

The Selection of Determiners in Noun Phrase Production

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Picture–word interference experiments conducted with Italian speakers investigated how determiners are selected in noun phrase (NP) production. Determiner production involves the selection of a noun’s syntactic features (mass or count, gender), which specify the type of determiner to be selected, and the subsequent selection of a particular phonological form (e.g., *the/a* in English). The research focused on the syntactic feature of gender. Results repeatedly failed to replicate the gender–congruity effect in NP production reported with Dutch speakers (longer latencies for target–distractor noun pairs with contrasting as opposed to the same gender). It is proposed that the discrepant results reflect processing differences in lexical access in Italian and Dutch: The selection of determiners in Italian, but not in Dutch, depends on phonological properties of the word that follows it in the NP. Evidence consistent with this explanation was obtained in an experiment in which determiner selection in NP production was hindered by conflicting phonological information in the NP.

Determiner production involves the selection of a set of grammatical features that jointly specify a determiner type, followed by the selection of a specific phonological form. For example, the production of the determiner “a” (as in “a car”) requires the selection of the features indicating [nondefinite], [singular], and [count noun]. Some of the features are context specific (e.g., “definite”), and others are specified lexically (mass or count, gender). These features jointly specify the type of determiner that will be selected for production. Thus, the problem of determiner production can be broken down into two distinct problems: How are grammatical features represented and selected? How is the phonological form of a determiner selected? In this research we examined the issues of syntactic feature selection (Experiments 1–4) and determiner form selection (Experiments 3–5).

The Selection of a Word’s Syntactic Features

How are a word’s syntactic features represented and accessed? A modified version of the picture–word interference paradigm has been used to obtain results that are relevant to this issue (Schriefers, 1993). In the picture–word interference paradigm, a picture and a word are presented concomitantly to the reader. Numerous researchers have

demonstrated that picture naming is affected by the concomitant presentation of a word (e.g., Glaser & Dünghoff, 1984; La Heij, 1988; Lupker, 1979, 1982; Meyer, 1996; Posnansky & Rayner, 1977; Schriefers, 1992; Schriefers, Meyer, & Levelt, 1990; for a review, see Glaser, 1992; MacLeod, 1991). Several factors have been shown to modulate the word’s interference effect. For example, picture naming is more difficult if the word is semantically (categorically) related to the picture: It takes longer to name the picture *table* when it appears with the word *desk* than with the word *duck*. Furthermore, the interference effect is at a maximum when the target picture and the word are shown simultaneously, or within a ± 100 -ms interval. The innovation introduced by Schriefers (1993) was to vary the syntactic features of target and distractor words.

Schriefers (1993) explored the effect of varying *grammatical gender* on the picture naming performance of Dutch speakers. To test this possibility, he varied gender relatedness in a picture–word interference naming task. Dutch speakers were required to produce noun phrases (NPs) of the type determiner + adjective NPs (e.g., “the red table”) and adjective NPs (e.g., “red table”) in response to colored pictures. In designing his experiments, Schriefers took advantage of the fact that in Dutch, determiners and adjectives (in some contexts) are marked for gender. Dutch has two determiners for singular nouns: “het” used for neuter gender nouns and “de” used for common, nonneuter gender nouns (historically feminine or masculine nouns; see, e.g., van Berkum, 1997). With plural nouns, the determiner “de” is used for both neuter and nonneuter gender nouns. When an adjective NP is produced without the determiner (as in “groene stoel” [“green chair”]), the adjective is marked for gender. That is, a schwa is added to the end of the adjective for nouns that are singular and nonneuter, whereas the citation form (which is identical to the stem) is used for singular nouns that are neuter (e.g., “groen boek” [“green book”]). For plural adjective NPs a final schwa is added to the adjective for both neuter and nonneuter gender nouns.

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Schriefers reasoned that by asking speakers to produce NPs in naming a picture, it might be possible to directly investigate how syntactic information is accessed. Specifically, he investigated whether the gender of the distractor noun would affect picture naming time. For this purpose he compared naming times for pictures paired with words of the same or different gender (i.e., whether the picture name and distractor noun took the same or different determiners and affixes). The results of his experiments were clear-cut: Naming latencies were longer when a target and distractor had different genders. This effect of gender congruity has been replicated in other studies conducted with Dutch speakers by La Heij, Mak, Sander, and Willeboordse (1998) and by van Berkum (1997). Thus, it seems that (at least in Dutch) the interference effect of gender is replicable and robust.

Critical for the interpretation of the gender-congruity results is the fact that in many languages, including Dutch, Italian, French, German, or Arabic, gender cannot be strongly predicted on the basis of the semantic and phonological properties of the noun (see, e.g., Corbett, 1991). With the exclusion of the relatively few cases in which gender is a semantic (male or female) feature of the concept (e.g., "mother," "uncle," "cow"), there is no obvious semantic basis for the gender taken by a given noun. This fact can be further appreciated by noting that the gender of a noun varies across languages. Thus, for example, "flower," "table," "plate," and "flute" are masculine in Italian but feminine in French, and "bag," "Sunday," "pencil," and "tiger" are feminine in Italian but masculine in French. If gender assignment were dictated by the semantics of a word, a noun's gender should be the same across languages. Similarly, a noun's gender is not determined by its phonology. To be sure, in some languages there may be a nonnegligible correlation between these two properties of a word. For example, in Italian feminine nouns tend to end in /a/, whereas masculine nouns tend to end in /o/. However, there are many exceptions to this pattern: There are many masculine words that end in /a/, /e/, and /i/ and many feminine words that end in /o/, /e/, and /i/. In fact, among the 3,000 most frequent words in Italian, only 66% of nouns have a regular ending (De Mauro, Mancini, Vedovelli, & Voghera, 1993). These observations suggest that a word's gender is autonomously specified with respect to its semantic features and its phonological form. Empirical support for this conclusion has been obtained in investigations conducted with neurologically intact speakers (Caramazza & Miozzo, 1997; Jescheniak & Levelt, 1994; Miozzo & Caramazza, 1997; Vigliocco, Antonini, & Garrett, 1997) and patients with brain damage (Badecker, Miozzo, & Zanuttini, 1995; Henaff-Gonon, Bruckert, & Michel, 1989).

Schriefers (1993) interpreted his finding of gender interference in the framework of a model of lexical access that distinguishes among several levels of lexical representation and processing (Jescheniak & Levelt, 1994; Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992, 1997). In this model, syntactic information is specified at the level of the lemma representation, an abstract lexical node that mediates between the semantic representation of the word and its

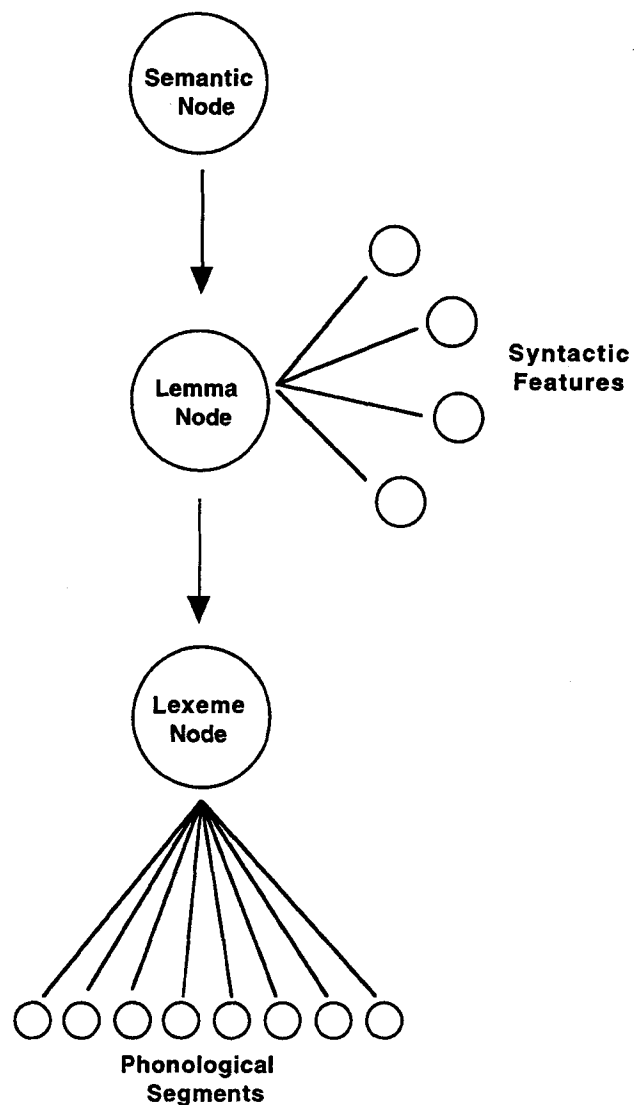


Figure 1. Fragment of the lexical system showing the relation between the lemma and other levels of lexical representation.

lexical-phonological representation.¹ Thus, two functions are attributed to lemmas. First, they mediate between the access of semantic and modality-specific lexical representations (also called *lexemes*). Second, and more relevant for our purposes, lemmas directly activate a word's syntactic features. A schematic representation of this model is depicted in Figure 1. Schriefers interpreted his results as

¹ The claim that there is a separate modality-independent lexical node between semantic representations and lexical-phonological representations is controversial (for discussions, see Caramazza, 1997; Caramazza & Miozzo, 1997, 1998; Miozzo & Caramazza, 1997; Roelofs, Meyer, & Levelt, 1998). However, whether one postulates two lexical nodes between a word's semantic representation and its phonological content or just one lexical node does not affect the nature of the arguments developed here.

indicating that as soon as the lemma representation is activated, activation “automatically” spreads to its syntactic nodes. He argued that the automatic activation of the gender feature of the distractor noun would interfere with the selection of the gender feature of the picture name when these do not match; that is, with gender-incongruent distractors “the selection threshold for the correct gender information will be reached later and selection of the correct gender information will be delayed” (Schriefers, 1993, p. 843).

In Dutch, the form of the article and the inflectional morpheme of the adjective are fully determined by the syntactic properties of the noun. Thus, for example, it is sufficient to know that a noun is singular and neuter to select the determiner *het*. This fact complicates the interpretation of the effect of gender interference observed in Dutch. It is unclear whether this effect arises at the level where the gender feature or the form of the determiner is specified (and, obviously, these two alternatives need not to be mutually exclusive). Schriefers (1993) interpreted the gender-congruity effect as reflecting competition in the selection of the gender feature. However, an alternative explanation for his results is that they reflect competition in the selection of specific determiners (or inflectional morphology in the case of adjective NPs), not competition in the selection of gender nodes. In this view, the activation and selection of a gender node is an automatic (noncompetitive) consequence of lexical node selection. However, selection of determiners is a competitive process just like the selection of lexical nodes. Consequently, if a word distractor were to take a different determiner from the target response, there would be competition at the level of determiner selection. That is, word distractors activate their associated determiners, which interfere with the selection of the determiners of the target words for the same reasons hypothesized by Schriefers: The selection threshold for the correct determiner will be reached later and its production will be delayed. The results reported by Schriefers do not allow an unambiguous choice between these two possibilities. To choose, the individual would have to uncouple the possible effects of gender selection from those of determiner selection. This is possible in Italian, in which the selection of a noun’s gender does not fully determine its determiner.

In Italian, gender-marked words (including the determiners) can be either masculine or feminine. There are two forms of feminine determiners: “la” for singular nouns and “le” for plural nouns. The picture is slightly more complex for masculine determiners, for which there are four forms: two singular (“il” and “lo”) and two plural forms (“i” and “gli”). The choice of a specific singular–plural pair (“il” and “i” or “lo” and “gli”) depends on the phonological characteristics of the word that follows it in the NP. The determiner “lo” (“gli”) is selected when the following word’s onset consists of a vowel, a consonant cluster of the form “s + consonant” or “gn,” or an affricate. In all other cases, the determiner “il” (“i”) is selected. This means that the selection of the form of the article in determiner NPs can take place only once the onset of the first syllable of the noun has been selected. The selection of the noun’s gender feature, then, can determine only the allomorphic set of

determiners and not its actual phonological form. To select a specific determiner, the system needs detailed information about the word that will follow it. Thus, in Italian, unlike in Dutch, there is not a complete match between a noun’s syntactic properties and the form of the determiner. This fact makes Italian determiners suitable for investigating the locus of the gender-congruity effect. We can investigate whether the effect reflects interference at the level of gender, determiner selection, or both. We begin with an attempt to replicate the phenomenon of gender congruity in Italian.

Experiment 1: Determiner + Adjective NPs

This experiment is a replication in Italian of Schriefers’s (1993, Experiment 1) adaptation of the picture–word interference paradigm to the production of NPs. In this task, speakers are required to name colored pictured objects by producing a full NP, including the article, adjective, and noun (e.g., “the black table”).

In Italian, determiners and adjectives are both marked for number and gender. The rules governing the selection of determiners were described in the preceding section. The inflectional morphology of adjectives is highly regular: The inflections *-o* and *-i* are used for masculine singular and plural adjectives, respectively; the inflections *-a* and *-e* are used for feminine singular and plural adjectives, respectively. Thus, for instance, to say “the black table” [“tavolo”_{masc}], the singular masculine form of the adjective (“ner-*o*”) is required (“il tavolo nero”); to say “the black chair” [“sedia”_{fem}], the singular feminine form (“ner-*a*”) is selected (“la sedia nera”). The plural forms would be “neri” and “nere,” respectively (here we ignore the case of e-ending adjectives, which are marked only for number).

Although this experiment was designed to be a replication of Schriefers’s (1993) Experiment 1, there are inevitably a number of discrepancies caused by differences in the structure of Italian and Dutch. Italian adjectives denoting colors are typically postnominal and are always marked for gender, whereas Dutch adjectives are prenominal and, in NPs that contain a determiner, are not marked for gender. Furthermore, we designed only a “stripped down” version of Schriefers’s experiment because a number of the factors considered in that experiment are not relevant here. Thus, for example, color words were not used as distractors because this condition does not speak directly to the phenomenon of gender interference. Furthermore, we used only one stimulus onset asynchrony condition—simultaneous presentation of picture and distractor—because this variable need not be manipulated to observe a possible gender interference effect.

Two distractor features were varied: (a) the semantic (categorical) relation between the picture and the word and (b) the gender (same or different) of the nouns in the target–distractor pairs. Thus, on some trials pictures and distractors were semantically related, whereas on other trials they were semantically unrelated; on some trials targets and distractors had the same gender, whereas on other trials their genders were different. The principal focus of the experiment was to determine whether the effect of gender interference observed in Dutch could be replicated in Italian. A

second objective of the experiment was to replicate a semantic interference effect for picture–word pairs. The semantic interference effect is a robust feature of the picture–word interference paradigm, and its presence in our experiment would guarantee that we had the power to detect a gender effect of roughly the magnitude of the semantic interference effect.

To maximize the probability of getting a gender effect, we observed the following two precautions. First, because Schriefers (1993) found a sizable effect of gender only with simultaneous presentation of pictures and words, we restricted our procedure to this condition. Second, the relation of target–distractor gender was manipulated in two separate sets of items. This allowed us to investigate the effect of gender with a relatively large number of observations (148 per participant) as well as to assess the replicability of any effect of gender across word sets.

Method

Participants. Twelve Italian students at the University of Padua (aged 19–26 years) were recruited for this experiment. They were paid for their participation.

Materials. Two sets of pictures were selected: a set of experimental items and a set of filler items. The criteria for choosing the targets and the distractors of the experimental set were the same as those used by Schriefers (1993): (a) For each semantic category, two pictures were selected, one with a masculine and the other with a feminine name; (b) each picture was paired with two related words (i.e., names of other items from the same semantic category) and two unrelated words (i.e., names of items from a different semantic category); and (c) gender and semantic relation between picture name and distractor were varied orthogonally. To illustrate this last point, the picture “lemon” (“limone”_{masc}) was paired with four words. Two words were of the same gender: one from the same semantic category (“fico”_{masc}[fig]) and the other from an unrelated category (“polo”_{masc}[pole]). Two words were of the different gender: one from the same semantic category (“pera”_{fem}[pear]) and the other from an unrelated category (“bara”_{fem}[coffin]). The picture also appeared with a string of 5 Xs (the control condition). The experimental set comprised a total of 22 pictures. Masculine and feminine target nouns were of comparable frequency ($t < 1$; norms were taken from the Istituto Italiano di Linguistica, Pisa, Italy). All masculine nouns took the singular determiner “il.” The gender-congruent distractors that were paired with a picture were matched for frequency and had the same number of syllables and consonant–vowel (CV) structure (the only exception was the pair *mento–bronzo* [chin–bronze]). The pairs of gender-incongruent words were selected in the same way. A two-way analysis of variance (ANOVA) was carried out to determine whether distractors’ frequency would vary as a function of semantic relatedness and gender. No significant results were found ($F_s < 1$). Finally, precautions were taken to avoid phonological overlap between the pairs of targets and distractors because previous studies have shown that phonological similarity can attenuate the picture–word interference effect (e.g., Lupker, 1982; Meyer & Schriefers, 1991; Posnansky & Rayner, 1977; Rayner & Springer, 1986; Starreveld & La Heij, 1995, 1996). The initial phoneme was the same in four (4.5%) of the pairs (two gender congruent and two gender incongruent). However, none of the word pairs rhymed, nor was there any systematic phonological overlap in the middle parts of words.

Pictures of the filler items ($n = 30$) were shown only three times,

twice with a word and once with a string of Xs (control condition). Half the filler pictures had masculine names, and the other half had feminine names. All masculine targets took the definite singular article *il*. Picture–word pairs were not semantically related in any obvious way. Only 3 of 60 (5%) pairs of stimuli shared the same initial phoneme, and in no case did the pairs rhyme or systematically share the middle part. Each filler picture was presented once with a distractor word of the same gender and once with a distractor word of different gender. Pairs of word distractors had the same number of syllables and CV structure (the only exception was the pair *corno–coppia* [horn–pair]) and were comparable with respect to frequency ($t < 1$). Note that because gender was systematically varied for both experimental items and fillers, the effect of gender could be examined in both sets of stimuli. Over all trials (experimental and filler items), only a relatively small proportion of cases (44; 22%) involved semantically related picture–word pairs. This was done to minimize the likelihood that participants would develop strong expectations concerning the relationship between picture–word pairs.

Pictures were presented in two colors: black or white. Black pictures were drawn with a white outline on black background, thus appearing as black objects; white pictures were drawn with a black outline on a white background. Because the items in the experimental set were presented on 5 trials, the number of times individual pictures were presented in one of the two colors varied (2 or 3 trials in white or black). Similarly, because each filler picture was presented three times, it appeared in a particular color on 1 or 2 trials. The color of pictures was counterbalanced across conditions. The words were shown in 20-point boldface capital letters in Geneva font and were superimposed on the pictures. Pictures were centered at fixation, and word position varied randomly in the region around fixation to prevent participants from systematically fixating the portion of the picture not containing the distractor (see Glaser & Glaser, 1989; La Heij, Van der Heijden, & Schreuder, 1985). However, for an individual picture, the position of all its distractors was the same.

The stimuli were presented in five blocks of 40 trials each. In a block, targets and distractors of the two grammatical genders were equally represented. Black and white pictures, semantically related and unrelated words, and gender-congruent and -incongruent words were evenly distributed across blocks. An individual picture appeared only once per block. Within each block, trials were randomized with the following restrictions: (a) Targets could have the same gender or color on no more than 3 consecutive trials; (b) pictures in successive trials could not belong to the same category; and (c) stimuli of the same experimental condition could appear on no more than 2 consecutive trials. A block started with three warm-up stimuli, which were later discarded from the analyses. The order of presentation of the trials in a block remained constant. However, the order of presentation of the five blocks was varied across participants. A practice block of 20 trials was also shown before the experiment proper. None of the pictures and words of the practice block was part of the sets of stimuli shown later in the experiment.

Procedure. Participants were tested individually. They were seated in a dimly lit testing room at a distance of about 80 cm from the computer screen. Before the experiment proper, participants were asked to name the pictures that would be later used in the experiment. Pictures (including those used in the practice block) were shown with a superimposed row of Xs. In the few cases in which participants produced a picture name that differed from that expected by the experimenter, they were invited to use the designated noun. Participants were informed that they would see pictures of different color with superimposed words and that they were required to name only the pictures and, specifically, to

produce NPs containing the determiner, the noun, and the adjective (in that order). Response speed and accuracy were both emphasized. After the instructions, participants performed the practice trials.

The following events occurred in a trial. First, a fixation point (a cross) appeared for 700 ms, which was then replaced by the stimulus. Pictures and words were shown simultaneously. Stimuli remained on the screen until a response was provided, or for a maximum of 1.5 s. Participants initiated the next trial by pressing the space bar. Stimulus presentation was controlled by the MacLab program (Costin, 1988). Response latencies were measured from the onset of the stimulus to the beginning of the naming response with a voice key (Lafayette Instruments, Lafayette, Indiana). The experimenter recorded participants' responses. An experimental session lasted approximately 40 min.

Analyses. Three types of responses were classified as errors: (a) production of the wrong determiner, name, or adjective; (b) verbal disfluencies (stuttering, utterance repairs, production of nonverbal sounds that triggered the voice key); and (c) failures by the voice key to record the response. The reaction times (RTs) of erroneous responses were replaced by a participant's condition means. The same procedure was adopted with responses that were 3 *SDs* from a participant's mean. ANOVAs were performed to examine error rates and response latencies. For response latencies, separate analyses were carried out with participants and items as random variables, yielding F_1 and F_2 statistics, respectively. The fact that the color of an individual picture varied across trials complicated an analysis with items as a random factor. However, if it is assumed that the variation of picture color did not induce any noticeable effect on item responses, an ANOVA by items could be performed. In separate analyses, we assessed whether response latencies were longer for pictures paired with word distractors than *Xs*. For this purpose, responses to *Xs* were compared with the mean of the responses to word distractors. The analyses were replicated with errors as a random factor. The results of the error analyses are reported only when they are significant.

Results and Discussion

The distribution of mean response latencies and errors as a function of item set and type of distractor is shown in Table 1. Error rates were identical (6%) for experimental and filler items. Erroneous responses were distributed as follows: 1.2%, 0.4%, and 0.7% for unexpected noun, determiner, and

adjective production, respectively; 1.2% for verbal disfluencies; and 1.6% for voice key malfunctioning. In the experimental set, error incidence was unequal across conditions, $F_1(4, 11) = 4.5$, $MSE = 21.8$, $p < .01$, reflecting more frequent errors with semantically related than unrelated distractors, $F_1(2, 11) = 19.4$, $MSE = 5.8$, $p < .002$, and with word distractors than *Xs*, $F_1(1, 11) = 8.8$, $MSE = 11.1$, $p < .02$.

Compared with the control condition (*Xs*), the presentation of a word distractor caused a sizable increase in response latencies, both in the experimental set (68 ms), $F_1(1, 11) = 12.9$, $MSE = 2,204.4$, $p < .01$, and $F_2(1, 21) = 35.5$, $MSE = 1,760.8$, $p < .0001$, and the filler set (46 ms), $F_1(1, 11) = 6.9$, $MSE = 1,864.5$, $p < .05$, and $F_2(1, 29) = 11.1$, $MSE = 3,129.4$, $p = .002$. For experimental items, responses were longer with related than unrelated stimuli (33 ms), $F_1(1, 11) = 8.3$, $MSE = 1,619.6$, $p = .01$. Mean naming latencies with gender-congruent and -incongruent pairs were nearly identical (781 vs. 782 ms; $F_1 < 1$). Furthermore, there was no sign of an interaction between the two factors ($F_1 < 1$). These results were confirmed in the analysis by items: Only the factor of semantic relatedness affected response latencies, $F_2(1, 21) = 12.4$, $MSE = 2,147.7$, $p = .002$, and for both gender and the interaction of the two factors ($F_2 < 1$). With fillers, response latencies were 19 ms longer when target and distractor had nouns of a different gender, a difference that was not statistically significant, $F_1(1, 11) = 3.2$, $MSE = 675.0$, $p = .10$, and $F_2(1, 29) = 1.4$, $MSE = 2,743.6$, $p = .24$.

Two clear results were obtained in this experiment: Semantic relatedness influenced the retrieval of picture names, but there was no effect of gender congruity. The latter result was obtained with two sets of items—the experimental and filler sets (although there was a nonsignificant trend in the latter set)—attesting to the generality of the result. Furthermore, because we obtained a strong and reliable effect of semantic relatedness, we were confident that the experimental paradigm had the power to reveal a gender effect of about 35 ms.

Experiment 2: Determiner NPs

Our failure to replicate the result of gender interference in Italian undermines the generality of this phenomenon. Nonetheless, it is still possible that the reason for our failure to replicate the gender-congruity effect could be because of some variation introduced in our experimental design. In particular, although Experiment 1 was intended to be a direct replication of Schriefers's (1993) Experiment 1, differences in the structure of NPs in Italian and Dutch necessarily introduced task variations that could be responsible for the discrepancies in results. In Italian, color adjectives are typically postnominal and are always marked for gender, whereas in Dutch, they are prenominal and when they appear with a determiner they are not marked for gender (the citation form is used). These differences in the structure of NPs in the two languages translate into differences in the use of gender information in the course of NP production: In Italian, gender information is used for the selection of the

Table 1
Mean Naming Latencies and Errors as a Function of Target Set and Distractor Type (Determiners + Adjective Noun Phrases) in Experiment 1

Target and distractor	Mean latencies (ms)	% errors
Experimental set		
Semantically related		
Same gender	800	9
Different gender	797	9
Semantically unrelated		
Same gender	762	5
Different gender	768	4
Control (<i>Xs</i>)	713	3
Fillers		
Same gender	775	6
Different gender	794	8
Control (<i>Xs</i>)	738	4

first (the determiner) and the last element of the NP (the inflectional morphology of the adjective); in Dutch, gender information is used only for the selection of the initial element (the determiner) of the NP. Although it is unclear how these cross-linguistic discrepancies might translate into specific differences in the gender interference effect, this possibility can be empirically evaluated by considering naming performance with simple determiner NPs in Italian. NPs of this type allow a direct comparison of the results in Italian and Dutch: In both languages, determiners are marked for gender. Furthermore, because La Heij et al. (1998) found a significant gender interference effect when Dutch speakers were asked to produce determiner NPs, we should find a similar effect in Italian.

Method

Participants. Fifteen Italian students at the University of Padua took part in the experiment. None had participated in the previous experiment. They were paid for their participation.

Materials and procedure. The materials and procedures were the same as in Experiment 1, except for the following two modifications: (a) Only pictures with a black outline and white background (white pictures) were shown and (b) participants responded by producing determiner NPs.

Results and Discussion

The mean correct naming latencies and errors in the various conditions and response sets are reported in Table 2. Error rates were identical in the two sets of stimuli (7%). Erroneous responses were distributed as follows: 1.9% and 1.3% for unexpected noun and determiner production, respectively; 2.1% for verbal disfluencies; and 1.8% for voice key malfunctioning.

Longer naming latencies were obtained for words than for control distractors (Xs), both with experimental items (63 ms), $F_1(1, 14) = 29.8$, $MSE = 1,024.4$, $p = .0001$, and $F_2(1, 21) = 43.0$, $MSE = 1,137.4$, $p < .0001$, and with fillers (74 ms), $F_1(1, 14) = 36.3$, $MSE = 1,153.0$, $p < .0001$, and $F_2(1, 29) = 73.1$, $MSE = 1,162.2$, $p < .0001$. In the experimental set, naming latencies were 27 ms longer with

semantically related than unrelated distractors ($M_s = 783$ and 756 ms, respectively), $F_1(1, 14) = 10.7$, $MSE = 985.7$, $p < .01$, and $F_2(1, 21) = 9.1$, $MSE = 1,960.4$, $p < .01$. In the same set, mean response latencies were comparable for gender-congruent and -incongruent pairs (774 vs. 765 ms, respectively), $F_1(1, 14) = 1.7$, $MSE = 712.6$, $p = .22$, and $F_2(1, 21) = 1.6$, $MSE = 1,644.8$, $p = .21$. No evidence of an interaction between semantic relatedness and gender was found ($F_s < 1$). With fillers, too, there was no significant difference between gender-congruent and -incongruent conditions (6 ms; $F_s < 1$).

The results of this experiment are clear-cut. We again failed to obtain a gender-congruity effect in Italian. The contrasting findings obtained in Italian and Dutch are puzzling. What might the reason be for this outcome? A possible cause may be found in the different roles played by phonology in the selection of determiners in Italian and in Dutch. In the introduction we noted that in Italian, but not in Dutch, the selection of determiners depends on phonological characteristics of the following word. This difference could be responsible for the contrasting results.

The structure of gender systems in Italian and Dutch. In Dutch, the selection of a determiner (or the inflection of an adjective) is determined strictly and only by the gender (and the number) of the noun. Once a lexical node has been selected, the subsequent selection of the form of the determiner and the adjective's inflection is fixed. Gender agreement in Italian is considerably more complex. The selection of the form of a determiner is not dependent only on the gender (and the number) of the noun but also on the noun's phonological form. Thus, for example, whether the "il" ("i" for plural) or the "lo" ("gli" for plural) form of the masculine determiner is selected in an NP depends on the phonological characteristics of the following word. An implication of these constraints on the selection of determiner forms in Italian is that, unlike in Dutch, both syntactic (the noun's gender) and phonological information (the noun's or the adjective's initial segment in prenominal adjective constructions) must be available before the determiner's form can be selected.

These differences in the structure of the gender systems in Italian and Dutch could affect the way in which determiners are selected in the two languages. Specifically, it is possible that because selection of determiners in Dutch does not depend on the phonology of the words that follow them, they could be selected relatively early in the course of NP production. In Italian, by contrast, because the selection of a determiner depends on having available information about the initial segment of the word that follows it in the NP, the selection of a specific determiner form will occur relatively late in the course of NP production. If these speculations were correct, we would have a possible explanation for why gender-congruity effects are observed in Dutch but not in Italian. The argument goes as follows: In Dutch, the selection of the gender (and the number) of the target lexical node is sufficient to initiate the process of selection of the determiner's form. Thus, any delay in the selection of a word's gender feature will slow down the selection of its associated determiner form and will be detected in speeded

Table 2
Mean Naming Latencies and Errors as a Function of Target Set and Distractor Type (Determiner Noun Phrases) in Experiment 2

Target and distractor	Mean latencies (ms)	% errors
Experimental set		
Semantically related		
Same gender	786	8
Different gender	780	8
Semantically unrelated		
Same gender	762	7
Different gender	750	7
Control (Xs)	706	3
Fillers		
Same gender	790	7
Different gender	784	8
Control (Xs)	713	6

phrase production tasks. In Italian, knowledge of the noun's phonological form is necessary for the selection of a determiner form (in determiner NPs). There is evidence that a word's phonological content becomes available later than its gender feature (van Turenout, Hagoort, & Brown, 1998). Furthermore, because the selection of a specific determiner cannot occur until the noun's phonological content is available, it follows that the selection of a determiner form cannot begin immediately at the selection of the word's gender feature but must wait for the selection of the relevant phonological context. This means that in Italian, unlike in Dutch, there may be substantial lag between the selection of a noun's gender feature and the selection of its determiner form. As a consequence, in Italian, any effect of gender congruity smaller than the built-in lag between the selection of a noun's gender and the selection of a determiner form will be invisible in NP production tasks. In other words, our failure to replicate the gender-congruity effect in Italian could mean either that gender congruity does not affect lexical selection and production processes or that it does affect these processes but is masked by the lag between gender and determiner form selection. We return to these issues in the General Discussion section. For now, we turn to the issue of determiner form selection.

The selection of determiner forms. In the introduction, we raised the question of whether the congruity effect observed by Schriefers (1993; see also La Heij et al., 1998; van Berkum, 1997) arises at the level of gender or determiner selection. We also noted that the structure of Italian allows researchers to distinguish between these alternatives. Our failure to replicate the effect of gender congruity in Italian forced us to reformulate our original question. Because we were not able to replicate the gender-congruity effect, the issue of whether such an effect is due to competition in gender node selection or competition in determiner form selection is moot. In fact, our results invite the inference that there is neither a gender- nor a determiner-congruity effect in Italian. This conclusion must be tempered by the observation that in Experiments 1 and 2, determiner congruity was completely confounded with gender congruity, a situation that does not provide the relevant conditions for revealing an effect of determiner congruity independent of gender congruity (see below). The relevant conditions are provided by considering the production of different masculine determiners.

Recall that in Italian, the masculine singular determiner can be either "il" or "lo" depending on the onset of the following word. For example, we say "il tavolo" ["the table"] but "lo zaino" ["the backpack"]. The selection of a determiner form is a process that can be initiated only once a gender node has been specified, and it is governed by phonological but not lexical principles (unlike gender selection). In other words, independent of the factors that determine the selection of gender nodes, there is the subsequent problem of selecting a determiner form that is appropriate for the phonological context in which it is to be embedded. Also, if determiners compete for selection, one should find a determiner-congruity effect. Furthermore,

because at this level of processing gender selection has been resolved, the only competition that can be observed is between the determiners for a given gender. This possibility can be tested by means of target-distractor pairs that have onsets requiring different masculine determiners. Consider the pairs "tavolo-sapone" [soap] and "tavolo-zaino." The target "tavolo" takes the masculine singular determiner "il" as does the distractor "sapone"; however, the distractor "zaino" takes the masculine singular determiner "lo." Assuming that the distractor activates its phonological features, the word distractor "zaino" should activate the determiner "lo" and the word distractor "sapone" should activate the determiner *il*. This should make the selection of the target's determiner *il* more difficult for the pair "tavolo-zaino" than for the pair "tavolo-sapone." Consequently, longer response latencies should be observed with different-determiner pairs such as "tavolo-zaino" than same-determiner pairs such as "tavolo-sapone." This prediction was tested in Experiment 3.

Experiment 3: Masculine Determiner NPs

In this experiment, we examined whether determiner agreement in target-distractor pairs would affect determiner production in simple determiner NPs. Another objective of this experiment was to again attempt to find a gender interference effect with two new sets of stimuli. Given our failure to find a gender interference effect in the preceding experiments, it seemed unlikely that we would observe such an effect here. Nevertheless, additional evidence would bolster the reliability of our findings concerning gender congruity.

Method

Participants. Twenty-five Italian students at the University of Padua participated in the experiment. None of the participants took part in any of our other experiments. They were paid for their participation.

Materials and procedure. A set of pictures with masculine nouns ($n = 24$) was selected. Target nouns took either the determiner "il" ($n = 12$) or "lo" ($n = 12$). Each picture was paired with a masculine distractor taking the same determiner as the target (e.g., "[lo] scoiattolo-[lo] zolfo [squirrel-sulfur]") and with a masculine distractor taking a different determiner (e.g., "[lo] scoiattolo-[il] frate [friar]"). These pictures were also paired with two feminine nouns, one semantically (categorically) related and the other unrelated (e.g., "scoiattolo-volpe [fox]" vs. "scoiattolo-pizza [pizza]"). A second list of pictures with feminine nouns ($n = 30$) was selected and paired with four words (two masculine and two feminine). Within each list, the words paired with a particular picture were matched for frequency and number of letters. In the set of pictures with masculine nouns, the mean frequency was distributed across the word lists as follows: distractors with the same versus a different masculine determiner, 90 versus 87 ($t < 1$); semantically related versus unrelated distractors, 48 versus 52 ($t < 1$). In the set of pictures with feminine nouns, the mean frequencies were 116 and 112 for feminine and masculine distractors, respectively ($t < 1$). The length (number of letters) of paired words was the same or varied by one letter. Paired stimuli did not share the initial letter (with two exceptions), and none rhymed.

The gender-congruity effect could be further examined by comparing two sets of distractors paired with masculine noun pictures (e.g., "scoiattolo-frate"_{masc} vs. "scoiattolo-pizza"_{fem}). The distractors used for this comparison were matched for frequency and number of letters ($F_s < 1$). An additional set of six pictures with masculine nouns was selected ("fillers"). These pictures were presented four times to obtain the identical total number of masculine and feminine targets. Fillers were used as warm-up trials and were not included in any of the analyses carried out. Stimuli were presented in six blocks of 40 trials. A given picture appeared only once per block. Targets and distractors of the various conditions were evenly distributed across blocks. Trials were randomized under the constraint that targets could have the same gender (or determiner) in no more than 3 consecutive trials. Block order was varied across participants.

The experimental procedure was identical to that described in Experiment 1, with one important modification: All the pictures were presented twice in the practice blocks. The distractors used for the training were not presented in the experiment proper. This variation was introduced to have a procedure closely resembling that used by La Heij et al. (1998). Stimulus presentation was controlled by the computer program PsychLab, Version 0.85 (Montreal, Canada; this program was also used for Experiments 4 and 5).

Results and Discussion

The mean response latencies and error rates are reported in Table 3. Errors were observed on 3.5% of the trials and were distributed as follows: 0.4% and 0.6% for production of an unexpected noun and determiner, respectively; 1.2% for verbal disfluences; and 1.2% for voice key malfunctioning. No significant difference was found in RTs for same versus different masculine determiner pairs ($M_s = 795$ and 796 ms, respectively; $F_s < 1$). For the set of feminine targets, the effect of gender congruity was not significant ($M_s = 765$ and 767 ms for gender congruent and gender incongruent, respectively, $F_s < 1$). A null effect was also obtained with masculine targets ($M_s = 796$ and 792 for gender congruent and gender incongruent, respectively; $F_s < 1$). Finally, there was a significant effect of semantic interference, $F_1(1, 24) = 17.8$, $MSE = 458.3$, $p < .001$, and $F_2(1, 23) = 9.2$, $MSE = 842.4$, $p < .01$.

In this experiment we investigated the interference effect of different types of target-distractor pairs. The only signifi-

cant effect obtained was that of semantic relatedness (longer response latencies with related than unrelated distractors). We again found no effect of gender congruity. The latter result was far from unexpected at this point: It reinforced the negative findings of the preceding experiments. Furthermore, because this result was replicated with two new lists of stimuli, it represented a significant extension of our previous findings. Finally, and of particular interest here, we also failed to find an effect of determiner congruity. However, before concluding that determiner congruity does not interfere in the production of target NPs, we must consider a potential caveat: It is possible that the distractor word did not activate its phonological segments and therefore could not activate its determiner. That is, because the selection of the masculine determiner depends crucially on activation from the noun's onset, the absence of activation of the distractor noun's phonological segments would forestall the possibility of activating its determiner. In the latter case, there would be no opportunity for determiner competition because the distractor's determiner would not have been activated sufficiently to compete for selection with the target word's determiner.

However, there is evidence indicating that word distractors do activate their corresponding phonological segments. The widely reported finding that it is easier to name a picture when the distractor shares some phonological and orthographic segments with the target (e.g., Briggs & Underwood, 1982; Costa & Sebastian-Gallés, 1998; Lupker, 1982; Meyer & Schriefers, 1991; Starreveld & La Heij, 1995, 1996) implies that the distractor's phonological features are activated. Furthermore, the phonological facilitation effect is typically obtained with targets and distractors that share word onsets. Thus, this effect seems to involve the same segmental features that are also critical for determiner selection. Moreover, evidence of phonological facilitation has been found with simultaneous presentation of visual distractors, the same procedure used in Experiment 3. Therefore, there are reasons to believe that our negative findings concerning determiner congruity were unlikely caused by a lack of activation of the distractor's phonological features. Still, the evidence we have reviewed showing activation of the distractor's phonological segments was obtained with a different naming task (production of picture names only) than the one used in our Experiment 3 (production of determiner NPs). Although it seems unlikely that this difference in naming tasks would affect whether there would be activation of the phonological segments of the distractor noun, we cannot exclude it outright. We addressed this issue in Experiment 4.

Table 3
Mean Naming Latencies and Errors as a Function of Target Set and Distractor Type (Determiner Noun Phrases) in Experiment 3

Target and distractor	Mean latencies (ms)	% errors
Masculine targets		
Masculine distractors		
Same determiner	795	2
Different determiner	796	4
Feminine distractors		
Semantically related	817	5
Unrelated	792	4
Feminine targets		
Feminine distractors	765	3
Masculine distractors	767	3

Experiment 4: Phonologically Related Distractors

The objective of Experiment 4 was to determine whether the effect of phonological facilitation would be obtained in a naming task involving the production of determiner NPs. The results of this experiment will provide crucial information for interpreting the negative finding of determiner congruity in Experiment 3. For this purpose, we chose related nouns that shared onsets: the phonological segments

that govern the selection of Italian determiners. The experiment was divided in two parts. In the first part, speakers produced "bare" picture names. The same material was then used in the second part of the experiment involving the production of determiner NPs.

Method

Participants. Two groups ($n = 12$) of Italian students at the University of Padua participated in the experiment. They did not participate in any other experiment. They were paid for their collaboration.

Materials and procedure. Thirty-two pictures were paired with two word distractors: a related noun that had the same initial syllable as the picture's name and an unrelated (control) noun. Targets and distractors were bi- and trisyllabic words. The words paired with a given picture had the same length and CV structure and were matched for frequency ($M_s = 18$ and 15 for related and unrelated, respectively; $t < 1$). Grammatical gender was systematically controlled: Half the targets and distractors were feminine, and the other half were masculine. Half the picture-word pairs had the same gender, and the other half had different genders. A set of filler pairs ($n = 188$) was also included. To create the set of fillers, we presented the pictures described above a third time; in addition, a second list of pictures ($n = 13$) was selected and shown 12 times. Fillers always appeared with an unrelated word. Stimuli were distributed over six blocks. Phonologically related distractors accounted for 12% of the trials and appeared either five or six times per block. Stimuli were randomized with the following constraints: (a) Targets with the same gender were shown in no more than 3 consecutive trials and (b) phonologically related distractors never appeared in consecutive trials. The order of presentation of the trials within a block remained fixed. The order of presentation of the six blocks was varied across participants.

The material described above was used in two naming tasks requiring the production of noun-only NPs and of determiner NPs, respectively. The procedure for presentation of the stimuli was the same as in Experiment 1. The training procedure was the one introduced in Experiment 3. The two naming tasks were performed by distinct groups of participants.

Results and Discussion

In the noun-only naming task, errors accounted for 2.7% of the responses (incorrect name = 0.3%; verbal disfluencies = 2.3%; and voice key malfunctioning = 0.1%) and occurred in 1.9% of the related trials and in 4.6% of the unrelated trials. In the determiner NPs naming task, 3.3% of the responses were incorrect (incorrect name = 0.3%; incorrect determiner = 0.4%; verbal disfluencies = 2.5%; and voice key malfunctioning = 0.1%) and occurred in 3.0% of the related trials and in 4.1% of the unrelated trials. Figure 2 shows the distribution of correct mean latencies for related and unrelated pairs in the two naming tasks. Response latencies were analyzed with a two-way ANOVA with task (no determiner vs. determiner NPs) and distractor (related vs. unrelated) as variables. The main effect of task was significant in the analysis by items, $F_2(1, 31) = 20.4$, $MSE = 2,432.5$, $p = .0001$, but not in that by participants, $F_1(1, 22) = 2.5$, $MSE = 7,945.4$, $p = .12$. More important in the present context, faster responses were found with related than unrelated words, $F_1(1, 11) = 26.2$, $MSE = 7,945.4$, $p < .0001$, and $F_2(1, 31) = 18.7$, $MSE = 1,392$, $p = .0001$, and the size of this effect was identical in the two tasks (29 ms). Errors were less frequent with related than unrelated distractors (2.4% vs. 4.3%), $F_1(1, 22) = 8.3$, $MSE = 1.0$, $p < .01$.

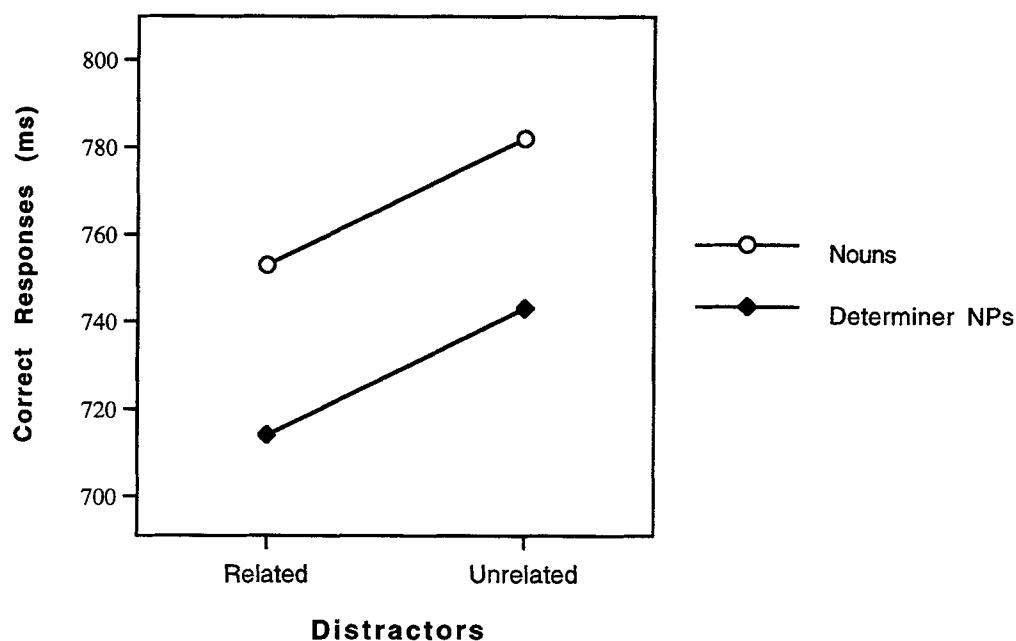


Figure 2. Distribution of correct naming latencies in Experiment 4 as a function of task (naming of "bare" picture names vs. naming of determiner noun phrases [NPs]) and distractors (phonologically related vs. unrelated).

Although Experiment 4 was not designed to assess whether distractors' gender would interfere with the selection of the determiner, it nevertheless provided an additional opportunity to examine this issue. Distractors' gender and phonological similarity were varied orthogonally in the experiment, and we could therefore assess whether there would be a gender-congruity effect as well as a phonological effect. As in the preceding experiments, there was not a trace of a main effect of gender congruity or of an interaction of gender congruity with phonological relatedness ($F_s < 1$). In fact, the size of the phonological effect was identical for both types of pairs (29 ms; the mean response latencies of related vs. unrelated pairs for same-gender pairs and different-gender pairs were 714 vs. 743 ms and 713 vs. 742 ms, respectively). Thus, we again failed to find a gender-congruity effect in Italian.

The phonological effect. The results of this experiment are clear: The phonological effect was observed with the traditional noun-only naming task and the determiner NP naming task. To account for the phonological effect, one has to assume that distractor words activate their segmental content. In addition, because phonological facilitation was obtained when speakers produced determiner NPs, it has to be further concluded that the distractors' phonological representations were activated in this task. The latter conclusion has direct implications for the negative findings concerning determiner congruity in Experiment 3. We had raised the possibility that the latter finding could be explained by assuming that phonological information crucial for the selection of the determiner was not activated in the determiner NP naming task. This possibility was ruled out by the results of Experiment 4, which showed that phonological facilitation was obtained when participants named determiner NPs. Thus, the absence of a congruity effect in Experiment 3 cannot be ascribed to insufficient activation of the distractors' phonological representations. These considerations led us to conclude that, in Italian, neither gender- nor determiner-congruity effects are found with the picture-word interference paradigm.²

Determiner selection as a very late process in noun-phrase production. What might the reason be for the absence of a determiner-congruity effect with the picture-word interference paradigm in Italian? A possible reason is that this paradigm depends crucially on interference effects induced by lexical competition. Also, if determiner selection were to occur at a stage of processing well beyond lexical selection, lexically induced effects might not be appropriate for revealing properties of the determiner selection process. In other words, the reason for the negative results for determiner congruity in Italian may be because we focused our investigation of determiner selection too narrowly on the problem of lexical access and did not consider it in the broader context of sentence production (of which NP production is a part). When the problem of determiner selection is seen in the latter context, an important fact about Italian determiners comes to light that may help explain why we failed to find a determiner-congruity effect in our experiments.

Thus far, we have emphasized the fact that in Italian the

determiner that is used with a noun in a determiner NP depends both on the gender and specific phonological properties of the noun. However, not all noun phrases are simple determiner NPs; there are also adjective NPs. In Italian, adjectives can occupy either (or both) prenominal and postnominal positions. Most adjectives are used postnominally (e.g., "il tavolo nero"—literally "the table black"), but there are also many contexts in which adjectives are used prenominally (e.g., "il grande tavolo"—literally "the big table") or both prenominally and postnominally when possessives are involved (e.g., "il mio tavolo nero"—literally "the my table black"). This fact about the structure of adjective NPs and the fact that the form of a determiner depends on the *immediately following* phonological context further restricts the nature of the mechanism that selects the form of a determiner in an NP. Specifically, knowledge of the gender and of the phonological structure of a noun is not sufficient for the correct selection of a determiner in an adjective NP. Consider the examples shown in Table 4. As is immediately apparent, the form of the determiner depends both on the gender of the noun and on the immediately following phonological context. In the case of masculine nouns, the form of the determiner in an adjective NP can be either "il" ("i" in the plural) or "lo" ("gli" in the plural) depending on the phonological form of the adjective and on whether the adjective is used prenominally or postnominally. In other words, the form of the determiner can be specified only at the point where phonological forms are ordered for output: a postlexical stage of processing. We refer to this account of determiner selection as the *late selection hypothesis*.

The late selection hypothesis provides a natural explanation for the negative findings of gender and determiner congruity in Italian. The argument goes as follows: Because the critical information needed for determiner selection is available only at the level of phonological phrase construction, there is enough time to resolve any conflict caused by the distractor in the selection of the target noun's gender feature. This would make the effect of gender congruity (if there were one) in the picture-word paradigm invisible in Italian. This same reasoning commits us to a clear prediction about the contexts in which we should find determiner-congruity effects. Specifically, we should find determiner-

² It is possible that our negative results reflect the use of unfamiliar word distractors. In Dutch, La Heij et al. (1998) obtained an effect of gender congruity with highly familiar distractors but not with distractors in the medium familiar range (Experiment 3b). Written frequency, a factor that is highly correlated with familiarity judgments (Gernsbacher, 1984), is available for the distractors of our Experiments 1–3. We could thus examine whether the effect of gender congruity would vary as a function of distractor frequency. We used an arbitrary cutoff of 20 occurrences per million to distinguish between low-frequency distractors (<20) and high-frequency distractors (>20). The effect of gender congruity was highly similar for pictures paired with high-frequency distractors ($n = 86$) and low-frequency distractors ($n = 146$; 4 vs. -4 ms; analysis based on the frequency of different-gender distractors). Thus, we could be sure that our failure to observe an effect of gender congruity was not due to the inclusion of low-frequency distractors.

Table 4
Examples of Determiner NPs and Determiner + Adjective NPs in Italian

Singular		
il treno <i>the train</i>	lo sgabello <i>the stool</i>	la matita <i>the pencil</i>
il treno grande <i>the train big</i>	lo sgabello grande <i>the stool big</i>	la matita grande <i>the pencil big</i>
il grande treno <i>the big train</i>	il grande sgabello <i>the big stool</i>	la grande matita <i>the big pencil</i>
lo strano treno <i>the strange train</i>	lo strano sgabello <i>the strange stool</i>	la strana matita <i>the strange pencil</i>
il treno strano <i>the train strange</i>	lo sgabello strano <i>the stool strange</i>	la matita strana <i>the pencil strange</i>
il mio strano treno <i>the my strange train</i>	il mio strano sgabello <i>the my strange stool</i>	la mia strana matita <i>the my strange pencil</i>
Plural		
i treni <i>the trains</i>	gli sgabelli <i>the stools</i>	le matite <i>the pencils</i>
i treni grandi <i>the trains big</i>	gli sgabelli grandi <i>the stools big</i>	le matite grandi <i>the pencils big</i>
i grandi treni <i>the big trains</i>	i grandi sgabelli <i>the big stools</i>	le grandi matite <i>the big pencils</i>
gli strani treni <i>the strange trains</i>	gli strani sgabelli <i>the strange stools</i>	le strane matite <i>the strange pencils</i>
i treni strani <i>the trains strange</i>	gli sgabelli strani <i>the stools strange</i>	le matite strane <i>the pencils strange</i>
i miei strani treni <i>the my strange trains</i>	i miei strani sgabelli <i>the my strange stools</i>	le mie strane matite <i>the my strange pencils</i>

Note. The literal English translation is in italics. NPs = noun phrases.

congruity effects in those cases in which there is conflicting information at the level of phonological phrase construction, the level where determiner selection takes place. This prediction can be tested in Italian with a picture naming task in which conflicting information is provided at the stage of phonological phrase construction.

Experiment 5: Prenominal-Adjective NPs

Pictures of different sizes were presented and speakers produced phrases consisting of a determiner, a prenominal adjective denoting picture size, and the picture name. Two types of phrases were used. In one group, the noun and the adjective agreed with respect to which determiner they would take if they were to follow the determiner. An example is given by the phrase “grande treno” [“big train”], where both the adjective and the noun take the determiner “il”: “il grande treno” and “il treno.” We refer to these phrases as “same-determiner phrases.” In the other group, the noun and the adjective did not agree with respect to which determiner they would take if they were to follow the determiner. For example, in the phrase “grande sgabello” [“big stool”], the adjective and the noun take the determiners “il” and “lo,” respectively: “il grande sgabello” and “lo sgabello.” We refer to these phrases as “different-determiner phrases.” The critical question is whether, as predicted by the late selection hypothesis, response latencies would be longer (or error rates higher) for different-determiner phrases (“il grande sgabello”) than for same-determiner phrases (“il grande treno”) relative to their respective baseline phrases (“lo sgabello” and “il treno”). Such an outcome would indicate that both the noun and the adjective activate their

respective determiners, creating the opportunity for conflict in the selection of the NP-appropriate determiner and hence longer naming latencies (and perhaps an increase in error rates).

Method

Participants. Thirty Italian students at the University of Padua took part in this experiment. They did not participate in any other experiment reported here. Participants were paid for their performance.

Materials and procedure. Two sets of 22 pictures with masculine gender names were selected. The lists comprised nouns that agreed either with the determiner “il” (*il* nouns) or “lo” (*lo* nouns). A third set of 22 pictures with feminine names (*la* nouns) was also selected. Names were of medium frequency (*M*s for *il*, *lo*, and *la* nouns = 26, 40, and 71, respectively). A set of 54 filler pictures was also selected. The majority of fillers ($n = 38$) had a feminine name. In this way, we had an equal number of masculine and feminine target nouns ($n = 60$). Each picture was presented in two sizes: normal and large. Pictures of normal size were contained in an area of 7×7 cm, whereas pictures of large size occupied an area of 12×12 cm. Pilot testing revealed that participants could easily discriminate between pictures of these sizes. The expected response varied as a function of picture size: determiner NPs for normal size pictures (e.g., “lo sgabello”) and determiner + adjective NPs for large size pictures. In this latter case, the expected adjective was “grande” [“big”], and participants were explicitly instructed to use it prenominally (e.g., “il grande sgabello”).

As already noted, in Italian adjectives can be produced either prenominally (“il grande sgabello”) or postnominally (“lo sgabello grande”). We chose to use only one form of the adjectival phrases to avoid confusion in the naming task. We chose the prenominal form because we expected it to be more likely to

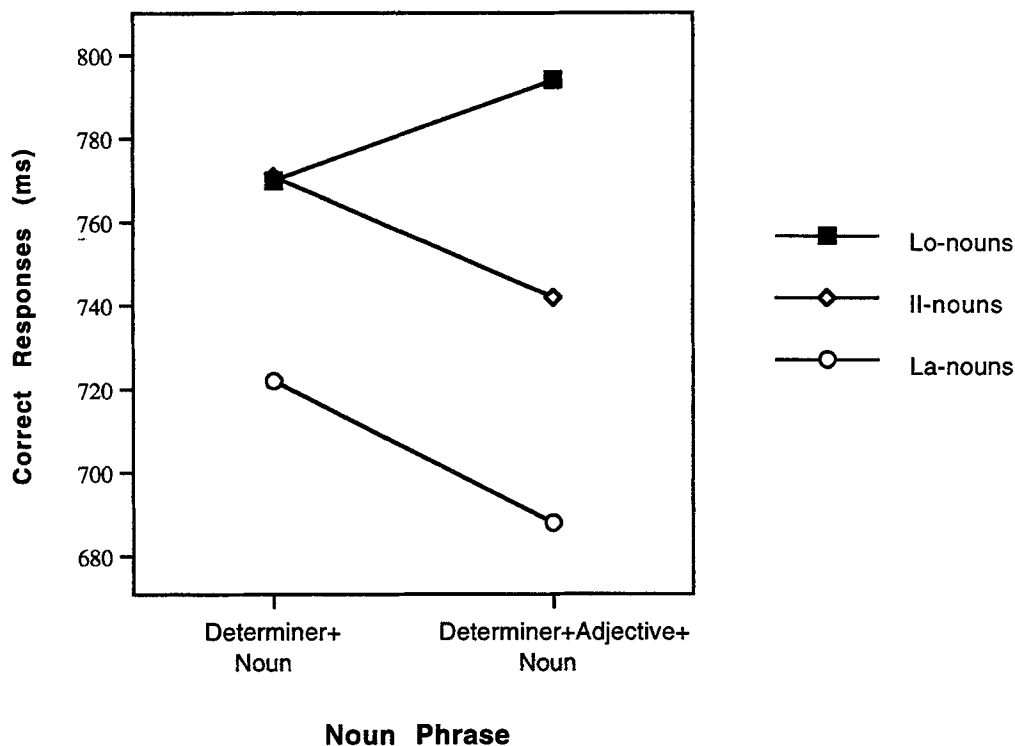


Figure 3. Distribution of correct naming latencies in a task in which Italian speakers produced noun phrases formed by determiner + noun or determiner + adjective + noun (Experiment 5). Targets (picture names) were *lo* nouns (masculine nouns, determiner "lo"), *il* nouns (masculine nouns, determiner "il"), and *la* nouns (feminine nouns, determiner "la").

produce interference. In Italian, determiners are more frequently followed by a noun than an adjective (see, e.g., Vincent, 1988).³ This might lead to greater activation of the determiner by the noun than the adjective. Furthermore, because nouns are heads of phrases, they are probably selected before adjectives. If this were the case, nouns would activate their determiners earlier than adjectives, a fact that could increase interference.

Pictures were presented in six blocks of 40 stimuli. In each block, a given picture appeared only once, and pictures of both sizes were represented equally. Pictures of the same size did not appear in more than 3 consecutive trials. The same constraint was applied for the expected determiner. Fillers were always used as warm-up trials (the first three stimuli of a block). The order of presentation was counterbalanced across participants: Half the participants saw the pictures first in one size and then in the other; the order was reversed for the other half of the participants.

The testing room and the equipment were the same described in Experiments 1 and 3, respectively. At the beginning of the experiment, participants were invited to name the entire set of pictures. This procedure was used to ensure that the stimuli were recognized and named with the designated nouns. Alternative nouns were corrected. A practice block of 20 trials followed. The 10 pictures used in this block were not shown in the experiment proper. A trial was structured as in Experiment 1.

Results and Discussion

Incorrect responses were observed in 4.9% of the trials and were distributed as follows: production of an unexpected noun = 0.6%, unexpected determiner = 0.7%, and

unexpected NP (e.g., "il tavolo" or "il tavolo grande" instead of "il grande tavolo") = 1.3%; verbal disfluencies = 2.2%; and voice key malfunctioning = 0.1%. Furthermore, for determiner NPs, errors occurred for 7.1% of *lo* nouns, 3.0% of *il* nouns, and 4.0% of *la* nouns, whereas for determiner + adjective NPs, errors occurred for 11.6% of *lo* nouns, 4.8% of *il* nouns, and 4.7% of *la* nouns. The distribution of correct response latencies as a function of type of NP and target's determiner is presented in Figure 3. Contrasting results were obtained with the two lists of masculine nouns. Compared with the baseline condition (determiner NPs), responses to determiner + adjective NPs were 30 ms faster for *il* nouns but 24 ms slower for *lo* nouns.

³ Only a subclass of Italian adjectives can be used prenominal, the so-called "predicative adjectives" (Giorgi & Longobardi, 1991). These adjectives describe a property of the noun (e.g., *nice*, *big*, *expensive*) without referring to a specific entity in the world: They have only a predicative function. Adjectives that can also refer to entities of the world (e.g., *French* or *German*) cannot be used prenominal (e.g., "la francese ragazza" ["the French girl"] is ungrammatical). However, the use of predicative adjectives in the prenominal form is restricted to cases in which the speaker wants to convey a connotative meaning. That is, when in this position, the adjective is interpreted as expressing the opinion of the speaker. With the exception of possessive adjectives (e.g., *mio*, *suo*, *loro* [my, his or her, their]), adjectives rarely occur prenominal (see Vincent, 1988).

Facilitation was also found with feminine *la* nouns. A two-way ANOVA was carried out to define the effect of two variables: phrase (determiner NPs vs. determiner + adjective NPs) and determiner (*il* vs. *lo* vs. *la*). In a preliminary analysis, the order of presentation was also included. However, because no main effect of order was found and because order did not interact with any other variable, we collapsed responses across orders. Significant main effects were obtained for both variables: phrase, $F_1(1, 29) = 8.1$, $MSE = 898.1$, $p < .01$, and $F_2(1, 63) = 6.4$, $MSE = 11,051.0$, $p = .01$; determiner, $F_1(2, 58) = 81.2$, $MSE = 1,131.6$, $p < .0001$, and $F_2(2, 63) = 18.0$, $MSE = 3,769.0$, $p < .0001$. More important, the interaction between these variables was significant, $F_1(2, 58) = 20.6$, $MSE = 741.0$, $p < .0001$, and $F_2(2, 63) = 12.8$, $MSE = 861.1$, $p < .0001$. To better characterize this interaction, we analyzed each noun list separately and directly contrasted responses to the different NPs. Significant results emerged in each of these analyses: *il* nouns, $F_1(1, 29) = 16.9$, $MSE = 720.4$, $p < .001$, and $F_2(1, 21) = 11.6$, $MSE = 764.0$, $p = .002$; *lo* nouns, $F_1(1, 29) = 6.7$, $MSE = 1,283.1$, $p = .01$, and $F_2(1, 21) = 5.9$, $MSE = 1,012.3$, $p < .02$; and *la* nouns, $F_1(1, 29) = 45.2$, $MSE = 376.6$, $p < .0001$, and $F_2(1, 21) = 15.7$, $MSE = 807.1$, $p < .001$.

The analysis of the participants' error rates revealed an effect of phrase, $F_1(1, 29) = 15.5$, $MSE = 0.7$, $p < .001$, reflecting a larger error incidence for determiner + adjective NPs than determiner NPs (7.1% vs. 4.7%).⁴ In addition, there was a significant effect of determiner, $F_1(2, 58) = 24.1$, $MSE = 1.1$, $p < .0001$, which reflected a larger number of errors with *lo* nouns (9.3%) than with *la* or *il* nouns (4.4% and 3.9%, respectively). The interaction between these variables approached significance, $F_1(2, 58) = 2.9$, $MSE = 2.9$, $p = .06$. Separate analyses were also performed for each target set. Errors were significantly more frequent with determiner + adjective NPs than determiner NPs only for *lo* nouns (11.6% vs. 7.1%), $F_1(1, 29) = 16.1$, $MSE = 0.9$, $p < .0001$; for *il* and *la* nouns, $F_s < 1$.

For the first time in these experiments, we found evidence of interference in the selection of Italian determiners. This interference was obtained with *lo* nouns and consisted of longer (and less accurate) responses for determiner + adjective NPs than determiner NPs (see Figure 3), as predicted on the basis of the hypothesis of the late selection of determiners. The opposite finding was obtained for *il* and *la* nouns: Responses were faster for determiner + adjective NPs (see Figure 3) than for their corresponding determiner NPs. The latter result probably reflects a combination of factors. First, in this condition both the noun and the adjective activated the same determiner, a fact that could have facilitated determiner selection. Second, the repeated use of the same adjective ("grande") could have greatly facilitated its selection. Third, as suggested by the results reported by Schriefers (1992, 1993), the articulation of the initial ("leftmost") elements of the phrase can be initiated even before all its constituents have been processed. This means, among other things, that discrepancies in RTs principally reflect the processing of the initial elements of the phrase. Therefore, given that the initial elements of the phrase—the determiner and the adjective—were arguably

processed particularly rapidly in the determiner + adjective NP condition, naming latencies would also be expected to be fast in this condition.

The exact causes of the interference effect observed with *lo* nouns are not clear. There are various possibilities. For example, it could be that at some point in the course of NP production, its major constituents "automatically" activate their corresponding determiners, creating the conditions for interference in determiner selection. If this were the case, we would expect a determiner-congruity effect with NPs having both prenominal and postnominal adjectives (e.g., "il grande sgabello" vs. "lo sgabello grande"). Alternatively, one might hypothesize that because nouns more frequently agree with the determiner they—but not adjectives—always activate their corresponding determiners, which must then be suppressed when an adjective is interposed between the determiner and the noun. This would lead to the observed interference effect, but it also leads to the prediction that there should be no interference with determiner-incongruent postnominal NPs (e.g., "lo sgabello grande"). The results we have reported do not allow us to choose between these possibilities. However, these contrasting accounts are empirically testable, and future investigations could provide evidence for discriminating between them.⁵ For the present purposes, however, what is important is that the interference effect documented here was obtained in conditions in which competing lexical forms were available for determiner selection. This fact provides direct support for the late selection hypothesis.

General Discussion

In a series of picture-word interference experiments conducted in Italian, we attempted to replicate the effect of gender interference obtained by Schriefers (1993; however, see also La Heij et al., 1998; van Berkum, 1997) in Dutch. Schriefers found that NP naming latencies increased when the target and the distractor nouns had different genders relative to the case in which they had the same gender. The motivation for investigating this effect in Italian was to test whether the gender-congruity effect obtained with Dutch speakers would reflect interference at the level of gender or determiner selection (or both). These alternative hypotheses can be tested with Italian speakers because in this language, gender information is not sufficient for the selection of specific determiners: Information about the immediately following phonological context is required for the selection of masculine determiners. Our failure to replicate the gender interference effect in several experiments in Italian leaves this issue unresolved. Nevertheless, the absence of a gender-

⁴ Responses were both faster and less accurate for determiner + adjective noun phrases (NPs) than determiner NPs. The pattern of results raises the possibility of a speed-accuracy trade-off. More plausibly, however, this discrepancy reflects the fact that determiner + adjective NPs are more complex and hence more likely to induce errors.

⁵ An interesting question is whether a similar phenomenon of determiner interference can be obtained in English with phrases such as "a large egg," in which the adjective and the noun take different determiners (*a* vs. *an*).

congruity effect in Italian raises the question of how determiner selection operates in this language and how it might differ from the corresponding process in Dutch. A relatively clear picture of the determiner selection process in Italian emerged from the experimental evidence reported here. An account of these mechanisms also provides the basis for an attempted explanation of our failure to reproduce the effect of gender interference in Italian.

Determiner Selection Is Special

The system for determiner agreement of Italian is complex. It requires the specification of both grammatical features (the noun's gender and number) and phonological features (the onset of the following word). Moreover, because Italian allows adjectives to occupy both prenominal and postnominal NP positions, the form of the determiner cannot be specified until the major constituents of the phrase are ordered. It is only at this point that the phonological context relevant for determiner selection (either the onset of the noun or an adjective) can be ascertained. In this view, determiner selection is a complex function of sentential and phrasal (number), lexical (gender), and phonological principles (local phonological context in an NP frame). These observations motivate the late selection hypothesis that we proposed to account for the production of determiners in Italian. The proposal is that the noun's gender and number activate an allomorphic set of determiners (e.g., *il/lo* for singular masculine) but that selection of a specific determiner will have to wait for the ordering and insertion of the phonological forms of the noun and adjectives into a phonological phrase. It is at this level of processing that the phonological features needed for determiner selection are made explicit and a specific determiner can be selected. Consequently, lexical-phonological features are not directly involved in the process of determiner selection. Rather, it is the local phonological context in a phonological phrase that determines which specific determiner should be produced.

The results we have reported here provide support for these claims. Especially relevant are the contrasting results of Experiments 3 and 5. The tasks used in these experiments were designed to provide the opportunity for interference in determiner selection. In both cases phonological information was available that could have interfered with the selection of the appropriate determiner. However, the potentially interfering information presumably had its effects at different stages of the naming process. This was achieved by manipulating whether the distracting element was or was not a candidate for insertion in the NP frame. In Experiment 3, in which a classical picture-word interference paradigm was used and the distractor word was not named, the interfering information was not a candidate for insertion in the phonological phrase. No evidence of interference was found in this experiment (see Table 3). This result suggests that the activation of a competing lexical representation does not interfere with the process of determiner selection. Importantly, this negative finding cannot be attributed to the fact that distractors did not activate their segmental features. When targets and distractors had the same initial segment, a

sizable phonological effect was obtained in Experiment 4 (see Figure 2). The latter result demonstrates that the segmental features of the distractors were activated.

A different pattern of results was obtained in Experiment 5. In this experiment, participants were required to produce determiner + adjective NPs. Potential interference was assessed by comparing NPs with adjective-noun pairs that either took the same or different determiner. Because participants produced the full adjectival phrase, the interfering element (in this case, the noun) was necessarily a candidate for insertion in the NP frame. A sizable effect of interference was obtained in this experiment (see Figure 3). This pattern of results can be readily explained by the late selection hypothesis. Because both the adjective and noun are inserted in the phonological phrase for production, they can interfere with each other in the selection of the correct determiner. Thus, the difference between Experiments 3 and 5 was due to the fact that in the latter experiment, but not in the former, there was conflicting phonological information for the selection of the determiner at the level of the phonological phrase.

There is an important implication of the preceding discussion. The fact that determiner selection is made late—it is made only at the stage where phonological phrases are assembled—suggests that this process might function differently from lexical selection (e.g., Garrett, 1980). There are in fact several important differences. Whereas lexical selection (nouns, verbs, and adjectives) is driven primarily by semantic information and is subject to interference from other lexical items, determiner access is a multistage process driven by a combination of sentential, lexical, and phonological factors that come into play at different stages of phrasal production: Number information is specified at the sentential level; gender information is specified after the selection of the head noun of the NP; and phonological information is specified only at the point where adjectives and nouns are ordered for output—at the level of phonological phrase assembly. Of particular relevance here is the fact that the information relevant for determiner selection, unlike that for lexical selection, is distributed over several levels of processing. Furthermore, determiners can be specified only after their corresponding nouns have been accessed, a process that Garrett (1980) called “indirect election” to emphasize the fact that the selection of determiners is fully determined by local lexical and phonological processes. In light of these major differences between lexical access and determiner selection, it is therefore not surprising that the two processes should be affected independently of each other in conditions of brain damage, reflecting the existence of distinct neural mechanisms for the control of these two classes of words (e.g., Caramazza & Berndt, 1985; Garrett, 1992; Kean, 1977).

More on the Causes of the Gender-Congruity Effect

The account we have given of the process of determiner selection in Italian provides the basis for explaining the contrasting gender-congruity effects obtained in Italian and in Dutch. In several picture-word naming experiments with

Italian speakers, we consistently failed to observe evidence of an interference effect of the distractors' gender (see Tables 1–3). This finding is surprising if we consider the robustness of the phenomenon of gender congruity in Dutch (La Heij et al., 1998; Schriefers, 1993; van Berkum, 1997) and the fact that we closely reproduced the procedures used in the Dutch studies. Nevertheless, our results with gender are highly reliable, having been replicated in four experiments (Experiments 1–4) with different types of distractors (semantically related, phonologically related, unrelated) and with various lists of stimuli. Our negative findings can be interpreted in two ways: either by concluding that in Italian the gender-congruity effect does not exist or by concluding that it does exist but remains invisible (see the *Results and Discussion* section in Experiment 2). We opted for the second solution, mainly because the system for gender assignment is essentially identical in Italian and Dutch. Where the two languages diverge, however, is in the structure of the determiner system. In Italian, but not in Dutch, the specification of phonological information (the onset of the following word) is needed for determiner selection. We argue that this cross-linguistic discrepancy provides the basis for a possible explanation of the contrasting results of Dutch and Italian.

Critical for our argument is *when*, in the course of determiner selection, gender information is needed in the two languages. In Dutch, determiner selection depends only on the retrieval of the noun's gender and number. As soon as these features are available, determiner selection can take place. In Italian, by contrast, there is no need to have gender information available early because it becomes functional only in conjunction with phonological information about the onset of the following word. The latter information is available considerably later than gender. These temporal constraints translate into different expectations about the effects of gender interference on determiner selection in the two languages. In Dutch, any event that perturbs gender selection inevitably interferes with determiner selection. In Italian, the process of determiner selection might not be so vulnerable: Interference with gender selection might not adversely affect determiner selection because there could be enough time to resolve conflicting information about gender before this information is needed for selecting a specific determiner at the level of phonological phrase assembly. In other words, to explain the absence of a gender-congruity effect in Italian, all one needs to assume is that phonological information crucial for determiner selection is available relatively late, allowing enough time for the resolution of any conflict in gender selection. The evidence reported in this article suggests that this phonological information is available "very" late, at a postlexical stage. Thus, the contrasting results in Dutch and Italian may be explained by the differential role played by phonology in determiner selection in the two languages.

The preceding argument about determiner selection in Italian and Dutch has an important implication for the principles that govern the organization of sentence production mechanisms. The implication follows from a consideration of why it would be that if gender interference effects are invisible in Italian, they would not similarly be invisible

in Dutch. We have argued that the reason for this difference is that in both languages, production of the determiner starts as soon as there is enough information for the unambiguous specification of the phonological form for output. In Dutch, the determiner system is such that once the gender and number of the noun are selected, the phonological form of the determiner is fully determined and can immediately be made available for production. In Italian, the phonological form of the determiner is not fully determined until the stage of phonological phrase assembly; it is only at this late stage of sentence production that determiners are ready for output. In this view, the optimal stages of processing for the production of determiners would be different in Dutch and Italian: In Dutch it would be at the point of gender selection; in Italian it would be at the stage of phonological phrase assembly. In conclusion, the contrast between Dutch and Italian would seem to be based on a kind of temporal "optimization" principle: Prepare material for production at the earliest possible stage of processing.

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