

**Morphological Constraints on Lexical Access:
Gender Priming in German**

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Abstract

To investigate how morphological constraints affect lexical access, results of an experiment on grammatical gender priming in German are reported. In a “continuous picture-naming” (CPN) task, large and reliable differences in naming times were found between pictures preceded by gender-congruent contexts and pictures preceded by a zero-gender baseline, suggesting that grammatical gender can facilitate word access. In addition, we also found significant differences between zero-gender and gender-incongruent contexts, suggesting that grammatical gender can also have an inhibitory effect on word retrieval in real time. These facilitative and inhibitory effects were consistent across all three noun genders in German (i.e., masculine, feminine and neuter). Our findings for word production in German complement reports of gender priming in Italian, Spanish and French, showing strong morphological effects on lexical access. Implications for modular vs. interactive theories of lexical access are discussed.

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The purpose of the present study is to investigate the effects of grammatical information on lexical access, with special reference to the facilitative and/or inhibitory effects of grammatical gender on word production in German. Earlier studies conducted in English revealed weak or nonexistent grammatical effects on lexical access (e.g., Seidenberg, Water, Sander, & Langer, 1984; Tyler & Wessels, 1983; Wright and Garrett, 1984). However, more recent studies in languages with richer systems of morphological marking have revealed robust morphological effects on word recognition and production. For example, priming effects on word recognition have been reported for French in lexical decision and gating tasks, using gender-marked articles as primes (Grosjean, Dommergues, Cornu, Guillelmon, & Besson, 1994). Significant gender-priming effects have also been reported for Italian in word repetition and gender classification tasks, using gender-marked adjectives as primes (Bates, Devescovi, Hernandez, & Pizzamiglio (in press), and for picture naming in Spanish, in sentence contexts that include gender-marked articles (Reyes, 1995). These results are compatible with a series of studies of word recognition in Serbo-Croatian assessing both gender and case priming, using visual lexical decision of nouns preceded by adjective primes (Gurjanov, Lukatela, Moskovljevic, & Turvey, 1985a; Gurjanov, Lukatela, Lukatela, Savic, & Turvey, 1985b) and case-marked prepositions (Lukatela, Kostic, Feldman, & Turvey, 1983). Thus, the general view that syntactic context does not influence lexical access (Tanenhaus & Lucas, 1987) may be compatible with results for English, but studies conducted in languages with a richly marked inflectional system reveal powerful morphological constraints on lexical access.

Although gender marking appears to be an established phenomenon, the locus of these effects is still controversial. At first blush, these morphological priming results seem to indicate that lexical access can be "penetrated" by grammatical information that lies outside the lexicon itself, thus providing *prima facie* evidence against modular organization of lexical and grammatical processing. But is this the only explanation? Does morphological priming reflect a truly prelexical influence on word recognition? Could we explain the same phenomenon with intralexical connections that take place entirely within the lexicon? Or do these priming results reflect the application of postlexical strategies that only apply after the word form has been recognized? As discussed by Bates et al. (in press), studies of morphological priming have varied in the timing parameters that were used to assess lexical access, the presence or absence

of a neutral baseline to determine whether the effects are facilitative or inhibitory, the tasks that are used and the kinds of strategies that subjects might apply within each task. Thus, studies that seem to support a prelexical interpretation of grammatical priming may reflect some process that takes place after the word comes to mind, in line with the traditional modular account.

The standard modular model postulates at least two distinct and nonoverlapping stages of lexical access, with parallel accounts for word recognition (e.g., Fodor, 1983; Swinney, 1979; for reviews, see Neely, 1991; Hernandez, Bates & Avila, in press; Hillert, 1996) and word production (Levelt, 1989).

In the first stage of recognition, word candidates are activated by the perceptual input (phonological or orthographic information) and/or by intralexical connections. In the second stage, selection of the appropriate candidate and/or inhibition of inappropriate candidates take place, based on the sentential and pragmatic context. For our purposes here, we will use the terms “prelexical” and “postlexical” to refer to these two stages of word access. Empirical support for this view has accrued from studies of semantic priming in a sentence context (e.g., Onifer & Swinney, 1982; Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982; Swinney, 1979). In this paradigm, subjects are presented with semantically ambiguous words like "bug" (which can mean "insect" or "microphone") in a sentence that favors only one meaning (e.g., the insect reading). When the prime and target are presented close together in time (approximately 200 milliseconds), priming is observed for both the contextually relevant target (e.g., bug-ant) and the contextually irrelevant meaning (e.g., bug-spy). With a separation between prime and target of no more than 750 milliseconds, only the contextually appropriate meaning of the word is active.

A parallel logic has been proposed in modular accounts of word production (Levelt, 1989), with two distinct stages for retrieval of the *word lemma* (which includes the semantic features that define a word, plus inherent syntactic features like form class and gender) and retrieval of the *word form* (the phonological specification of the word, including morphological adjustments required for a particular phrase or sentence context). Although these two stages of word production occur closely together in time, they do not overlap; each one is subject to different processes, and each gives rise to a different pattern of speech errors (see also Garrett, 1980).

Extending the standard model to gender priming, we would expect to find that effects of the gender context will apply at postlexical level in word recognition, after the word form has been activated. In word production, effects of the phrasal context in which a word must appear should also be restricted to the second stage, when words are integrated into their context (but see

below, for a discussion of gender priming as an “intralexical” phenomenon). How can we distinguish between pre- and postlexical accounts of the gender-priming phenomenon? First, a prelexical account is more likely if the temporal interval between prime and target is very short. In the present study, the interval between offset of the gender-marked prime and onset of the target picture will be kept very close to zero. Second, a postlexical account is more likely if we find that gender-priming effects are inhibitory in nature. Following Posner & Snyder (1975), it is usually assumed that automatic, modular priming effects are purely facilitative in nature; controlled, postmodular effects can be associated with inhibition as well as facilitation. To answer this question, response to gender-congruent and gender-incongruent primes should be compared with a gender-neutral baseline. Third, following Levelt (1989), we want to be sure that the process we observe reflects full access of the lexical items in question, both the sound pattern (word form) and its associated meaning (lemma). In contrast with tasks like lexical decision (Grosjean et al., 1994) or word repetition (Bates et al., in press), which could (at least in principle) be performed without access to word meaning, the picture-naming task requires subjects to access the appropriate word form for a meaningful nonlinguistic stimulus (Glaser, 1992; see also Cattell, 1985). If we find gender-priming effects in the picture-naming task, it is more likely that these results will generalize to the processes that govern word finding in real speech situations.

Before presenting our results for gender priming of picture naming in German, a brief review of the German gender system is required.

GENDER IN GERMAN

Gender-marked languages can vary in the number of gender distinctions that they provide, and in the kinds of interactions that take place between gender and other morphological categories. For example, the Romance languages (e.g., French, Italian, Portuguese and Spanish) have two genders, German and Russian have three, and some languages (e.g., Swahili) have a gender system in which the relationship between object and its grammatical gender is specified to a much greater degree, with different gender forms for animate beings, inanimate objects, plants, animals, tools, and objects of a particular shape.

In German, the singular (sg) form of the definite article marks three gender classes: feminine (fem), masculine (masc) and neuter (neut). In addition, the article also carries information about case, and the form that gender marking takes varies with case marking. With four cases and three genders, this yields twelve possible cells in the definite singular alone. However, there are only six distinct forms of the singular definite article to fill this twelve-cell paradigm (*die, der,*

den, des, dem, das), and the same form can be used to mark two different genders depending on case (e.g., *der* marks masculine in the nominative, feminine in the dative). To complicate matters further, three of these forms (*die, den, der*) are also used in the definite plural, where case is marked but gender is ambiguous (e.g., *die* is the definite plural for masculine, feminine and neuter in the nominative case). Table 1 summarizes this relatively complex case-by-gender system, for singular definite, plural definite and indefinite articles.

 TABLE 1

Grammatical gender is often associated with semantic gender, but the two can be dissociated to a surprising degree (for a discussion, see Bates, Devescovi, Pizzamiglio, D'Amico & Hernandez, 1995). For example, in *der Sohn* (the son) or *die Stute* (the mare), grammatical gender and natural gender coincide. In case of words that designate professions, this inherent semantic feature is morphologically marked on the noun as well as its accompanying adjective, for example

die(fem) *StudentIN* (the student) vs. *der* (masc) *Student* (the student)

der(masc) *HexeRICH* (the witch) vs *die* (fem) *Hexe*.

In the former case (which is more frequent), the suffix +IN expresses the feminine feature. In the latter case, the suffix +RICH reflects the masculine feature. From an etymological viewpoint, semantic motivation can sometimes lead to a fixed link between a gender-specific article and a noun. Although some general observations give us the impression that a certain set of words have a certain gender because of their semantic properties (e.g., *das*(neut) *Schiff* (the ship), *die*(fem)*Sonne* (the sun), *der*(masc) *Krieg* (the war), this is not the case. In German (and in most languages with grammatical gender), gender assignment is semantically arbitrary. As Bates et al. (1995) note in their discussion of this point, who can explain why the word for *die Flöte* (flute) is feminine in German while *das Mädchen* (little girl) is neuter? Or why the word for *ocean* is neuter in German (*das Meer*), feminine in French (*la mer*), and masculine in Italian (*il mare*)?

In contrast with the low positive correlation between grammatical gender and semantics, there are some rather robust correlations in German between gender assignment and morphophonological features. According to Eisenberg (1986), phonological factors correctly predict gender assignment for 90% of the one-syllabic nouns in German. Although these

correlations may be helpful during the processing of language learning, a large number of exceptions still exist.¹ In view of these facts, it is likely that German listeners rely on multiple cues to gender in the course of language learning and language processing (Zubin & Köpcke, 1981; MacWhinney, Leinbach, Taraban, & McDonald, 1989). The article constitutes one of the best cues to noun gender for in German, although (as we have seen) there is enough homophony in the full case-by-gender paradigm to discourage complete reliance on the article for gender assignment.

Assuming that the article can play a role in gender access in German, the frequency of different article forms must be considered. If a language has articles, then their frequency of occurrence is always very high. This may be also the case for suffix-marking gender like *+o* masc and *+a* fem in Portuguese, Spanish or Italian. In Meier's (1964) word frequency tables on written German, all three determiners are among the seven most frequent words in German (1st rank: *die* (fem), 2nd rank: *der* (masc), 7th rank: *das* (neut)).

TABLE 2

However, these rankings do not differentiate between case and number as found in Ruoff's (1981) tables on spoken German word frequencies.² They are among the most frequent words, and only the auxiliaries *sein* (24.11%, to be) and *haben* (22.72%, to have) are more frequent (cf. Table 2). Thus, they are much more frequent than the most frequent nouns in German (Ruoff: *Jahr* (2.8%, year); Meier: *Herr* (9,688%, Mister)).

TABLE 3

As we noted above, the investigation of gender priming in German forces us to consider the relation between gender and case (Table 1). For example, if we present the masculine singular nominative article *der* followed by the feminine word *Frau*, we have not created a true grammatical violation, because native speakers of German are free to reinterpret this stimulus as

¹ In a test with 274 speakers of German as a foreign language, it was found that native speakers of Germanic or Romance languages (with article) had an error score of 11.4 % and native speakers of Slavic languages (without article) an error score of 18.6% (Grimm, 1983: 32ff).

² Ruoff's (1981) tables reflect the word distribution of everyday language in Southwest Germany. The recordings themselves were conducted in 1955 (see Ruoff (1973) for methods of evaluation).

a perfectly grammatical phrase in the dative or genitive case. Thus, in investigating gender *per se* it is important to provide a single context that excludes other possible overlaps. In order to isolate the effects of gender, our best course is to examine gender priming in the nominative case, i.e., the citation form and the form that is most appropriate when words are recognized or produced out of context. Thus, for the noun following the determiner, no syntactic or thematic role is specified. Even with this restriction, there is enough ambiguity in German to preclude the total isolation of gender effects. For example, if we present the article *die*(fem. nom. sg.), we have to deal with the fact that all three genders take *die* in the plural. Hence we need to restrict the experimental situation to nominative case, and we have to assume a microworld in which objects only appear in the singular form.

METHOD

Subjects

Sixteen German native speakers (including two Swiss-German speakers) were paid to participate in this study. Their average age was 28 years (range: 18-60). Most of them were educated at a German-speaking university, and all lived in Germany or Switzerland before they arrived in the USA. Most of them were students of an academic exchange program at UCSD. With the exception of three persons, who lived in the USA longer than thirty years, subjects had lived here between three and fourteen months. Because subjects were examined in a foreign country, we paid special attention to the fluency of their (native) German language in our picture-naming task. As we shall see, this factor did matter, and it was necessary to eliminate four subjects with exceptionally high error rates.

Materials

The stimuli for naming were 135 black-and-white drawings of objects or persons. The drawings were selected from Snodgrass & Vanderwart (1980) and from Abbate & LaChapelle (1984a,b), and were filed with the software AdoBePhotoshop. The target names for these pictured objects were all high frequency and one- or two-syllabic (Ruoff, 1981), and were (in our judgment) easily recognized and categorized by their target name. Most drawings depicted inanimate objects without semantic gender. However, because Bates et al. (1995) have shown that semantic or natural gender has no influence of word recognition or gender classification, we also selected some animate objects if they matched our main criterion of fast categorization.

All target pictures [PIC] were presented at the end of a short, auditorily presented lead-in phrase. Each phrase contained a gender-ambiguous demonstrative pronoun and a copular verb

(equivalent to “This is”). In the two gender-marked conditions, the copula was followed by a gender-marked article (equivalent to “This is the [PIC]”). In the gender-ambiguous condition, the article was omitted (equivalent to “This is [PIC]”). It was our intention to treat the gender-ambiguous condition as a neutral baseline, to assess the facilitative effects of a match between article and pictured noun, and the inhibitory effects of a mismatch between the two. Strictly speaking, however, the omission of the article in a lead-in phrase results in another kind of grammatical violation, because articles are required in a naming context of this sort. We will return to this issue later.

Three main conditions of which each consists of forty-five lead-in sentences were examined: (1) congruent condition (correct gender: + GEN), (2) baseline condition (zero gender: \emptyset -GEN), (3) incongruent condition (incorrect gender: -GEN). These three conditions were crossed with the three different genders of German, yielding a total of nine different subconditions: (1) masc/masc, (2) fem/fem, (3) neut/neut, (4) \emptyset -masc, (5) \emptyset -fem, (6) \emptyset -neut, (7) masc/fem (8) neut/masc, and (9) fem/neut.³ Nine different word lists were created to fill these nine conditions. Below, an example for each condition is shown (the complete stimuli set is listed in the Appendix):

List 1-3: + GEN (congruent)

Dies ist der [Apfel] (masc/masc)
(This is the apple)

Dies ist die [Ampel] (fem/fem)
(This is the traffic light)

Dies ist das [Auge] (neut/neut)
(This is the eye)

List 4-6: \emptyset -GEN (neutral)

*Dies ist _ [Ball] (\emptyset /masc)
(This is ball)

*Dies ist _ [Ente] (\emptyset /fem)
(This is duck)

³ This point presupposes that NOM in contrast to DAT or ACC has a minimal syntactic function.

*Dies ist _ [Boot] (ø/neut)
(This is boat)

List 7-9: - GEN (incongruent)

*Dies ist das [Baum] (neut/masc)
(This is the tree)

*Dies ist der [Kirche] (masc/fem)
(This is the church)

*Dies ist die [Brett] (fem/neut)
(This is the board)

The phrases were recorded with a digital audio tape (16-bit CD quality sound) by a male native speaker of German and digitized using the Macintosh SoundEdit 16 software. Both sound files and picture files were placed within the PsyScope experiment shell (Cohen, MacWhinney, Flatt, & Provost, 1993). The picture file in PsyScope was divided into nine lists consisting of fifteen pictures each which were linked to a certain type of phrase (see Appendix). The PsyScope shell selected the trials randomly across all nine conditions; that is, for each subject verbal and pictorial information was presented in a unique random order.

The pictures were presented for the duration of 3000 milliseconds, beginning immediately at the offset of the lead-in phrase. If the subject responded before the picture was shown or if the subject failed to respond within the 3000-msec time window, that trial was treated as nonresponse. The intertrial interval was 500 msec.

Procedure

All subjects were run on this experiment individually in a quiet room. They were all tested by the same examiner. The subjects were told that they would hear via their headphones short sentences like *Dies ist der ...* continued by a picture shown on the monitor in front of them. It was pointed out to the subjects that sometimes the article would match the article required by the picture, sometimes it would not match, and sometimes an article would be missing altogether. Thus, the examiner emphasized that it would be important for the success of this experiment not to correct incorrect sentences by trying to find an alternative name of the picture presented. The subjects were instructed to name the picture as fast as possible by speaking clearly into the microphone and to produce the most typical and basic word they could think of. Moreover, the examiner checked each response behavior to make sure that RTs did not reflect productions

caused by a nonverbal response (e.g., a cough or clearing of the throat). To assist the Experimenter in this screening process, a small dot appeared in the middle of the lower edge of the screen whenever a response was measured via the microphone. RTs for picture naming were collected by a voice key contained within the button box. This button box, developed at Carnegie-Mellon, contains an independent timing crystal with 1-msec accuracy and is designed for Macintosh work stations. RTs were measured from the onset of the target item (picture) to the onset of the subject's naming response, and were fed directly into a PsyScope file.

RESULTS

Accuracy

Four of the sixteen subjects had error rates over 50%, due perhaps to their prolonged immersion in an English-speaking environment. The error rates of the remaining twelve subjects were closer to those rates found with picture-naming experiments in a linguistically uncontaminated environment (averaging 1-8 errors per subject). All remaining analyses are based only on data for these twelve subjects.

Reaction time

All reaction times above 2000 milliseconds were removed from the data set. The remaining reaction times were subjected to a 3 (Congruent, Incongruent, Baseline) x 3 (Masculine, Feminine, Neuter nouns) within-subjects analysis of variance over subjects. This analysis yielded a significant main effect of gender-priming condition ($F(2,22) = 49.52, p < .0001$). There was no significant main effect of gender ($F(2,22) = 0.186, n.s.$), and the priming condition by gender interaction missed significance ($F(4,44) = 2.024, p < .11$).

Compared to the baseline condition (921 msec), facilitation was found for the congruent condition (806 msec) and inhibition for the incongruent condition (1045 msec). Simple one-way analyses of variance were performed to assess the reliability of these separate effects. The difference between congruent and baseline was highly reliable ($F(1,11) = 27.453, p < .0001$), as was the difference between incongruent and baseline ($F(1,11) = 21.218, p < .001$). Although the priming-by-gender interaction missed significance, we wanted to be certain that the priming effects were in the same direction in all three genders. Figure 1 illustrates that the priming relations are indeed quite similar for masculine, feminine and neuter noun targets, although there are small differences in magnitude of these effects.

FIGURE 1

DISCUSSION

The main purpose of this study was to examine the contribution of grammatical gender to lexical access in German. The results provide us with a clear answer: Robust priming is observed in German, including facilitation when the gender of an article is congruent with the internal gender of the noun and inhibition when the gender is incongruent. This outcome confirms and extends previous results on gender priming in Italian (Bates et al., 1995, in press), French (Grosjean et al., 1994), and Spanish (Reyes, 1995), and it is compatible with studies demonstrating morphosyntactic of noun recognition by adjectives (Gurjanow et al., 1985) or prepositions (Gurjanov et al., 1985a,b; Lukatela et al., 1983) in Serbo-Croatian.

Within some versions of the standard two-stage model, inhibition is interpreted to be an index of a controlled, postmodular form of processing; by contrast, facilitation is supposed to reflect automatic processes, controlled processes, or some combination of the two (Posner & Snyder, 1975; see Hernandez et al., in press, for a review). Because we found gender facilitation at such a short time lag, it would not be unreasonable to conclude that this facilitation reflects an automatic, intralexical form of gender priming. As Bates et al. (in press) have pointed out, the conclusion that all inhibition is controlled in nature is also open to dispute. Fast and early forms of inhibition have been observed in color priming (including Stroop effects), and in other picture priming tasks (Glaser, 1992). Hence the combination of facilitation and inhibition that we have observed here may mean that gender priming is an automatic process by which external phrasal information “penetrates” the lexical module.

However, conclusions about facilitation and inhibition are valid only if we assume that the zero-gender baseline condition constitutes an appropriate neutral control. As we noted in the introduction, the baseline condition in this experiment did involve a grammatical violation, although that violation is independent of gender. Specifically, when our lead-in sentences appear without an article, the resulting phrase is ill-formed in German, just as it would be in English (e.g., “This is TREE”). Hence one possible interpretation of our results would be that the baseline and incongruent conditions are both ungrammatical, and as a result, they both elicit a form of morphosyntactic inhibition. If this is the case, then we cannot be absolutely certain whether our congruent condition constitutes a true facilitation, or absence of inhibition. Returning to the traditional notion that inhibition always reflects controlled, postmodular effects,

our results would still be compatible with the two-stage modular model of lexical access followed by sentential integration.

Yet another way to interpret our results within the standard model would be to view gender priming as a form of spreading activation that takes place entirely within the lexicon. By analogy to the well-known semantic-priming effect (Posner & Snyder, 1975), one might argue that spreading activation facilitates access of any word that shares the same gender features with the preceding word, independent of the larger sentence context in which those words occur. On this argument, the facilitating effects of the singular masculine noun *der* on all masculine nouns is similar to the facilitating effects one observes when the prime *dog* is followed by the target *cat*.

Although this possibility cannot be ruled out, there are reasons to be skeptical about the possibility of structure-independent gender effects. As Bates et al. (in press) discuss at some length in explaining their results for Italian, structure-independent effects of gender could have a highly disruptive effect on sentence processing. They note that there are often many nouns, adjectives and other elements of the same gender within a single sentence or phrase. If gender priming were structure independent (i.e., it had nothing to do with agreement, as specified by syntactic relations), then such priming effects could do far more harm than good. In support of this argument, they offer the following example from Italian:

Perche la trova così bella, Giovanni ha invitato Maria alla festa.

Because her_{feminine-object-clitic} finds so beautiful_{feminine}, Giovanni_{masculine} invited Maria_{feminine} to the party_{feminine}.

Note that the feminine adjective “bella” (beautiful) modifies Maria, but it immediately precedes the noun “Giovanni” (John). If gender priming spread forward in a structure-independent manner, it would erroneously block or inhibit perception of the noun that serves as the subject of the next clause. A similar problem holds for German, e.g.,

Es war Maria die Hans kennegelernt hatte.

It was Maria_{feminine-nominative} whom_{feminine-accusative} Hans_{masculine-nominative} got to know.

This example illustrates an ambiguity in German that we have not discussed so far, i.e., that articles are identical in form to relative clauses in the same gender and case. The form *die* agrees

with *Maria* in gender, and it takes the accusative case appropriate for the role that *Maria* plays in the embedded clause (see Table 1). If *die* were being used as an article, we would never expect it to precede a masculine nominative singular proper noun like *Hans*. But a modular lexicon with no structural information could not possibly distinguish between these two uses of the form *die*. Therefore, if gender priming spreads forward automatically as a structure-independent account would suggest, then the form *die* could interfere with recognition of the masculine word that follows. Examples like this are quite common. Although we cannot rule out the possibility that our effects are due to structure-independent spreading activation within the lexicon, the danger that such effects would portend for lexical and grammatical processing in German suggests that gender priming must be constrained by structural relations.

This problem is complemented by another in the opposite direction: structurally related words that agree in gender are often separated by other words. It is not unusual in German to find cases in which co-reference is assigned across more than twenty words, as shown below:

Obwohl *der*(masc) Onkel, aus Südamerika anreisend und unheimlich abenteuer lustig, seine Ankunft rechtzeitig uns seit Wochen mit einem Telegramm angekündigt hatte, erwarteten wir aus Erfahrung von *ihm*(masc) kein pünktliches Eintreffen.

Although the uncle, arriving from South Africa and incredibly adventurous, had announced his arrival in time weeks ago by telegram, from experience we did not expect him to arrive on time.

If the facilitating or inhibitory effects of gender occur in a structure-independent manner, it is hard to see how such effects could be preserved across a distance of this kind. One could, of course, invoke some kind of structure-dependent priming to account for such long-distance activations. But if grammatically constrained priming does exist for the long-distance case, what is to prevent its application across adjacent words?

Could we, then, move all structurally constrained gender priming into the lexicon? That is a possibility as well, but given the pervasiveness of gender agreement in this language, such a move is tantamount to placing much of the grammar within the lexicon. In fact, a number of proposals of that type have been put forward in the last few years within linguistic theory. Hence this may be a reasonable move from a linguistic point of view. However, if we eliminate the distinction between grammar and the lexicon, then the classic psycholinguistic distinction between “prelexical” and “postlexical” processes loses much of its value.

Another possibility is that gender priming constitutes an isolated exception to the modular border between grammar and lexical access. As Levelt (1989) notes, gender is an inherent property of the lexical item that remains constant across sentence contexts (i.e., gender is assigned to the lemma). Hence it might make sense to permit penetration of the lexicon by gender cues. In this vein, we note that form class is also an inherent property of the lemma in Levelt's model. Liu (in preparation) has shown that lead-in phrases like "I want the ----" and "I want to ---" can prime access to nouns vs. verbs in word recognition, and Federmeier and Bates (1996) report a similar form class priming effect for naming of pictured objects vs. actions. We could, then, suggest an alternative version of the two-stage model in which grammatical context primes properties of the lemma (e.g., gender and form class), but all other forms of grammatical priming are excluded (e.g., case -- but see Lukatela et al., 1983, for evidence that case-marked primes can facilitate or inhibit recognition of a case-marked noun).

Overall, this study in German replicates gender-priming effects already found for at least four other languages (French, Italian, Spanish, and Serbo-Croatian), providing evidence that grammatical congruence has a strong effect on lexical access. However, the modularity hypothesis is not necessarily violated because these effects might reflect intralexical structures. Similarly, it is not possible to decide whether these effects are automatic or controlled in nature, since the possibility of *automatic inhibitory processes* cannot be excluded. In future studies, we will look at gender *and* case variations in German to establish a possible difference between lexical and syntactic constraints on word recognition.

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APPENDIX

Practice Trials

Sentence type was selected randomly by PsyScope shell and combined with following pictures:

[Bart]masc	(beard)
[Halskette]fem	(necklace)
[Bügeleisen]neu	(iron)
[Kehrschaufel]masc	(dustpan)
[Kinderwagen]masc	(stroller)
[Rettungsring]masc	(lifebuoy)
[Hydrant]masc	(hydrant)

List 1: + GEN (masc/masc)

Dies ist der [PIC]

1. Apfel (apple)
2. Affe (monkey)
3. Besen (broom)
4. Biber (beaver)
5. Bügel (hanger)
6. Wurm (worm)
7. Eimer (bucket)
8. Esel (donkey)
9. Globus (globe)
10. Gürtel (belt)
11. Zaun (fence)
12. Hase (rabbit)
13. Fisch (fish)
14. Junge (boy)
15. Käse (cheese)

List 2: + GEN (fem/fem)

Dies ist die [PIC]

1. Ampel (traffic light)
2. Vase (vase)
3. Bank (bench)
4. Büchse (can)
5. Biene (bee)

6. Spinne (spider)
7. Birne(prune)
8. Säge (saw)
9. Bluse (blouse)
10. Tüte (bag)
11. Brille (glasses)
12. Tanne (Christmas tree)
13. Brust(chest)
14. Rose (rose)
15. Bürste (scrubbing brush)

List 3: + GEN (neu/neut)

Dies ist das [PIC]

1. Auge (eye)
2. Puzzle (puzzle)
3. Bein (leg)
4. Bett (bed)
5. Blatt (leaf)
6. Buch (book)
7. Glas(glass)
8. Haus (house)
9. Hemd (shirt)
10. Herz (heart)
11. Kind (child)
12. Klavier (piano)
13. Kleid (dress)
14. Messer (knife)
15. Ohr (ear)

List 4: ϕ - GEN (ϕ /masc)

*Dies ist _ [PIC]

1. Ball (ball)
2. Knopf (button)
3. Koffer (suitcase)
4. König (king)
5. Löffel (spoon)
6. Löwe (lion)
7. Mann (man)
8. Mantel (coat)
9. Nagel (nail)
10. Pinsel (paintbrush)
11. Schuh (shoe)
12. Soldat (soldier)
13. Stiefel (boot)
14. Teller (plate)
15. Tiger (tiger)

List 5: ϕ - GEN (ϕ /fem)

* Dies ist_ [PIC]

1. Ente(duck)
2. Erde (earth)
3. Feder (feather)
4. Frau(woman)
5. Gabel (fork)
6. Brücke (bridge)
7. Glocke (bell)
8. Hand (hand)
9. Hose (trousers)
10. Mühle (windmill)
11. Katze (cat)
12. Kerze (candle)
13. Kette (chain)
14. Straße (street)
15. Träne (tear)

LIST 6: ϕ -GEN(ϕ /neut)

*Dies ist _ [PIC]

1. Boot (boat)
2. Brot(bread)
3. Fenster (window)
4. Gewehr (rifle)
5. Huhn (chicken)
6. Pferd (horse)
7. Rad (wheel)
8. Radio (radio)
9. Schaf (sheep)
10. Schiff (ship)
11. Geld (money)
12. Zebra (zebra)
13. Zelt (tent)
14. Baby (baby)
15. U-Boot (submarine)

List 7: - GEN (masc/fem)

* Dies ist der [PIC]

1. Kirche (church)
2. Krone (crown)
3. Kuh (cow)
4. Lampe (lamp)
5. Leiter (ladder)
6. Maus (mouse)

7. Mütze (cap)
8. Nadel (needle)
9. Nase (nose)
10. Nuß(nut)
11. Pfanne (pan)
12. Hexe (witch)
13. Schere (scissors)
14. Socke (sock)
15. Sonne (sun)

LIST 8: - GEN (fem/neut)

Dies ist die [PIC]

1. Brett (board)
2. Feuer (fire)
3. Kanu (canoe)
4. Kinn (chin)
5. Paket(parcel)
6. Eis (ice-cream)
7. Seil (rope)
8. Sieb (sieve)
9. Faß (barrel)
10. Kamel (camel)
11. Obst (fruit)
12. Kreuz (cross)
13. Schach (chess)
14. Dach (roof)
15. Dreieck (triangle)

List 9: -GEN (neu/masc)

*Dies ist das [PIC]

1. Baum (tree)
2. Bus (bus)
3. Geist (ghost)
4. Hahn (rooster)
5. Vulkan (vulcano)
6. Drachen (kite)
7. Hund (dog)
8. Kamm (comb)
9. Knochen (bone)
10. Mund (mouth)
11. Pilz (mushroom)
12. Fuchs (fox)
13. Stock (stick)
14. Stuhl (chair)
15. Tisch (table)

sg/pl	FEM	MASC	NEU
NOM	die /eine die	der /ein die	das /ein die
ACC	die /eine die	den /einen die	das /ein die
DAT	der /einer den (+n)	dem /einem den (+n)	dem /einem den (+n)
GEN	der /einer der	des /eines (+e)s der	des / eines (+e)s der

Table 1. Declination of the definite and indefinite German article in consideration of Gender, Case, and Number. Usually a noun suffix (+s, +es, or +n) is added in the cases indicated above. A relatively small number of exclusively masculine nouns adding one of the suffixes +en, +n, +ns in all declinations (e.g., DAT-sg: *dem/einem Menschen* - *the/a human*) with exception of NOM-sg (e.g., *der Mensch*).

Meier (1964)	DIE	DER	DAS
frequency	349,553	341,522	124,232

Table 2. Meier's statistic reflects the frequency of the word forms but not their grammatical function. Thus, grammatical ambiguities are not considered (see Table 1).

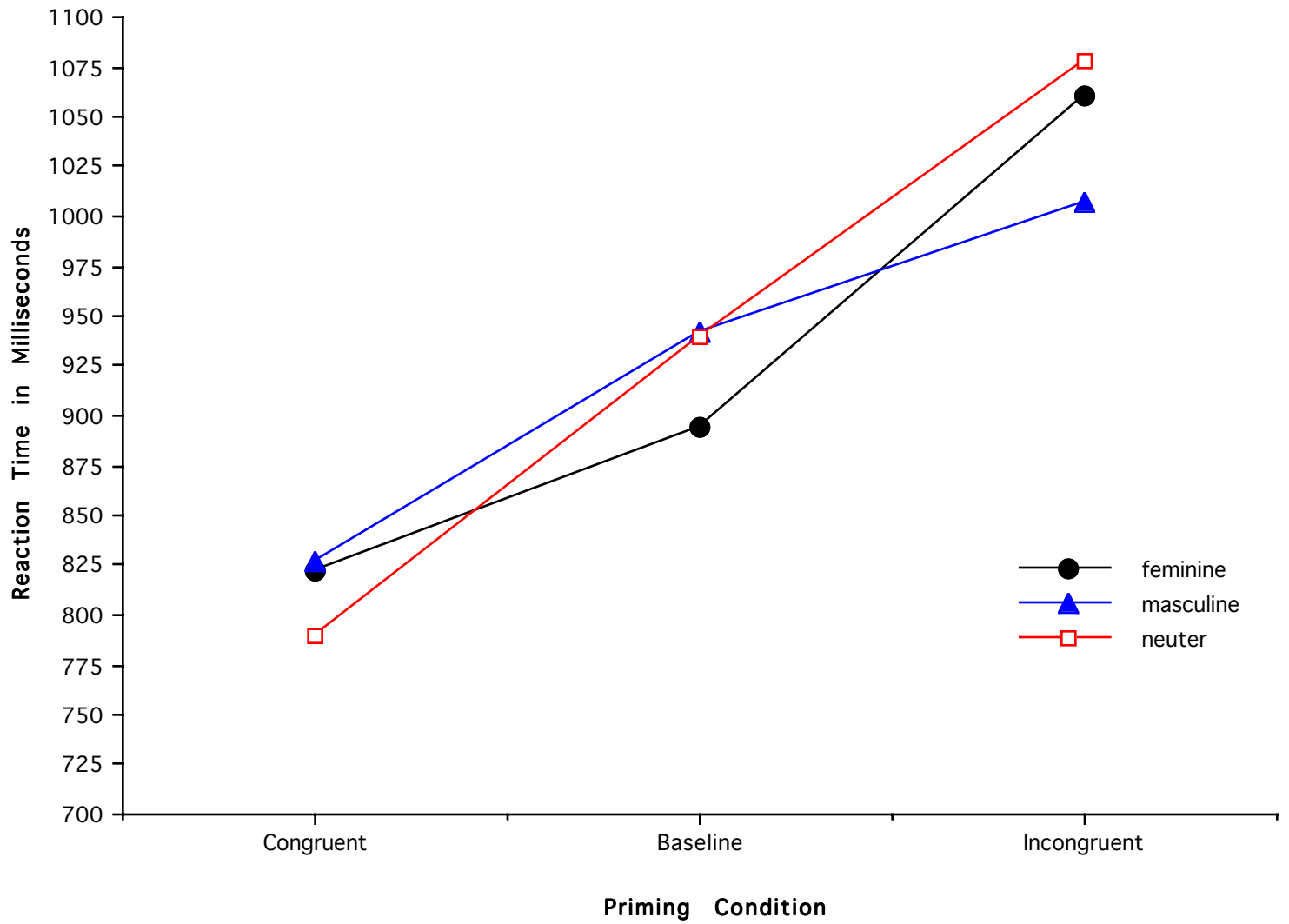


Figure 1: Gender Priming in All Three Noun Genders