CLOSED-CLASS WORD SELECTION

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GRAMMATICAL AND NON-GRAMMATICAL CONTRIBUTIONS

TO CLOSED-CLASS WORD SELECTION

F.-Xavier ALARIO, Pauline AYORA

CNRS & Aix-Marseille Université, Marseille (France)

Albert COSTA

GRNC Parc Científic de Barcelona, Departament de Psicologia Bàsica, Universitat de
Barcelona (Spain)

Alissa MELINGER

Department of Computational Psycholinguistics, Saarland University, Saarbrücken

(Germany)

Corresponding author

F.-Xavier ALARIO
Laboratoire de Psychologie Cognitive
CNRS & Aix-Marseille Université - Centre St Charles
3 place Victor Hugo (Bâtiment 9, Case D)
13331 Marseille CEDEX 3 - France
Francois-Xavier.Alario@univ-provence.fr
Telephone: +33 4 88 57 69 00
Fax: +33 4 88 57 68 95
Abstract

Closed-class word selection was investigated by focusing on determiner production. Native speakers from three different languages named pictures of objects using determiner + noun phrases (e.g. in French “La Table”, \(\text{the}_\text{feminine}\) table) while ignoring distractor determiners printed on the pictures (e.g. “LE”, \(\text{the}_\text{masculine}\)). The target and distractor expressed either shared or different grammatical and non-grammatical features (gender, number, and definiteness). A gender facilitation effect was observed and attributed to noun processing. Crucially, across five experiments, distractors that shared a feature with the target determiner never resulted in longer naming latencies than distractors that were more different. These results indicate that activating related candidates is not detrimental for determiner retrieval, suggesting a non-competitive mechanism of closed-class word selection.

1. Language production
2. Grammar
3. Lexical selection
4. Closed-class
5. Determiners
Grammatical and Non-Grammatical Contributions to Closed-Class Word Selection

In order to produce language, a speaker has to select a variety of words and to apply linguistic rules such as word order or agreement. The results of these processes are well-formed utterances that convey the intended message. Within the words composing these utterances, a distinction is often made between open- and closed-class words. Open-class words serve (primarily) to convey the intended message: mostly nouns, verbs, adjectives, and some adverbs. By contrast, closed-class words serve (primarily) to convey sentential structure in word sequences: determiners, prepositions, auxiliary verbs, conjunctions, etc. (see Bird, Franklin, & Howard, 2002, for a detailed presentation of the two word classes).

Neuropsychological investigations of aphasic individuals have revealed that the production of the two types of words can be dissociated after brain damage. Some patients have deficits producing words of the closed-class while their open-class word production is by-and-large preserved, and the reverse dissociation is also observed (Andreewsky & Seron, 1975; Friederici & Schoenle, 1980; Friederici, 1982; Gardner & Zurif, 1975; B. Gordon & Caramazza, 1983; Miceli, Mazzucchi, Menn, & Goodglass, 1983; Nespoulous, Dordain, Perron, & Ska, 1988). Some of these deficits are restricted to one language production modality: either speaking or writing (Alario & Cohen, 2004; Assal, Buttet, & Jolivet, 1981; Lecours & Rouillon, 1976; Lhermitte & Derouesné, 1974; Miceli et al., 1983; Patterson & Shewell, 1987; Rapp & Caramazza, 1997). Modality specific deficits have been taken to suggest that what can be disrupted is the retrieval or selection of the word’s representation, not of their meaning (Caramazza & Hillis, 1990). The two types of words also present
differential effects in the production of healthy speakers. For example, slips of the tongue are more likely to occur on open-class words than on closed-class words, and the types of errors affecting these two word classes are different. Open-class items are more likely to be involved in word substitutions, whereas closed-class words are more often lost or added than involved in substitutions or exchanges. They can be stranded or mis-located. Also, phonological errors almost exclusively affect open-class words, although this latter effect could be a consequence of differential frequency between the two word classes (Dell, 1990; Garrett, 1975; Stemberger, 1984).

These differential effects have led researchers to propose that open- and closed-class words are processed by different mechanisms during sentence production (most notably by Garrett 1975; 1984; 1988; see also Bock & Levelt, 1994, for discussion of differences between open- and closed-class as well as bound morphemes; see Berndt, 2001, for a review of models; see below for a thorough discussion). Despite these proposals, the precise processing differences between word classes remain largely unknown. This article reports an exploration of closed-class word selection whose logic is directly inspired by investigations of the selection of open-class words, namely nouns. To investigate determiner retrieval, we asked participants to produce determiners in noun phrases (i.e. a determiner and a noun) while they ignored distractor determiners whose similarity with the target was manipulated (e.g. in terms of grammatical features; Schriefers, 1993; Vigliocco, Lauer, Damian, & Levelt, 2002; Vigliocco, Vinson, Indefrey, Levelt, & Hellwig, 2004). The results of the experiments were
used to constrain the process of determiner selection and to compare the selection process for open- and closed-class words.

*Open-class word selection*

The selection of open-class words, mostly nouns, during speech production has received a lot of attention. One extremely popular paradigm in this research is the picture-word interference task, in which participants are asked to name a target picture and to ignore a distractor word presented visually or auditorily. Picture naming latencies are longer when the distractor word is a semantic coordinate of the target picture (e.g. *horse* – *dog*), compared to when it is an unrelated word (e.g. Lupker, 1979; Roelofs, 1992, among a vast number of references). The interference among semantically related alternative nouns is also found in other picture naming settings (Damian, Vigliocco, & Levelt, 2001; Howard, Nickels, Coltheart, & Cole-Virtue, 2006; Vitkovitch, Humphreys, & Lloyd-Jones, 1993; Wheeldon & Monsell, 1994). Not any semantic relationship can produce semantic interference. The effect appears to be restricted to coordinates within a single semantic category (e.g. two pieces of *furniture* such as *desk* and *cabinet*). Other meaning relationships such as verbal association, subordination or distractors that are parts of the target object produce no effect, or produce facilitation (Alario, Segui, & Ferrand, 2000; Costa, Mahon, Savova, & Caramazza, 2003; Costa, Alario, & Caramazza, 2005; Glaser & Düngelhoff, 1984; La Heij, Dirkx, & Kramer, 1990; Lupker, 1979; Roelofs, 1992; Vitkovitch & Tyrrell, 1999; however, see Hantsch, Jescheniak, & Schriefers, 2005, for competition effects with subordinates; see Mahon, Costa, Peterson, Vargas, & Caramazza, 2007, for extensive discussion). According to one prominent
interpretation based on localist representations of lexical items, the semantic co-ordinate interference effect arises because both the target and the distractor activate representations that are potentially relevant for the task at hand (i.e. for naming the picture). When these two representations are semantically similar (i.e. in the semantic co-ordinate condition), they are harder to discriminate from one another than when they are unrelated (Lupker, 1979). In other words, the semantic interference effect is interpreted as evidence that the process of selecting open-class words is competitive in nature. That is to say, the duration of the selection process depends on the level of activation of the target that will be ultimately selected, but also on the level of activation of competing alternatives. One implementation of the mechanism states that the processing of the target activates the distractor word more in the related than in the unrelated condition, hence making it a better competitor (Roelofs, 1992; although see Caramazza & Costa, 2000; Caramazza & Costa, 2001). Notice however that there are alternative accounts for these findings. For example, Miozzo and Caramazza (2003) have questioned the idea of competitive selection. In their experiments, distractor words presumed to be more active (because they had higher lexical frequency) induced less, not more, competition than distractors presumed to be less active (because of their lower frequency). Our discussion of the results we report for determiners will take into account the widespread competitive account as well as this latter alternative view of selection.

Closed-class word selection

Compared to the detailed models of open-class word selection (for reviews see Alario, 2004; Goldrick, 2007), closed-class word selection models are much less developed (although see
Dell, 1990; Spalek & Schriefers, 2005). Garrett (1975; 1984; 1988) used the speech error evidence to hypothesize that open- and closed-class words are selected by different mechanisms in the course of sentence production. In this model, the retrieval of open-class words follows roughly the principles described above. By contrast, the retrieval of closed-class words is closely tied to the representation of sentence frames. More specifically, closed-class words are represented in abstract featural form at the level of the sentence frame (Garrett proposes that the surface phrasal frame “bears inflectional elements and minor category free forms”, i.e. closed-class words; Garrett, 1982, p. 50). What is retrieved at this stage is not a word representation but rather the frame itself. During a later process, closed-class words are spelled out phonologically, only after the phonological spell out of open-class words. In this model, then, closed-class words are not explicitly selected; their retrieval is an automatic consequence of the processing of the frame (see Alario & Cohen, 2004; Miceli et al., 1983; Rapp & Caramazza, 1997, for detailed discussions of the link between syntactic processing and closed-class word retrieval on the basis of single-case studies; see Berndt, 2001, for review). One account of these grammatical category dissociations is based on distributed representations. J.K. Gordon and Dell (2003) describe a model that learns to associate semantic and syntactic properties with lexical representations of nouns and verbs (both meaning loaded heavy-verbs and light-verbs). The model learns to rely more on syntax or semantics depending on the mapping regularities between these domains and the corresponding lexical items. The model can presumably be extended to account for dissociations between open- and closed-class words, which are thought to differ along those dimensions too.
Evidence from psycholinguistic chronometric studies has also been used to investigate closed-class word retrieval. These experiments have mainly used interference techniques to investigate how determiners are selected (Schriefers, 1993). Determiners are closed-class words whose production involves the operation of syntactic rules (e.g. gender agreement) as well as semantic constraints (since determiners contribute partly to the meaning of noun phrases: compare “the table”, “this table” and “these tables”). This double constraint makes determiner selection an important test-case for understanding closed-class word retrieval and its relation to syntactic processing. The accounts given to chronometric data have highlighted the need for determiners to be activated and selected. By doing so, these accounts have adopted (somewhat implicitly) a lexicalist view of the representation of determiners. As described below, this view has been motivated by variations in the speed at which determiners are produced depending on the context in which they are produced, or the features that drive their selection. In the context of Garrett's model described above, such a view is more similar to the hypothesis made for open-class words than for closed-class words.
Determiner selection

The chronometric experimental evidence on determiner selection has led to two rather different proposals. According to Schriefers, Jescheniak, and Hantsch (2002; 2005), the selection of determiners is governed by essentially the same principles as the selection of open-class words: activation levels and competitive selection. A different perspective is put forward by Alario and Caramazza (2002), according to which the selection of a determiner depends on its activation level, but not on the activation levels of alternative candidates (i.e. non-competitive selection).

One fundamental observation regarding determiner selection has been made with the picture-word interference paradigm when the gender and/or number of the distractor nouns were manipulated. In some languages, participants are faster to produce a determiner noun phrase when the distractor and the target nouns are of the same gender and require the same determiner, than when they are of different genders and require different determiners (Schriefers, 1993). In principle, this gender effect could originate during the processing of the grammatical gender representation of the target noun, or during the retrieval of the determiner forms (Schiller & Caramazza, 2002, 2003). Several results argue in favor of the latter.

First, when the distractor and the target have different genders but require the same determiner form (e.g. in German plural definite noun phrases; Table 1), the gender effect is not observed. This means the effect is not driven by a difference in grammatical gender between target and distractor. Rather, it is driven by a difference on which determiner the target and the distractor require (Schiller & Caramazza, 2002, 2003). Secondly, the effect is
found in Germanic languages (La Heij, Mak, Sander, & Willeboordse, 1998; Schiller & Caramazza, 2003; Schriefers, 1993; Schriefers & Teruel, 2000; Starreveld & La Heij, 2004) but not in Romance languages (Alario & Caramazza, 2002; Costa, Sebastian-Galles, Miozzo, & Caramazza, 1999; Miozzo & Caramazza, 1999; Miozzo, Costa, & Caramazza, 2002; although see Schriefers & Teruel, 1999). The parameter responsible for this modulation appears to be whether or not the phonological context plays any role in determiner retrieval (Table 1). The absence of effect in Romance languages has been interpreted as evidence that determiner selection is delayed until the point where the noun’s phonology becomes available; this delay prevents the transient activation induced by the distractor word to have an effect (Caramazza, Miozzo, Costa, Schiller, & Alario, 2001; Miozzo & Caramazza, 1999). The fact that the gender effect is modulated by a constraint on determiner form retrieval, rather than on gender processing, suggests that the locus of the distractor word effect is not gender processing per se. Finally, when the participants’ response is changed from one that requires agreement on a determiner (e.g. “der Tischmasc” the table, “das Klavierneuter” the piano) to one that requires agreement on a bound morpheme (e.g. “roter Tishmasc” red table, “rote Klavierneuter” red piano), contrasting results have been reported. Some authors failed to observe the gender effect (Costa, Kovacic, Fedorenko, & Caramazza, 2003; Schiller & Caramazza, 2003) while others reported it (Lemhöfer, Schriefers, & Jescheniak, 2006; Schriefers, 1993; Schriefers et al., 2002, 2005; for extensive discussion of the available evidence see Schiller & Costa, 2006). If the distractor word affects the target’s gender retrieval during noun phrase production, the effect should be present in any context in which target’s gender retrieval is needed (e.g. any gender agreement). The absence of an effect with
bound morphemes would therefore argue against a grammatical gender locus for the effect.

If the gender feature discussed in these studies is equated to the feature-bearing frame in Garrett's sentence production model, then the interpretation suggests that determiner retrieval is not only a late and automatic byproduct of retrieving a syntactic frame. On the contrary, determiner retrieval can be influenced by the properties of a distractor noun, which is taken as an indication that determiner retrieval involves (possibly lexical) representations that are sensitive to activation levels. One account could be as follows. When the target and distractor are of the same gender, the target determiner receives activation from both these sources; when the distractor is of a different gender, the activation induced by the distractor goes to a non-target determiner. Notice that, as is the case for any priming effect calculated without an unambiguous baseline, it is not clear a priori whether the gender effect results from facilitation in the congruent condition or inhibition in the incongruent condition. Therefore, while the evidence strongly suggests that determiner form retrieval is sensitive to activation levels, we cannot conclude that it is subject to competition.

The process of determiner retrieval is further clarified by experiments where the pictures are presented without distractors. As can be seen in Table 1, determiners from many languages are selected on the basis of a combination of features, and these features taken individually do not always favor the same determiner form. For example, a French speaker talking about her possession of a singular entity whose name is feminine and begins with a consonant (e.g. “table_fem”) will retrieve the determiner “ma”, thus producing “ma table_fem”. If, however, the name of the entity she possesses begins with a vowel, then (everything else
being equal) the speaker needs to retrieve the masculine determiner form “mon” thus producing “mon étoile\textsubscript{fem}”. Two types of noun phrases can then be distinguished. First, there are noun phrases where the different features put consistent constraints on what determiner should be selected (e.g. French possessive noun phrases with masculine nouns, where both masculine and vowel are associated with “mon”; Alario & Caramazza, 2002, referred to those as standard determiners). Second, there are noun phrases where gender and phonology put inconsistent constraints on what determiner should be selected (e.g. French possessive noun phrases with vowel-initial feminine nouns, where feminine is associated with “ma” and vowel-initial “mon”; referred to as non-standard determiners by Alario & Caramazza, 2002).

Alario and Caramazza (2002) took advantage of this property. They observed longer naming latencies for noun phrases in which the features used to compute agreement provide inconsistent information. This observation has been generalized to other languages. Dutch participants are slower in producing plural noun phrases (definite determiner “de”, \textit{the}) with nouns whose gender requires the definite determiner “het” in singular than with nouns whose gender requires the determiner “de” in singular (for evidence in Dutch see: Janssen & Caramazza, 2003; Schiller & Caramazza, 2006; Spalek & Schriefers, 2005; for evidence in German see Lemhöfer, et al., 2006; Schriefers et al., 2002; 2005). This has been interpreted as evidence that features contribute individually to the activation of determiner forms. When a feature is activated (e.g. feminine), its activation in turn cascades to the determiners it is compatible with within the naming situation. If the features involved in the noun phrase do not all converge on a single form, then the target will receive less activation (or it will receive
it slower) than if all the features converge on a single form. This delay in the activation of the determiner form is reflected in the naming latencies.

According to the available evidence, then, the retrieval of determiners is sensitive to their level of activation. This activation is at least in part produced independently by the different features contributing to agreement. The interpretation also suggests that alternative candidates are activated during this process (e.g., the determiners used with another gender or number). Accordingly, the system needs to specify how the right candidate is identified and retrieved among the activated alternatives. As advanced above, Alario and Caramazza (2002) proposed a selection model in which, once all the required features become available, a deterministic process retrieves the right determiner form. The duration of this retrieval is a function of the activation level reached by the target determiner on the basis of feature activation. Importantly, this selection process is not competitive, since it does not take into account the levels of activation of other candidates. Schriefers et al. (2002; 2005) had a different interpretation. They hypothesized that the selection mechanism is actually competitive in nature. In their view, determiner selection is sensitive not only to the level of activation of the target determiner but also to other determiner forms that become activated in the course of noun phrase production. The discrimination effects discussed above are a result of this competition. At present, however, both of these theoretical proposals can account for the available data, and further experimentation is needed to adjudicate between them.
Rationale of our study

We investigated whether the selection of a determiner is affected by increasing the availability of related alternative determiner forms. Determiners, rather than nouns, were presented as distractors (Figure 1). Two major reasons motivate this choice. First, the interpretation of noun distractor effects requires a complex hypothesis describing how the distractor activates its corresponding gender, which in turn activates the corresponding determiner in the naming situation. Distractor determiners avoid this hypothetical sequence of activation, hence producing a direct and strong activation of determiner representations. This should create ideal conditions for observing interference during determiner retrieval, if it were to exist. Second, presenting determiners as distractors allows a fine grained manipulation of a variety of distractor properties. By assessing the effects of shared and non-shared features between target and distractor determiners, we can investigate whether feature differences modulate determiners activation and selection. This manipulation cannot be achieved with noun distractors, because nouns do not specify all the features of the determiner.

The experiments reported below focus on the roles of number, definiteness, and gender. Number and definiteness depend on the message and on the conversational context in which the message is expressed. By contrast, grammatical gender is a constant property of lexical items. The Minimalist Program in syntactic research (Chomsky, 1993) distinguishes between “interpretable” features which have meaning outside the grammatical system (e.g., definiteness, number) and “uninterpretable” features which are only grammar internal (e.g., agreement). Given the contrastive properties between number and definiteness, on the one
hand, and grammatical gender, on the other, it could be expected that they put differentiable constraints on determiner selection. For these reasons, in the experiments reported below number and definiteness were considered, in a first approximation, as comparable kinds of features while grammatical gender was considered as a different type of feature.

Experiments 1a and 1b

The main goal of these experiments is to test whether determiner selection is sensitive to the levels of activation of alternative candidates. In Experiment 1a participants produced definite noun phrases (e.g. “la table”, the table) while they ignored visually presented determiners. In Experiment 1b, other participants produced bare nouns (e.g. “table”, table) in the same experimental setting. Any effect observed in Experiment 1a which is due to noun retrieval should also be observed in bare noun naming (when no determiner is produced). In contrast, any effect genuinely due to determiner processing should disappear or be reduced in bare noun naming. This contrast is important, given that a feature such as grammatical gender characterizes nouns as well as determiners. Potential effects of this variable could stem from determiner retrieval and / or noun retrieval.

Several studies (Alario, Matos, & Segui, 2004; Bentrovato, Devescovi, D'amico, & Bates, 1999; Jacobsen, 1999; Jescheniak, 1999) have shown that naming pictures with bare nouns is affected by a gender-marked context (e.g. a determiner) presented shortly before the picture. In these experiments, participants were faster when the determiner was gender congruent with the target, or they were slower when it was incongruent, or both. This effect was interpreted as evidence that the gender information carried by the prime activated a
gender representation associated to the noun, thus facilitating its retrieval (see also Cubelli, Lotto, Paolieri, Girelli, & Job, 2005, for effects of grammatical gender in the picture word interference paradigm). Of course, the fact that a feature like gender can affect the processing of nouns does not prejudge whether it will or will not affect the retrieval of determiners in the experimental situation we used, where participants produced both determiners and nouns.

Two factors were manipulated: the definiteness feature and the grammatical gender of the distractor determiner, thus yielding four conditions (Table 2). The condition where the distractor and the target share both the definiteness feature and the grammatical gender is in fact an identity condition. It is included to test the sensitivity of the paradigm to the availability of determiner representations. The critical comparisons are made among the three other conditions. According to the view that determiners compete for selection, the more similar the distractor is to the target, the slower the retrieval of the determiner and the longer the noun phrase production latency. This is because distractors sharing one common feature with the target should be harder to discriminate than distractors sharing no feature, thus delaying the selection of the target determiner and producing slower naming latencies. By contrast, if determiners are selected solely on the basis of an activation process then determiner distractors that are more similar to the target should not induce longer naming latencies.

The comparison between the conditions 2 and 4 of Table 2 (i.e. definite vs. indefinite distractors of incongruent gender) provides a measure of the effect of definiteness. If the target determiner is harder to discriminate among related distractors, then responses should be
slower when definiteness is the same (condition 2) than when it is different (condition 4). Similarly, the comparison between conditions 3 and 4 (i.e. congruent vs. incongruent gender distractors of the incongruent definiteness) provides a measure of the effect of grammatical gender. If the selection of determiners is harder to discriminate among grammatically (gender) related distractors, then responses should be slower when the gender is the same (condition 3) than when it is different (condition 4).

Several constrains were considered when designing the experiment. First, determiner production may be a relatively simple process, not subject to much variance and hence unlikely subject to reliable experimental effects. Against this view is the empirical work reviewed in the introduction, in which many noun phrase production experiments show effects attributed to determiner processing. Second, there is a large repetition of target determiners, since the determiners of a given language all come from a reduced set. Note, however that Stroop interference effects are observed with reduced response sets and across many repetitions (see discussion and references on the effect of practice in Caramazza & Costa, 2000, 2001; MacLeod, 1991). Also, previous research on noun phrase production has evidenced naming latency effects in related experimental conditions.

Thirdly, in many languages determiners that share features (e.g. definiteness or gender) also tend to share phonological properties (e.g. in French, the masculine and feminine singular definite determiners are “le” and “la” respectively, and the plural form is “les”). Thus, the potential effect of this confounding variable when interpreting the results of the experiment should be considered (see Experiment 4 in Jescheniak, Schriefers, & Hantsch,
Fourth (and finally), contrary to the classical assessment of semantic interference with open-class words, we lack a neutral baseline distractor condition in these experiments. It is impossible to find neutral distractor determiners because any determiner carries information about grammatical and/or semantic features (e.g., number, or gender, or definiteness, etc.). For this reason, we defined comparisons among conditions in which the distractor determiners differed by the features they shared with the target determiner, without attempting to define a globally neutral condition (see detailed description above).

Methods

Participants.

A total of 24 native speakers of French participated in this experiment for course credit. They were students of psychology at the Université de Provence (Aix-en-Provence), aged between 18 and 30 years old. They reported having no language disturbance, and having not followed any language rehabilitation therapy.

Materials.

We selected 30 black and white pictures of common objects from a French picture database (Alario & Ferrand, 1999), half with a masculine name and the other with a feminine name. All pictures’ names started with a consonant (see the Appendix). For each picture (e.g., “TABLE”, table\textsubscript{fem}) we selected four different singular distractor words: (1) the definite determiner of the same gender as the target (e.g., “LA”, the\textsubscript{fem}), (2) the indefinite determiner of the same gender as the target (e.g., “UNE”, a\textsubscript{fem}), (3) the definite determiner of the opposite gender of the target (e.g., “LE”, the\textsubscript{man}), and (4) the indefinite determiner of the opposite
gender of the target (e.g., “UN”, $a_{ masc}$). The stimuli were created by writing the distractor words on the pictures in black uppercase letters (Arial font, size 30 points; see Figure 1).

In order to increase the number of determiners in the response set, we included filler trials in which two pictures were presented instead of one, and for which participants had to provide a noun phrase in plural. The distractor words for these trials were plural determiners that are not gender marked in French. Five other pictures, paired with similar distractors, were used as training and warm-up trials.

*Design.*

Two factors were manipulated: (a) the congruency in gender between target and distractor and (b) the congruency in definiteness between target and distractor. These factors had two levels each (congruent vs. incongruent). Notice that the condition in which distractors are both gender- and type-congruent is in fact an "identity" condition. Target-distractor relatedness was manipulated in a within-participant and within-item design.

All participants saw the experimental pictures in all 4 conditions. The order of presentation of the trials was quasi-random with the following constraints: (a) pictures of the same object were at least 10 trials apart, (b) two successive pictures were never from the same semantic category or phonologically related, (c) there were never more than four pictures of the same gender or number in a row, (d) there were never more than two identical target or distractor determiners in a row, (e) there were never more than three trials from a given condition in a row, and (f) the number of trials in which the determiner to be produced corresponded to the determiner to be ignored in the previous trial was equated across
experimental conditions. We created four lists of experimental stimuli, and four additional lists corresponding to the reversed order. The lists were divided in three blocks of 60 experimental trials. The blocks began with 2 warm-up trials

*Procedure.*

The experiment was controlled by the software DmDX (Forster & Forster, 2003). Participants were tested individually. Before the experiment proper they were familiarized with the materials. They were presented the pictures once, without any distractor word, and asked to provide the most appropriate name. They were corrected if they did not produce the intended name. Then, participants were familiarized with the experimental procedure. This familiarization included 10 trials of filler pictures. The familiarization trials were identical to those of the experiment proper. During a trial of the experiment proper, participants first saw a blank screen for 300 ms, then a fixation point for 500 ms, and finally the target picture. The picture remained on the screen until the participant's response was detected or a deadline of 2000 ms was reached, whichever came first. The next trial started 2000 ms later. Response latencies were measured from the onset of picture display to the onset of articulation, as detected by the software voice-key. The experimenter stayed in the same room with the participant to control the experiment progress and to note down participants' naming errors.

*Data Analyses.*

Trials where responses started with noise, recording errors, and naming latencies below 350 ms were considered as recording errors and excluded from the analysis (101 trials overall; 3.5 % of the 2880 data points). Reaction times were considered as outliers, also
excluded from further treatment, when they were above the deadline limit of 2000 ms, or when they were more than 3 standard deviations away from the participant’s mean (41 outliers; 1.4 % of the data). Finally, trials in which participants produced the expected determiner or noun incorrectly (e.g. phonologically deviant responses), a different word than the intended response or other verbal responses were considered as errors (150 errors, 5.5 % of the remaining 2738 data points). A summary of the data for this experiment is shown on Table 3.

We conducted $F1$ and $F2$ analysis of variance (ANOVAs) on the naming latencies and error rates, with gender congruency and determiner type congruency as within-participants and within-items factors. For all experiments, the alpha level was set at .05; $p$ values are only reported when they are above this level.

Results and Discussion

We first report the analysis of the naming latencies. There was an effect of gender congruency. Responses were significantly faster in gender congruent trials than in gender incongruent trials $[F1(1, 23) = 32.5, MSE = 21870; F2(1, 29) = 44.0, MSE = 40627]$. The effect of determiner type (faster responses in determiner-type congruent than in determiner-type incongruent trials) was significant by participants but only marginal by items $[F1(1, 23) = 6.54, MSE = 1917; F2(1, 29) = 3.28, MSE = 1968, p = .08]$. The interaction between the two factors was significant $[F1(1, 23) = 5.22, MSE = 1387; F2(1, 29) = 4.23, MSE = 4130]$.

Three bilateral Student $t$-tests clarify this interaction (for confidence intervals see Table 3). Within gender congruent trials, there was a significant difference between definite
and indefinite distractors [conditions 1 vs. 2 of Table 2, identity effect: \( t1(23) = 2.85; t2(29) = 2.81 \)]. By contrast, within gender incongruent trials, there was no difference between the definite and the indefinite conditions [conditions 2 vs. 4 of Table 2, no definiteness effect: both \( t's < 1 \)]. Finally, within indefinite trials, there was a significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 2, gender effect: \( t1(23) = 4.12; t2(29) = 3.20 \)].

The analysis of the error rates yielded consistent results. There was a significant main effect of Gender congruency \([F1(1, 23) = 15.2, MSE = 25.1; F2(1, 29) = 12.7, MSE = 36.0]\). There was no effect of Determiner type congruency and no interaction between the two factors [all \( F's < 1.15 \)].

The results of this experiment show that the properties of the distractor determiner have an impact on the time it takes to produce noun phrases. Three findings are noteworthy in this experiment. First, the gender and determiner-type congruent condition produced the fastest responses. In this condition, the distractor determiner was in fact the target determiner that the participant has to produce (identity condition). A simple explanation of this effect follows from the assumption of priming between identical representations. However, this result is interesting by itself because it reveals that, despite the number of target repetitions, there is still room to find an effect of the distractor over the target. This identity effect will not be discussed any further.

A second relevant result is the lack of differences between trials in which the distractor definiteness value was the same as the target and those for which it was not (conditions 2 and
4 of Table 2). In other words, determiners sharing the feature definiteness (and which are actually produced in other experimental trials) are not stronger competitors than determiners that do not share this feature and that are not produced at all during the experiment.

The third relevant finding concerns the comparison between the two definiteness incongruent distractors that do (condition 3 of Table 2) or do not (condition 4 of Table 2) have the same gender as the target word. Contrary to the expectation of inhibition, responses were facilitated when the distractors were more similar: distractor determiners that shared the grammatical gender feature with the target (and hence would be appropriate for the picture name) produce shorter naming latencies than distractor determiners that did not share the gender and that could not be used with the picture name. In other words, it is not the case that the more similar a distractor is to the target determiner, the slower responses are.

It is important to clarify the origin of this pattern of results. Particularly, if the gender facilitation effect originates in the processing of the noun, it does not reflect the retrieval of determiner forms. To address this issue, participants in Experiment 1b were presented with the same stimuli as in Experiment 1a but were asked to produce bare nouns instead of noun phrases.
Experiment 1b

Methods

Participants.

A total of 24 participants from the same pool as before, and that had not participated in the previous experiment, volunteered for this experiment.


The materials, design and procedure were identical to those of the previous experiment, except for the fact that now participants were asked to name the target pictures with bare nouns (e.g. "TABLE") instead of definite noun phrases.

Results and Discussion

Measurement errors (257 trials overall; 8.9 % of the 2880 data points), outliers (38 outliers; 1.3 % of the data) and participants’ errors (43 errors, 1.7 % of the remaining 2585 data points) were identified as before. A summary of the data for this experiment is shown in Table 4. Two way ANOVAs conducted on the naming latencies showed a significant main effect of gender \[F1(1, 23) = 36.1, \text{MSE} = 10922; F2(1, 29) = 38.7, \text{MSE} = 14719\], no effect of determiner type [both \(F\)’s < 1], and no interaction between the two factors [both \(F\)’s < 1]. Due to their low number, the error rates were not analyzed.

The results of this experiment were clear: when participants named the pictures with bare nouns we observed a grammatical gender congruency facilitation effect. This observation is in line with the results of previous experiments (Alario, et al., 2004; Bentrovato, et al.,
1999; Jacobsen, 1999; Jescheniak, 1999) in which participants were faster to produce bare nouns shortly after having processed a gender marked context.

What is critical for us, however, is the contrast between Experiments 1a and 1b which, for the first time informs us about the impact of activating a distractor determiner on the selection of a target determiner. The gender facilitation effect found here was very similar in size to the effect found when noun phrases were produced (Experiment 1a). Following the rationale stated above, observing the gender effect when bare nouns are produced instills confidence in the attribution of the grammatical gender facilitation effect observed in Experiment 1a to noun retrieval rather than to determiner retrieval. Of course, what stood as the Identity condition in Experiment 1a did not produce the facilitation observed previously. This is expected since in this experiment no determiner selection was required for producing the responses and the Definite vs. Indefinite contrast no longer instantiated a Congruent vs. Incongruent contrast.

Taken together, the results of these experiments suggest that the discrimination between the target and distractor determiner is not affected by a match or mismatch between their corresponding gender values. This discrimination appears also to be unaffected by the definiteness similarity of the distractors, since no difference was observed between gender-incongruent definite vs. indefinite distractors (i.e. conditions 2 and 4 of Table 2). In other words, whether the distractor and the target determiners are similar in their gender and definiteness values does not affect the selection of the target. Consequently, no evidence of competition between determiners that differ in their grammatical gender or definiteness was
observed. Before drawing strong conclusions about these observations some additional issues need to be considered.

The first issue concerns the timing parameters of our experimental setting. Distractor determiners were superimposed on the pictures such that the stimulus onset asynchrony (or SOA) between them was 0 ms. This was done in an attempt to optimize the conditions of observation of distractor determiner representations interfering with the retrieval of the target (consider for example the SOA modulation of semantic interference effect in noun production reported by Glaser & Düngelhoff, 1984). During noun phrase production, however, determiner retrieval is dependent upon the retrieval of certain features of the noun. Determiner selection may happen later than noun retrieval, and the experimental paradigm may be sensitive to this timing difference. For the distractor to produce a maximum interference effect, its presentation may have to be delayed.

In fact, there are empirical observations suggesting that, contrary to this logic, the timing parameters may not be critical in the absence of competition between determiners. Miozzo et al. (2002) investigated whether the absence of determiner congruency effect for Romance (vs. Germanic languages) could be challenged by manipulating SOA (previous studies only used SOA = 0 ms). The results indicated that the effect was also absent at the other SOAs tested. More generally, in those studies that have used SOA manipulations in Germanic languages, determiner competition was present at SOAs different from 0 ms only when it was also present at SOAs 0 ms (REFERENCES). Despite this indications, which stem from experiments with noun distractors, we manipulated the SOA between picture and
distractor presentation (Experiment 2 reported below). This was done to test whether the apparent absence of competition between determiner forms discussed above is due to the determiner distractor being presented too early.

The second issue concerns the possible confounding role of phonological overlap between target and distractor determiners in the effects reported above. Consider for example the absence of a significant difference between the two gender incongruent conditions (conditions 2 and 4 of Table 2). These two conditions not only differ in their gender congruency, they also differ on the phonological overlap between the target determiner and the distractor determiner. Thus, if the phonological properties of the distractor affected naming latencies, then the absence of a type of determiner effect could be the result of two contrasting effects canceling each other: a/ the definite condition would be facilitated by its phonological properties and b/ the definite condition would be delayed because the definite distractor is closer and harder to discriminate from the target than the indefinite distractor (i.e. competition effect). For this explanation to work, the two opposing effects should be of comparable magnitudes. The role of phonological overlap between target and distractor determiners on the observed effects is addressed in Experiment 3. It is worth noting that there is one data point suggesting that processing phonologically related items can facilitate the production of closed-class words. In a variant of the picture word interference paradigm, Jescheniak et al. (2001) found that pronoun production (e.g., the German equivalents of he, she, or it) was facilitated when participants heard non-words phonologically related (vs. unrelated) to the target pronoun they had to utter.
The third issue concerns a limitation of the design used in the previous experiments, where the features definiteness and grammatical gender of the distractors do not have the same experimental status. The naming task involves producing only masculine and feminine definite determiners. Accordingly, definite determiner distractors of the two genders are potential responses in the experiment, whereas indefinite distractors are not potential responses. Although, the relevance of the response-set to observe interference effects with nouns in this paradigm is controversial (Caramazza & Costa, 2000, 2001; Roelofs, 2001), we cannot dismiss its potential effects in our previous experiments. It could be the case that for the duration of the experiment the representation of indefinite determiners is not activated as much as that of definite determiners or that, even if indefinite determiners are activated, they are not considered by the selection process. If this were to be the case, the level of activation of indefinite determiners is not expected to influence the selection process. In this situation, the design used in our previous experiments would have artificially reduced the chances for obtaining a competition effect between different determiner types. This issue is addressed in Experiment 4.

Experiment 2

The purpose of this experiment is to test whether the results observed in Experiment 1a are affected by the timing at which the picture and the distractor are presented. Given that determiner selection depends on the retrieval of certain noun features, its processing could lag behind that of the noun. Presenting the distractor later with respect to the picture may delay its processing (on average) which may increase the likelihood of
influencing the processing of the target determiner. This possibility was tested with two
SOAs: distractors presented 150 ms or 300 ms after the picture.

Method

Participants.

A total of 24 participants from the same pool as before, and that had not participated in
previous experiments, volunteered for this experiment.


The materials, design and procedure were identical to those of Experiment 1a, except for the
following points. SOA was manipulated within participants and within items. Participants
took part in two experimental runs each. During the first run, the SOA between picture and
distractor was held constant (either 150 or 300 ms). During the second run, the other SOA
was used. The order of SOAs was alternated across participants. For everything else, each of
the two runs mirrored the runs of Experiment 1a.

Results

Measurement errors (10 trials overall; 0.18 % of the 5760 data points), outliers (94 outliers;
1.6% of the data) and participants' errors (255 errors, 4.5% of the remaining 5656 data
points) were identified as before. A summary of the data for this experiment is shown in
Table 5.

On the naming latencies, we conducted two three-way ANOVAs with participants and
items as random variables. The analysis included a new within-participants and within-items
factor, SOA, with two levels (150 and 300 ms). The factor SOA had no effect by participants, but was significant by items \( F1(1, 23) = 2.66, \text{MSE} = 17749, p = .12; F2(1, 29) = 69.8, \text{MSE} = 22952 \). The effect of gender was significant \( F1(1, 23) = 7.01, \text{MSE} = 3745; F2(1, 29) = 11.5, \text{MSE} = 3689 \), as was the effect of determiner type \( F1(1, 23) = 7.90, \text{MSE} = 3570; F2(1, 29) = 8.78, \text{MSE} = 5772 \). As in Experiment 1a, we observed a significant interaction between gender and determiner type \( F1(1, 23) = 10.0, \text{MSE} = 3978; F2(1, 29) = 15.6, \text{MSE} = 5069 \).

There is a suggestion that SOA modulated this pattern. This is because SOA interacted significantly with gender \( F1(1, 23) = 10.3, \text{MSE} = 2408; F2(1, 29) = 7.26, \text{MSE} = 3017 \) and interacted with determiner type [only significant by items: \( F1(1, 23) = 3.91, \text{MSE} = 1365, p = .06; F2(1, 29) = 6.86, \text{MSE} = 1722 \)]. However, the modulation by SOA was not complete, as the interaction between the three factors was not significant \( F1(1, 23) = 7.01, \text{MSE} = 3745; F2(1, 29) = 1.52, \text{MSE} = 357, p = .23 \).

To clarify the pattern and its possible modulation by SOA, we conducted two way ANOVAs for each of the two SOA values separately. This analysis mirrors the analysis conducted for Experiments 1a and 1b above. It also mirrors the analysis that will be conducted for several of the experiments reported below.

At SOA 150 ms, there was an effect of gender congruency. Responses were significantly faster in gender congruent trials than in gender incongruent trials \( F1(1, 23) = 16.4, \text{MSE} = 6080; F2(1, 29) = 17.7, \text{MSE} = 6690 \). The effect of determiner type (faster responses in determiner-type congruent than in determiner-type incongruent trials) was significant \( F1(1,23) = 8.84, \text{MSE} = 4676; F2(1, 29) = 12.0, \text{MSE} = 6901 \), as was the
interaction between the two factors \( F1(1, 23) = 8.31, MSE = 3197; F2(1, 29) = 18.2, MSE = 4060 \). Three bilateral Student t-tests clarify this interaction (for confidence intervals see Table 5). Within gender congruent trials, there was a significant difference between definite and indefinite distractors [conditions 1 vs. 2 of Table 2, identity effect: \( t1(23) = 4.39; t2(29) = 5.33 \)]. By contrast, within gender incongruent trials, there was no difference between the definite and the indefinite conditions [conditions 2 vs. 4 of Table 2, no definiteness effect: both \( t's < 1 \)]. Finally, within indefinite trials, there was no significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 2, no gender effect: both \( t's < 1 \)].

At SOA 300 ms, there was no main effect of gender congruency [both \( F's < 1 \)]. There was no main effect determiner type [both \( F's < 1.78 \), both \( p's > .19 \)]. The interaction between the two factors was marginally significant by participants and items \( F1(1, 23) = 2.96, MSE = 1067, p = .10; F2(1, 29) = 4.04, MSE = 1367, p = .054 \). Despite this marginal significance, three bilateral Student t-tests were computed to clarify the pattern (for confidence intervals see Table 5). Within gender congruent trials, there was a marginally significant difference between definite and indefinite distractors [conditions 1 vs. 2 of Table 2, identity effect: \( t1(23) = 1.98, p = .06; t2(29) = 2.27, p = .03 \)]. By contrast, within gender incongruent trials, there was no difference between the definite and the indefinite conditions [conditions 2 vs. 4 of Table 2, no definiteness effect: both \( t's < 1 \)]. Finally, within indefinite trials, there was no significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 2, no gender effect: both \( t's < 1.39 \), both \( p's > .18 \)].
The three-way ANOVAs were also conducted on the error rates. We only report comparisons that were significant or marginally significant by participants. SOA and definiteness interacted \([F1 = 5.83, \text{MSE} = .0063; F2 = 6.10, \text{MSE} = .0079]\). The three-way interaction was marginally significant \([F1 = 3.16; \text{MSE} = .0035; p = .09; F2 = 3.68, \text{MSE} = .0045, p = .06]\). These results are compatible with the latency data (see also Table 5).

**Discussion**

Similar to Experiment 1a, the data at SOA 150 ms show an identity effect, and no difference between trials in which the distractor definiteness value was the same as the target and those for which it was not (conditions 2 and 4 of Table 2). By contrast, the data do not show the gender facilitation effect observed in Experiment 1a, which was attributed to noun processing on the basis of Experiment 1b. The analysis of SOA 300 ms shows considerably reduced significance levels. The pattern observed in Experiment 1a and at SOA 150 ms of the current experiment is still observed, but the effects are now only marginally significant.

The absence of the gender facilitation effect may be due to the distractor activation arriving too late to influence noun processing. Importantly for us, the data show that the absence of competition effects we concluded from the interpretation of Experiments 1a and 1b is not due to the distractor activation occurring (and disappearing) too early. This observation strengthens the conclusions reached on the basis of Experiments 1a and 1b.
Experiment 3

The main purpose of this experiment is to assess whether the results observed in Experiment 1a are affected by the phonological overlap between the distractor and the target determiners. In Experiment 1a definite distractors were phonologically more similar to the targets than indefinite distractors. To solve this potential confound we run a very similar experiment to Experiment 1a but in Spanish, a language in which the definite determiner forms of the two genders have little phonological overlap. The feminine form of the definite article in Spanish is “la”, and the masculine form is “el”. Note that although the segment /l/ is present in these two words, it appears in word-initial position in the feminine form, and in word-final position in the masculine form. Previous research has indicated that phonological effects only occur when the concerned segments share their position in the word. For example, Mahon, Costa, and Caramazza (2001) investigated this issue with monosyllabic words in the picture-word paradigm. The initial segment of the pictures was either identical to the initial or to the final segment of the distractor word. In two experiments, the phonological effect was not observed when the phoneme shared by target and distractor did not share their syllabic position. Moreover, Dell (1986) observed that a majority of phoneme exchanges in natural speech preserve syllabic position. To account for this finding, Dell (1986; see also Sevald & Dell, 1994) proposed a phonological encoding model where segment representations are coded for their syllabic position. A given consonant has two distinct representations: one to be used in syllabic onsets, and one in syllabic codas. It is therefore reasonable to expect that any phonological effect that could be at play in Experiment 1a
should not be present (or considerably reduced) in Experiment 3 where the Spanish articles “la” and “el” used. If the absence of a difference between gender incongruent definite and indefinite distractors is due to a phonological facilitation effect compensating for the inhibition effect, such a difference should be visible here. If, by contrast, phonological overlap between distractors and target, did not influence the outcome of Experiment 1a, then the results of Experiment 3 should mirror those of Experiment 1a.

Method

Participants.

A total of 24 native speakers of Spanish participated in this experiment for course credit. They were students of psychology at the Universidad de Barcelona, aged between 18 and 30 years old. They reported having no language disturbance, and having not followed any language rehabilitation therapy.

Materials.

Six pictures were changed with respect to Experiment 1a because they did not have the same gender in Spanish as in French, or because the name agreement was not high enough in Spanish (see Appendix for details).

Design and Procedure.

In Experiment 1a, trials with plural targets were included to increase the number of determiners produced by participants. Those plural trials were considered as fillers because, in French, the plural forms of the definite determiner are invariant with respect to gender (the
masculine and feminine definite article is “les”). In Spanish, by contrast, the plural form of the definite and indefinite determiners is gender marked. This property allowed creating the four experimental conditions in plural trials, by associating distractor determiners in the plural form. In this experiment, then, targets were both singular and plural. The definiteness and gender manipulations of Experiment 1a were used. Singular targets always had singular distractors and plural targets always had plural distractors (see Table 6).

Participants were asked to name the pictures with Spanish definite determiners in singular (e.g. “LA MESA”, the table) or in plural (e.g. “LAS MESAS”, the tables) depending on the number of objects depicted on the picture (one or two).

**Results**

Two items were excluded altogether from the analysis: 1/ the item “POMO” (i.e. doorknob), as one of its pictures appeared incorrectly on the screen because of an unintended picture resolution difference and 2/ the item “CESTA” (i.e. basket) because participants named it alternatively in its masculine and feminine form (“CESTO” or “CESTA”; both words exist, they have a slight difference in meaning related to the size of the object). Measurement errors (413 trials overall; 7.8 % of the 5376 data points), outliers (56 outliers; 1.0 % of the data) and participants' errors (214 errors, 4.4 % of the remaining 4907 data points) were identified as before. A summary of the data for this experiment is shown in Table 7.

We first report the analysis of the naming latencies. There was an effect of grammatical gender congruency, with faster responses in gender congruent trials than in
gender incongruent trials \( F1(1, 22) = 50.4, \text{MSE} = 10292; F2(1, 27) = 47.3, \text{MSE} = 11829 \). There was a significant effect of determiner type \( F1(1, 22) = 5.29, \text{MSE} = 683; F2(1, 27) = 5.94, \text{MSE} = 841 \), and there was a significant interaction between the two factors \( F1(1, 22) = 8.46, \text{MSE} = 771; F2(1, 27) = 5.57, \text{MSE} = 788 \).

Three bilateral Student \( t \)-tests clarify this interaction (for confidence intervals see Table 7). Within gender congruent trials, there was a significant difference between definite and indefinite trials [conditions 1 vs. 2 of Table 6, identity effect: \( t1(23) = 2.85; t2(29) = 3.94 \)]. By contrast, within gender incongruent trials, no difference was observed between definite and indefinite trials [conditions 2 vs. 4 of Table 6, no definiteness effect: both \( t \)'s < 1]. Finally, within indefinite trials, there was a significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 6, gender facilitation effect: \( t1(23) = 4.44; t2(29) = 4.50 \)].

The analysis of the error rates were consistent, except for one comparison (noted below). There was a significant effect of Gender congruency \( F1(1, 23) = 7.51, \text{MSE} = 70.6; F2(1, 27) = 4.19, \text{MSE} = 82.63 \). There was no effect of Determiner type congruency [both \( F \)'s < 1]. The interaction between the two factors was significant \( F1(1, 23) = 5.22, \text{MSE} = 58.7; F2(1, 27) = 4.19, \text{MSE} = 82.6 \). Two-tailed Student \( t \)-tests yielded the following results (for confidence intervals see Table 7). Within gender congruent trials, there was no significant difference between definite and indefinite trials [no identity effect: \( t1(23) = 1.40, p = .17; t2(27) = 1.64, p = .11 \)]. By contrast, within gender incongruent trials, a significant difference was observed between definite and indefinite trials [an unexpected definiteness
effect: \( t1(23) = 2.35; t2(27) = 2.40 \). Finally, within indefinite trials, there was no difference between gender congruent and incongruent trials [no gender effect: both \( t \)'s < 1]. Further discussion of the difference in error rates between the two gender incongruent conditions is deferred to the discussion of Experiment 4.

Discussion

The results of this experiment are very similar to those of Experiment 1a conducted in French. Naming latencies were shorter in the identity condition than in any other condition. Also, they were shorter with gender congruent than with gender incongruent distractors. Finally, there was no difference between the two gender incongruent conditions (definite vs. indefinite). The comparison between Experiment 1a and Experiment 3 provides indirect evidence that the phonological properties of the distractor do not influence the retrieval of closed-class words in the paradigm we use. This conclusion stands in contrast to that reached by Jescheniak et al. (2001) on the basis of their Experiment 4. The detailed explanation of this contrast is beyond the scope of our investigation. Methodological differences between that experiment and ours could well be responsible for the difference. In particular, our distractors were words presented visually whereas theirs were pseudo-words presented auditorily. The latter stimuli could provide more direct access to the phonological properties. Also, in our experiments participants produced full noun phrases comprising a variable determiner and a variable noun, whereas in their experiment participants simply produced bare pronouns which resulted in a kind of choice task (in German, choosing between the German pronouns “er”, “sie” or “es”).
The Spanish data show that the pattern of results observed in French is not dependent on the phonological similarity of the items used as distractors, so the absence of a difference between the definite and the indefinite gender-incongruent conditions is not due to a compensation of opposite facilitatory and inhibitory effects. Rather, the replication in the new language indicates that increasing the level of activation of a semantically related distractor does not induce a discrimination cost in the naming latencies, just as we concluded for the gender manipulation.

Experiment 4

The aim of Experiment 4 is to investigate whether response set membership influenced the outcome of the previous experiments. In Experiment 1a, participants produced noun phrases with definite determiners while they ignored either definite distractors (in the response set) or indefinite distractors (not in the response set). One way to circumvent this asymmetry would be to include both distractor types in the response set. However, it is quite difficult to trigger the use of these different determiner types in a relatively natural manner upon the presentation of a given picture. We chose to take another experimental approach to solve this shortcoming. As argued in the Introduction, contrary to grammatical gender, definiteness and number are both interpretable outside the grammatical system because they depend on the message to be expressed. Given the relative similar status of these two features, and that number allows for a natural elicitation of its two values upon the presentation of a given stimulus (one object vs. two objects) the manipulation of definiteness was replaced by a manipulation of the number of objects to be named. This allows equating the response-set
status of the distractors in the experiment while using features that are relatively comparable. We used singular and plural distractor determiners in an experiment where participants produced noun phrases in Spanish containing singular (if only one object was presented) and plural target determiners (if two similar objects were presented). The distractor determiners were number-congruent or number-incongruent with the target determiner, and they were gender-congruent or gender incongruent (Table 8).

**Method**

*Participants.*

A total of 24 new participants from the pool used for Experiment 3 volunteered for this experiment.

*Materials.*

The pictures were the same as in Experiment 3. The distractors were all definite determiners: singular or plural, and masculine or feminine. Each object was presented four times in singular (one object per picture) and four times in plural (two objects per picture). Both singular and plural trials were experimental trials. Each item was associated with four distractors (Table 8). Importantly, all these distractors were part of the response set, meaning that during the experiment they were produced on every fourth trial on average.

*Procedure and design.*

The procedure and design were similar to those of the Experiment 3.
**Results**

As in the previous experiment, the item “CESTA” (i.e. basket) was excluded because it led to many gender errors. The file resolution problem affecting the item “POMO” (i.e. doorknob) in Experiment 3 had been corrected. Measurement errors (151 trials overall; 2.7 % of the 5568 data points), outliers (182 outliers; 3.3 % of the data) and participants' errors (182 errors, 4.5 % of the remaining 5235 data points) were identified as before. Table 9 presents a summary of the data in this experiment.

In the naming latencies, there was an effect of gender congruency, with faster responses in gender congruent than in gender incongruent trials \([F1(1, 23) = 45.3, MSE = 13633; F2(1, 28) = 49.0, MSE = 15781]\). There was also an effect of number of the distractor, with faster responses in number congruent than in number incongruent trials \([F1(1, 23) = 8.29, MSE = 1473; F2(1, 28) = 5.06, MSE = 1331]\). The interaction between the two factors was also significant \([F1(1, 23) = 3.99, MSE = 1040, p = .06; F2(1, 28) = 7.53, MSE = 1542, p = .01]\). Two-tailed Student t-tests clarify this interaction (for confidence intervals see Table 10). The effect of distractor number was present for gender congruent trials [conditions 1 vs. 2 of Table 8, identity effect: \(t1(23) = 3.85; t2(28) = 3.39\)] but not for gender incongruent trials [conditions 2 vs. 4 of Table 8, no number congruency effect: both \(t's < 1\)]. Also, within number incongruent trials, there was a significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 8, gender facilitation effect: \(t1(23) = 3.10; t2(29) = 3.53\)].
The analysis of the error rates yielded consistent results. There was no main effect of Gender congruency [both $F$'s < 1]. There was an effect of Number congruency [$F1(1, 23) = 3.76$, $MSE = 42.8$, $p = .06$; $F2(1, 28) = 5.88$, $MSE = 54.1$, $p = .02$]. Finally, there was a significant interaction between the two factors [$F1(1, 23) = 9.39$, $MSE = 87.6$; $F2(1, 28) = 15.4$, $MSE = 117$]. Two-tailed Student $t$-tests yielded the following results. Within gender congruent trials, there was a significant difference between number congruent and incongruent trials [identity effect: $t1(23) = 3.09$; $t2(28) = 5.65$]. Within gender incongruent trials, there was no such difference [no number congruency effect: both $t$’s < 1]. Finally, within number incongruent trials, there was no difference between gender congruent and incongruent trials [no gender effect: both $t$’s < 1.49]. Notably, the unexpected definiteness effect in error rates that was observed in the Experiment 3 was not replicated here with the number feature. Given that this effect was only observed in one of four experiments, and that the naming latency pattern is consistent across experiments, we will not discuss it any further.

Discussion

In this experiment we assessed whether the absence of a semantic discrimination cost in the comparison between definite and indefinite distractors in Experiments 1a, 2 and 3 was due to the response set status of the distractors. To do so, we resorted to another manipulation (number) with which we compared conditions whose distractors were all in the response set of the experiment. The results of Experiment 4 mirror those found in the previous experiments. Most critically, there was no difference between the number congruent and the number incongruent conditions when they were both gender-incongruent. In other words,
neither the grammatical nor the semantic manipulations that were applied to the distractor determiners induced a discrimination cost in the naming latencies.

Up to here we have presented four experiments conducted in French and Spanish exploring the principles involved in determiner selection competition. These experiments led to consistent results indicating that there is no differential discrimination cost for selecting determiner forms that are more or less similar to the target determiner. One possible explanation for this observation is that the process of determiner selection does not take into account the activation of alternative determiners when selecting the response. In other words, determiner selection is not a competitive process. However this conclusion is not yet warranted given the cross-linguistic differences already observed in the processes involved in determiner selection.

As was described in the Introduction, previous research has revealed a major cross-linguistic difference in how determiner retrieval is achieved in Germanic and in Romance languages. According to the so-called “late selection hypothesis” (Caramazza et al., 2001; Miozzo & Caramazza, 1999), determiners of Romance languages are selected at a later point in time relative to Germanic languages because the phonological context constrains the form of determiners in Romance languages. The empirical result that motivated such a hypothesis is the observation that distractor nouns produce a determiner congruity effect in Germanic languages, while such an effect is consistently not observed in Romance languages. Given, that the experiments presented above were conducted in two Romance languages where phonology constrains the form of determiners, it might be argued that the lack of
discrimination effects in our experiments is due to the “late selection” nature of such languages. Note however, that there are reasons to think that the cross-linguistic empirical difference observed with noun distractors does not apply to the Stroop-like determiner distractors we used. From the start, we explicitly hypothesized that presenting determiners as distractors instead of nouns should ensure that determiner representations get more fully activated than by the indirect (and possibly more transient) chain of activations triggered by a noun distractor. Yet, given that the ultimate reasons why determiner selection is different in Germanic and in Romance languages are still unknown, it remains an empirical question to determine if the cross-linguistic contrast is also present with the distractors we used.

Experiment 5

The aim of this experiment is to test whether the contrast between “early” and “late selection” processes may affect the interference produced by determiner distractors in the experimental setting used in our previous experiments. If such is the case, the discrimination effect among competing determiners should be present when the experiment is conducted in a “late selection” language (i.e., a language in which the selection of the determiner is independent of its phonological context). Experiment 5 was very similar to Experiments 1a and 3, their main difference being the language in which they were was conducted: German instead of French or Spanish.

Method

The method was the same as that of Experiment 1a expect for the following points.
Participants.

A total of 24 native speakers of German participated in this experiment for monetary compensation. They were students at Saarland University, aged between 20 and 46 years old with the bulk being in their twenties. They reported having no language disturbance and having not followed any language rehabilitation therapy.

Materials.

Eighteen of the objects used in Experiment 1a were used in this experiment. An additional 22 objects with high name agreement in German were selected. Half of the objects had a masculine name and half of them had a feminine name. Although German has three genders, objects with neuter gender were not included in order to maintain an overall design comparable to Experiments 1a and 3. Additionally, masculine and neuter indefinite determiner forms are homophonous (both ein) and thus an equal proportion of distractor forms and trials per condition would not have been possible if neuter has been included. Since the plural determiner form in German is also homophonous with the feminine singular determiner form (both die), we also did not include plural filler trials in this experiment. A summary of the experimental conditions is provided on Table 10.

Design and Procedure.

Participants were asked to name the pictures in German with singular definite determiners (e.g., “die lampe”, the lamp). Everything else was similar to Experiment 1a.
Results

Measurement errors (53 trials overall; 1.3% of the 3840 data points), outliers (94 outliers; 2.5% of the data) and participants’ errors (110 errors, 2.9% of the remaining 3693 data points) were identified as before. A summary of the data for this experiment is shown in Table 11.

In the naming latencies, there was an effect of grammatical gender congruency, with faster responses in gender congruent than in gender incongruent trials \[F1(1, 23) = 28.6, \text{MSE} = 215; F2(1, 39) = 20.0, \text{MSE} = 595\]. There was also a significant effect of determiner type, with faster naming times with definite distractors compared to indefinite distractors \[F1(1, 23) = 4.4, \text{MSE} = 416; F2(1, 39) = 9.3, \text{MSE} = 359\]. There was a significant interaction between the two factors \[F1(1, 23) = 8.6, \text{MSE} = 386; F2(1, 39) = 17.0, \text{MSE} = 344\].

Two-tailed Student t-tests clarify this interaction (for confidence intervals see Table 11). Within gender congruent trials, there was a significant difference between definite and indefinite trials [conditions 1 vs. 2 of Table 10, identity effect: \(t1(23) = 3.61; t2(39) = 5.4\)]. By contrast, within gender incongruent trials, no difference was observed between definite and indefinite trials [conditions 2 vs. 4 of Table 10, no definiteness effect: both \(t’s < 1\)]. Finally, within indefinite trials, there was no significant difference between gender congruent and incongruent trials [conditions 3 vs. 4 of Table 10, no gender facilitation effect: \(t1< 1; t2(39) = 1.1, p = .28\)]. Error rates in this Experiment were much lower than in Experiments 1a, 2 or 3. This is possibly due to the simpler more homogeneous design, which did not include any plural responses. Due to their low number, the error rates were not analyzed.
Discussion

In relation to the main issue addressed in this research, the results in German are very similar to those observed in Spanish and French (Experiments 1a, 2, and 3). In none of the experiments did more similar determiner distractors lead to slower latencies than more different distractors. However there is also a difference between the results in German and in Romance languages. In experiments involving simultaneous presentation of target picture and distractor determiner (Experiments 1a and 3), a gender facilitation effect was observed for definite incongruent distractors. However, this effect was not observed at SOAs 150 and 300 ms (Experiment 2) in French, just as it was not observed with simultaneous presentation in German. The available empirical evidence does not allow a full account of this pattern. We can speculate that in German, a language with three genders, the activation dynamics of gender information could be different than in French and Spanish, which both have two genders. More generally, the distributional properties of gender across the nouns of the languages may have differential influences on processing speeds across languages. This being said, no further attempt was made to clarify the origin of this difference, given that the results of Experiments 1a and 1b, together with the evidence cited previously, have allowed attributing the grammatical gender effect to noun rather than to the determiner retrieval, which is the focus of our research.

In short, the results from this experiment show an identity facilitation effect, and no signs of increased naming latencies when the distractor is more similar to the target. Pending
further evidence, we conclude that the absence of an inhibition discrimination effect cannot be ascribed to potentially different selection processes in Germanic and Romance languages.

General Discussion

Research on open-class word production —mostly nouns— indicates that lexical selection involves a stage where alternative candidates are discriminated from one another. This process is delayed when non-target candidates receive extra activation, for example when an alternative candidate is processed concurrently or in close temporal vicinity with the target word. Although the precise origin of this delay (e.g. semantic interference in the picture-word paradigm) is still under debate, it has been used to inform models of lexical selection. In this article, we have followed the same rationale in order to assess the similarities and differences between the selection processes for open- and closed-class words by investigating the selection of a particular type of closed-class word: determiners.

Summary of findings

The five picture-word experiments we report parallel the kind of experiments that are conducted to investigate noun retrieval. The results showed that noun phrase production latencies were influenced by the linguistic properties of ignored distractor determiners. However, this influence did not mirror the discrimination inhibition effect that is observed in noun retrieval. More specifically, when the grammatical and non-grammatical properties of the distractor determiners were manipulated, we observed: a) an identity effect (faster responses with distractors identical to the target), b) a grammatical gender facilitation effect
(faster responses for gender congruent than for gender incongruent distractors), and c) no effect of definiteness or number.

The identity effect could be interpreted as an increase in the availability of the target determiner when the very same determiner is used as a distractor word. Given that this effect could stem from facilitation at various processing levels (semantic, grammatical, lexical, phonological), it cannot be easily used to draw strong conclusions about determiner selection. The grammatical gender facilitation effect observed in Experiment 1a was ascribed to noun retrieval because it was observed again in Experiment 1b in which bare nouns were produced. Thus it indirectly indicates the absence of an effect of the gender congruency manipulation for determiner selection. The results of Experiments 1a, 2, 3, 4 and 5 allow the following relevant empirical generalization. To the extent of our empirical tests, determiner distractors with different features than the target determiner do not affect determiner selection irrespective of: a) the timing of their presentation (Experiment 2), b) the phonological overlap (Experiment 3), c) the status of the determiner distractors (members of the response set or not, Experiment 4), and d) the language family tested (Romance vs. Germanic; Experiment 5). These results are summarized in Figure 2. Thus, the main empirical contribution of this study is the absence of a discrimination cost between conditions in which the distractor determiners were more or less similar to the target determiner.

Importantly, this lack of a discrimination cost occurs in a situation where other effects of the distractor determiner are observed: the identity priming of Experiment 1a, or the gender congruency effect (tied to noun processing) of Experiments 1a, 3, and 4. The presence of this
pervasive facilitation effect indicates that the absence of a discrimination inhibition effect is not simply due to the distractors’ representations not being active enough, or to the target representation being over-activated by repetitive use during the experiment. Indeed, distractor determiners activate representations in the production lexicon, and that the variability of activation of these representations can be reflected in the naming latencies. Also, the absence of discrimination inhibition occurs in an experimental paradigm which is in many respects is similar to other paradigms in which determiners performance is subject to other manipulations. Overall, then, we can be confident that the absence of such an effect is not due to the lack of power in our experiment.

Contrastive models of closed-class word retrieval

Two major families of determiner (or closed-class word) production models can be distinguished. In Garrett's (1975; 1984; 1988) model, closed-class words are represented in an abstract featural form within the sentence frame. The process by which they are phonologically spelled-out is not described in detail (beyond the hypothesis that it happens after the phonological spell-out of open-class words). The results we report in this article could be accommodated within Garrett's model of sentence production, or one of its variants. The absence of competition between proximal determiners can be predicted within the hypothesis that determiners are abstract features of the frame. The standard version of this model, however, does not appear to predict certain observations that have been reviewed in the Introduction. In particular, the observation made in picture naming experiments that determiner retrieval can be faster or slower in the context of different distractor nouns, or as a
function of the features driving selection, has highlighted the critical played by the stage of
determiner selection.

In models used to account for chronometric data, determiners have a more lexicalist
representation. This representation is activated by (grammatical) features, and is then
explicitly retrieved (i.e. its retrieval is not a byproduct of frame processing). In this view,
more than one determiner is activated by the processing of the object to be named and the task
instruction. For example, members of the same determiner type but of different genders (e.g.
masculine and feminine possessives in French: “mon” and “ma”, my) are expected to be
active when a possessive noun phrase is to be uttered. Our observations reveal that providing
an extra boost of activation to alternative determiners (by presenting them as written
distractors) does not delay the production of the response. Remarkably, the absence of a
discrimination cost applies for distractor determiners that were in the response set and in fact
produced in the other trials of the experiment (gender alternatives), as well as to determiners
that were not in the response set but that were appropriate in terms of gender for the target
noun that was being produced (definiteness alternatives). As noted above, discrimination
inhibition effects in noun research, as well as some effects in determiner research, have been
taken as an indication of a competitive process among activated candidates. The absence of
such discrimination costs here could suggest that the same principle does not apply to
determiner selection.
Does determiner selection involve competitive processing?

The conclusion reached in the previous paragraph would stand in contrast with the view that determiners are selected through a competition process. The question then becomes one of assessing whether there are other results that compel us to embrace the notion of competition for selection. When doing so, what is relevant is not to identify those results that are compatible (or consistent) with the notion of competition, but rather those that argue against alternative options. As we will see, the observation of delays in the response times of certain experimental conditions does not necessarily imply that a competition mechanism is operating. What is critical is what levels of activation are taken into account in the criteria used by the postulated selection process (Wheeldon & Monsell, 1994). Competition as it has been used in word selection for production can be briefly described as a process where selection speed is:

1/ a decreasing function of the level of activation of the target that will eventually be selected, and

2/ an increasing function of the levels of activation of alternative candidates that are transiently considered as potential targets before selection occurs.

The first assumption simply ties variability in the retrieval times to activation levels. The critical assumption to assess, then, is the second one: does the speed of selection (and therefore the speed of response) depend on the levels of activation of alternative non-target candidates? The first set of results that have been considered as positive evidence for the competition account is the gender congruency effect in the picture-word interference
paradigm. However, in these experiments, the gender congruency effect was always assessed by comparing distractors of the same gender of the target word against distractors with a different gender. So no neutral condition was included, because of obvious reasons. In the gender-marked languages investigated to date, all the members of the gender-marked grammatical category noun are indeed marked for gender (see also footnote 3). Given this property of the experiments, the gender congruency effect can be attributed either to the priming of the target representation in the congruent condition (as in 1/ above) or to competition induced by the over-activation of non-target representation(s) in the incongruent condition (as in 2/ above. See Schriefers et al., 2005, p. 167 for a similar argument). Thus, the gender congruency effect cannot be used to support the notion of selection by competition.

Other results used to argue in favor of competition in determiner retrieval come from picture naming experiments in which the combination of features that drives determiner selection is manipulated (Alario & Caramazza, 2002). These experiments typically involve the comparison of conditions in which all the features contribute to the activation of a single determiner form, with conditions where different features are compatible with different determiner forms (Table 1). To interpret the results of these comparisons, it is assumed that each feature (e.g. gender or plural) activates the corresponding determiner forms it is compatible with (Alario & Caramazza, 2002). For example, Schriefers et al. (2002; 2005) took advantage of the fact that in German the singular definite determiner varies with the gender of the noun, whereas in plural only one form is used with the three genders, in fact the singular feminine form “die”. They asked participants to name singular and plural pictures
with definite noun phrases. They observed that feminine noun phrases were produced faster in the plural than in the singular. By contrast, masculine and neuter NPs were produced slower in the plural than in the singular (for comparable results with Dutch singulars and plurals see Janssen & Caramazza, 2003). According to Schriefers et al. (2005), feminine plurals are produced faster than feminine singulars because in the plural the two features converge to activate the target form “die”, whereas in the singular only one such feature is present (Figure 3). This convergence allows a faster build up of activation. More importantly, still according to Schriefers et al. (2005), masculine and neuter plurals are produced slower than their singular counterparts because in plural noun phrases the gender and plural features activate different forms (Figure 3). These forms compete with one another for selection, thus delaying the responses. In other words, the delay in the case of inconsistent feature-determiner combinations (masculine or neuter plurals) is the critical observation that motivates determiner competition.

However, an alternative explanation that holds only the assumption of selection by activation levels and dispenses with the assumption of competition can be put forward. The explanation hinges on the assumption that different features may activate the corresponding determiners with different strengths. Assume that gender features activate forms more strongly than the plural feature (i.e. imagine a thinner line in the rightmost arrow of Figure 3). Masculine and neuter noun phrases in plural would be produced slower than their singular counterpart because the feature that drives the activation of the target determiner in the plural case (i.e. number) provides less activation than the feature driving the activation in the second
case (i.e. gender). In other words, the buildup of activation on the target form would be slower or less effective when such activation comes from the plural feature than when it comes from a gender feature. Critically, in this account, naming latencies are predicted by the target’s activation level, without reference to the activation level of alternative (e.g. singular) forms. Importantly, this framework also accounts for the results reported here because the level of activation of alternative determiners (e.g. those presented as distractors) does not affect the speed of determiner selection. Only the activation of the target determiner matters.

To support this proposal, it would be useful to have independent motivation for a modulation of activation strength. One such motivation is frequency. Singulars are overall more frequent than plurals. For example, in French, the pooled written frequency of the singular definite determiners “le, “la and “l’” is around 4 times larger than the frequency of the invariant plural form “les”. The corresponding German computation is harder to estimate because of the homographic form of “die” for singular and plural, as well as the complication introduced by case marking on the determiners. However, a query of the NEGRA corpus (http://www.coli.uni-saarland.de/projects/sfb378/negra-corpus/) reveals a similar pattern, namely nominative plural determiners are substantially less frequent than nominative singular determiners. Accordingly the driving features of gender (e.g., masculine, feminine, or neuter) can be expected to have a stronger role than the driving feature plural. A second type of evidence suggesting an activation strength modulation comes from Spalek and Schriefers’s study (2005) assessing the role played by dominance in determiner selection. Dominance refers to the relative frequency with which various specific morphological forms (e.g. singular
vs. plural) are distributed for a given noun. In a series of four experiments, these authors observed that the manipulation of dominance has an impact on the naming latencies of gender marked noun phrases. The dominance effects were interpreted as a modulation of the amount of activation that a given feature can send to its corresponding determiner forms.

In short, then, the results of the experiments on determiner production that have been previously published can be accounted for without postulating a process of determiner competition. To be clear, postulating competition is not wrong, as the data can also be accounted for with this hypothesis. However the explanation in terms of activation developed above is also appropriate, and the results of the Stroop-like experiments we report in the present article call for an interpretation where no competition is postulated.

Different selection principles for closed-class and open-class words?

The main contribution of our study concerns the principles governing the selection of closed-class words. According to the interpretation we put forward, the selection of these words depends on their activation level, and is not competitive in nature. Throughout this manuscript, we have contrasted this view with the received view concerning the selection of open-class words, a process governed by activation levels and subject to competition. If this were to be the case, one could derive the general idea that determiners and nouns, exemplars of (respectively) the closed- and the open-classes, rely on different selection mechanisms for production. It is important to note that the arguments developed here for the selection of closed-class words are independent, and certainly not compromised, by whether or not this latter assumption about open-class words is correct. That is, the selection of closed-class
words could be a non-competitive process irrespective of whether this is also true for open-class words.

In fact, the received view of lexical selection by competition has been recently challenged (Costa, Mahon et al., 2003; Costa et al., 2005; Mahon et al., 2007; Miozzo & Caramazza, 2003). According to these researchers, lexical selection of open-class words is dependent on activation levels, but it is not competitive. The results reported above for closed-class words fit perfectly in such a framework, and do not need to postulate different selection principles for different word classes. The resolution of whether the selection of open-class words is subject to competition or not falls out of the scope of the present article.

Finally, a curious empirical generalization may be attempted on the basis of the data we report and that reported in previous studies. Picture-word interference studies where participants produce noun phrases while ignoring *determiners* (reported in this article) show a gender effect, which is attributed to noun processing. By contrast, previously reported picture word-interference studies where participants produce noun phrases while ignoring *nouns* have shown gender effects, which have been attributed to determiner processing (data in German and Dutch reviewed in the Introduction). At this point we cannot offer a complete explanation for this combined set of findings, yet we can highlight two points. First, the contrastive patterns could suggest that in this paradigm syntactic constraints operate on the interaction between target and distractor. We can speculate that the distractor activates its grammatical category, and fills a slot in the frame the speaker is encoding. From that slot, it influences directly the encoding of the item in the other slot, hence the determiner influences the noun
and *vice-versa*. Secondly, a proper account of the empirical generalization should take into account the detailed patterns in each of the two conditions stated above. The observations are not as general as they may seem at first look. Noun distractors do not produce gender effects on determiners in many languages (Caramazza, et al., 2001), and an effect of distractor nouns on bare noun production has been reported (Cubelli et al., 2005). In any case, whatever the exact reason for the relatively contrasting effects reported for determiners and noun distractors, the conclusion reached previously that we have no evidence for competitive processes during determiner selection is not compromised. Further empirical research, especially with determiner distractors, would certainly be helpful to provide a full account of how noun phrase production is engaged in the picture-word paradigm.

**Conclusion**

Our objective was to investigate the mechanism involved in the selection of closed-class words. This investigation was motivated by the classic hypothesis that the processes involved in the selection of closed- and open-class words could be different. According to this view, the mechanisms proposed for the selection of open-class words cannot be extrapolated to describe closed-class selection. The Stroop-like experiments we conducted showed no discrimination inhibition effect when the semantic and grammatical similarity of distractor determiners was manipulated. We argued that these results call for a selection mechanism which does not involve a process of competition. Furthermore, we argued that previous results used in favor of a competition process can be accounted for with an alternative proposal that does not involve competition. The activation explanation we discussed above is
very similar to the one put forward by Alario and Caramazza (2002) to account for French data on gender and phonological inconsistencies (similar to the gender and number inconsistencies of German represented on Figure 3). The so-called “Primed Unitized Activation” hypothesis postulates that features such as grammatical gender activate their determiner forms independently from one another. Once all relevant features have been activated, a deterministic process of selection picks the right determiner form; the speed of this retrieval is an increasing function of the activation level of the target determiner, but it does not depend on the activation level of alternative forms. Such a deterministic process of selection bears similarities with the retrieval of a surface phrasal frame that carries closed-class word forms, as postulated by Garrett (1975; 1984; 1988), but it differs in that it postulates that closed-class words are actively selected on the basis of their level of activation. It is likely that such a proposal, or some of its parts, will ultimately have to be changed. What this discussion and the data reported above make clear, however, is that the idea of competition between determiner forms has been proposed in a significant number of studies without it being necessarily required by the data.
References


Appendix

Materials used in the experiments (French, Spanish, and German), with English translations.
<table>
<thead>
<tr>
<th>Feminine</th>
<th>Experiments 1a &amp; 1b</th>
<th>Experiments 2 &amp; 3</th>
<th>Experiment 4</th>
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<tr>
<td></td>
<td>French</td>
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<td>Flor</td>
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<td>Door</td>
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<th>Masculine</th>
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<th>Experiment 4</th>
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Authors’ note

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Footnotes

1 Despite some agreement on the conditions of observation of the discrimination interference effect, its exact locus is still discussed. The standard view is that the effect occurs at the level of lexical representations. An alternative proposal suggests a reinterpretation which locates the effect a the pre-linguistic semantic level (see Costa et al., 2005; Damian & Bowers, 2003; Kuipers, Costa, & La Heij, 2006; Mahon et al., 2007, for discussion, differing results and differing interpretations). For now we concentrate on the mechanism rather than on where selection occurs. We come back to this issue in the General Discussion.

2 We thank reviewer Cynthia Thompson for suggesting the inclusion of this linguistic distinction.

3 The effect of grammatical gender on noun retrieval has also been observed in speech errors occurring in natural contexts (Marx, 1999) and in experimental settings. Vigliocco et al. (2004) asked participants to name pictures in time constrained conditions, thus inducing a significant number of speech errors. By using the appropriate control conditions, they found that the grammatical gender of the target was significantly preserved in noun substitutions whenever participants produced utterances with gender marked determiners. They linked this effect to the activation induced by gender-marked morpho-phonological frames on the process of lexical selection (see also Experiment 2, in Vigliocco, Vinson, Paganelli, & Dworzynski, 2005, for further evidence and discussion)
Alternatively, using a word that is not a determiner or that is not a word opens the possibility that the differences among conditions are due to grammatical class effects or lexicality effects (Ehri, 1977; Pechmann, Garrett, & Zerbst, 2004; Vigliocco, Vinson, & Siri, 2005), two questions that are different from the one we want to address.

The fact that indefinite determiners produced shorter naming latencies when they were gender-congruent than when they were gender-incongruent suggests that these distractors indeed activate their representation in the system.

The experimental manipulation of the number of the distractor with respect to the number of the target is conducted in Experiment 3 (see below).

Details about these two functions need to be specified for how the levels of activation of the alternative candidates (when there is more than one) are lumped together, for how the selection criteria is defined in relation to the activation functions (e.g. differential threshold, Luce ratio, etc.), for whether activated candidates can inhibit or deactivate each other, etc. (see Alario, 2004; Goldrick, 2007; Wheeldon & Monsell, 1994, for discussion in the case of noun production).

These results can be readily attributed to the selection of determiners and not to a difference between noun retrieval in singular and in plural. A control experiment in which the same materials were named with bare nouns showed no difference between the singular and plural conditions (Schriefers et al., 2005). Notice that the control experiment yielded less clear
results in Schriefers et al. (2002), where bare noun production for plurals was significantly slower than for singulars, thus complicating the interpretation of the determiner experiment.

9 This explanation can also be adapted to account for the so-called phonological consistency effect reported by Miozzo and Caramazza (1999) as well as Alario and Caramazza (2002). In languages where phonology constrains the form of the determiner, participants are slower to produce adjectival NPs in which the adjective and the noun carry conflicting information with regard to which determiner should be selected. For example in French, mon ancienne table (i.e. my old table) involves a vowel initial adjective and a consonant initial noun (see also Table 1).
Tables

Table 1 – Examples of how different types of features (semantic, grammatical or phonological) constrain the selection of determiners across languages.

<table>
<thead>
<tr>
<th>Language</th>
<th>Number</th>
<th>Noun’s gender</th>
<th>Noun’s 1st phoneme</th>
<th>Appropriate determiner</th>
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<tr>
<td>French</td>
<td>Singular</td>
<td>Masculine</td>
<td>any</td>
<td>MON</td>
</tr>
<tr>
<td>French</td>
<td>Singular</td>
<td>Feminine</td>
<td>Consonant</td>
<td>MA</td>
</tr>
<tr>
<td>French</td>
<td>Singular</td>
<td>Feminine</td>
<td>Vowel</td>
<td>MON</td>
</tr>
<tr>
<td>French</td>
<td>Plural</td>
<td>any</td>
<td>any</td>
<td>MES</td>
</tr>
<tr>
<td>Dutch</td>
<td>Singular</td>
<td>Common</td>
<td>any</td>
<td>DE</td>
</tr>
<tr>
<td>Dutch</td>
<td>Singular</td>
<td>Neuter</td>
<td>any</td>
<td>HET</td>
</tr>
<tr>
<td>Dutch</td>
<td>Plural</td>
<td>any</td>
<td>any</td>
<td>DE</td>
</tr>
<tr>
<td>German</td>
<td>Singular</td>
<td>Masculine</td>
<td>any</td>
<td>DER</td>
</tr>
<tr>
<td>German</td>
<td>Singular</td>
<td>Feminine</td>
<td>any</td>
<td>DIE</td>
</tr>
<tr>
<td>German</td>
<td>Singular</td>
<td>Neuter</td>
<td>any</td>
<td>DAS</td>
</tr>
<tr>
<td>German</td>
<td>Plural</td>
<td>any</td>
<td>any</td>
<td>DIE</td>
</tr>
</tbody>
</table>
Table 2 – The four conditions used in Experiments 1a and 1b. For masculine targets (half of them), the distractor-gender associations were reversed.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Definiteness</th>
<th>Gender</th>
<th>Distractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Congruent</td>
<td>Congruent</td>
<td>LA</td>
</tr>
<tr>
<td>2</td>
<td>Congruent</td>
<td>Incongruent</td>
<td>LE</td>
</tr>
<tr>
<td>3</td>
<td>Incongruent</td>
<td>Congruent</td>
<td>UNE</td>
</tr>
<tr>
<td>4</td>
<td>Incongruent</td>
<td>Incongruent</td>
<td>UN</td>
</tr>
</tbody>
</table>

Target: *LA table*
Table 3 – Experiment 1a: Naming latencies, error rates, effects and confidence intervals for the different conditions (CI = confidence interval).

<table>
<thead>
<tr>
<th>Definiteness</th>
<th>Gender</th>
<th>RT</th>
<th>SD</th>
<th>RT</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>S_D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Congruent</td>
<td>587</td>
<td>114</td>
<td>3.3%</td>
<td>3.2</td>
<td>625</td>
<td>119</td>
<td>6.8%</td>
</tr>
<tr>
<td></td>
<td>Incongruent</td>
<td>604</td>
<td>111</td>
<td>4.6%</td>
<td>4.2</td>
<td>627</td>
<td>114</td>
<td>5.6%</td>
</tr>
<tr>
<td>difference</td>
<td></td>
<td>17</td>
<td>1.3%</td>
<td>2</td>
<td>-1.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% CI of the difference</td>
<td>12</td>
<td>2.3%</td>
<td>7</td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4 – Experiment 1b: Naming latencies, error rates, and effects for the different conditions (CI = confidence interval).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Congruent</th>
<th>Incongruent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RT</td>
<td>Err</td>
</tr>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Definiteness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definite</td>
<td>542 46</td>
<td>1.8% 2.1</td>
</tr>
<tr>
<td>Indefinite</td>
<td>541 43</td>
<td>0.7% 1.5</td>
</tr>
<tr>
<td>difference</td>
<td>-1</td>
<td>-1,1%</td>
</tr>
</tbody>
</table>
Table 5 – Experiment 2: Naming latencies, error rates, and effects for the different conditions (CI = confidence interval).

<table>
<thead>
<tr>
<th>SOA</th>
<th>Definiteness</th>
<th>Congruent</th>
<th>Incongruent</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 ms</td>
<td>Definite</td>
<td>571</td>
<td>75</td>
<td>2.6%</td>
</tr>
<tr>
<td></td>
<td>Indefinite</td>
<td>597</td>
<td>81</td>
<td>6.2%</td>
</tr>
<tr>
<td></td>
<td>difference</td>
<td>26</td>
<td>12</td>
<td>3.6%</td>
</tr>
<tr>
<td>300 ms</td>
<td>Definite</td>
<td>567</td>
<td>69</td>
<td>3.4%</td>
</tr>
<tr>
<td></td>
<td>Indefinite</td>
<td>577</td>
<td>83</td>
<td>7.8%</td>
</tr>
<tr>
<td></td>
<td>difference</td>
<td>10</td>
<td>3</td>
<td>4.4%</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td>10</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
Table 6 – The four conditions used in Experiment 3. For masculine targets (half of them), the distractor-gender associations were reversed.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Definiteness</th>
<th>Gender</th>
<th>Distractor</th>
<th>Distractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Congruent</td>
<td>Congruent</td>
<td>LA&lt;sub&gt;mesa&lt;/sub&gt; identity</td>
<td>LAS&lt;sub&gt;mesas&lt;/sub&gt; identity</td>
</tr>
<tr>
<td>2</td>
<td>Congruent</td>
<td>Incongruent</td>
<td>EL</td>
<td>LOS</td>
</tr>
<tr>
<td>3</td>
<td>Incongruent</td>
<td>Congruent</td>
<td>UNA</td>
<td>UNAS</td>
</tr>
<tr>
<td>4</td>
<td>Incongruent</td>
<td>Incongruent</td>
<td>UN</td>
<td>UNOS</td>
</tr>
</tbody>
</table>
Table 7 – Experiment 3: Naming latencies, error rates, effects and confidence intervals for the different conditions (CI = confidence interval).

<table>
<thead>
<tr>
<th>Determiner Type</th>
<th>Gender</th>
<th>Congruent</th>
<th>Incongruent</th>
<th>95% CI of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RT</td>
<td>Err</td>
<td>RT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Congruent</td>
<td></td>
<td>482 52</td>
<td>2.8 3.5</td>
<td>509 54</td>
</tr>
<tr>
<td>Incongruent</td>
<td></td>
<td>493 48</td>
<td>4.1 4.5</td>
<td>508 51</td>
</tr>
<tr>
<td>difference</td>
<td></td>
<td>11 1.3</td>
<td>-1 1.9</td>
<td>7 1.8</td>
</tr>
</tbody>
</table>
Table 8 – The four conditions used in Experiment 4. For masculine targets (half of them), the distractor-gender associations were reversed.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number</th>
<th>Gender</th>
<th>Distractor 1</th>
<th>Distractor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Congruent</td>
<td>Congruent</td>
<td>LA identity</td>
<td>LAS identity</td>
</tr>
<tr>
<td>2</td>
<td>Congruent</td>
<td>Incongruent</td>
<td>EL</td>
<td>LOS</td>
</tr>
<tr>
<td>3</td>
<td>Incongruent</td>
<td>Congruent</td>
<td>LAS</td>
<td>LA</td>
</tr>
<tr>
<td>4</td>
<td>Incongruent</td>
<td>Incongruent</td>
<td>LOS</td>
<td>EL</td>
</tr>
</tbody>
</table>
Table 9 – Experiment 4: Naming latencies, error rates, effects and confidence intervals for the different conditions ($CI =$ confidence interval).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Congruent</th>
<th></th>
<th>Incongruent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RT</td>
<td>Err</td>
<td>RT</td>
<td>Err</td>
</tr>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congruent</td>
<td>529</td>
<td>52</td>
<td>2.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Incongruent</td>
<td>544</td>
<td>50</td>
<td>5.9</td>
<td>4.1</td>
</tr>
<tr>
<td>Difference</td>
<td>15</td>
<td>3.3</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>95% CI of the difference</td>
<td>8</td>
<td>2.2</td>
<td>10</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Table 10 – The four conditions used in Experiment 5. For masculine targets (half of them), the distractor-gender associations were reversed.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Definitness</th>
<th>Gender</th>
<th>Distractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Congruent</td>
<td>Congruent</td>
<td>DIE identity</td>
</tr>
<tr>
<td>2</td>
<td>Congruent</td>
<td>Incongruent</td>
<td>DER</td>
</tr>
<tr>
<td>3</td>
<td>Incongruent</td>
<td>Congruent</td>
<td>EINE</td>
</tr>
<tr>
<td>4</td>
<td>Incongruent</td>
<td>Incongruent</td>
<td>EIN</td>
</tr>
</tbody>
</table>

Target: DIE 
* Lampe
Table 11 – Experiment 5: Naming latencies, error rates, effects and confidence intervals for the different conditions (CI = confidence interval).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Congruent</th>
<th>Incongruent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RT</td>
<td>Err</td>
</tr>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Congruent</td>
<td>628 74</td>
<td>1.7 2.7</td>
</tr>
<tr>
<td>Incongruent</td>
<td>649 79</td>
<td>1.5 1.7</td>
</tr>
<tr>
<td>difference</td>
<td>21 0.2</td>
<td>-3 0.4</td>
</tr>
<tr>
<td>95% CI of the difference</td>
<td>8 0.5</td>
<td>9 0.5</td>
</tr>
</tbody>
</table>
Figure Captions

Figure 1 – Example of the four experimental conditions applied to the feminine item *table* in Experiment 1a. In all conditions, participants produce the same response “la table” while ignoring the written distractor determiner. Targets in the experiment (picture names) are both feminine and masculine.

Figure 2 – Mean noun phrase naming latencies (in milliseconds) per condition in the noun phrase production experiments. “Congruent” and “Incongruent” labels on the x-axis refer to the gender conditions. Error bars indicate 95% confidence intervals around the differences (within gender condition comparison). SOA = 0 ms unless otherwise indicated.

Figure 3 – The activation relationship between features and determiner forms for the German definite article in nominative case. (masc. = masculine; fem. = feminine). In this figure, the singular feature is not represented because it is considered as a default value which does contribute differentially to the activation process.
Figure 1
Figure 2
Figure 3