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Grammatical Priming of Inflected Nouns by the Gender of Possessive Adjectives

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Two experiments examined the effect on lexical decision times for inflected Serbo-Croatian nouns when the nouns were preceded by possessive adjectives (my, your, our). For any given pairing the possessive adjective and the noun agreed always in number (singular) and case (nominative) but only agreed half of the time in gender (masculine or feminine). Lexical decisions were faster when the noun targets were of the same gender as their primes. This gender congruency/incongruency effect was shown to hold whether the inflections of the adjective and noun were the same (as is the case for typical Serbo-Croatian nouns) or different (as is the case for atypical Serbo-Croatian nouns). The results are discussed in terms of a postlexical influence of grammatical processing on the recognition of individual words.

Priming is a term referring to the influence of one stimulus upon the processing of another. Most experiments on priming with word stimuli have considered words that are associatively related. Where lexical decision latency is the measure of processing time it has been shown that processing is more rapid when a word is preceded by an associate compared with when it is preceded by a nonassociate (Lupker, 1984). Recently other relations between and among words have come under examination. Goodman, McClelland, and Gibbs (1981) asked whether lexical decision is speeded when successive words are instances of word types that ordinarily occur in succession in the language. These authors found that when two words were syntactically legal (e.g., men swear) the target word was responded to slightly but significantly faster than when the two words were syntactically illegal (e.g., whose swear). Wright and Garrett (1984) used fragments of sentences as the priming context. They found that the grammatical structure of the incomplete sentence affected the lexical decision time for a target word that followed it. For example, modal verb contexts preceding main verb targets and preposition contexts preceding noun targets yielded shorter decision latencies than the contrary pairings (that is, modal-noun and preposition-verb).

English uses word order as its major syntactical device. A language like Serbo-Croatian exploits inflection as its primary means of conveying grammatical information. Experiments on syntactic or grammatical priming in Serbo-Croatian have preserved the ordinary word-type adjacencies of the language. The grammatical violations have been introduced at the level of inflected morphemes. For example, Gurjanov, Lukatela, Moskovljević, Savić, and Turvey (1985) paired adjectives and nouns in a lexical decision task. Grammatical agreement requires that the two words be of the same number, case, and gender. This agreement is to be found at the level of the inflectional morphemes that are suffixed to the adjective and noun stems. Gurjanov et al. (1985) violated case agreement and found that lexical decision times for the noun targets were

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Dr. M. Gurjanov died in August, 1983. "Gura" has been a central figure in this research program from its inception in 1973. Without his contribution to the designing and analyzing of experiments, programming the computer, and building apparatus, very little would have been achieved. Without his consistently good-humored nature to buoy up those around him, doing research would have been a much less pleasant task. His presence will be sadly missed.

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slower than when the paired words were in full agreement. In another experiment with nouns, Lukatela, Kostić, Feldman, and Turvey (1983) observed slower decision times when the noun's inflection was appropriate for a preceding preposition than when it was inappropriate. And in an experiment with verb targets by Lukatela et al. (1982), lexical decisions were found to be faster when the preceding personal pronoun agreed in person than when it disagreed in person.

How are these various instances of syntactic influences on lexical decision to be understood? Where the context for a target word in the lexical decision task is an associate the expediting of lexical decision is often described as due to an automatic, intralexical process. This process is not consciously directed. It is simply a consequence of the way in which the lexical memory is organized (Collins & Loftus, 1975; Forster, 1979). The context mechanically increases the activation level of the target's location in memory prior to the processing of the target. This fast mechanical priming is generally said to be accompanied by a slower, attentional priming. Here the idea is that the context can induce a directing of the focus of attention to a particular region of the internal lexicon (Neely, 1977; Posner & Snyder, 1975). Following a distinction suggested by Seidenberg, Tanenhaus, Leiman, and Bienkowski (1982), contexts that include an associate or semantic relative and which allow, in principle, the foregoing priming processes are termed *priming contexts.* A priming context contrasts with the context under investigation in the present article, namely, a minimal grammatical context. A context of this latter type, referred to as "nonpriming" by Seidenberg et al. (1982), does not appear to precipitate automatic spreading activation (Lukatela et al., 1982). The difference in lexical decision times that accompanies the syntactic congruency/syntactic incongruency contrast seems to be due to postlexical processes rather than lexical processes (Seidenberg, Waters, Sanders, & Langer, 1984). The important point to be underscored is that lexical decision is a complex operation. The accessing of the context's and of the target's representations in the internal lexicon is but one component process. Other processes might include (a) recognizing the grammatical relation between context and target and (b) assigning a meaning to the context–target structure (cf. deGroot, Thomassen, & Hudson, 1982; Forster, 1979, 1982; West & Stanovich, 1982). If these postlexical processes are completed before the internal deadline for emitting a lexical decision they may influence positively (to shorten) or negatively (to lengthen) the response latency (West & Stanovich, 1982).

The present experiments extend the aforementioned studies on the grammatical priming of nouns. They examine the situation in which nouns agree or disagree in gender with the preceding word, a possessive adjective (in English, my, your, our, etc.). They also examine the sensitivity of the nominative singular case to priming. The preposition priming study of Lukatela et al. (1983) did not address this issue directly because the nominative singular case of Serbo-Croatian nouns is not governed by a preposition. The study by Gurjanov et al. (1985) did address this issue directly and yielded a negative result: decision times for nouns in the nominative singular case were unaffected by case agreement with preceding adjectives. This issue of the priming sensitivity of the nominative singular case of nouns is important, given the demonstration that this case plays a central role in the organization of the inflected forms of a noun in the internal lexicon (Lukatela, Gligorijević, Kostić, & Turvey, 1980). Although the various cases occur with different frequencies the evidence suggests that speed of lexical access is indifferent to case frequency. The nominative singular is accessed fastest with the different oblique cases accessed at roughly the same speed.

The question posed is whether the privileged lexical status of the nominative singular is associated with a general insensitivity to grammatic context. Is it possible that case agreement and gender agreement are not of equal significance? If they are not then failure to find an effect of agreement in case (Gurjanov et al., 1985) may not extend to agreement of gender. To anticipate, the experimental outcome is that gender agreement does affect the processing of nouns in the nominative singular.

Experiment 1

The lexical decision time for any given target noun in the nominative singular form was measured in two contexts—one in which it was preceded by a possessive adjective in the nominative singular form and one in which it was preceded by a visually similar pseudopossessive adjective. For one half of the noun targets the possessive adjective agreed in gender. It was expected that if gender agreement influenced the processing of nominative singular noun forms, then gender agreement would result in faster decisions than gender disagreement.

The majority of Serbo-Croatian masculine nouns in the nominative singular case end in a consonant. In comparison, the majority of feminine nouns in the nominative singular end in A and the majority of neuter nouns end in either O or E. Some masculine nouns in the nominative singular, however, end in A. There are some feminine nouns in the nominative singular that end in a consonant. In the first experiment only typical masculine and feminine nouns were used. (In the second experiment both the typical and atypical types are examined.)

Method

Subjects. Nineteen students from the Department of Psychology, University of Belgrade, received academic credit for participation in the experiment.

Materials. Letter strings of uppercase letters were typed with an IBM Selectric Typewriter. The letter strings were used to prepare black on white slides.

Two types of slides were constructed. In one type, the letter string was arranged horizontally in the upper half of a 35-mm slide and, in the other type, letters of the same kind were arranged horizontally in the lower half of a 35-mm slide. Letter strings in the first type of slides were always possessive adjectives in nominative singular form (or their pseudoword analogues), and letter strings in the second type of slide were always ordinary nouns in nominative singular form (or their pseudoword analogues). Altogether, there were 144 *possessive adjective* stimuli and 144 *noun* stimuli with each set evenly divided into words and pseudowords.

The 36 nouns were selected from the middle frequency range of a corpus of one million Serbo-Croatian words (Kostić, 1965). Half of the nouns were masculine and half of the nouns were feminine. A different set of 36 nouns (18 masculine and 18 feminine) of the same frequency was used to generate the pseudonouns. This was done by simply changing one letter in the root morpheme. The replacement was an orthotactically and phonotactically legal letter. Importantly, all nouns (words and pseudowords) were five letters in length and consisted of two syllables. Thirty-six possessive adjective stimuli were possessive adjectives in the nominative singular form of the masculine gender: 12 were the first person singular (MOJ = my); 12 were the second person singular (TVOJ = your); and 12 were the first person plural (NAS = our). The other 36 possessive adjective stimuli were the same possessive adjectives in the same case and in the same proportion but of the feminine gender (MOJA, TVOJA, and NASA). In addition to these 72 possessive adjective stimuli another 72 possessive adjective stimuli were constructed with the pseudoword analogues of the three masculine and feminine possessive adjectives, namely, MEJ, TLOJ, LAS, MEJA, TLOJA, LASA.

In total, a subject was presented 144 pairs of stimuli in the experimental session. Sixteen other different pairs of stimuli were used for the preliminary training of subjects.

Design. Each noun was presented two times to a given subject. On the two occasions a noun was presented, it was preceded by a possessive adjective on one occasion and by a pseudopossessive adjective on the other occasion. Importantly, between the first and second presentation of a given noun there were always 71 presentations of other pairs. This constraint on the design of the experiment meant that the 36 nouns and the 36 pseudonouns that were exposed in a pseudorandom order in the first half of each experimental session were exposed in the same order in the second half of the session. However, the priming stimuli in the first and second half of the session were mutually interchanged. Those nouns and pseudonouns, that in the first half of the session were preceded by possessive adjectives, were preceded in the second half by the corresponding pseudopossessive adjectives and vice versa. Hence, a given subject never experienced a given pair of stimuli more than once.

As noted, for any given subject a target noun appeared only twice with one appearance preceded by a pseudopossessive adjective. The other appearance was preceded by a possessive adjective. The possessive adjective context could either agree or disagree in gender with the noun. That is, if the noun were masculine then the preceding possessive adjective could be either masculine or feminine. Consequently, for a given subject, the nouns that occurred in an appropriate possessive adjective context were different from the nouns that occurred in an inappropriate possessive adjective context. In summarizing the data in Table 1 this fact that different word sets comprised the appropriate and inappropriate pairings is marked by the use of two exemplary masculine nouns, LONAC and SAPUN, and two exemplary feminine nouns, TABLA and PTICA. There is a further feature of the design to be remarked on. If a target noun, say, LONAC, was preceded by a possessive adjective of the proper gender, say, MOJ, on one of its appearances, then it was preceded by a visually similar pseudopossessive adjective, say, MEJ, on the other appearance. Similarly if LONAC was preceded by the inappropriate context MOJA on one appearance it was preceded by the pseudopossessive adjective MEJA on the other. The design permitted, therefore, the direct comparison within a subject of lexical decision times to the same word in two different contexts—one in which the prime agreed or disagreed grammatically and one in which the prime was a pseudoword.

To reiterate, a given subject saw 144 different pairs of stimuli: one quarter of the 144 trials consisted of possessive adjective–noun pairs (half of which agreed and half of which disagreed in gender), one quarter consisted of pseudopossessive adjective–noun pairs, one quarter consisted of possessive adjective–pseudonoun pairs and one quarter consisted of pseudopossessive adjectives–pseudonoun pairs. The presentation order was pseudorandom.

Procedure. On each trial, two slides were presented. The subjects' task was to decide as rapidly as possible whether the letter string contained in a slide was a word. Each slide was exposed in one channel of a three-channel tahistoscope (Scientific prototype Model GB) illuminated at 10.3 cd/m^2. Both hands were used in responding to the stimuli. Both thumbs were placed on a telegraph key close to the subject, and both forefingers on another telegraph key 2 in. further away. The closer key was depressed for a *no* response (the string of letters was not a word); and the farther key was depressed for a *yes* response (the string of letters was a word).

Latency was measured from the onset of a slide. The subject's response to the first slide terminated its duration and initiated the second slide (at effectively a delay of 0 ms) unless the latency exceeded 1,300 ms in which case the second slide was initiated automatically. The duration of the second slide, unlike that of the first, was fixed at 1,300 ms.

Table 1
Lexical Decision Times for Examples of Masculine and Feminine Nouns Primed by Real and Pseudo Possessive Adjectives

Prime inflection	Noun gender: Masculine	Noun gender: Feminine
Possessive adjective		
Masculine (∅)		
Mean reaction time	608	665
SD	41	39
Noun example	LONAC	PTICA
Feminine (A)		
Mean reaction time	672	593
SD	27	36
Noun example	SAPUN	TABLA
Pseudo Possessive adjective		
Masculine (∅)		
Mean reaction time	653	640
SD	40	36
Noun example	LONAC	PTICA
Feminine (A)		
Mean reaction time	623	614
SD	42	27
Noun example	SAPUN	TABLA

Results

A mean reaction time was computed for each subject on each type of word pair. Latencies shorter than 300 ms and longer than 1,300 ms were excluded as were latencies associated with incorrect responses. The total exclusions did not exceed 1.4% of all responses. The mean latencies for the primes, namely, masculine possessive adjective (e.g., MOJ), feminine possessive adjective (e.g., MOJA), pseudomasculine possessive adjective (e.g., MEJ), and pseudofeminine possessive adjective (e.g., MEJA) were: 542 ms, 543 ms, 638 ms, and 637 ms, respectively.

Because of the design of the experiment, a subject saw any given masculine noun in the nominative singular, for example, LONAC, preceded once by a masculine possessive adjective in nominative singular, for example, MOJ, and preceded once by a mutated version of that same masculine possessive adjective, namely, MEJ. Likewise, the subject saw any given feminine noun in the nominative singular, for example, PTICA, preceded once by MOJA and once by MEJA. The same arrangement was true for the incongruent pairings: MOJA SAPUN with MEJA SAPUN for a masculine noun, and MOJ TABLA with MEJ TABLA for a feminine noun. These relations and comparisons are captured in Table 1.

Only effects that were significant by both the analysis based on subject means and the analysis based on item means are reported. The question of major interest is whether lexical decision times were affected by the grammatical relation between the prime and the target. This effect, if it exists, should be found in the two-way interaction between target gender and prime inflection and the three-way interaction among target gender, prime inflection, and lexicality. Both interactions proved to be significant, $F(1, 18) = 74.93$, $MS_e = 641$, $p < .001$, and $F(1, 18) = 52.43$, $MS_e = 877$, $p < .001$, by the subject analysis; and $F(1, 32) = 17.18$, $MS_e = 19{,}220$, $p < .001$, and $F(1, 32) = 15.68$, $MS_e = 21{,}794$, $p < .001$, by the item analysis. Also significant was the main effect of prime inflection, $F(1, 18) = 19.79$, $MS_e = 291$, $p < .001$, and $F(1, 32) = 4.10$, $MS_e = 4{,}591$, $p < .05$, by the subjects and items analyses, respectively. On the average, lexical decisions following the uninflected primes (e.g., MOJ, MEJ) were slower than those following the inflected primes (e.g., MOJA, MEJA): 642 ms versus 625 ms.

The analysis supports the hypothesis that lexical decision on a noun in the minimal grammatical context provided by a possessive adjective depends on whether or not the noun and possessive adjective agree in gender. For masculine nouns the difference between the inappropriate pairing and the appropriate pairing was 64 ms; for feminine nouns it was 72 ms. These magnitudes are considerably larger than the inappropriate–appropriate difference reported by Goodman et al. (1983). Comparisons of English word sequences such as "men swear" (appropriate) and "whose swears" (inappropriate) yielded small differences of 19 ms (Experiment 1) and 13 ms (Experiment 2).

The grammatical congruent–grammatical incongruent contrast is a reliable measure of grammatical priming. Less reliable but of larger theoretical importance is the measure of grammatical priming that divides the congruency effect into facilitative and inhibitory components. This division rests on the availability of a suitable baseline. In the present experiment nouns following pseudowords provide the baseline. What is missing, however, is an independent evaluation of the effect of pseudowords on lexical decision. Another weakness of the current baseline is that a pseudopossessive adjective–noun sequence involves a negative response followed by a positive response, raising the possibility of an inhibitory influence on the noun decision-making process. The analysis that follows should be interpreted with these caveats in mind.

As just noted, because of the design of the experiment it is possible to make a within-subjects comparison of a noun with itself in two different contexts, namely, those of possessive adjective and pseudopossessive adjective. Facilitation of lexical decision is here defined operationally by a significant positive difference between pairs of type MOJ LONAC (congruent prime) and MEJ LONAC (nonsense prime), or MOJA PTICA (congruent prime) and MEJA PTICA (nonsense prime), and inhibition of lexical decision is defined by a significant negative difference between pairs of type MOJA SAPUN (incongruent prime) and MEJA SAPUN (nonsense prime), or MOJ TABLA (incongruent prime) and MEJ TABLA (nonsense prime). Protected t tests [Cohen & Cohen, 1975; the error term from the analysis of variance (ANOVA) is used as the estimate of the variance] on subject means revealed that there was facilitation: $t(18) = 4.79$, $p < .001$, and $t(18) = 2.29$, $p < .05$, for the masculine (LONAC) and feminine (PTICA) situations, respectively; and that there was inhibition, $t(18) = 4.49$, $p < .001$, and $t(18) = 2.50$, $p < .05$, for the masculine (SAPUN) and feminine (TABLA) situations, respectively. These outcomes were nearly corroborated in full by protected t tests on item means: $t(32) = 3.49$, $p < .001$, and $t(32) = 1.75$, $p < .05$, for the masculine (LONAC) and feminine (PTICA) situations, respectively; $t(32) = 3.72$, $p < .001$, and $t(32) = 1.59$, $p > .05$. for the masculine (SAPUN) and feminine (TABLA) situations, respectively.

An ANOVA conducted on the pseudonoun data revealed no main effects or interactions.

Experiment 2

The inflectional morphemes of a masculine possessive adjective in nominative singular and a typical masculine noun in nominative singular are identical, that is, Ø. Similarly, the inflectional morphemes of a feminine possessive adjective in nominative singular and a typical feminine noun in nominative singular are identical, that is, A. The second experiment examines the contribution of this identity in inflectional morphemes to the gender congruency/incongruency effect observed in Experiment 1.

As noted earlier, there are (very few) masculine nouns that end in A in the nominative singular and (relatively more) feminine nouns that end in Ø in the nominative singular. It is possible, therefore, to have a possessive adjective and noun that agree in nominative singular case and in gender but which do not share the same inflected ending, for example, MOJ DEDA (my grandfather), where both words are masculine nominative singular, and MOJA MATER (my mother), where both words are feminine nominative singular. The second experiment exploits pairs of the preceding kind along with pairs constructed, as before, from typical masculine and feminine nouns, for example, MOJ LONAC and MOJA PTICA. If the gender congruency/incongruency effect is not tied to the visual or linguistic identity of the prime and target suffixes, then the effect should hold for possessive adjective–noun pairs constructed with atypical nouns as it does for such pairs constructed with typical nouns. If MOJ LONAC is faster than MOJA LONAC, then MOJ DEDA should be faster than MOJA DEDA. The latter observation would rule out the hypothesis that the effect obtained in the first experiment was due to dimensions of visual similarity rather than grammatical similarity.

The design of the second experiment differed from that of the first. In the second experiment, unlike the first, no noun or pseudonoun target was repeated in the sequence of prime–target pairs seen by a subject. In the second experiment, unlike the first, the nouns preceded by congruent possessive adjectives were also the nouns preceded by incongruent possessive adjectives. This was achieved by a between-subjects manipulation. Where one group of subjects saw a given noun preceded by a grammatically appropriate prime, another group of subjects saw the same noun preceded by a grammatically inappropriate prime. The analysis of the experiment focuses on the grammatical congruency/grammatical incongruency effect. What few merits the analysis into facilitation and inhibition effects might have had in the first experiment, given its within-subjects comparison of a target noun preceded by a word prime and a pseudoword prime, were reduced further by the between-subjects design of the second experiment. Consequently, no attempts were made in the second experiment to quantify facilitation and inhibition.

Method

Subjects. Fifty-two students from the Department of Psychology, University of Belgrade, received academic credit for participation in the experiment. A subject was assigned to one of four subgroups according to the subjects' appearance at the laboratory, for a total of 13 subjects per subgroup. None of the subjects had participated in Experiment 1.

Materials. The stimuli were of the same physical appearance as in Experiment 1. Altogether, there were constructed 128 possessive adjective stimuli and 128 noun stimuli, with each set evenly divided into words and pseudowords. The 64 real possessive adjective stimuli represented the possessive adjectives MOJ, MOJA (my), and TVOJ, TVOJA (your). The 64 pseudopossessive adjective stimuli were derived from the possessive adjectives by replacement of a consonant or a vowel (MEJ, MEJA, MOS, MOSA, FOJ, FOJA, KVOJ, KVOJA, TVOK, TVOKA, TVEJ, TVEJA).

Thirty-two of the nouns in Experiment 2 were similar to those used in Experiment 1—there were 16 typical masculine nouns and 16 typical feminine nouns. In comparison to Experiment 1 an additional set of 32 atypical nouns was also used: 16 masculine nouns ending in the vowel A and 16 feminine nouns ending in a consonant. The 64 pseudonouns were generated from these typical and atypical nouns by replacing the initial or middle consonant by another consonant of same phonemic class. Consequently, 32 pseudonouns ended in a consonant and 32 pseudonouns ended in A.

In total, there were 512 different pairs of stimuli of which a given subject saw 128 pairs. Thirty-two other pairs of stimuli were used for the preliminary training of subjects.

Design. The constraint of the design of the experiment was that a given subject never experienced a given noun or pseudonoun more than once.

As mentioned, a given subject saw 128 different pairs of stimuli. Each subject saw the same nouns and pseudonouns as every other subject but not preceded by the same possessive adjective or pseudopossessive adjective type. Consider, for example, the masculine noun LONAC. In one group of subjects this noun was preceded by a possessive adjective in the same case, number, and gender (e.g., MOJ); in a second group it was preceded by a possessive adjective of the same case and number but of a different gender (e.g., MOJA); in a third group it was preceded by a pseudoword visually similar to the congruent prime (e.g., MEJ or MOJ or FOJ); and in a fourth group it was preceded by a pseudoword visually similar to the incongruent prime (e.g., MEJA or MOJA or FOJA). In one half of the 128 trials the second stimulus in a pair was a noun, and in the other half the second stimulus was a pseudonoun. In one half of the 32 possessive adjective–noun trials a given subject saw 8 typical masculine and 8 typical feminine nouns. There was a similar division for the 32 pseudopossessive adjective–noun trials, the 32 possessive adjective–pseudonoun trials, and the 32 pseudopossessive adjective–pseudonoun trials. Within each combination gender-congruent possessive adjectives and gender-incongruent possessive adjectives appeared equally often.

Procedure. The procedure was the same as in Experiment 1.

Results

A mean reaction time was computed for each subject in each of the four groups. The criteria for excluding responses were the same as in Experiment 1. Approximately 3.5% of all responses were excluded from the analysis by these criteria.

The first question to be addressed is whether the results of the first experiment, which were obtained with typical masculine and feminine nouns, were replicated in the second experiment. Table 2 presents the data for typical masculine and feminine nouns as a function of prime lexicality and prime inflection. A Group × Prime Lexicality × Target Gender × Prime Inflection ANOVA suggests that the outcome of Experiment 2 was very similar to that of Experiment 1: Target gender was significant, $F(1, 48) = 15.69$, $MS_e = 2{,}610$, $p < .001$; Target Gender × Prime Inflection was significant, $F(1, 48) = 20.53$, $MS_e = 4{,}534$, $p < .001$; and Target Gender × Prime Inflection × Prime Lexicality was significant, $F(1, 48) = 30.47$,

Table 2
Lexical Decision Times and Error Rates for Typical Masculine and Feminine Nouns as a Function of Prime Lexicality and Prime Inflection

	Noun gender (typical)	
Prime inflection	Masculine (Ø)	Feminine (A)
Possessive adjective		
Masculine (Ø)		
Mean reaction time	657	687
SD	93	92
% correct responses	1.4	2.4
Feminine (A)		
Mean reaction time	717	636
SD	112	79
% correct responses	4.8	0.50
Pseudo Possessive adjective		
Masculine (Ø)		
Mean reaction time	670	661
SD	84	91
% correct responses	5.8	1.4
Feminine (A)		
Mean reaction time	666	647
SD	80	73
% correct responses	4.3	1.9

MS_e = 2,232, $p < .001$. Although the main effect of groups was not significant, there were significant interactions involving groups: Group × Prime Inflection, $F(3, 48) = 13.66$, MS_e = 2,222, $p < .001$; Group × Prime Lexicality, $F(3, 48) = 5.57$, MS_e = 5,670, $p < .01$; Group × Prime Inflection × Prime Lexicality, $F(3, 48) = 11.30$, MS_e = 1,958, $p < .001$; and the four-way interaction. These interactions identify the differences in the pairs of stimuli assigned to the groups.

As with Experiment 1 it can be claimed that lexical decision times for target nouns of the typical type depended on whether the inflected ending of the prime was consistent with the gender of the noun. This dependency is greater for word–word pairs than for pseudoword–word pairs. Protected *t* tests confirmed the difference between congruent word–word pairs and incongruent word–word pairs for the masculine nouns, $t(48) = 6.49$, $p < .001$, and between congruent word–word pairs and incongruent word–word pairs for the feminine nouns, $t(48) = 5.52$, $p < .001$. However, neither the masculine nor the feminine comparison was significant for the pseudoword–word pairs.

Is the gender congruency/incongruency effect exhibited by possessive adjective–noun pairs constructed with atypical nouns? Table 3 presents the data for the atypical masculine and feminine nouns as a function of prime lexicality and prime inflection. Comparison of Table 3 with Table 2 suggests a similar, though not identical, pattern of results. An ANOVA conducted over the combinations of groups, prime lexicality, target gender, and prime inflection yielded significant effects for target gender, $F(1, 48) = 99.87$, MS_e = 3,495, $p < .001$, and for the interaction of target gender with prime inflection, $F(1, 48) = 21.68$, MS_e = 2,869, $p < .001$. There was no main effect of groups but all the interactions with group were significant, as just mentioned. Like typical nouns, atypical nouns exhibit a gender congruency/incongruency effect but, unlike typical nouns, the magnitude of the effect is less dependent on the lexicality of the prime.

It is noteworthy that there was a large difference in errors between atypical masculine nouns (more) and atypical feminine nouns (less), $F(1, 48) = 11.92$, $p < .001$, and that the errors committed on these two noun types de-

Table 3
Lexical Decision Times and Error Rates for Atypical Masculine and Feminine Nouns as a Function of Prime Lexicality and Prime Inflection

	Noun gender (atypical)	
Prime inflection	Masculine (A)	Feminine (Ø)
Possessive adjective		
Masculine (Ø)		
Mean reaction time	712	692
SD	107	108
% correct responses	5.8	4.8
Feminine (A)		
Mean reaction time	734	647
SD	102	86
% correct responses	7.7	1.4
Pseudo Possessive adjective		
Masculine (Ø)		
Mean reaction time	723	675
SD	104	75
% correct responses	8.2	5.3
Feminine (A)		
Mean reaction time	730	652
SD	99	69
% correct responses	8.7	2.4

pended differently on the inflection of the preceding prime, $F(1, 48) = 4.44$, $p < .05$. The same analysis on the typical nouns revealed that the masculine nouns were again the source of most errors, $F(1, 48) = 7.65$, $p < .01$, but that there was no interaction of target gender with prime inflection. Overall, the errors for both analyses follow the pattern of the decision latencies (compare Tables 2 and 3) but it is not obvious why, in all analyses (Experiment 1 and Experiment 2), latencies are longer on average and errors are greater on average for masculine nouns.

The third question is whether the gender congruency/incongruency effect differs between typical and atypical masculine nouns. The number of masculine nouns that end in A is very small, as noted, and the number of nouns in this category used in the experiment almost exhausts the category. By and large, masculine nouns inflected with A in the nominative singular occur less frequently than masculine nouns inflected with Ø in the nominative singular. A Group × Prime Lexicality × Prime Inflection × Target Inflection (typical vs. atypical type) ANOVA was conducted. The main effect of prime inflection was significant, $F(1, 48) = 4.99$, $MS_e = 9{,}249$, $p < .05$; Ø-inflected primes were associated with faster lexical decisions (691 ms) than A-inflected primes (711 ms). The difference between typical and atypical nouns was significant, $F(1, 48) = 83.39$, $MS_e = 2{,}768$, $p < .001$; the atypical nouns were responded to more slowly (723 ms) than the typical nouns (680 ms) probably because of their lower frequency of occurrence. The interaction of prime lexicality and prime inflection was significant, $F(1, 48) = 4.28$, $MS_e = 9{,}822$, $p < .05$, as was the interaction of prime lexicality and target inflection, $F(1, 48) = 5.97$, $MS_e = 2{,}145$, $p < .01$. There was no two-way interaction between inflection of the prime and the typicality of the inflection of the noun. Lexical decision times for typical masculine nouns preceded by the congruent Ø-inflected primes (real and pseudo) were 33 ms shorter, on the average, than lexical decision times for typical masculine nouns preceded by incongruent A-inflected primes (real and pseudo). This average difference for atypical masculine nouns was 15 ms. There was, however, a significant three-way interaction among prime lexicality, prime inflection, and target inflection (typical vs. atypical), $F(1, 15) = 5.06$, $MS_e = 3{,}193$, $p < .05$. Inspection of Tables 2 and 3 reveals that the inflection of the pseudoadjective prime did not matter for either typical or atypical nouns. The congruency/incongruency difference was −4 ms and −7 ms, respectively. In contrast, the inflection of the adjective prime did matter for both typical nouns and atypical nouns, and it mattered more for the typical nouns than the atypical nouns. The congruency/incongruency difference was 60 ms and 22 ms, respectively. In sum, the data suggest that the magnitude of the gender congruency/incongruency effect differed between typical and atypical masculine nouns.

The fourth question addressed parallels the third. Does the gender congruency/incongruency effect differ between typical and atypical feminine nouns? The answer in this case is negative. A Group × Prime Lexicality × Prime Inflection × Target Inflection (typical vs. atypical) revealed only one significant effect, namely, the main effect of prime inflection, $F(1, 48) = 17.30$, $MS_e = 6{,}675$, $p < .001$; A-inflected primes were associated with faster lexical decision (648 ms) than Ø-inflected primes (678 ms) as ought to be the case for feminine noun targets.

Finally, with respect to the pseudonoun data, separate ANOVA revealed that for both the typical and atypical cases there was a significant effect of target inflection (Ø vs. A): $F(1, 51) = 6.54$, $MS_e = 3{,}050$, $p < .01$, and $F(1, 51) = 4.77$, $MS_e = 4{,}290$, $p < .05$, respectively. Pseudonouns ending in A were rejected more slowly. A further significant effect was observed in the atypical analysis, namely, the interaction of prime lexicality and target inflection, $F(1, 51) = 18.90$, $MS_e = 2{,}827$, $p < .001$. Where Ø-inflected atypical pseudonouns were responded to faster when preceded by a pseudopossessive adjective, A-inflected atypical pseudonouns were responded to faster when preceded by a possessive adjective. The data equivocate on whether or not rejecting pseudonouns was made more difficult by a grammatically and lexically proper context.

General Discussion

In the present experiments, possessive adjectives provide a minimal grammatical context for nouns in the nominative singular. With case and number held constant it is shown that when the two words agree in gender, lexical decision on the target noun is faster than when the two words disagree in gender. A previous experiment (Gurjanov et al., 1985) found no effect of *case* congruency on the processing of nouns in the nominative singular. That *gender* congruency does affect the processing of nominative singulars may have implications for the representation of inflected nouns in the internal lexicon (Lukatela et al., 1980).

The lesson learned from Experiment 2 is that the gender congruency/incongruency effect is not mediated by visual identity or phonemic identity of the morphemes that inflect the possessive adjective and the noun. This latter observation implies that the gender congruency/incongruency effect must involve the recognition of the genders of the possessive adjective and the noun which implies, in turn, that gender is part of a word's representation in the lexicon. It is not presumptuous to assume that one's knowledge of words includes a knowledge of the grammatical arrangements into which they may enter. To know that the feminine possessive adjective MOJA cannot be entered into a grammatical arrangement with the masculine nouns LONAC or DEDA is to know that MOJA and LONAC or MOJA and DEDA are of unlike gender. On the other hand, to know that the masculine possessive adjective MOJ can be linked to the masculine nouns LONAC and DEDA is to know that these words are alike in case, number, and gender.

The argument that there is a syntactical/grammatical processor is an argument for a device separate from the device that accesses lexical representations and separate from the device that assigns meaning to an arrangement of words (cf. Forster, 1979). The syntactic/grammatical processor assigns a syntactical structure or a grammatical relation to a context-target arrangement. It obviously has a degree of autonomy; there are many celebrated examples of English syntactical structure being assignable to a list of nonsense letter strings. However, with respect to the question of the information with which the syntactic or grammatical processor works, it must be supposed that that information is derived in large part by the lexical processor. Seidenberg et al. (1982) showed that in English lexical priming contexts, facilitation effects are not indifferent to the grammatical function of words and argue for a model of the internal lexicon enriched by syntactical details—an argument consonant with the suggestions of Kaplan and Bresnan (1982) and Gazdar (1982) in theoretical linguistics and continuous with the experimental efforts of Huttenlocher and Lui (1979) and Miller and Johnson–Laird (1976) and others to distinguish the mental representations of different word classes.

Given the notions of lexical processor, grammatical processor, and message processor (Forster, 1979) as three relatively independent systems underlying lexical decision, an account of the gender congruency/incongruency effect takes the following form (after West & Stanovich, 1982). When a grammatically congruent pair (e.g., MOJ LANAC, MOJ DEDA, MOJA PTICA, or MOJA MATER) is presented, the outputs from the lexical processor, grammatical processor, and message processor are all positive: the ideal situation for a subsequent decision-making mechanism that must arrive at the appropriate response *yes*. However, when a grammatically incongruent pair (e.g., MOJA LONAC, MOJA DEDA, MOJ PTICA, or MOJ MATER) is presented, the output from the lexical processor is positive and so, perhaps, is the output from the message processor, but the output from the grammatical processor is negative. The information made available to the grammatical processor from the lexical processor is that the context is one gender and the target is another gender. Consequently, the situation for the decision-making system is less than ideal; there are discrepancies in the outputs and the *no* bias from the grammatical processor must be overcome (West & Stanovich, 1982). As a result, lexical decision to a grammatically incongruent pair (e.g., MOJA LONAC) is slower than lexical decision to a grammatically congruent pair (e.g., MOJ LONAC).

The foregoing account is sufficiently general to accommodate the syntactic or grammatical priming effects found with English language materials (Goodman et al., 1981; Wright & Garrett, 1984) and those found with Serbo-Croatian language materials. Where the account is weak is in its failure to distinguish those components of grammatical processing that are automatic or reflexive (Fodor, 1983; Wright & Garrett, 1984) from those that are merely strategic, that is, those that are *conscious-attentive* and shaped by the conditions of the experiment. This failure is due in part to the lack of data relevant to the contrast. It has been established empirically that associative priming involves components of both kinds and the theory of associative priming ably recognizes the distinction (Neely, 1977). If syntactic or grammatical priming proves to depend similarly on a fast-acting automatic process and a slow-acting conscious-attentive process, then this much seems certain: In syntactic or grammatical priming both of these processes are postlexical (Gurjanov et al., 1985; Seidenberg et al., 1984; West & Stanovich, 1982).

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