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The Gender Congruency Effect and the Selection of Freestanding and Bound Morphemes: Evidence From Croatian

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The authors report 3 picture–word interference experiments in which they explore some properties of the agreement process in speech production. In Experiment 1, Croatian speakers were asked to produce utterances in which the noun's gender value had an impact on the selection of gender-marked freestanding morphemes (pronouns) while ignoring the presentation of same- or different-gender distractor words. In Experiments 2 and 3, Croatian speakers were asked to name the same pictures using noun phrases in which the noun's gender value surfaced as an inflectional suffix. Different-gender distractors interfered more than same-gender distractors (the gender congruency effect) in Experiment 1, but not in Experiments 2 and 3. These contrasting results show that the cause of the gender congruency effect is not at the level where lexical–grammatical information is selected but at the level of selection of freestanding morphemes.

A characteristic property of the language system is the relationship of dependency among the words in an utterance. To produce well-formed sentences, speakers must access the grammatical properties that govern agreement among the words in the utterance. This is necessary because the selection of some words and morphological inflections depends on the grammatical properties of other words included in the sentence. In some languages, one such property is grammatical gender. For example, when a Dutch speaker wants to produce a simple noun phrase (NP) such as *de stoel* [the chair], he or she needs to retrieve the gender of the noun *stoel* to select the proper determiner form (*de*, in this case). This is because nouns with different grammatical genders (e.g., *stoel* is a common gender noun and *huis* [house] is a neuter gender noun) take different determiner forms (*de* and *het*, respectively). Access to grammatical gender is necessary not only for the selection of freestanding morphemes, such as determiners and pronouns, but also for the retrieval of the inflectional suffixes of adjectives. For example, in the Dutch NP *groene stoel* [green chair], the adjective ends with the inflection *e* that is used with common gender nouns in adjective + noun NPs.

How are the selection of the noun's gender and, subsequently, that of the proper determiner and inflectional forms achieved? In other words, how is gender agreement computed during speech production? Although resolution of this issue is important for understanding how sentences are built during speech production, our knowledge about how we compute agreement is rather limited (Bock & Levelt, 1994; Bock & Miller, 1991; Bock, Nicol, & Cutting, 1999; Haskell & MacDonald, 2003; Meyer & Bock, 1999; Thornton & MacDonald, 2003; Vigliocco, Butterworth, & Semenza, 1995; Vigliocco & Franck, 1999). In this article, we use the picture–word interference paradigm to explore gender agreement in speech production by Croatian speakers.

The picture–word interference paradigm is a Stroop-like task in which participants are asked to name a picture while ignoring the presentation of a distractor word (see MacLeod, 1991, for a review of Stroop-like tasks). Manipulating the relationship between the picture's name and the distractor word leads to different effects. For example, when both stimuli belong to the same semantic category, naming latencies are longer than when they do not (the so-called semantic interference effect; e.g., Caramazza & Costa, 2000, 2001; Glaser, & Düngelhoff, 1984; Glaser & Glaser, 1989; La Heij, 1988; Lupker, 1979; Roelofs, 1992, 2001). On the assumption that the contextual effects observed with this paradigm

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reflect the processes involved in lexical access in speech production, researchers have used the paradigm to explore the mechanisms of lexical selection (e.g., Schriefers, 1992; Schriefers, Meyer & Levelt, 1990; Starreveld & La Heij, 1995; Vitkovitch & Tyrrell, 1999). For example, the semantic interference effect is assumed to arise as a consequence of competition among lexical nodes during lexical selection. That is, the ease with which a word is selected depends not only on its level of activation but also on the level of activation of other lexical nodes that act as competitors (e.g., Roelofs, 1992; but see Costa, Mahon, Savova, & Caramazza, 2003; Miozzo & Caramazza, 2003).

Schriefers (1993) was the first to use the picture–word interference paradigm to explore the processes involved in the selection of grammatical features and, specifically, in the selection of grammatical gender. He investigated whether the retrieval of grammatical features is a competitive process, as in lexical selection. He asked Dutch speakers to name colored pictures using either determiner + adjective + noun NPs (*de groene stoel* [the green chair]) or adjective + noun NPs (*groene stoel* [green chair]), while ignoring distractor words that had either the same or different gender as the pictures' names. In Dutch, determiners are gender marked, as are adjectives when used in adjective + noun NPs. Thus, in both types of NPs, speakers had to retrieve the noun's gender to produce the correct determiner (freestanding morpheme) or the correct inflection (bound morpheme). Given the assumptions that (a) the distractor word activates its grammatical features (and specifically its grammatical gender) and (b) the selection of grammatical features is a competitive process, Schriefers argued that the selection of the target's gender feature would be more difficult when the distractor and the picture's name have different genders than when they have the same gender. The results confirmed this prediction: Naming latencies were faster when pictures' names and distractor words had the same gender in both types of NPs tested (determiner + adjective + noun and adjective + noun). Schriefers attributed the so-called gender congruency effect to the priming (or interference) in the retrieval of the gender feature associated with the lexical node corresponding to the picture's name. He concluded that the selection of a lexical node does not lead to automatic selection of its grammatical gender. Instead, once the lexical node is selected, there is another process responsible for the selection of the noun's grammatical features, and the selection of these features is subject to competition.

This seminal observation has been followed by several investigations that have revealed the language-specific nature of the gender congruency effect: Whereas the effect has been replicated in Dutch and in German (La Heij, Mark, Sander, & Willeboordse, 1998; Schiller & Caramazza, 1999, 2003; Schriefers & Teruel, 2000; Van Berkum, 1997), it has never been observed in any of the Romance languages tested until now (Alario & Caramazza, 2002; Costa, Sebastian-Galles, Miozzo & Caramazza, 1999; Miozzo & Caramazza, 1999; Miozzo, Costa & Caramazza, 2002; see Caramazza, Miozzo, Costa, Schiller & Alario, 2001, for a summary of results in Catalan, French, Italian and Spanish). Crucially, in the latter languages, unlike in German and in Dutch, grammatical (and semantic, such as +/− definite) information is not sufficient to select determiner forms. In these languages, the phonological context in which a determiner appears also plays a role in its selection.

Miozzo and Caramazza (1999) noted that this property of Romance languages could render invisible a gender congruency effect in these languages. This is because the selection of a determiner form needs "to wait" until the phonology of the following word is available, thereby masking any delay in gender feature selection. Consider the case of definite determiners in Italian, in which singular definite determiners depend on the gender of the noun, masculine nouns take *il* or *lo* and feminine nouns take *la*. The choice between the masculine determiners *il* versus *lo* depends on the phonological properties of the word that follows the determiner. If the following word begins with a vowel, a consonant cluster of the form s + consonant or *gn*, or an affricate, then the proper masculine determiner is *lo* (e.g., *lo* sg*abello* [the stool], *lo* gn*omo* [the gnome]). In all other cases, the correct determiner is *il*. Thus, one cannot select a determiner until the phonology of the word that follows it becomes available. In this scenario, it is possible that by the time the phonology is available, any competition in the retrieval of the noun's gender has been resolved. In other words, it is possible that gender congruency effects exist in these languages but are invisible because of some language-specific properties affecting determiner selection.

Independent of this cross-linguistic variation, there is still an open debate about the origin of the gender congruency effect. According to Schriefers (1993), the gender congruency effect is a result of competition (or priming) at the level where the grammatical properties of the noun are retrieved. One implication of this proposal is that the selection of a given lexical node does not imply the selection of its grammatical features. Rather, the retrieval of these features, including gender, is an independent competitive process that follows the selection of a lexical node. There is, however, another possible explanation for the gender congruency effect, according to which the effect reflects competition in the selection of determiner forms rather than in the selection of the gender feature associated with the noun's lexical node (Caramazza et al., 2001). On this account, the distractor word automatically activates its gender feature, which sends some activation to its associated determiner. When the distractor word has the same gender as the picture's name, the target determiner form would receive activation from two sources (the distractor and the target lexical node). In contrast, when the two items have different genders, they will activate different determiners. Given the assumption that lexical selection is a competitive process, the selection of the determiner would be faster in the same-gender than in the different-gender condition. In sum, the gender congruency effect reveals the general competitive nature of lexical (determiner) retrieval and not the nature of grammatical feature selection.

Recent results are relevant for the resolution of this issue. Schiller and Caramazza (2003; see also Caramazza et al., 2001, for a summary of the results) asked Dutch speakers to produce singular and plural determiner + noun NPs while ignoring same- or different-gender distractor words. As already noted, Dutch singular NPs take one of two determiner forms, depending on the gender of the noun. However, plural NPs take the same determiner regardless of the noun's gender (both neuter and common gender words take the plural determiner *de*). The authors argued that if the origin of the gender congruency effect was at the level of the

retrieval of the nouns' gender features, it should also be obtained in the production of plural NPs, because at that level of processing the target and the distractor nouns would have activated different gender features, irrespective of number. Alternatively, if the origin of the gender congruency effect was at the level of the retrieval of determiner forms, no gender congruency effect should be expected in the plural NP condition, because in the latter case there is only one determiner form (*de)* for both genders. The results of Schiller and Caramazza were clear: A gender congruency effect was obtained with singular NPs, whereas no such effect was obtained with plural NPs. The authors obtained parallel results in German, a language with similar gender properties to Dutch. According to Caramazza et al. (2001), these results support the notion that the gender congruency effect reflects competition among different determiner forms rather than competition between the gender features of target and distractor nouns.

As discussed above, a noun's grammatical gender determines not only the selection of freestanding forms but also the selection of bound morphemes, such as adjectival inflections. Is retrieval of the gender-marked inflection governed by the same principles that apply in the selection of freestanding morphemes, such as determiners? Is the selection of bound morphemes a competitive selection process that can result in a gender congruency effect? Here, the results are less clear than in the case of determiners. There are two sets of data. Schriefers (1993) obtained a gender congruency effect when participants had to produce NPs without determiners (adjective + noun), suggesting either that the selection of the gender feature is a competitive process or that there is competition in the selection of the bound morphemes associated with the gender inflection of adjectives. However, Schiller and Caramazza (2003) failed to observe such an effect in both Dutch and German in similar experimental conditions to those used by Schriefers. On the basis of their results, Schiller and Caramazza argued that the competition that leads to the gender congruency effect is restricted to freestanding morphemes, such as determiners, and that either the selection of bound morphemes is not a competitive process or the paradigm is not sufficiently sensitive to reliably reveal this process. Although it is reasonable to assume that the selection of freestanding grammatical morphemes is a competitive process, as has been argued for the selection of other lexical forms, it is possible that the selection of inflections is a fundamentally different process—one that is not subject to competition. Thus, the question of whether bound morphemes are also subject to some form of competition for selection remains unresolved. In other words, it is an empirical question whether gender congruency effects are observed when the noun's gender value surfaces as an inflectional morpheme.

The present research has three goals. First, we explore whether the gender congruency effect is present in a language family that has not yet been studied, the Slavic family. Given that the gender congruency effect does not seem to be a universal effect, it is important to explore it in different language families. Second, we provide new experimental evidence on whether gender congruency effects are observed when the noun's gender value only surfaces as an inflectional suffix in the participants' responses. Third, we test the hypothesis that gender congruency effects arise whenever grammatically determined freestanding morphemes are produced.

We report three picture–word interference experiments in which Croatian speakers were asked to name pictures while ignoring distractor words. Croatian belongs to the Slavic languages family, and it has three grammatical genders: feminine, masculine, and neuter. Possessive adjectives are usually inflected for gender, to agree with the noun. For example, in the case of the Croatian possessive adjective *moj* [my] the inflected forms are feminine: *moja*, masculine: *moj*, and neuter: *moje*. However, in other contexts the noun's gender value determines, among other things, the selection of a freestanding morpheme. For example, in Croatian the pronoun corresponding to the direct object produced in phrases such as "see it" depends on the gender of the referent noun. However, in this case, the noun's gender governs the selection of a freestanding morpheme (feminine: *je*, masculine: *ga*, neuter: *ga*). (See Jescheniak, Schriefers & Ansgar, 2001, for a study in which pronoun retrieval is investigated.)

The three goals presented above can only be addressed if the properties of the gender system in Croatian allow, in principle, the detectability of gender congruency effects. As discussed previously, it has been argued that the detectability of a gender congruency effect is tied to the distinction between early- and late-selection languages—gender congruency effects are only detectable for early-selection languages. Croatian belongs to the so-called early-selection languages, in the sense that the selection of the freestanding morphemes can be accomplished as soon as the gender of the noun (and other relevant grammatical and semantic features) is retrieved (see Caramazza et al., 2001, Costa et al., 1999, for a description of early- and late-selection languages). Unlike some Romance languages (late-selection languages), the phonological forms of Croatian pronouns do not depend on the phonological context in which they are produced. Thus, in principle, it should be possible to observe a gender congruency effect in this language. If we do obtain a gender congruency effect in Croatian, the issue then becomes one of exploring whether the effect is observed in the context of any gender-marked utterance or whether it is only present when the noun's gender value surfaces as a freestanding morpheme in the participants' utterances.

Even though the gender system of Croatian (see Appendix A) shares several properties with German and Dutch—languages in which the gender congruency effect has been observed—there is also one important difference: Croatian does not have articles. For example, the NP "the red car" in Croatian is produced as *crven auto* [red car]. So far, the gender congruency effect has been reliably obtained only when participants were asked to produce NPs in which a definite article was the first word to be produced (*de stoel* [the chair] and *de groene stoel* [the green chair]). Thus, given the available experimental evidence, it is an open question whether we can observe gender congruency effects in a language that does not have determiners. This is because it could be argued that the gender congruency effect reveals some aspect of the processes involved in the retrieval of articles rather than a general mechanism involved in the retrieval of any grammatically determined freestanding morpheme.

Overview of the Experiments

The main difference among the three experiments reported here is whether the noun's gender value surfaces as a freestanding

morpheme (pronouns; Experiment 1) or as a bound morpheme (adjective inflections; Experiments 2 and 3) in the particular utterance format used in the experiments. The freestanding morphemes were pronouns marked for gender and accusative case; the bound morphemes were clearly distinguishable morphemes suffixed to possessive adjective stems. What is crucial here is the fact that in Experiment 1, a freestanding morpheme carries the lexical and gender values (the pronoun) as an inseparable whole, whereas in Experiments 2 and 3, these are carried by two morphologically separable parts, with the gender value represented by a bound morpheme.

In Experiment 1, participants were asked to produce simple sentences such as *Vidim ga* [literally, "see it"]. Pronouns in Croatian are gender (and number) marked, thus participants produced the sentence *Vidim* ga_{masc} when the referent noun was masculine and *Vidim* je_{fem} when the referent noun was feminine. The pronoun in Croatian is also marked for case, which in our experiment was always accusative. If gender congruency effects reflect the competitive processes involved in the retrieval of *any* gender-marked freestanding morpheme, as proposed by Schiller and Caramazza (2003), then we should expect to observe such an effect in Experiment 1. Note, however, that such an outcome is also predicted by those models that locate the gender congruency effect at the level at which grammatical features are retrieved.

In Experiments 2 and 3, we asked participants to produce NPs of the type possessive adjective + noun. The possessive adjective used was *my*, an adjective that in Croatian is gender-marked (*moj* $klarinet_{\text{masc}}$ [my clarinet] vs. *moja* $truba_{\text{fem}}$ [my trumpet]). If gender congruency effects are restricted to those contexts in which the noun's gender value surfaces as a freestanding morpheme, then such an effect should not be present in this experiment. This is because the noun's gender value only affects the retrieval of an inflectional suffix. In contrast, if the gender congruency effect is located at the level at which grammatical features are retrieved, then the effect should be present in any context in which the noun's gender feature is required, and therefore, it should be present in Experiments 2 and 3.

To anticipate the results, we found that different-gender distractors interfered more than same-gender distractors (the gender congruency effect) in the experiment where the noun's gender value was necessary for the selection of a freestanding morpheme (Experiment 1). In contrast, when the noun's gender value surfaced in the utterance as an inflectional suffix, no gender congruency effects were observed (Experiments 2 and 3).

Experiment 1: Gender Congruency Effects in Croatian: The Case of Pronouns

Our aim in this experiment was to explore whether gender congruency effects could be observed in a Slavic language when participants were asked to produce utterances in which the noun's gender value surfaces as a freestanding morpheme. We asked Croatian speakers to produce phrases such as *vidim ga* or *vidim je* (literally, "see it" in masculine and feminine, respectively) when presented with different pictures. Pronouns in Croatian are gender marked, and therefore, in this utterance format the noun's gender value surfaces as a pronoun (*ga* and *je*). So, if we did observe a gender congruency effect in this experiment, it would indicate that such an effect can be obtained in the following: (a) in Slavic languages, (b) in utterance types other than NPs, and (c) with freestanding morphemes other than articles. It is important to note that the first word of each response was always the same, *vidim* ("see" in first-person singular). This may lead to a reduction of the observed interference effects (see Costa & Caramazza, 2002).

Furthermore, this was the first time that gender congruency effects were tested in utterances that involved referential processing and in which the target noun was not produced. Although, in principle, there is no independent reason to believe that such referential processing would affect the detection of the gender congruency effect, it is an empirical issue whether that would be the case. We defer further discussion of this issue to the General Discussion.

Method

Participants. Twenty college students, native speakers of Croatian living in Trieste, Italy, took part in the experiment. They were paid 10 Euros (approximately $11.30) for their participation.

Materials. We selected 28 pictures, half with masculine gender names and half with feminine (see Appendix B). Only masculine and feminine nouns were included in the experiment because they account for almost 90% of the nouns in Croatian. The inclusion of neuter nouns would have made the selection of the materials more difficult. Each picture (e.g., $truba_{\text{fem}}$ [trumpet]) was paired with four different distractor words: (a) a word of the same gender as the picture's name ($zmija_{\text{fem}}$ [snake]), (b) a word of a different gender ($kaput_{\text{masc}}$ [coat]), (c) a semantically related distractor (*klarinet* [clarinet]), (d) a semantically unrelated distractor matched to the semantically related distractor on several variables (*odvijač* [screwdriver]), as discussed later. The related distractors and their corresponding unrelated distractors were matched in both the number of letters and frequency. To make sure that the distractors in the gender related and unrelated conditions were equally semantically unrelated to the picture, we asked 10 native speakers of English to rate (from 1 to 5) the semantic similarity between the picture and its paired distractors. The similarity ratings revealed that same-gender distractors (1.86) and different-gender distractors (1.77) were equally unrelated to the pictures ($F < 1$).

This design is somewhat different from that used originally by Schriefers (1993), in which the semantic relationship and the gender value were crossed leading to a 2×2 design. Here, we do not explore the interaction between the two variables (gender and semantic relationship), but rather whether there is an independent effect of the gender value of the distractor word. Given that the 2×2 design includes more restrictions in the selection of the materials than a simple manipulation of two variables without crossing them factorially, we decided to manipulate the two variables independently of each other. This allowed us to include a large number of picture–word pairs, larger than that used by Schriefers (1993) or Schriefers and Teruel (2000). The four sets of distractors were matched in frequency and in number of letters (all Fs < 1). To reduce the number of related items, we also presented the pictures once with a row of XXXs as a filler condition. For a given picture, the distractor words in the semantically related and corresponding unrelated conditions had the same gender. However, their gender value could be the same or different from that of the picture's name. For 13 out of the 28 pictures included in the experiment, the picture's name and the semantically related and unrelated words had the same gender; for the remaining 15, they had different genders. Three filler pictures were used as warm-up stimuli at the beginning of each block.

Pictures appeared in black and white in the center of the screen. As it has been shown that presenting the distractor words always at the fixation point may reduce their effects (La Heij, Van der Heijden, & Schreuder, 1985), the distractors appeared at slightly different positions around the fixation

point. For each individual picture, however, all the distractors were placed in the same position. The distractor words were shown in capital letters (Helvetica font, bold, 27 point) and were superimposed on the pictures. The stimulus onset asynchrony (SOA) between the presentation of the picture and that of the distractor was 0 ms. In other words, the picture and the distractor appeared simultaneously. Stimuli were presented in five blocks of 31 trials (28 experimental plus 3 warm-up fillers). Each picture appeared once per block. In each block, stimuli of the various conditions appeared a similar number of times (five or six). Block trials were randomized with the restriction that distractors of the same experimental condition appeared in no more than two consecutive trials. Five different block orders were constructed, and equal numbers of participants were randomly assigned to each block order.

Procedure. Participants were tested individually. They were instructed to name the picture as quickly and as accurately as possible by using the sentence *Vidim* ga or *Vidim je*. They were informed that they would see picture–word pairs and were asked to ignore the words. Before the experiment proper, participants were presented with the entire set of pictures and were asked to name the pictures using bare nouns. Each experimental trial had the following structure. First, a fixation point (an asterisk) was shown in the center of the screen for 1 s, followed by a blank interval of 500 ms. Then, the picture–word pair was presented for 2 s or until the response was given. If a response was not provided within 2 s, the next trial started automatically. The intertrial interval was 1.5 s. Response latencies were measured from the onset of the stimulus to the beginning of the naming response. Stimulus presentation was controlled by the program Psyscope (Cohen, MacWhinney, Flatt, & Provost, 1993). Response latencies were measured by means of a voice key. The session lasted approximately 35 min.

Results and Discussion

Three types of responses were scored as errors: (a) production of names that differed from those designated by the experimenter, (b) verbal dysfluencies (stuttering, utterance repairs, production of nonverbal sounds that triggered the voice key), and (c) recording failures. Erroneous responses and outliers (i.e., responses exceeding 3 standard deviations from the participant's mean) were excluded from the analyses of response latencies. We also excluded naming latencies for one picture because of the high naming inconsistency observed during the familiarization phase. Separate analyses were carried out for subjects and items, yielding F_1 and F_2 statistics, respectively. Two main analyses were conducted. In the first analysis, we considered two variables: gender of the target (masculine vs. feminine) and gender relationship (same vs. different gender). In the second analysis, we considered also two variables: gender of the target (masculine vs. feminine) and semantic relationship (semantically related vs. semantically unrelated). Table 1 shows the mean response latencies and error rates as a function of type of distractor.

The percentage of discarded data points accounted for 6.9% of the trials. In the first error analyses no significant differences were observed (all Fs < 1). In the second analyses the main effect of the variable gender of the target was not significant, $F_1(1, 19) = 3.5$, $MSE = 1.27$, $p < .08$; $F_2(1, 25) = 2.5$, $MSE = 3.60$, $p < .13$. The main effect of the variable semantic relationship was significant in the analysis by subjects and marginal in the analyses by items, $F_1(1, 19) = 4.7$, $MSE = 0.96$, $p < .05$; $F_2(1, 25) = 3.2$, $MSE = 2.03$, $p < .08$, revealing that semantically related distractors produced more errors than semantically unrelated distractors. The interaction between the two variables was not significant, $F_1(1, 19) = 2.5$, $MSE = 0.59$, $p < .13$; $F_2 < 1$.

Table 1
Naming Latencies (in ms) and Percentage Error (E%), by Type of Distractor and Gender of the Target in Experiment 1 (Verb + Pronoun Production)

	Masculine target		Feminine target		Total	
Type of distractor	*M*	E%	*M*	E%	*M*	E%
Same gender	695	3.6	719	5.8	706	4.6
Different gender	717	4.6	732	6.5	724	5.6
Semantically related	710	9.3	727	11.5	718	10.4
Semantically unrelated	699	3.9	706	10.0	702	6.9
Gender congruency effect (same − different)	−22		−13		−18	
Semantic interference effect	11		21		16	

In the analyses of naming latencies, the main effect of the variable gender relationship was significant, $F_1(1, 19) = 4.4$, $MSE = 1{,}416.60$, $p < .05$; $F_2(1, 25) = 7.2$, $MSE = 628.98$, $p < .05$, revealing that naming latencies were faster for same- than for different-gender distractors. The main effect of the variable gender of the target was not significant, $F_1(1, 19) = 1.7$, $MSE = 2{,}913.38$, $p < .20$; $F_2 < 1$. The interaction between the two variables was not significant, $F_1(1, 19) = 1.2$, $MSE = 1{,}030.68$, $p < .28$; $F_2(1, 25) = 2.7$; $MSE = 628.98$, $p < .11$.

The main effect of the variable semantic relationship approached significance in the analysis by subjects, $F_1(1, 19) = 3.2$, $MSE = 1{,}634.78$, $p < .09$, and reached significance in the analysis by items, $F_2(1, 25) = 5.7$, $MSE = 688.33$, $p < .05$. The main effect of the variable gender of the target was not significant, $F_1(1, 19) = 1.9$, $MSE = 2{,}648.99$, $p < .18$; $F_2(1, 25) = 1.3$, $MSE = 2{,}016.76$, $p < .27$. The interaction between the two variables was not significant, $F_1(1, 19) = 3.4$, $MSE = 471.10$, $p < .08$; $F_2 < 1$.[1]

The results of this experiment are clear: Different-gender distractors interfere more than same-gender distractors. Furthermore, semantically related distractors led to slower naming latencies and to higher error rates than semantically unrelated distractors. These results replicate the seminal gender congruency effect reported by Schriefers (1993).

The gender congruency effect observed in this experiment provides evidence that such an effect can be obtained in Slavic languages such as Croatian. Furthermore, the fact that this experiment departed in many respects from those carried out in Dutch and German allows us to extend the observation of gender con-

[1] Seven distractor words included in the gender conditions had homographic names (three were included in the same-gender condition and four in the different-gender condition). However, four out of the seven homographs were nouns of the same gender as that of the intended meaning (*luk* [onion, arch], *poklon* [gift, bow], *tresnja* [cherry, shake], *ruza* [rose, lipstick]). For example, "onion" and "arch" are homographs in Croatian, but both nouns have the same gender value. Nevertheless, when these words were removed from the analysis, the magnitude of the gender congruency effect remained significant (20 ms) in Experiment 1 and nonsignificant in Experiments 2 and 3 (0 ms and 1 ms, respectively).

gruency effects to (a) another utterance type (sentences rather than NPs), (b) another type of gender-marked words (pronouns rather than articles), and (c) utterance formats in which the target's name is not produced and referential processing is involved.

In the studies in which gender congruency effects have been reliably observed, participants were asked to produce NPs in which the article was the word carrying the gender marking, and it was placed in the first position of the utterance (La Heij et al., 1998; Schiller & Caramazza, 2003; Schriefers, 1993; Schriefers & Teruel, 2000). Furthermore, in those studies gender agreement was computed in the local context of the NP. The results of Experiment 1 show that neither of these properties of previous experiments is necessary for obtaining a gender congruency effect: A gender congruency effect is observed when participants produce sentences involving referential processing and in which the noun's gender value surfaces in a pronoun that does not occupy the first position in the utterance.

Thus, at this point we can safely conclude that in early selection languages gender congruency effects are observed whenever the noun's gender value has an impact on the selection of gender-marked freestanding morphemes regardless of the grammatical category of such elements and their position in an utterance. Having established this property of the gender congruency effect, and that such an effect is present in Slavic languages, we address the main goal of our research.

The question that remains open is the extent to which such an effect can also be observed when producing utterances in which the noun's gender value surfaces as a bound inflection. As discussed in the introduction, the results regarding this issue are controversial. Although gender congruency effects in such circumstances were observed by Schriefers (1993), Schiller and Caramazza (2003) failed to replicate them. In this scenario, it is important to establish whether the phenomenon can be reproduced reliably. This is important because whether there is a gender congruency effect in utterances in which the noun's gender value surfaces as an inflectional suffix may help constrain both the origin of the gender congruency effect and the principles that govern the selection of gender-marked inflections. Recall that if the locus of the gender congruency effect is at the retrieval of the noun's gender feature, then such an effect should be present whenever the noun's gender value surfaces in the participants' utterances. In Experiments 2 and 3, we explore this issue in the context of possessive adjectives in Croatian.

Experiment 2: Gender Congruency Effects in Possessive Adjective + Noun NPs in Croatian

In this experiment, participants were presented with the same picture–word pairs used in Experiment 1 and asked to name the pictures using the possessive adjective plus the noun (*moj krevet*$_{\text{masc}}$ [my bed], *moja kuća*$_{\text{fem}}$ [my house]). Possessive adjectives in Croatian agree with the noun in case, number, and gender. Crucially for present purposes, the gender feature surfaces as an inflection, which is suffixed to the lexical stem of the possessive adjective.

The observation of gender congruency effects in this experiment would suggest that the selection of bound inflectional morphemes follows the same principles as those used in the selection of freestanding morphemes, such as articles and pronouns. Alternatively, if the gender congruency effect does not exhibit itself in this type of NPs, we would conclude that the selection of inflectional morphemes is not a competitive process.

Method

Participants. Twenty college students, speakers of Croatian, took part in the experiment. None of them had participated in the previous experiment.

Materials. The only difference between this experiment and Experiment 1 was the utterance format in which participants were asked to name the pictures (sentences in Experiment 1 and NPs in the present experiment) and the way in which the noun's gender feature surfaces in those utterances (freestanding morphemes in Experiment 1 and bound morpheme inflections in the present experiment).

Results and Discussion

One picture was excluded from the analysis because of the high naming inconsistency observed during the familiarization phase (the same item that was excluded in Experiment 1). Following the same criteria as in Experiment 1, 8.4% of the trials were excluded from the analysis (see Table 2).

The only significant effect in the error analyses was the main effect of the variable semantic relationship, $F_1(1, 19) = 4.80$, $p < .05$; $F_2(1, 25) = 4.40$, $p < .05$, revealing that semantically related distractors led to more errors than unrelated distractors.

In the analysis of naming latencies, the main effect of the variable gender relationship was not significant (both Fs < 1), revealing that same-gender distractors led to similar naming latencies than different gender distractors. The main effect of the gender of the target was only significant in the subject analysis, $F_1(1, 19) = 4.50$, $MSE = 1{,}022.48$, $p < .05$; $F_2(1, 25) = 2.11$, $MSE = 1{,}600.50$; $p < .16$. The interaction between the two variables was not significant, $F_1(1, 19) = 3.31$, $MSE = 571.01$, $p < .09$; $F_2(1, 25) = 1.88$, $MSE = 870.04$, $p < .19$.

In contrast, the main effect of the variable semantic relationship was significant, $F_1(1, 19) = 8.14$, $MSE = 854.42$, $p < .05$; $F_2(1, 25) = 13.69$, $MSE = 304.64$, $p < .05$, revealing that semantically related distractors led to longer naming latencies than semantically unrelated distractors.[2] The main effect of the variable gender of the target was marginally significant, $F_1(1, 19) = 7.13$, $MSE = 959.86$, $p < .05$; $F_2(1, 25) = 3.37$, $MSE = 2{,}049.47$, $p < .08$. The interaction between these two variables was not significant, $F_1 < 1$; $F_2(1, 25) = 1.56$, $MSE = 304.64$, $p < .22$.

The results of this experiment are clear. In the production of adjective + noun NPs, in which the noun's gender value surfaces as a bound morpheme, naming latencies are independent of whether the picture's name and the distractor word have the same or different gender values. This pattern of results contrasts instructively with that of Experiment 1. In that experiment, we observed an 18 ms gender congruency effect, whereas no effect was observed in Experiment 2. However, semantically related distractors produced a sizeable semantic interference effect in both experi-

[2] A combined analysis of Experiments 1 and 2 revealed that the amount of semantic interference produced by a semantically related distractor was independent of its gender value in relation to that of the picture's name.

Table 2
Naming Latencies (in ms) and Percentage Error (E%), by Type of Distractor and Gender of the Target in Experiment 2 (Adjective + Noun Production)

	Masculine target		Feminine target		Total	
Type of distractor	*M*	E%	*M*	E%	*M*	E%
Same gender	666	5.7	691	8.5	678	7.0
Different gender	675	6.1	681	8.5	677	7.2
Semantically related	683	11.8	703	11.9	692	11.9
Semantically unrelated	666	6.4	683	8.8	674	7.6
Gender congruency effect (same − different)	−9		10		1	
Semantic interference effect	17		20		18	

ments, indicating that the distractor words were processed lexically. Thus the absence of a gender congruency effect cannot be attributed to a lack of power in our experiment.

As we used the same stimuli across experiments, we can carry out a joint analysis of Experiments 1 and 2. In this analysis, we explored whether the magnitudes of the main effects of the variables gender relationship and semantic relationship were different in the two experiments. The magnitude of the main effect of the semantic relationship variable (the semantic interference effect) was similar in the two experiments, as is shown by the nonsignificant interaction between the factor experiment and the factor semantic relationship (both Fs < 1). Furthermore, the magnitude of the effect did not depend on the gender of the target, as revealed by the nonsignificant interaction between this variable and the semantic relationship (both Fs < 1). In contrast, the interaction of Gender Relationship × Experiment was marginally significant, $F_1(1, 38) = 3.51$, $MSE = 897.73$, $p < .06$; $F_2(1, 25) = 3.52$, $MSE = 741.75$, $p < .07$, revealing that the magnitude of the gender congruency effects varied across experiments (–18 ms and 1 ms for Experiment 1 and 2, respectively). Finally, the difference between same-gender distractors and different-gender distractors appeared larger for masculine targets than for feminine targets, as revealed by the Gender of the Target × Gender Relationship interaction, $F_1(1, 38) = 3.86$, $MSE = 800.84$, $p < .06$; $F_2(1, 25) = 4.4$, $MSE = 757.27$, $p < .05$.

The absence of a gender congruency effect for adjective + noun NPs is in accordance with the results reported by Schiller and Caramazza (2003) and contrasts with those of Schriefers (1993). Our results suggest that the gender congruency effect is restricted to those utterances in which the gender of the noun surfaces as a freestanding morpheme. However, before reaching this conclusion, we should consider the possibility that we did not obtain a gender congruency effect in this experiment because the specific SOA between the picture and the distractor used is not the appropriate one to observe such an effect. In Experiments 1 and 2, we chose the SOA (SOA 0) at which gender congruency effects have been observed most consistently (La Heij et al., 1998; Schiller & Caramazza, 2003; Schriefers, 1993; Schriefers & Teruel, 2000; Van Berkum, 1997). Nevertheless, in a recent article Schriefers and Teruel (2000) have shown that a gender congruency effect can be present at SOAs other than SOA 0 when producing determiner + noun NPs. In their study, the gender congruency effect appeared reliably only when the distractor was presented 75 ms after the picture. The authors suggest that "a definitive conclusion on the absence of a gender interference effect in a given language should preferably be based on experiments with systematic manipulation of SOA." (p. 1372) Thus, before concluding that the gender congruency effect is not present in adjective + noun utterances in Croatian, we follow Schriefers and Teruel's suggestion and further explore whether a gender congruency effect is observed at the SOA used by these authors.

Experiment 3: Gender Congruency Effects in Possessive Adjective + Noun NPs in Croatian: A Question of SOA?

The main difference between this experiment and Experiment 2 is that distractors were presented after the picture onset (SOAs +75 ms and SOA +150 ms). If gender congruency effects were to be present in Croatian for adjective + noun NPs, then we should observe them at either of these two SOAs.

Method

Participants. Twenty college students, speakers of Croatian, took part in the experiment. None had participated in the previous experiments.

Materials and procedure. The same materials as in the previous experiment were used. The experiment consisted of two main blocks, corresponding to the two SOAs included in the experiment. All materials were presented at the two SOAs. Following Schriefers and Teruel's (2000) design, each participant was tested in both blocks, corresponding to the two SOAs, with a pause between the two blocks. Half of the participants were given the +75 ms SOA block first and the other half were given the +150 ms SOA block first. The specific order in which the materials were presented in each block (SOA) was the same as that used in Experiment 2. All the other details of this experiment are the same as in Experiment 2. The data-points from 1 participant were excluded from the analysis because of a technical problem in recording naming latencies.

Results and Discussion

Naming latencies for the picture excluded from Experiments 1 and 2 were also excluded from the analyses in this experiment (see Table 3). The same criteria for the exclusion of data points used in Experiment 1 were applied here, accounting for 6.4% and 5.0% of the trials for SOA +75 and SOA +150, respectively. As in Experiment 1, two main analyses were conducted. In the first analysis, we analyzed three variables: gender of the target (masculine vs. feminine), gender relationship (same vs. different gender), and SOA. In the second analysis, we analyzed three variables: gender of the target (masculine vs. feminine), semantic relationship (semantically related vs. semantically unrelated), and SOA.

In the first error analyses no significant differences were observed. In the second error analyses, semantically related distractors led to more errors than semantically unrelated distractors, $F_1(1, 18) = 25.40$, $MSE = 0.54$, $p < .05$; $F_2(1, 25) = 20.99$, $MSE = 0.85$, $p < .05$. Also, the SOA × Gender of the Target interaction was significant, $F_1(1, 18) = 8.00$, $MSE = 0.64$, $p < .05$; $F_2(1, 25) = 9.84$, $MSE = .76$, $p < .05$. No other significant effects were observed.

In the first analysis of naming latencies, the main effect of the variable SOA was significant, $F_1(1, 18) = 7.10$, $MSE = 3{,}947.21$,

Table 3
Naming Latencies (in ms) and Percentage Error (E%), by Type of Distractor and Gender of the Target in Experiment 3 (Adjective + Noun Production)

	Masculine target		Feminine target		Total	
Type of distractor	*M*	E%	*M*	E%	*M*	E%
	SOA +75					
Same gender	676	4.9	681	8.9	678	6.9
Different gender	683	6.0	686	4.0	684	5.0
Semantically related	681	8.3	684	12.1	682	10.2
Semantically unrelated	670	3.4	689	4.0	679	3.7
Gender congruency effect (same − different)	−7		−5		−6	
Semantic interference effect (related − unrelated)	9		−7		3	
	SOA +150					
Same gender	663	4.5	657	6.1	660	5.3
Different gender	654	2.6	662	4.9	658	3.7
Semantically related	657	8.6	656	4.9	656	6.7
Semantically unrelated	649	5.6	665	2.8	657	4.2
Gender congruency effect (same − different)	9		−5		2	
Semantic interference effect (related − unrelated)	8		−9		−1	

Note. SOA = stimulus onset asynchrony.

$p < .05$; $F_2(1, 25) = 22.21$, $MSE = 605.65$, $p < .05$. The main effects of the variables gender relationship and gender of the target were not significant (all Fs < 1). None of the interactions among these three factors was significant (all ps $< .30$).

In the second analysis, neither the main effect of the variable semantic relationship (both Fs < 1) nor the main effect of the variable gender of the target was significant, $F_1(1, 18) = 2.02$, $MSE = 975.37$, $p < .17$; $F_2 < 1$. The main effect of SOA was significant, $F_1(1, 18) = 6.58$, $MSE = 5{,}092.29$, $p < .02$; $F_2(1, 25) = 45.74$, $MSE = 633.13$; $p < .05$. None of the interactions were significant.[3]

The results of Experiment 3 replicate the absence of a gender congruency effect observed in Experiment 2: Naming latencies are independent of whether the picture's name and the distractor word have the same gender. Furthermore, at SOAs +75 ms and +150 ms naming latencies for semantically related and unrelated distractors were statistically indistinguishable. Nevertheless, semantically related distractors led to more errors than unrelated distractors, revealing a trace of semantic interference. Thus, it appears that the lack of a gender congruency effect cannot be attributed to the selection of the wrong SOA. In all three experiments, we also observed a trend for feminine target words to be named more slowly than masculine target words. This difference reflects most likely an intrinsic difference between the two sets of pictures. However, what is important for our purposes is that such differences do not seem to affect the polarity of the interference effects observed across experiments.

The results of Experiments 2 and 3 replicate the absence of a gender congruency effect in adjective + noun NP production observed by Schiller and Caramazza (2003; but see Schriefers, 1993). Furthermore, our results extend that observation to the case of closed-class adjectives—possessive adjectives (see General Discussion).

The common feature of our results and those reported by Schiller and Caramazza (2003) is that in the gender-marked adjectives used in both studies, the noun's gender value surfaces as a bound morpheme. Thus, one could interpret these results as suggesting that the presence of gender congruency effects is determined by the way the noun's gender value surfaces in the utterance. If it surfaces as a bound-morpheme suffix—that is, as a consequence of an inflectional process—then gender congruency effects are not observed. In contrast, if it surfaces as a freestanding morpheme, gender congruency effects are observed.

General Discussion

Three picture–word interference experiments were conducted to further explore the properties of the gender congruency effect. In Experiment 1, Croatian speakers were asked to name pictures by using sentences of the type *Vidim ga* [literally, "see it"], while ignoring the presentation of distractor words with the same- or different-gender value of that of the target's name. The pronoun in these sentences was a freestanding gender- (number- and case-) marked element (*ga* for masculine and *je* for feminine). Naming latencies were faster in the context of same-gender distractors than in the context of different-gender distractors, revealing that the gender congruency effect can be found in Slavic languages. In Experiments 2 and 3, participants were asked to name the same pictures by means of possessive adjective + noun NPs. Crucially, the noun's gender value in this type of utterance surfaces as an inflectional suffix attached to the adjective. For this type of NPs, same-gender distractors interfered as much as different-gender distractors. The gender congruency effect was absent both when the distractors were presented at the same time as the picture (Experiment 2, SOA 0) and when they were presented after the picture (Experiment 3, SOAs +75 and +150).

Summarizing, gender congruency effects were observed in the experiment in which the noun's gender value was necessary for the selection of a freestanding morpheme (Experiment 1). However, no gender congruency effects were observed in those experiments in which gender agreement surfaced as a bound morpheme—that is, an inflectional process.

These results have several implications. The first relates to the explanations given to the gender congruency effect observed in this paradigm. As already noted, Schriefers (1993) interpreted the effect as reflecting competition (or priming) at the level of grammatical feature selection, whereas Caramazza et al. (2001) located the effect at the level of determiner form selection. According to Schriefers' explanation, a gender congruency effect is expected whenever the noun's gender has to be selected, as in the case of the

[3] In a further analysis, the results of Experiments 2 and 3 were combined. The main effect of the variable gender relationship was not significant (both Fs < 1). Also the SOA (SOA 0, +75, +150) × Gender Relationship interaction was not significant (all ps $< .3$), suggesting that the difference between same- and different-gender distractors was similar across SOAs.

Croatian adjective + noun NPs tested in Experiments 2 and 3. However, contrary to that prediction, no gender congruency effect was obtained in any of those experiments. This result is consistent with the results reported by Schiller and Caramazza (2003), who failed to observe the effect in adjective + noun naming in Dutch and in German. It remains unclear what variable(s) may be responsible for the discrepant result reported by Schriefers (1993) in Dutch.

When we consider the absence of a gender congruency effect in the production of adjective + noun NPs, together with the absence of such an effect in the production of plural determiner + noun NPs in Dutch and in German, it seems reasonable to conclude that the effect does not arise at the level where the gender feature is retrieved but rather at the level at which competing determiner forms are selected (see Caramazza et al., 2001). Recall that in Dutch and in German plural NPs, a single determiner form (*de* and *die*, respectively) is used for all genders. Thus, the absence of a gender congruency effect for plural NPs localizes the congruity effect obtained with singular determiner + noun NPs at the level of determiner selection, as the effect is found only when alternative determiner forms and not alternative grammatical features are available for selection in a given context.

The results reported here also extend our understanding of the gender congruency effect in an important way by allowing a better characterization of the conditions under which the effect is observed. There are two empirical generalizations that we can make from the present results. First, the specific grammatical class of the word that carries the gender marking appears *not* to be a crucial factor for obtaining a gender congruency effect. There are three results that support this claim. The first is the contrasting results observed in Experiment 1 and in Experiments 2 and 3. Despite the fact that we used closed-class words in all the experiments (possessive adjectives and pronouns), the gender congruency effect was only present in Experiment 1. Second, gender congruency effects are not observed for adjectives when the noun's gender value surfaces as a suffix, regardless of whether they are closed-class (as the possessive adjectives used in our Experiments 2 and 3) or open-class words (as the adjectives used in Schiller and Caramazza, 2003). Third, gender congruency effects are observed for at least one other grammatical class, in addition to determiners, namely, for pronouns. Thus, it appears that grammatical class is not a relevant variable in determining the presence or absence of a gender congruency effect. The crucial variable appears to be whether the noun's gender value surfaces as a bound or a freestanding morpheme.

The second empirical generalization that we can make on the basis of our results concerns the phrasal contexts in which the gender congruency effect is observed. Given that all previous studies exploring such an effect had used simple NPs, it could have been claimed that the effect reflects a narrowly defined phenomenon related to the production of NPs of the format (determiner + noun) in which the agreement is computed locally (short-distance dependencies) and in which the target noun is produced. The results of our Experiment 1 reveal that this is not the case and that gender congruency effects can be obtained in other contexts besides simple NP production: They can be obtained with freestanding morphemes other than determiners and when the target's name is not produced (referential processing). This is an important observation because it shows that the gender congruency effect can be observed in many different contexts, making the lack of an effect in Experiments 2 and 3 a more informative datum.

Thus, it appears that several dimensions are *not* crucial for the presence of the gender congruency effect: (a) the close- or open-class membership of the gender-marked elements, (b) the type of utterance used in the experiment (provided that it requires gender access), (c) the grammatical class of the gender-marked freestanding morpheme, and (d) the type of agreement process (short distance or long distance). Considering these factors together, it seems that the only crucial condition for observing the gender congruency effect is that the gender of the noun surfaces as a freestanding morpheme during the production of an utterance.[4]

Why is it important to establish the cause(s) of the gender congruency effect? One reason is that it would help us to understand the selection process of lexical–grammatical features used in specifying phrasal agreement. Specifically, resolution of the locus of the gender congruency effect would allow us to decide whether the retrieval of a word's grammatical properties is a competitive process; that is, whether the availability of a word's grammatical features depends both on the level of activation of those features *and* on the level of activation of the corresponding grammatical features associated with other activated nouns. If the gender congruency effect is not located at the level at which the noun's gender feature is retrieved, then we cannot use this phenomenon to support claims specifically about the selection of grammatical features. If anything, and as has been discussed earlier, the pattern of results that is emerging from the studies that have manipulated grammatical gender in the picture–word interference paradigm is more compatible with the notion that the selection of a lexical node makes its grammatical properties available automatically (Caramazza et al., 2001).

Note that this conclusion is not in disagreement with those studies that have shown that number and/or gender agreement may be derailed in certain circumstances. A well-documented phenomenon is that of number and/or gender attraction that is found in experiments on agreement processing. For example, when participants have to complete a sentence fragment of the type "the label

[4] It may be possible to find a specific explanation for each utterance format that predicts the presence or absence of a gender congruency effect in that specific context. For example, one could argue that adjectives may behave in some particular way (different than determiners and pronouns) that prevents us from observing gender congruency effects in Experiments 2 and 3. We have argued that the reason why gender congruency effects are not observed with possessive and color adjectives is because the noun's gender value surfaces as a bound-morpheme rather than as a freestanding morpheme. However, we cannot exclude the possibility that adjectives behave in very different ways from pronouns and determiners, not because of the distinction between freestanding and bound morphemes but because of their grammatical class. Embracing such a view would require us to develop an explanation of why gender congruency effects interact with grammatical class in such a way as that they are not found for adjectives but they are found for pronouns and determiners. It is unclear at this point whether an explanation along such lines would be plausible. At any rate, the explanation we put forward in terms of freestanding versus bound-morphemes captures the whole pattern of results by appealing to only one dimension, making this explanation more parsimonious and, therefore, preferred.

of the bottles. . .” with the proper verb form *is*, they produce more agreement errors than they do if the two nouns in the sentence fragment have the same number value (“the label of the bottle”; see Bock et al., 1999). Participants also make more gender agreement errors when the two nouns have different genders than when they have the same gender (e.g., Vigliocco & Franck, 1999). In other words, the probability of producing the wrong gender or number inflection (or freestanding morpheme) is larger if the so-called “interloper” (the second noun) is of a different gender than that of the noun for which agreement has to be computed (the first noun). However, this effect does not imply that the gender features of the two nouns are competing for selection. Instead, it may simply reveal the fact that the process in charge of determining which grammatical features govern agreement (those of the first or those of the second noun) has derailed and has selected those of the wrong noun (the second rather than the first). In the process of building agreement in a task such as the one described here, the speaker needs to choose which head of the two NPs is the one that governs gender agreement. This decision may sometimes fail, leading to the selection of the wrong head (selecting the interloper rather than the first noun). If the two head nouns have the same gender, then no gender agreement error can arise, even when the system derails. However, if the two nouns have different genders, the selection of the incorrect head will result in a gender agreement error. The number/gender attraction phenomenon reveals properties of the mechanism of head selection and not properties of the selection of the grammatical features associated with specific words. In other words, this phenomenon is silent on the issue of whether the selection of a noun’s gender feature is an automatic consequence of noun selection or whether it is a competitive process that considers the activation levels of the features of all words that are currently active (but see Haskell & MacDonald, 2003, Thornton & MacDonald, 2003, for a recent model about subject–verb agreement).

An important question that remains unanswered is why the gender congruency effect is not found when gender determines only the selection of bound morphemes, as in the case of Experiments 2 and 3. That is, although a gender congruency effect is observed when the noun’s gender determines the selection of freestanding morphemes, no such effect is found when gender determines the selection of the bound forms. Later, we discuss two possible explanations for such a discrepancy.[5]

One explanation is strictly methodological—it has to do with possible limitations of the picture–word interference paradigm to reveal interference (or facilitation) effects in the selection of bound morphemes that “attach” at the end of words. In the languages tested to date, the gender inflection in the adjectives has always attached to the end of the word (e.g., *moj*/*moja* in Croatian [“my”]; *grüne*/*grüner*/*grünes* in German [“green”]). This means that the phonology of the adjective stem has to be retrieved before the gender inflection can attach to it. Under these conditions, it is possible that by the time the phonology corresponding to the adjective stem has been retrieved, any competition for the selection of the gender inflection could have been resolved. In other words, it is possible that there is selection competition between the inflections activated by the genders of the target noun and the distractor word, but because of the position of the gender inflection (in relation to that of the word stem) any effects of competition are rendered invisible in this experimental paradigm. Mitigating against this explanation of the absence of a gender congruency in the production of inflected forms is the result obtained in Experiment 1. In that experiment, the gender-marked pronoun is also produced in a noninitial position (after the verb in this case), and yet we did obtain a clear gender congruency effect.

Another explanation for the absence of a gender congruency effect in adjective + noun NPs hinges on intrinsic differences in the retrieval of inflections versus freestanding morphemes. In the introduction we mentioned the two conditions that need to be met for obtaining a gender congruency effect: (a) the gender value of the noun determines the different forms of determiners in a NP and (b) the selection of determiner forms depends only on grammatical and phrasal variables and, therefore, can be achieved as soon as that information is available. When these two criteria are met, as in the case of singular definite articles in Dutch and in German (and pronouns in Croatian), the gender congruency effect is observed. However, if the first condition is not met, as in the case of plural definite determiners in Dutch and in German, where there is only one determiner form for all the genders, no gender congruency effect is observed. When the second criterion is not met, as in the case of determiners in Romance languages, in which grammatical and phrasal information is not sufficient to specify the form of determiners, the gender congruency effect is also not observed.

The question then is whether the retrieval of the gender inflections that attach to the adjectives in Croatian meets the previously mentioned criteria. It clearly meets the first criterion: The gender of the noun determines which inflectional suffix will be produced for the adjective in adjective + noun NPs. What about the second criterion? Here the issue is far more complicated, and it depends on what assumptions we make about the structure of morphophonological processes.

Thus far, we have been assuming that the production of inflected adjectives involves a process of affixation in which a stem and a suffix are selected independently, and they are subsequently combined by a process of attachment in a phonological frame. On this view, an inflectional suffix has an independent phonological status similar to that of a stem. Consequently, it would be expected to be subject to the same principles of selection as any other phonological lexical forms. Thus, given the assumption that phonological-lexical forms are selected through a competitive process, we would expect that the selection of inflectional affixes would also be a competitive process. However, if we assume that morphophonological processes involve phonological transformations rather than the simple concatenation of bits of phonological material, then the role of grammatical features would not be to select a specific bit of phonological material but to select a phonological transformation.

[5] In the following, we have adopted the view that the lexical representations of the adjectives do not include their gender suffix. That is, words such as *moj* and *moja* (“my,” for masculine and feminine, respectively) are not represented as independent lexical nodes. Rather, we assume that there is a single representation that is retrieved from the lexicon, which undergoes morphophonological transformations leading to the production of the inflected forms. If this assumption was wrong and the possessive adjectives are represented as two freestanding morphemes (*moj* and *moja*), they should have behaved as the pronouns and the determiners in the context of experiments designed to reveal a gender congruency effect.

On this view, inflected forms are produced by transforming a base form into other forms and not by attaching affixes to bare stems (see Anderson, 1992; Scalise, 1994). Note that this view also captures the notion that the processes involved in inflectional morphology constitute a relatively independent system, which is governed by different principles than those involved in the retrieval of lexical items (Stump, 2001). It is an empirical question of great importance whether the selection of these transformations is a competitive process like the selection of lexical forms. Given our results, it would seem that morphophonological processes are not selected competitively. However, this conclusion is highly speculative, and we will need to collect direct experimental evidence before we can entertain it seriously.

To conclude, the results reported here along with other observations (Alario & Caramazza, 2002, Costa et al., 1999; Jescheniak & Schriefers, 1999; Miozzo & Caramazza, 1999; Schiller & Caramazza, 2003; Van Berkum, 1997; but see Jescheniak and Levelt, 1994) suggest that although the selection of lexical nodes may be a competitive process, the selection of their grammatical properties is an automatic consequence of lexical selection. Furthermore, the selection of morphophonological transformations also seems to be a noncompetitive process. Although the latter conclusion is quite speculative, it is consistent with the spirit of a major divide between two types of processes: the selection of freestanding lexical forms and the selection of grammatical features and their associated morphophonological processes—the former are selected competitively, the latter are selected automatically as a consequence of morphosyntactic processes.

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Appendix A

Brief Description of the Gender Systems in Croatian

Croatian belongs to the Slavic group of the IndoEuropean language family. Both have three grammatical genders, which are distributed as follows: Croatian masculine (40%), feminine (45%), and neuter (15%; Corbett, 1991). The small number of neuter nouns in both languages was the reason we chose to work with only two genders in our experiments.

The grammatical gender of a noun is relevant for the selection of morphological inflections in the case of, for example, adjectives, and for the selection of freestanding morphemes, such as pronouns. Nouns are marked for gender (three genders), number (two numbers: singular and plural), and case (seven in Croatian with an addition of vocative). Although noun inflections can indicate the gender of the noun, it is not always the case. For example, in Croatian, nouns ending in *a* are usually feminine (*kuća* [house], *lampa* [lamp]), in *e* are usually neutral (*dijete* [child], *sunce* [sun]), and in a consonant are usually masculine (*zrakoplov* [plane], *stol* [table]). However, there are nouns (e.g., $gazda_{\text{Masc}}$ [landlord], $misao_{\text{Fem}}$ [thought], $auto_{\text{Masc}}$ [car], $suptilnost_{\text{Fem}}$ [subtlety]) that depart from the above-mentioned rule. However, formal (phonological) properties of nouns do not reliably predict the gender value.

In Croatian, adjectives, which occupy always a pronominal position, are marked for gender, number, and case. In the nominative case, no suffix is added to the adjectives used with masculine nouns. When used with feminine nouns, adjectives take the suffix *a*; they take the suffix *e* when used with neuter nouns.

Most pronouns are marked for gender, number, and case. For example, the Croatian pronouns used in this study, *ga* and *je,* are the masculine and feminine versions of the pronoun *it* in the accusative case. Pronouns are freestanding morphemes, as they can occur on various positions in a sentence (e.g., *Vidim ga* [see it_{Masc}] for "I see it_{Masc}"; *Ja ga vidim* [I it_{Masc} see] for "I see it_{Masc}"; *Sigurno ga vidim* [certainly it_{Masc} see] for "I see it_{Masc} certainly"). The choice of *ga* or *je* depends only on the gender of the referent noun.

(*Appendixes continue*)

Appendix B

Words [and English Translations] Used in Experiments 1, 2, and 3

Picture	Same gender	Different gender	Semantically related	Unrelated
kua	*torba*	*duh*	*crkva*	*utrka*
[house]	[bag]	[ghost]	[church]	[race]
kravata	*lula*	*svitak*	*šal*	*ep*
[tie]	[pipe]	[scroll]	[scarf]	[cork]
rukavica	*luka*	*struk*	*arapa*	*etka*
[glove]	[harbour]	[waist]	[sock]	[brush]
jabuka	*magla*	*prsluk*	*šljiva*	*ploa*
[apple]	[fog]	[lapel]	[plum]	[board]
lopata	*knjiga*	*posao*	*eki*	*šator*
[shovel]	[book]	[business]	[hammer]	[tent]
noga	*pjesma*	*prsten*	*ruka*	*igra*
[leg]	[song]	[ring]	[arm]	[game]
podmornica	*arulja*	*runik*	*amac*	*duhan*
[submarine]	[bulb]	[towel]	[boat]	[tobacco]
šalica	*farma*	*klaun*	*aša*	*bajka*
[cup]	[farm]	[clown]	[glass]	[tale]
viljuška	*svijea*	*svjetionik*	*lica*	*smokva*
[fork]	[candle]	[lighthouse]	[spoon]	[fig]
truba	*zmija*	*kaput*	*klarinet*	*odvija*
[trumpet]	[snake]	[coat]	[clarinet]	[screwdriver]
haljina	*groznica*	*novanik*	*suknja*	*grana*
[dress]	[fever]	[wallet]	[skirt]	[branch]
mrkva	*kemija*	*buket*	*krastavac*	*radijator*
[carrot]	[chemistry]	[bouquet]	[cucumber]	[radiator]
cipela	*baraka*	*kola*	*izma*	*lopta*
[shoe]	[hut]	[cake]	[boot]	[ball]
gitara	*plaa*	*oblak*	*saksofon*	*patlidan*
[guitar]	[beach]	[cloud]	[saxophone]	[eggplant]
krevet	*zglob*	*tableta*	*ormar*	*ured*
[bed]	[wrist]	[tablet]	[wardrobe]	[office]
auto	*krov*	*lampa*	*traktor*	*tulipan*
[car]	[roof]	[lamp]	[tractor]	[tulip]
prst	*kostim*	*trešnja*	*jezik*	*mir*
[finger]	[costume]	[cherry]	[tongue]	[peace]
vr	*poklon*	*košulja*	*boca*	*oma*
[pitcher]	[gift]	[shirt]	[bottle]	[noose]
limun	*azil*	*kada*	*narana*	*kapela*
[lemon]	[asylum]	[bath]	[orange]	[chapel]
stol	*rat*	*ulica*	*kau*	*metak*
[table]	[war]	[street]	[couch]	[bullet]
nos	*luk*	*vaka*	*vrat*	*radio*
[nose]	[onion]	[chewing gum]	[neck]	[radio]
kruh	*ma*	*veera*	*sir*	*veo*
[bread]	[sword]	[dinner]	[cheese]	[veil]
klavir	*most*	*igla*	*violina*	*ladica*
[piano]	[bridge]	[needle]	[violin]	[drawer]
kist	*sok*	*tava*	*olovka*	*strijela*
[paintbrush]	[juice]	[pan]	[pencil]	[arrow]
šešir	*park*	*bomba*	*kapa*	*kruška*
[hat]	[park]	[bomb]	[cap]	[pear]
prozor	*ananas*	*bundeva*	*vrata*	*toka*
[window]	[pineapple]	[pumpkin]	[door]	[point]
tanjur	*sat*	*rua*	*lonac*	*kljun*
[plate]	[clock]	[rose]	[pot]	[beak]
avion	*klju*	*palaa*	*vlak*	*ugao*
[airplane]	[key]	[palace]	[train]	[corner]

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