decision is usually taken as evidence that that task is subject to postlexical influences. Second, previous work in the Serbo-Croatian language has indicated that, because of the straightforward relationship between script and sound, there is a nonlexical route to assembling a name for a letter string (involving grapheme-phoneme correspondence [GPC] rules). This argument has been buttressed by the finding that naming is immune to the lexical influence of semantic priming (Frost et al., 1987; Katz & Feldman, 1983). How, then, can naming in Serbo-Croatian be susceptible to the lexical influence of associative priming?

With respect to the first puzzle, the priming of pseudowords, there appears to be a speed-accuracy trade-off in Experiment 1 that may mitigate this finding somewhat. However, in the absence of significant differences in the error analysis, this cannot be asserted. Another possibility involves the use of a row of Xs as the neutral context. Although our assumption was that this would simply enhance the likelihood that an associative priming effect would be found (given the reported inhibitory influence of this sort of prime [e.g., de Groot et al., 1982]), it may have changed the effect to one of "linguistic priming." That is, preceding a target with linguistic material of any sort may engage the linguistic machinery, resulting in facilitation relative to a nonlinguistic context. This would be true of the word targets, as well, however. It remains to be seen, therefore, whether or not the second puzzle—associative priming of naming in (educated speakers of) Serbo-Croatian—exists. Experiment 3 tested this by using unrelated primes instead of the row of Xs.

## EXPERIMENT 3

### Method

**Subjects.** Fifty-two psychology students from the University of Belgrade participated in the experiment as one way of fulfilling a course requirement. All had experience with visual processing experiments. A subject was assigned to one of two subgroups according to his/her order of appearance at the laboratory.

**Materials.** One hundred twelve words of four to seven letters were chosen. All were of the consonant-vowel or vowel-consonant-vowel-consonant type. Selection was not restricted with respect to frequency or phonological uniqueness. Associates were determined as in Experiment 1. Pseudowords were generated by changing one consonant in each of the target words. When pseudowords were preceded by a related prime, it was an associate of the word from which the pseudoword was derived. Unrelated primes were also defined relative to the source word.

**Design.** There were four conditions: related and unrelated contexts for word and pseudoword targets. Counterbalancing of these conditions ensured that every subject encountered every condition, every context, and every target; every target appeared in every condition; not every subject saw every target in the same conditions.

**Procedure.** The procedure was the same as for the associative priming of naming condition of Experiment 1, except that unrelated words replaced the row of Xs.

Table 2

Naming Latency (RT in msec) and Percent Error (PE) to Verbs and Pseudoverbs When Primed by Grammatically Congruent or Incongruent Pronouns or Pseudopronouns in Experiment 2

Context	Target			
	Verbs		Pseudoverbs	
	RT	PE	RT	PE
Congruous Pronoun	536	1.9	546	2.6
Incongruous Pronoun	542	2.0	550	2.2
Pseudopronoun	540	2.7	553	3.6

Table 3  
Mean Naming Latencies (RT in msec) and Errors (E in Percent)  
for Words and Pseudowords in Experiment 3

Lexicality	Related		Unrelated	
	RT	E	RT	E
Words	616	6.0	642	6.9
Pseudowords	684	14.7	685	15.7

## Results

Latencies longer than 1,400 msec and shorter than 300 msec were dropped from the reaction time analysis and included in the error analyses. Context  $\times$  lexicality ( $2 \times 2$ ) ANOVAs on latencies and errors, using both subjects and stimuli as the error term, were performed. Latencies and errors for words and pseudowords are shown in Table 3. In the subject analysis, both effects and the interaction were significant: lexicality,  $F(1,51) = 122.03$ ,  $MSe = 161501.76$ ,  $p < .001$ , with words averaging 629 msec and pseudowords averaging 684.5 msec; context,  $F(1,51) = 23.76$ ,  $MSe = 9197.04$ ,  $p < .001$ , with a difference between associated and unassociated contexts of 13 msec; and context  $\times$  lexicality,  $F(1,51) = 12.68$ ,  $MSe = 9000.13$ ,  $p > .001$ , with a priming effect of 26.5 msec for words but only 1 msec for pseudowords. Planned comparisons of the means in the interaction indicated that only the effect on words was a significant difference [ $F(1,51) = 23.07$ ,  $p < .001$ ]. In the stimulus analysis, the main effects were significant: lexicality,  $F(1,110) = 23.19$ ,  $MSe = 203403.88$ ,  $p < .001$ ; and context,  $F(1,110) = 5.02$ ,  $MSe = 41169.71$ ,  $p < .03$ . Although the interaction was not significant ( $F < 1$ ), planned comparisons of the means revealed an effect on words [ $F(1,55) = 6.33$ ,  $p < .015$ ], but not on pseudowords [ $F(1,55) = 1.75$ ,  $p > .15$ ]. In the error analyses, only the effect of lexicality was significant. For subjects,  $F(1,51) = 77.69$ ,  $MSe = 3925.2$ ,  $p < .001$ ; for stimuli,  $F(1,51) = 36.79$ ,  $MSe = 7104.82$ ,  $p < .001$ .

## Discussion

Unlike Experiment 1, there was no hint of a speed-accuracy trade-off, even though the error rate was rather high. (This was due to the presence of some phonologically ambiguous letter strings [see General Discussion]. These letter strings showed the same pattern of results as the phonologically unique strings.) An associative priming effect was found in naming for words, but not for pseudowords. It appears that the context effect on pseudowords in Experiment 1 was an artifact of the nonlinguistic XXX contexts, of the speed-accuracy trade-off, or of both.

## GENERAL DISCUSSION

How is a lexical priming effect to be reconciled with the claim that, in the Serbo-Croatian language, there is a nonlexical, grapheme-phoneme correspondence (GPC)

route to assembling a name for a letter string? Relatedly, if GPC rules can be used, then why should pseudowords take longer to name than words? The basic argument is that the shallow orthography demands that the phonological route to the lexicon is nonoptional, that is, a name for a letter string is assembled prelexically using GPC rules (e.g., Feldman, 1981, 1983; Feldman, Lukatela, & Turvey, 1985; Turvey, Feldman, & Lukatela, 1984). However, there must be a second automatic process in which the name thus assembled is looked up and confirmed in the lexicon. The rationale for requiring both assembling and confirming processes derives from two other related features of the Serbo-Croatian language. First, there is not one shallow orthography, but two. The spoken language can be transcribed in either the Roman alphabet or the Cyrillic alphabet (e.g., /bluza/ "blouse" can be written BLUZA or БЛУЗА, respectively). For each, a given grapheme has only one pronunciation, and there are no silent or doubled letters. Second, the two alphabets are largely distinct, but do share some letters. Seven of these are common letters; they are pronounced the same way in both alphabets. Four of the shared letters are ambiguous: a given grapheme (e.g., B) is pronounced one way if read as Roman (/b/) and a different way if read as Cyrillic (/v/).

These so-called phonologically ambiguous letters are not unusual, and words that contain them are common. They do have interesting effects in psycholinguistic experiments, however. Namely, lexical decision and naming are both slowed, and errors are increased, for phonologically ambiguous words (BABA, "grandma") relative to their unambiguous counterparts (БАБА). Such findings (e.g., Feldman, 1981; Lukatela, Popadić, Ognjenović, & Turvey, 1980) suggest that the phonological route to the lexicon is automatic. Notice, however, that for a phonologically ambiguous letter string, GPC rules would assemble more than one pronunciation. There would also have to be a lexical look-up of each of the alternatives in order to confirm which pronunciation was correct. Since the process is automatic, all letter strings (phonologically unique and ambiguous, words and pseudowords) are subjected to lexical look-up. The suggestion that two automatic processes are involved in naming, one prelexical and one lexical, would account for phonological ambiguity effects, lexicality effects, and lexical context effects. The existence of lexical involvement does not contravene prelexical phonology.

The framework laid out by Seidenberg et al. (1984) is supported by the present results. When grammatical violations do not simultaneously violate message plausibility, naming appears to be immune to the kinds of automatic, postlexical coherence checks that influence lexical decision. Lexical decision should be susceptible to postlexical influences, such as syntactic congruity checks, because, as characterized by Seidenberg et al. (1984), it is a signal detection task. In contrast, their characterization of naming as a task that involves no overt biasable decision means that it should be susceptible to lexical in-

fluences only. This explanation also accommodates evidence for the influence of message information on lexical decision. Message-level effects on naming are troublesome, however, because of the proposed hierarchical structure of the language processor. That is, if naming is not influenced by the lower level syntactic processor, then it should not be influenced by the higher level message processor. A return to the arguments of Stanovich and West (1983), however, reveals a logic that avoids this logical conundrum. They cite evidence of the persistence of spreading activation—a lexical process—over time (e.g., Blank & Foss, 1978; Warren, 1972) and despite the interposition of words between the prime and target (Blank, 1980; Blank & Foss, 1978; Brown & Block, 1980; Davelaar & Coltheart, 1975; E. F. Loftus, 1973; G. R. Loftus & E. F. Loftus, 1974; Schvaneveldt & Meyer, 1973). In light of these observations, they noted, “We do not wish to argue that spreading activation in sentences comes only from individual words considered singly. It is possible that spreading activation also results from semantic states induced by combinations of words” (Stanovich & West, 1983, p. 30). In other words, they suggested that even sentences can be lexical contexts, an interpretation that preserves the distinction between lexical decision and naming with respect to their differential sensitivity to postlexical effects.

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## NOTE

1. Although it is assumed that pseudowords have no lexical entry, there is evidence that some pseudowords derived from real words may access the lexical entry of the source words (e.g., Martin, 1982; but see Chambers, 1979). Of course, this would affect syntactically congruent and incongruent situations to the same extent.

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