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The representation of grammatical gender in the bilingual lexicon: Evidence from Greek and German*

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This paper investigates the shared or independent nature of grammatical gender representations in the bilingual mental lexicon and the role word form similarity (as in the case of cognates) plays in these representations. In a translation task from Greek (L1) to German (L2), nouns that had the same gender in both languages were translated faster than nouns with different genders, but only when the L2 target utterance required computation of gender agreement (adjective + noun). This tendency held for both cognates and noncognates. Unlike noncognates, however, gender-incongruent cognates yielded more errors than gender-congruent cognates. These results are interpreted as evidence for a shared L1–L2 gender system with L2 cognates relying more heavily on the L1 gender value than noncognates.

Introduction

The question of the organisation of the bilingual lexicon has, until recently, referred almost exclusively to "lexicosemantic" (de Groot, 1995) organisation, i.e. to the extent of the L1–L2 interaction at the conceptual, lexical-semantic and phonological/orthographic levels.[1] This picture, however, of the bilingual representational system, which takes into account only the interrelation of word meaning and word form and is based mainly on single word tasks, is definitely not complete. Apart from meaning and form, words are also associated with lexical-syntactic information such as syntactic category, gender and number, and it is their lexical-syntactic information that determines – to a large extent – the way words combine with each other in naturally-occurring speech.

This paper explores the nature of the representation of lexical-syntactic information of words, and more specifically of grammatical gender, in bilingual memory. It investigates cross-linguistic processing of grammatical gender (from L1 to L2) in order to provide evidence about two theoretical questions that are relevant to modelling the bilingual lexicon: (i) Do L1 and L2 nouns of the same gender share representations of their gender feature (and hence of their inherent syntactic properties)? and (ii) Is formal similarity of L1 and L2 nouns – as in the case of cognates – a prerequisite for a shared representation of gender features, given that the lexical entries of cognates overlap more than those of noncongates (e.g. Dijkstra, Grainger and van Heuven, 1999)?

The choice of grammatical gender – from among other syntactic features – was based on two factors. First, grammatical gender is an inherent property of all nouns of a gender language and is largely independent of a noun's meaning and the linguistic context in which a noun occurs (e.g. a noun has the same gender whether it occurs in singular or plural). Thus, unlike other grammatical features of nouns whose values vary and are determined by the to-be-expressed message (e.g. number), grammatical gender is a purely "syntactic" and a fixed feature. Second, grammatical gender is a linguistic phenomenon that has been extensively researched in the monolingual literature from a variety of viewpoints. The above research questions will be investigated using Greek (L1) and German (L2). Both languages have a tripartite gender system with the same values (masculine, feminine, neuter), thus lending themselves well to comparing and contrasting cases of L1–L2 gender equivalence or non-equivalence.

In the remainder of this paper we will first briefly review issues regarding the representation of grammatical gender in L1 and discuss the scant evidence about the gender representation in L2. We will then report an experiment that addresses the latter issue using an on-line L1-to-L2 translation task.

Grammatical gender in L1 production

The issue of how grammatical gender information is represented (and processed) in the mental lexicon has, thus

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[1] In this paper the term *bilingual* is used in its wider sense to denote a person who possesses and regularly uses two languages in any degree.

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far, been addressed within the framework of L1 models of lexical access and processing. In Roelofs' (1992) and subsequently in Levelt, Roelofs' and Meyer's (1999) model, grammatical gender is represented as an abstract lexical-syntactic property at the lemma level by means of syntactic nodes. Each gender value is represented by a different node shared by all noun lemmas that have this gender. Thus, all masculine noun lemmas are connected to the masculine gender node, all feminine noun lemmas to the feminine gender node and so on. Activation or selection of a noun's gender depends upon activation or selection respectively of its noun lemma. However, selection of a noun lemma does not automatically entail selection of its gender node in all contexts. A gender node is selected only when gender agreement needs to be computed during NP production as in gender-marked phrases. By contrast, a gender node is simply activated but not selected when no gender information is required for NP production as is the case in bare noun phrases (Roelofs, Meyer and Levelt, 1998). Caramazza's (1997) Independent Network model also assumes that gender features are represented by a separate node each and are shared by nouns (lexemes) of the same gender, although it makes different assumptions with respect to gender processing.

The primary paradigm used to explore the architecture and mechanisms of the representation and retrieval of grammatical gender during speech production is the gender-congruency effect. The first experimental evidence for the gender-congruency effect was obtained by Schriefers (1993) in L1 Dutch. He employed the picture–word interference task, in which pictures are typically named by a single word or a short phrase and are accompanied by a visually or aurally presented DISTRACTOR WORD that participants must ignore during naming. Schriefers manipulated the gender information between distractor and target name. Distractor and target names either had the same gender (GENDER-CONGRUENT) or a different gender (GENDER-INCONGRUENT). In two experiments, native Dutch speakers named pictures using a gender-marked NP in Dutch consisting of either a definite determiner + adjective + noun (e.g. ***de***$_{\mathrm{COM}}$ *groene stoel*$_{\mathrm{COM}}$ "the green chair", ***het***$_{\mathrm{NEUT}}$ *groene bed*$_{\mathrm{NEUT}}$ "the green bed"), or an adjective + noun (e.g. *groen**e***$_{\mathrm{COM}}$ *stoel*$_{\mathrm{COM}}$ "green chair", *groen*$_{\mathrm{NEUT}}$ *bed*$_{\mathrm{NEUT}}$ "green bed"). The visually presented distractor words were bare nouns that were not overtly marked for gender. This gender manipulation resulted in a GENDER-CONGRUENCY effect: naming latencies were significantly faster following a gender-congruent distractor than following a gender-incongruent distractor.

Schriefers (1993) interpreted these findings within the framework of Roelofs' (1992) model for nouns (subsequently incorporated in Levelt et al.'s (1999) model). The target noun lemma activates its corresponding gender feature, necessary for the choice of the appropriate agreement targets such as definite determiners and adjective inflections. In parallel, the distractor noun lemma automatically activates its gender feature too, although the distractor is not accompanied by any overt marking of its gender. In the gender-incongruent condition target and distractor noun simultaneously activate different gender features, as opposed to the gender-congruent condition where both of them lead to activation of the same gender information.

The gender-congruency effect has since been replicated and explored further in a number of monolingual studies (van Berkum, 1997; La Heij, Mak, Sander and Willeboordse, 1998; Schriefers and Teruel, 2000; Vigliocco, Lauer, Damian and Levelt, 2002; Schiller and Caramazza, 2003). For instance, La Heij et al. (1998) found that the effect is obtained only when gender has to be selected for the production of the target utterance (e.g. an utterance that involves gender agreement) but not when gender information is not required (e.g. production of bare nouns; but see also Cubelli, Lotto, Paolieri, Girelli and Job (2005) for a different view). Leaving aside the particulars about the locus of the gender-congruency effect, i.e. whether it is due to competition among abstract gender nodes (cf. e.g. Schriefers, 1993) or the word-form nodes of gender agreement targets (cf. e.g. Schiller and Caramazza, 2003), the important point for our current purposes is that this effect involves activation of gender information and that the manipulation of gender-congruency or gender-incongruency can be fruitfully exploited to investigate the nature of gender representation in the mental lexicon.

Grammatical gender in L2 production

Costa, Kovačić, Franck and Caramazza (2003) investigated the processing of grammatical gender in L2 production. The main question was whether the gender information of one language influences the processing of gender in the other language. They used simple picture naming tasks, i.e. without the presence of distractor words, but half of the target picture names shared gender with their translation equivalent nouns whereas the other half had a different gender from their translation. The participants were four groups of highly proficient bilinguals.

In three experiments, Croatian-Italian bilinguals named pictures by means of gender-marked definite determiner + noun or definite determiner + adjective + noun in their L2 (Italian). Naming latencies were not affected by whether the Croatian translation of the Italian target responses had the same or different gender. The same result held under conditions of speeded naming or mixed language naming (target pictures were named in L2 and filler pictures in L1). These findings were also replicated with three other bilingual groups: Spanish-Catalan bilinguals naming pictures in their L1 (Spanish) using gender-marked definite determiner +

noun, and Catalan–Spanish as well as Italian–French bilinguals namimg pictures in their L2 (Spanish and French respectively). Costa, Kovačić, Franck and Caramazza (2003) claimed that, although their results do not distinguish between a language-shared or language-separate gender system in the bilingual lexicon, they advocate the autonomy of the L1 and L2 gender systems in highly proficient bilinguals, regardless of the symmetry of the two systems in terms of gender values and gender agreement targets. Croatian, for example, has three gender values (masculine, feminine, neuter) as opposed to Italian, which has only two (masculine, feminine); all other language pairs used in the study have an equal number and type of gender values (masculine, feminine). Moreover, in all Romance languages definite determiners are gender agreement targets in a determiner + noun NP, whereas Croatian has no determiners and thus the corresponding NP does not require computation of gender agreement.

However, these findings cannot be considered conclusive with respect to the representational status of the L1 and L2 gender systems in the bilingual lexicon for the following three reasons, set out in the remained of the present section. First, the failure to observe any effect from L1 might be due to the type of processes involved in determiner retrieval in the target languages used in the study (Italian, Spanish, French). Although a gender-congruency effect has been repeatedly reported in L1 Dutch and German when using a determiner NP to name pictures accompanied by a distractor word (the picture–word interference paradigm: Schriefers, 1993; van Berkum, 1997; La Heij et al., 1998; Schriefers and Teruel, 2000), it has repeatedly failed to manifest itself in Romance languages – Italian, Spanish, Catalan and French (Costa, Sebastián-Gallés, Miozzo and Caramazza, 1999; Miozzo and Caramazza, 1999; Alario and Caramazza, 2002). A plausible explanation of this difference was provided by Miozzo and Caramazza (1999) in terms of EARLY AND LATE DETERMINER SELECTION LANGUAGES. In Dutch and German the gender value of the head noun is sufficient to fully determine the form of the appropriate definite determiner. Thus, determiner selection in these languages takes place early during NP production and can be subject to priming from the gender value activated by a distractor word. By contrast, in Italian, Spanish, Catalan and French the gender value of the head noun does not suffice in all cases to choose the appropriate definite determiner form. Phonological information about the onset of the word following the determiner is often needed, as well. In Italian, for example, the grammatical features MASCULINE-SINGULAR will activate an allomorphic set of definite determiners: *il* and *lo*, and the grammatical features MASCULINE-PLURAL will activate *i* and *gli*. It is the following word's onset that will determine the appropriate form: *lo* and *gli* precede words that start with a vowel, an *s*+consonant cluster, *gn* or an affricate; in all other cases, *il* and *i* are used. Determiner selection in these languages, therefore, occurs at a later stage during NP production than in Dutch and German, namely, when phonological information is retrieved. Given that the system of gender assignment is essentially the same in Germanic and Romance languages, Miozzo and Caramazza (1999) argued that a gender-congruency effect at the level of gender selection may also be present in a language like Italian but it is rendered invisible because any competition that may have arisen at the stage of gender selection (due to the activation of a different gender feature by the distractor word) will have been resolved by the later stage of phonological phrase assembly where determiner forms are selected. Thus, determiner selection in these languages takes place too late to be influenced by gender priming from a distractor word.[2]

Although there were no distractor words in the Costa, Kovačić, Franck and Caramazza (2003) study, there is a clear analogy between the two types of naming tasks. The role of "distractor words" in the simple naming tasks performed by bilinguals is assumed by the target noun's translation in the non-response language. These distractors are "internally set" by the structure of the bilingual mental lexicon, following the widely accepted assumption that a concept (in the form of a picture in this case) simultaneously activates its lexical representations in both lexicons. In the same way, therefore, that a gender-congruency effect is rendered invisible in late selection L1s, any activation of the gender of the L1 translation will have dissipated by the time determiners are selected during NP production in late selection L2s and hence, any influence of the L1 gender on naming latencies in L2 will not be possible to detect.

Second, the manifestation of an L1 gender effect might be further hindered by the specific characteristics of the gender assignment systems of the target languages. Italian, Spanish and, to a much lesser degree, French (Tucker, Lambert and Rigault, 1977; Holmes and Dejean de la Bâtie, 1999) have relatively transparent formal (phonological/morphological) principles of gender assignment, i.e. classification of nouns into gender classes. Languages with such transparent gender attribution systems might encourage superficial processing of L2 gender on the part of L2 learner: instead of retrieving a noun's gender from the mental lexicon, L2 learners might compute the gender and the corresponding determiner by analogy to the noun's ending, a much easier way to remember

[2] Note that these allomorphic variations do not apply to bound morphemes that mark gender (e.g. Italian: *blanco*$_{\text{MASC}}$, *blanca*$_{\text{FEM}}$ 'white'). However, it is currently under debate whether bound gender-marked morphemes are subject to the same competitive selection process as freestanding gender-marked morphemes, such as determiners (cf. Costa, Kovačić, Fedorenko and Caramazza, 2003; Schriefers, Jescheniak and Hantsch, 2005); we will therefore not discuss this issue further.

and recover this apparently arbitrary information (Carroll, 1989; Holmes and Dejean de la Bâtie, 1999). Since the majority of nouns used in the Costa, Kovačić, Franck and Caramazza (2003) study abide by the above typical rules of gender assignment, the last possibility cannot be excluded and could explain the absence of an effect.

Third, all participants in the Costa, Kovačić, Franck and Caramazza (2003) study were highly proficient, almost balanced bilinguals. This proficiency is evidenced by their L2 error rates, which were not significantly different from those of the native speaker groups tested on the same material.[3] This low error rate is surprising for L2 production that involves retrieval of grammatical gender since the difficulty of L2 learners, even advanced L2 learners, with gender assignment and gender agreement in L2 is well attested (Rogers, 1984; Dewaele and Véronique, 2001; Sabourin, 2003). It might be the case therefore that the autonomy of gender systems observed in this study is restricted to highly proficient, balanced bilinguals, whereas the influence of the L1 gender values is more pronounced in less fluent, L1-dominant bilinguals.

The Greek and German gender system

In this section, we briefly describe the grammatical gender system of the two languages to be used in this study, Greek (L1) and German (L2). Greek distinguishes three gender classes: masculine, feminine and neuter. Regarding the distribution of the three grammatical genders across nouns, the general consensus is that the neuter is the most frequent, followed by the feminine and finally the masculine gender (Mirambel, 1959, quoted in Makridge, 1985).

Turning to the relation between gender and form, it appears that simple phonological (and orthographic) rules can predict gender for the majority of nouns, if one considers the form of the nouns in the nominative singular, which is the form to be used in the current task. Nouns ending in -*ης* /-is/, -*ής* /-ˈis/, -*ές* /-ˈεs/, -*έας* /-ˈεas/, -*άς* /-ˈas/ and -*ούς* /-ˈus/ in the nominative singular are masculine; nouns ending in -*α* /-a/, -*ά* /-ˈa/, -*η* /i/, -*ού* /-ˈu/, -*ω* /-ɔ/ and -*ώ* /-ˈɔ/ are feminine; and nouns ending in -*ο* /-ɔ/, -*ι* /-i/, -*ί* /-ˈi/, -*υ* /-i/, -*ύ* /-ˈi/ -*μα* /-ma/, -*ιμο* /-imɔ /, -*ως* /-ɔs/, -*ώς* /-ˈɔs/ and -*ν* /-n/ are neuter (Holton, Mackridge and Philippaki-Warburton, 1997). Such heuristic rules do not work for nouns ending in -*ος* /-ɔs/ that can be masculine, feminine or neuter, nor for nouns ending in -*ας* /-as/ which can be either masculine or neuter. The gender of nouns that remains unaccounted for by phonological rules can be partly determined by morphological rules and, in particular, declensional class – the set of inflectional endings a noun takes to denote case and number. Declensional class can distinguish between masculine and neuter nouns in -*ας*, as well as between neuter and all other nouns in -*ος*, but not between feminine and masculine nouns in -*ος* which belong to the same declensional class.

In Greek, gender agreement is realised on all nominal modifiers, all coreferential pronouns, and on the active and passive participles of verbs. Appendix A compares the types of word-classes that show gender agreement in Greek and German, illustrated with some examples. It is evident from Appendix A that the main means of marking gender agreement in Greek (and German) are inflectional suffixes. Gender agreement is also instantiated through free-standing morphemes such as determiner and clitic forms. To sum up, grammatical gender in Greek is largely an inherent and context-independent property of all nouns. For a considerable number of nouns, phonological or morphological criteria or a combination of both can predict gender although there are cases that still remain unaccounted for.

Like Greek, German has three gender values: masculine, feminine and neuter. As for the relative size of each gender, German presents the reverse pattern from Greek: 50% masculine, 30% feminine and 20% neuter nouns (Bauch 1971, cited in Mills, 1986, p. 32).

In terms of morphology, a number of regularities have been established between gender and certain derivational affixes (e.g. *-ung*, *-heit*, *-erei*, *-shaft*, *-keit* and *-in* = feminine, *-lein*, *-chen*, *-ment* and *ge-* = neuter). Mills (1986, p. 33) also provides a compilation of probabilistic phonetic rules claimed to account for gender assignment in German (based mainly on Köpcke, 1982). Both the ending and the beginning of a noun play a role. Nouns ending in /-ə/ (*Kerze*) or /-iuː/ (*Industrie*) and monosyllabic nouns ending in /-Cft/, /-Cçt/, /-Cxt/ (*Bucht*), or /-ur/, /-ür/ (*Tür*) are associated with feminine gender. Monosyllabic nouns ending in /-ɪx/ (*Teppich*), or /-C_{nasal}C/ (*Sand*), beginning with /kn-/ (*Knall*), or /tr-/, /dr-/ (*Drall*), or /ʃC-/ (*Schlamm*), or have the form /CC-CC/ (*Zwerg*) are associated with masculine gender. Nouns ending in /-εt/ (*Bett*), or /-iːr/ (*Bier*) are associated with neuter gender. Finally, syllabicity appears to be linked to gender, as well. Arndt (1970) identified a dissociation between monosyllabic nouns and feminine gender and between polysyllabic nouns and neuter gender. For monosyllabic nouns, in particular, Köpcke (1982) showed that 64% of them are masculine. Note however, that very few of the rules outlined above have no exceptions and there are a number of nouns that do not conform to any of these rules. As a result, they do not necessarily make the German gender system appear less arbitrary to L2 learners. Rogers (1987), for example, presents evidence suggesting that grammatical gender in German is a persistent problem even for advanced L2 learners.

Declensional class cannot predict gender in German either; for example, a number of masculine and neuter

[3] In fact, the Catalan-Spanish bilinguals produced significantly *less* errors than the native Spanish speakers in Experiment 4A.

nouns fall in the same declensional class (e.g. *Tag*$_{MASC}$ "day" and *Brot*$_{NEUT}$ "bread" or *Park*$_{MASC}$ "park" and *Auto*$_{NEUT}$ "car"), although there is some correlation between the two categories (Hickey, 2000, pp. 630, 646f.). The main lexical categories that present gender agreement in German are shown in Appendix A. As in Greek, gender agreement in German governs both free-standing morphemes (e.g. determiners, personal pronoun forms) and bound morphemes (e.g. suffixation on adjectives, pronouns, etc.). Moreover, suffixation on adjectives within each gender class varies depending on whether the adjective is preceded by a definite determiner (weak endings), an indefinite determiner (mixed endings) or no determiner (strong endings). In summary, gender assignment in German is a quite complex process, involving an abundance of morphological and phonological factors.

The present study

The present study investigated the language-shared or language-independent nature of the representation of gender information in the bilingual lexicon by testing for a gender-congruency effect across languages. It employed a translation task from Greek (L1) to German (L2) with NP (N or Adjective + N) target responses. A translation task was chosen as it allows greater flexibility in the selection of material than, for example, picture naming. Moreover, it has been successfully used to investigate the retrieval of gender information in L1 NP production, yielding a gender-congruency effect (Vigliocco et al., 2002). Vigliocco et al. (2002) asked bilinguals to translate bare nouns from English (L2 and a non-grammatical-gender language) into a gender-marked NP in Dutch (L1). L1 NPs were produced faster in a gender-homogenous block which included trials of the same gender only than in a gender-heterogeneous block which included trials of all genders. In the present experiment L1 (Greek) bare nouns were translated into L2 (German) using first a Single Noun and then a (gender-marked) Adjective + Noun. Some of the L1 nouns were gender-congruent with their L2 translation (having the same gender as their L2 equivalent, e.g. *σπίτι* /ˈspiti/ **L1 NEUT** = Haus /haʊs/ **L2 NEUT** ("house")) and some others were gender-incongruent (having a different gender from their L2 equivalent, e.g. *χέρι* /ˈçeri/ **L1 NEUT** = Hand /hant/ **L2 FEM** ("hand")). Note that in this task there is no need to activate the grammatical gender or any other syntactic features of the L1 bare noun to produce the L2 target NP.

The L1 (Greek) – L2 (German) pair employed in the present experiment suggests itself as a much better test-bed for the presence/absence of a cross-language gender congruency effect than the L1–L2 pairs used in the previous literature for two reasons. First, Greek and German are early selection languages and a gender-congruency effect has been obtained in both L1 Greek (Plemmenou, Bard and Branigan, 2002; Plemmenou, 2003; Salamoura, 2004) and L1 German (e.g. Schriefers and Teruel, 2000). Second, German has relatively "opaque" morphophonological principles of gender assignment on nouns – or at least, much more opaque than in languages such as Italian and Spanish where for the majority of nouns gender information surfaces on the nominal suffix – thus discouraging computation of L2 gender based exclusively on morphophonological cues.

The use of an adjective in the L2 NP (where grammatical gender is realised as a bound morpheme at the word ending) was preferred over the use of a definite determiner (which is a gender-marked free-standing morpheme) so as to deflect arguments that any possible effect might be ascribed to translation priming between L1 and L2 definite determiner lemmas. Only concrete nouns were used in this task as concreteness effects (advantage of concrete over abstract words) are well established in both monolingual and cross-language processing of words or phrases out of context for a variety of paradigms, including L1-to-L2 translation (de Groot, 1992b; de Groot, Danneneburg and van Hell, 1994) and L2-to-L1 translation (de Groot et al., 1994).

If L1 and L2 gender features are shared, then the activated L1 gender information will affect the retrieval and selection of the L2 gender: it will facilitate retrieval if it coincides with L2 gender or inhibit/not facilitate retrieval if it is different from the L2 gender. In this case, a gender-congruency effect is predicted in the Adjective + Noun Translation, i.e. L1–L2 gender-congruent words should be translated faster than L1–L2 gender-incongruent words because the target translation requires computation of grammatical gender. Any processing advantage in the L1–L2 gender-congruent condition in the Adjective + Noun Translation would be the result of enhanced activation of the shared L1 and L2 gender feature necessary for the production of the target phrase. No such priming is predicted in the Single Noun Translation condition as monolingual studies have shown that computation of gender information is not required (La Heij et al., 1998; Roelofs et al., 1998; Levelt et al., 1999). On the other hand, if L1 and L2 gender features are independently represented, L1 gender information may be activated but will not influence gender retrieval and selection in L2. Consequently, no gender-congruency effect is expected, i.e., there should be no processing difference between L1–L2 gender-congruent words and L1–L2 gender-incongruent words during either Single Noun or Adjective + Noun Translation.

In addition to studying the role of cross-language gender congruency, the present experiment investigated the role of word type in the interaction of gender information across languages. For that reason, apart from gender congruency, the L1–L2 translation pairs were also manipulated for cognate status. COGNATES are defined here as words from two different languages which share aspects of meaning, phonological and orthographic form (e.g. L1 *μάσκα* /ˈmaska/ = L2 *Maske* /ˈmaskə/ "mask"). NONCOGNATES are translation equivalents that are dissimilar in phonological and orthographic form (e.g. *μήλο* /ˈmilɔ/ L1 = *Apfel* /ˈapfəl/ L2 "apple"). The cognate status of linguistic materials has proved to be an important determinant of cross-language word processing in general and word translation in particular. For instance, the speed and accuracy when translating cognate words is much higher than when translating noncognate words, both from L1 to L2 and L2 to L1 (de Groot, 1992b; Sánchez-Casas, Davis and García-Albea, 1992; de Groot et al., 1994; Kroll and Stewart, 1994).

The cognate facilitatory effect in cross-language lexical processing has been attributed to the greater degree of overlap and interaction between the lexical entries of cognates than noncognates across three different levels of representation: at the level of phonemic and graphemic representation (Costa, Caramazza and Sebastián-Gallés, 2000), or the lexical/lexeme level (de Groot, 1992b; Costa et al., 2000) or the semantic level (de Groot, 1992b; Kroll and Stewart, 1994; van Hell and de Groot, 1998). Alternatively, the privileged status of cognates might reflect a combination of factors. It might be the result of both their semantic and phonological/orthographic similarity across languages (Dijkstra et al., 1999) or the way they are learnt. Due to the salient similarity in form (and meaning) between cognates, it has been suggested that the L2 learner may simply add the new but similar L2 form into an already existing L1 lexical entry rather than create a completely new and different entry, as they would do for a new L2 noncognate word (Carroll, 1992; de Groot, 1992a; Lotto and de Groot, 1998).

Following on from the findings of previous research (de Groot, 1992b; Sánchez-Casas et al., 1992; de Groot et al., 1994; Kroll and Stewart, 1994), it is predicted that cognate items will be translated faster than noncognate ones. Moreover, since, as suggested by the literature above, the lexical entries of cognates overlap more than those of noncognates, cognate translation pairs are more likely candidates for activating the gender information of the non-target (L1) word than noncognate pairs. If learning of L2 cognates draws heavily on L1 resources and consists mainly of relating the new word to existing L1 information, then L2 cognates might tend to utilise the L1 lemma-to-gender link to activate gender information, developing only a weak direct link from L2 lemma to gender node. Such a strategy would have obvious advantages in the case of L1–L2 gender-congruent cognates, leading to easy access of the gender node with minimal processing load and to faster learning and processing. In the case of gender-incongruent cognates, however, this strategy would lead to less efficient access of the gender node and to slower learning and processing as well as errors.

Method

Participants

The participants were 18 native Greek-speaking advanced learners of German. A more detailed profile was gained through a language history questionnaire that they filled at the beginning of the experimental section. All were students at the department of German Studies of the University of Athens and all had an advanced level language certificate in German. On average they started learning German at the age of 10 (*SD* 4.8) and they had received 11 years (*SD* 3.1) of formal instruction; they had lived in a German-speaking country an average of 2.35 years ($SD = 4.25$) and 10 of them reported learning German through formal instruction whereas 8 through a combination of classroom instruction and exposure to a German-speaking environment. All but one spoke at least one other foreign language apart from German ($M = 1.5$) but none were balanced bilingual in any of them.

They scored a mean of 3.15 (*SD* 0.43) on Bachman and Palmer's (1989) self-assessment four-point scale measuring L2 communicative competence and a mean of 7.39 (*SD* 1.46) when asked to rate their L2 oral proficiency on a ten-point scale.

Material

The critical experimental material consisted of two-, three- or four-syllable Greek (L1) nouns to be translated into German (L2). The L1 stimuli (and their L2 translation) were divided into a NonCognate (NonCOG) and a Cognate (COG) block. As discussed above, L2 COGs share more lexical information with their L1 counterparts and are thus more likely to be affected by L1 information than L2 NonCOGs. Therefore, to avoid any transfer or spread of L1 effects from COG to NonCOG material, we opted to block "cognateness" in order to test NonCOG nouns separately and before COG nouns (see the following Design section). The L1–L2 noncognate nouns had only equivalent meaning but no similarity in phonological or orthographic form. The L1–L2 cognate nouns had equivalent meaning AND similar phonology and orthography.[4] Each block included 30 L1 words: 15 (five of each gender) were gender-congruent (CON) in L2, i.e. their L2 translation had the same grammatical gender (e.g. L1 $\mu\acute{\upsilon}\tau\eta_{\text{FEM}}$ /ˈmiti/ – L2 $\textit{Nase}_{\text{FEM}}$ "nose"), and 15 (five of each gender) were gender-incongruent (INC) in L2, i.e. their L2 translation had a different grammatical gender (e.g. L1 $\mu\acute{\eta}\lambda o_{\text{NEUT}}$ /ˈmilɔ/ – L2 $\textit{Apfel}_{\text{MASC}}$ "apple"). The L1 nouns were presented in nominative singular. In

4 Given that the Greek and German alphabets contain different characters, the orthographic similarity of Greek-German cognates is less pronounced than the orthographic similarity of cognates from languages that use exactly the same characters (e.g. English-Spanish).

Table 1. *Example set of critical material.*

Translation task	L1 noun type	Example	g	Designated L2 Translation	g
Single Noun	NonCOG CON	σπίτι /'spiti/ "house"	n	Haus/haʊs/	n
	NonCOG INC	χέρι /'çeri/ "hand"	n	Hand/hant/	m
	COG CON	μπάνιο /'banjɔ/ "bathroom"	n	Bad/bɑːd/	n
	COG INC	πάρκο /'parkɔ/ "park"	n	Park/park/	m
Adjective+Noun	NonCOG CON	σπίτι/σπίτι	n	kleines/großes Haus	n
	NonCOG INC	χέρι/χέρι	n	kleiner/großer Hand	m
	COG CON	μπάνιο/μπάνιο	n	kleines/großes Bad	n
	COG INC	πάρκο/πάρκο	n	kleiner/großer Park	m

COG = cognate, CON = Gender-congruent, g = gender, INC = Gender-incongruent, m = masculine, n = neuter, NonCOG = noncognate.

Table 2. *Frequency, syllable and letter length of the critical material.*

	NONCOGNATE WORDS				COGNATE WORDS			
	L1 Nouns		L2 Translation		L1 Nouns		L2 Translation	
	CON	INC	CON	INC	CON	INC	CON	INC
Frequency*	80.80	81.40	91.46	108.30	27.50	22.60	19.00	13.90
Syllable length	2.40	2.20	1.46	1.53	2.86	2.93	2.33	2.33
Letter length	5.93	5.53	4.93	4.60	6.73	6.66	6.06	5.80

CON = Gender-congruent, INC = Gender-incongruent.
* Number of occurrences per million, using the word form frequency estimate of the HNC (1999) for the Greek stimuli and the German version of the CELEX Lexical Database (1998) for the German stimuli.

the case of the German stimuli, care was taken to avoid correlations between phonological form and grammatical gender (Köpcke and Zubin, 1984) as much as possible.

In every block each of the 30 L1 words appeared in: a) standard font size (Arial 22) used in the Single Noun Translation part, b) in small font size (Arial 18) and c) in large font size (Arial 28), the last two used in the Adjective + Noun Translation part where participants had to produce the adjectives *klein* "small" or *groß* "big" depending on the size of the L1 word. An example set of the material can be viewed in Table 1. In both blocks in the INC conditions, there was an equal number of incongruent L2 translations of the three genders. All the L1 words and their designated L2 translations are listed in Appendix B. In each block an additional 15 L1 nouns were selected to serve as practice material.

The words comprising the two "gender-congruency" groups (L1–L2 CON and L1–L2 INC words) were matched in terms of frequency of occurrence, syllable and letter length as much as possible (one-way ANOVAs for frequency, number of syllables and letters: *L1 NonCOG-CON* vs. *-INC*: all $Fs(1,28) < 1.4$, $p > .24$; *L2 NonCOG-CON* vs. *-INC*: all $Fs(1,28) < .51$, $p > .48$; *L1 COG-CON* vs. *-INC*: all $Fs(1,28) < .13$, $p > .72$; *L2 COG-CON* vs. *-INC*: all $Fs(1,28) < .22$, $p > .64$; see Table 2).

Procedure

Participants were tested individually. They were seated comfortably in front of a 14-inch PC monitor at a viewing distance of approximately 80cm and a lip microphone was attached to them.

The task consisted of a NonCognate block followed by a Cognate block. Each block included three parts: presentation, Single Noun Translation and Adjective + Noun Translation, the last being the main experimental session. The presentation parts were displayed twice, once before the Single Noun and once before the Adjective + Noun Translation. In these parts, participants saw a list containing all the Greek words of each block together with the designated German response (i.e. the bare German nouns before the Single Noun part and the German nouns preceded by the appropriate form of *klein* and *groß* before the Adjective + Noun part). Participants were instructed to look at the word list and use only words from this list when they would translate from Greek into German in the following part of the task. At this stage participants were also asked to confirm that none of the L2 words was new for them. The purpose of the presentation parts was to familiarize participants with the experimental material in each block and to ensure that they all translated using the same word.

In the Single Noun Translation parts, participants were instructed to translate the Greek words presented on the screen in German as quickly and as accurately as possible or say "don't remember"/"don't know". They were also reminded to use only the German words they had seen in the previous presentation list. The purpose of these parts was to assess whether there is any difference in terms of RT between the L1–L2 gender-congruent nouns and the L1–L2 gender-incongruent nouns when no grammatical gender information needs to be accessed for their processing, as in a single word translation task. At the same time, the Single Noun Translation parts allowed participants to practise L1-to-L2 translation of the critical nouns. In these parts all critical words were presented and translated three times.

In the Adjective + Noun Translation parts, participants were again presented with the Greek words of the previous part(s). This time, however, some of the words appeared in small font and others in large font. Participants were asked to translate them into German using either the adjective *klein* "small" or *groß* "big" (depending on presentation size) before the appropriate noun. In addition to case and number, adjective and noun had to agree in terms of grammatical gender and this agreement was reflected by the inflectional suffix of the adjective (*klein**er**/groß**er*** for masculine, *klein**e**/groß**e*** for feminine and *klein**es**/groß**es*** for neuter gender). Participants were further instructed to reply as quickly and as accurately as possible but to avoid starting an NP with the adjective without knowing what they would say next. Four examples of Greek stimuli together with the designated German responses (taken from the practice material) were used in the instructions. In these parts all critical words were presented and translated twice – once in the small font and once in the large font.

In both blocks and all parts instructions were given on the screen in L2. In each experimental trial in the Single Noun and Adjective + Noun Translation parts, a fixation point (*) appeared on the centre of the screen for 600 ms, followed by the L1 word which was displayed until the participant's response. The ITI was 600 ms. All words were presented in black lowercase letters on a white background and in singular, nominative case form.

The presentation of the experimental material was controlled by SuperLab software. The whole experimental session was audio-recorded. From the recordings, response latencies were measured manually on a speech editor[5] to the nearest millisecond from the onset of the target stimulus (picture) to the onset of the noun in the Single Noun block and to the onset of the adjective in the Adjective + Noun block. This measurement was made possible by using a beep sound, which was played simultaneously with the onset of each target stimulus and was inaudible to participants as it was sent directly from the PC on which the experiment was run to a tape recorder connected with the PC.

A practice section consisting of 15 trials preceded both the Single Noun and the Adjective + Noun Translation part in each block. There was a small break between the two blocks and between the two Translation parts in each block (three breaks in total). Before the experiment proper, participants were given a brief questionnaire to fill in. The experiment lasted approximately 45 minutes.

Design

Both the Single Noun and the Adjective + Noun part comprised two factors, with two levels each: Noun Type (NonCognate [NonCOG] vs. Cognate [COG]) and Gender Congruency of L1–L2 noun (Congruent [CON] vs. Incongruent [INC]).[6] The experimental factors were within-participants and between-items. Each participant translated 30 NonCOG and 30 COG words three times in the Single Noun Translation, and the same 30 NonCOG and 30 COG words twice in the Adjective + Noun Translation. Thus, all participants saw all 3 versions (standard, small and large font) of the 60 experimental items.

One experimental list was created that contained 360 trials in total (300 critical and 60 practice trials). The order of the different blocks in it was fixed as follows: Single Noun Translation – NonCognates, Adjective + Noun Translation – NonCognates, Single Noun Translation – Cognates, Adjective + Noun Translation – Cognates.[7] The order of critical trials within the list was individually randomised so that:

(a) no more than three successive trials belonged to the same condition;

(b) an L1 item (and its L2 translation) was never preceded by a semantically, associatively, or phonologically related trial;

(c) an item was not repeated within 10 consecutive trials;

(d) items did not have the same gender on more than 3 successive trials.

[5] The advantages of this method over the on-line measurement of latencies via a voice key are discussed in detail by Morrison and Ellis (1995).

[6] The task type (Single Noun vs. Adjective + Noun Translation) is not a factor in the experimental design because comparison of RTs between the two tasks does not provide any new information on the hypotheses tested.

[7] For the choice of the block order, please refer back to the Material section.

Table 3. *Results for the mean response latencies and percentage of errors and long responses in the Single Noun trials (N = 18). Response latencies were measured to the nearest millisecond from the onset of the picture to the onset of the noun.*

NONCOGNATES						COGNATES					
Gender-congruent			Gender-incongruent			Gender-congruent			Gender-incongruent		
RT (SD)	%Error [a]	%Long [b]	RT (SD)	%Error [a]	%Long [b]	RT (SD)	%Error [a]	%Long [b]	RT (SD)	%Error [a]	%Long [b]
852 (85)	4.3	6.5	854 (101)	4.1	6.1	761 (109)	2	4.6	772 (98)	3.5	5.2

RT = mean Response Time (in ms), SD = Standard Deviation.
[a] Mean percentage of data lost due to error (application of data cleaning criteria (i) & (ii), i.e. wrong or "don't know"/"don't remember" responses).
[b] Mean percentage of long responses (application of data cleaning criteria (iii) and (iv), i.e. outliers and responses over the 2.5 sec cut-off collapsed).

Results

Target response latencies that fell into any of the following categories were discarded from the data analyses:

(i) latencies from trials on which the response produced was not the designated one,

(ii) latencies from trials on which the response was "don't remember" or "don't know",

(iii) latencies from trials on which there was a pause between the two words of the NP (disfluency) or a response was longer than 2.5s,

(iv) latencies that deviated more than 2.5 standard deviations (*SD*) from a participant's or an item's mean (outliers).

In addition, since one of the purposes of the Single Noun Translation block was to provide training in L1-to-L2 target item translation, responses to the first presentation – out of a total of three presentations – of each target word in this block were discarded from the analyses. After application of the above four criteria, 9.2% of all data points (3.5% in the Single Noun and 14.8% in the Adjective + Noun block) were identified as erroneous (criteria (i) and (ii)) and 5.6% of data (in both the Single Noun and Adjective + Noun blocks) were identified as long responses (criteria (iii) and (iv)) and were analysed separately. In total, 14.8% of all data points were lost either to error or long response (9.1% in the Single Noun block and 20.5% in the Adjective + Noun block, cf. Tables 3 and 4 and Appendix C). By-participant and by-item analyses of variance were performed of mean response latency and arcsine-transformed percentage of lost data. The analyses treated participants and items as random variables. Separate analyses were conducted for the Single Noun and the Adjective + Noun blocks.

Single Noun block

Table 3 displays the mean response latency and the percentage of errors and long responses for each prime condition in the Single Noun block. Response latencies were measured to the onset of the noun in the Single Noun block.

For the response latencies, a 2 (CON vs. INC) × 2 (NonCOG vs. COG) ANOVA revealed a significant main effect of Noun ($F_1(1,17) = 54.82$, $MSe = 2464.6$, $p < .001$; $F_2(1,56) = 26.34$, $MSe = 5056.9$, $p < .001$). The mean RTs in Table 3 show that participants were faster at translating a cognate noun from L1 to L2 than a noncognate noun. Neither the main effect of Gender Congruency nor their interaction reached significance (all Fs < 1), meaning that RTs were not influenced by whether the L1–L2 translation pair of nouns had the same or a different gender.

Details of the data lost to each category and each condition are provided in Appendix C. In summary, the results of the lost data analyses support those of the RT analyses: there was only a significant effect of Noun by-participants in the Total Lost data, Long Response and Wrong Noun rates (all $p < .05$), suggesting that errors in these categories were more numerous with the noncognate than cognate nouns.

Interestingly, the gender-congruency effect was non-significant in any of the lost data analyses, suggesting that the amount of errors produced during L1-to-L2 single noun translation was not significantly affected by whether the L1–L2 translation pair of nouns was gender-congruent or gender-incongruent.

Adjective + Noun block

Table 4 displays the mean response latency and the percentage of errors and long responses for each prime condition in the Adjective + Noun block. Response latencies were measured to the onset of the adjective in the Adjective + Noun block.

For the response latencies, a 2 (CON vs. INC) × 2 (NonCOG vs. COG) ANOVA revealed a significant main effect of Gender Congruency ($F_1(1,17) = 44.94$, $MSe = 4206.1$, $p < .001$; $F_2(1,56) = 10.79$, $MSe = 13420.3$,

Table 4. *Results for the mean response latencies and percentage of errors and long responses in the Adjective + Noun trials (N = 18). Response latencies were measured to the nearest millisecond from the onset of the picture to the onset of the adjective.*

NONCOGNATES						COGNATES					
Gender-congruent			Gender-incongruent			Gender-congruent			Gender-incongruent		
RT (SD)	%Error[a]	%Long[b]	RT (SD)	%Error[a]	%Long[b]	RT (SD)	%Error[a]	%Long[b]	RT (SD)	%Error[a]	%Long[b]
1219 (300)	13.3	5.6	1299 (347)	12.8	6.5	1134 (248)	9.6	4.8	1259 (271)	23.9	5.4

RT = mean Response Time (in ms), SD = Standard Deviation.
[a]Mean percentage of data lost due to error (application of data cleaning criteria (i) and (ii), i.e. wrong or "don't know"/"don't remember" responses).
[b]Mean percentage of long responses (application of data cleaning criteria (iii) and (iv), i.e. outliers and responses over the 2.5 sec cut-off collapsed).

$p < .01$) and a significant main effect of Noun in the participant analysis ($F_1(1,17) = 4.8$, $MSe = 14798.7$, $p < .05$) but not in the item analysis ($F_2(1,56) = 2.36$, $p > .13$). Their interaction did not reach significance (both Fs < 2.97, $p > .1$). However, inspection of the INC-CON numerical difference in Table 4 reveals that the gender-congruency effect in the noncognate conditions (80 ms) is less than two-thirds the size of the effect in the cognate conditions (125 ms). Nonetheless, simple contrasts confirmed the existence of a significant main effect of gender congruency for both cognates ($t_1(17) = 6.01$, $p < .001$; $t_2(28) = 3.30$, $p < .01$) and noncognates ($t_1(17) = 4.14$, $p < .001$; $t_2(28) = 1.54$, $p = .065$). The mean RTs in Table 4 show that participants were faster at translating a target NP from L1 to L2 when L1 and L2 nouns had the same gender than when they had a different gender. In addition, the cognate nouns were translated faster than the noncognate nouns in the participant but not in the item analysis.

Details of the data lost to each category and each condition are provided in Appendix C. In summary, the pattern of results in the lost data analyses follows that of the RT analyses. More total lost data were generated when L1 prime and L2 target cognate nouns had a different gender than when they had the same gender ($p > .001$). No such difference was obtained with the noncognate nouns. Exactly the same pattern was observed with the total erroneous ($p > .001$) and "wrong gender" data ($p > .001$). In addition, the translation of cognate material resulted in more wrong L2 adjective endings that were congruent with the gender of the L1 prime noun than the translation of noncognate material ($p < .01$). On the other hand, more "wrong noun" data were produced when L1 prime and L2 target noncognate nouns had the same gender than when they had a different gender ($p > .05$). No such difference was observed with the cognate nouns. The long responses and pauses yielded no statistically significant differences.

Discussion

The results demonstrate that the L1-to-L2 oral translation process (of gender-marked adjective + noun phrases) is susceptible to a gender-congruency effect. When participants used only a single word to translate L1 nouns into L2, no significant difference in terms of RTs or errors was obtained between the L1–L2 gender-congruent and L1–L2 gender-incongruent group of stimuli. However, when participants were asked to use a gender-marked phrase (adjective + noun) while translating into L2, L1–L2 gender-congruent words were translated 103 ms faster than L1–L2 gender-incongruent ones. This priming was observed with both noncognate and cognate L1–L2 pairs of nouns. L1–L2 noncognate pairs were translated 80 ms faster when they were gender-congruent than when they were gender-incongruent. In L1–L2 cognate pairs this tendency was 125 ms. This numerical difference between noncognate and cognate noun conditions did not reach significance. In addition, as expected, L2 learners were 63 ms faster to translate L1–L2 cognate than noncognate nouns. This finding is consistent with evidence from previous translation studies that reported a clear advantage of cognates (de Groot, 1992b; Sánchez-Casas et al., 1992; de Groot et al., 1994; Kroll and Stewart, 1994). Altogether, these results lend support to a shared representation of gender features between L1 and L2 that explains why the gender of an L1 phrase influences the production of the translation equivalent (gender-marked) phrase in L2 in the process of translation.

Translation priming does not seem a plausible account for this gender-congruency effect. Even if it is assumed that the L1 bare nouns activate the equivalent L1 adjective form of the target response (stem + suffix) and that separate entries exist for every single bound morpheme in the mental lexicon[8] among which translation links can be

[8] Here, we follow the widely accepted view that stems and inflectional affixes are represented separately in the mental lexicon (cf. Levelt

established, there is no one-to-one equivalence between the L2 adjectival inflectional suffixes employed in this task's target responses and their L1 counterparts. The equivalence is rather many-to-one or many-to-many. In both Greek and German there is a considerable degree of "affixal synonymy", i.e. the same "grammatical meaning" corresponds to more than one bound morpheme. As a result, the Greek adjectival suffix *-ος* (-ός) [*case*: nom, *number*: sg, *gender*: masc] would be linked to and activate both *-er* (strong and mixed adjective declension) and *-e* (weak adjective declension) in German. This "affixal synonymy", which also holds for the feminine and neuter adjectival inflections, excludes the possibility that the L1 adjectival suffixes unambiguously activated the equivalent L2 target suffixes, thus causing translation priming between L1 and L2 suffixes. In such cases of no clear one-to-one equivalence between L1 and L2, the speaker (or rather the system) learns that an L2 adjectival suffix corresponds to an L1 adjectival suffix in terms of gender by discovering that the two suffixes are used in equivalent linguistic contexts.

Moreover, the fact that a gender-congruency effect was found only in the Adjective + Noun but not in the Single Noun Translation section indicates that the effect is contingent on the syntactic requirements of the response type. This means that gender is selected only when production of the target response requires computation of grammatical gender – when producing, for instance, a gender-marked phrase. These results are in line with La Heij et al.'s (1998) monolingual study that obtained no gender-congruency effect using a picture–word interference task in L1 Dutch when the target response involved only a single noun as opposed to a phrase consisting of a (gender-marked) determiner and noun. This condition does not seem to be restricted to grammatical gender though. Other syntactic information associated with a noun also functions in the same manner. Pechmann and Zerbst (2002) have shown that the syntactic category of a distractor word (e.g. noun, adverb) influenced results in a picture–word interference task in L1 German only during the production of phrases that required computation of the grammatical category of their components (the phrases were produced as completions to sentence fragments).

The results of the present study in L2 German and La Heij et al.'s (1998) data in L1 Dutch contrast with those by Cubelli et al. (2005) who found a gender-congruency effect in bare noun production in L1 Italian. Cubelli et al. explained this difference by assuming that grammatical gender in Italian is selected along with open class words, such as nouns, as gender has important morphophonological consequences for the form of the noun itself, determining, for example, its plural form (e.g. feminine nouns ending in *-a* in the singular (*stella* "star") take the suffix *-e* for the plural (*stelle*)). By contrast, in Dutch grammatical gender is not overtly realised on the noun; it merely controls agreement with the noun's modifiers. It is therefore selected together with closed class words, such as determiners.

However, Cubelli et al.'s (2005) hypothesis cannot be readily applied to all gender languages. German, for instance, cannot be classified into one of the two previously described categories, as grammatical gender sometimes has and some other times does not have morphophonological consequences for the noun's form. Even if it is assumed that L1 German speakers may select gender during bare noun production, the present results show that L2 learners do not access and/or select gender unless absolutely necessary, for instance, in order to derive the form of a noun modifier. This selective gender access might, in turn, reflect an attempt to ease the processing demands of lexical access and production in L2.

The selection or not of grammatical gender in bare noun production appears to be an open question at present, as in addition to Dutch (La Heij et al., 1998), no gender-congruency effect has been obtained in single noun production in L1 Greek either (Plemmenou, 2003; Salamoura, 2004) – although in Greek, like in Italian, gender is reflected in the morphophonological form of the majority of nouns. A possible explanation may be that gender assignment in Greek reflects a combination of phonological and morphological rules (Plemmenou, 2003; Salamoura, 2004), whereas in Italian gender assignment follows phonological rules only (Corbett, 1991).

The present pattern of findings points to the operation of an economy principle in relation to the processing of syntactic features during cross-language production. Selection and processing of syntactic information linked to a lemma node, such as grammatical gender or word class, does not take place automatically upon selection and/or activation of the lemma node. Rather, it takes place when such information is necessary for retrieving the correct components of an utterance, as predicted by the Levelt et al. (1999) model. However, once a response requires selection of a particular type of syntactic information, the language processor will take into account this specific information not only of the target lemma but also of all other lemmas that happen to be active at the time of selection. The results of the present experiment, in particular, show that when L2 production requires computation of gender during L1–L2 translation, gender features are activated not only by the target noun but also by its L1 translation equivalent consistent with the notion of between-language competition in production (Green, 1998; Hermans, Bongaerts, De Bot and Schreuder, 1998).

et al., 1999; Dell, 1986). Inflectional affixes are added to or generated by stems during word formation. As a result, different forms of the same adjective like *μικρός*$_{\text{MASC}}$, *μικρή*$_{\text{FEM}}$, *μικρό*$_{\text{NEU}}$ /mikr-ˈɔs -ˈi -ˈɔ/ 'small' do not have distinct representations. Since adjectives can be segmented into a stem and an inflectional part (*μικρ-ός, μικρ-ή, μικρ-ό*), the adjectival stem is represented by a single lemma/lexical node which can combine with a given set of inflectional affixes depending on its syntactic specifications.

Furthermore, the present results which advocate a shared L1–L2 representation of gender information contrast with Costa, Kovačić, Franck and Caramazza's (2003) failure to find any influence from the L1 gender system during L2 production. As already discussed, this absence of an effect in the latter study might be attributable to a number of factors, such as the native-like and balanced proficiency of the bilingual participants in both languages, the fact that the target L2 languages used did not yield a gender-congruency effect in L1 production either, or the potential superficial processing of gender information due to its morphophonological transparency in the target languages. By contrast, the participants in the present study, albeit advanced L2 users, were L1-dominant bilinguals as manifested by the particularly high error rates in the Adjective + Noun block (14.8% overall); both Greek and German have generated a gender-congruency effect in L1 production; and German, the target L2, has rather "opaque" gender assignment principles. All these factors may be important for the presence or absence of a gender effect across languages and ultimately the degree of interaction or autonomy of the L1–L2 gender systems.

Although some of the L2 nouns in the present study followed a rather transparent formal principle of gender assignment (i.e. nouns ending in *-e* which is highly associated with feminine gender), post-hoc analyses showed no difference in L2 performance between the more gender-opaque and gender-transparent L2 nouns; a gender-congruency effect was obtained with both types of nouns in the Adjective + Noun task. Since, however, this study was not designed to test such an issue and there were only very few gender-transparent L2 nouns ending in *-e* ($N = 16$), differences on L2 performance between gender-opaque and gender-transparent nouns remains an open question for future research.

Furthermore, the numerical difference in the gender-congruency effect between cognates and noncognates did not reach significance but their difference with respect to error rates did. Unlike L2 noncognate responses, L2 cognate responses led to significantly more errors in general and "wrong gender" errors in particular when their L1 translation was of a different gender (INC condition) than when it had the same gender (CON condition). More importantly, in the INC condition participants generated more "wrong gender" errors with cognate material that were congruent with the gender of the L1 prime noun than noncognate material. The findings from the error rates suggest that cognateness plays a role. L2 cognates are affected more by the gender congruency or incongruency of their L1 translation than L2 noncognates, resulting in more wrong gender retrievals.

Note that the mean frequency of the cognate items is significantly lower than that of noncognate items ($p > .001$). This difference was to a certain extent unavoidable in order to match evenly the noncognate and cognate stimuli along the three gender values. However, the gender-congruency effect obtained in the Adjective + Noun task cannot be ascribed to the frequency difference between noncognates and cognates. The critical comparison for the gender-congruency effect is not between cognates and noncongates but between the gender-congruent and gender-incongruent condition within each noun type (noncognate vs. cognate), and these two conditions were matched for frequency within the noncongate set and within the cognate set (see Materials section). Moreover, the critical comparison between the gender-incongruent cognates and noncognates in the Adjective + Noun block is not the overall error rates that may reflect differences in frequency between the two noun types but the percentage of "wrong gender – L1 CON" responses – responses containing a wrong adjective ending that was congruent with the gender of the L1 translation of the target L2 noun – for which there is no reason to believe that they are affected by frequency differences.

A possible explanation for the effect of cognateness might lie in the role of cognates in cross-language transfer during L2 learning. If grammatical gender is an existing category in L1, then the challenge in learning an L2 gender language is not to familiarise oneself with the workings of gender as a language feature but to learn new mappings between the existing gender values and L2 words. During the early stages of this process, the formal similarity of cognates may prompt learners to link the new L2 word onto the gender value of its L1 translation until evidence to the contrary is provided, particularly when grammatical gender is an arbitrary, minimally predictable feature of an L2 lexical item.[9] On the other hand, the formal dissimilarity of noncognates may force learners to develop a stronger, L1-independent link between the L2 lemma and its gender feature. However, not all cognates exhibit a one-to-one equivalence at all linguistic levels. For instance, there are false cognates with similar form and meaning but different gender such as the gender-incongruent cognates in the present study (e.g. *πάρκο*$_{\text{NEUT}}$ /'parkɔ/ (Greek) - *Park*$_{\text{MASC}}$/park/ (German) "park"). The mapping of L2 cognates onto the corresponding L1 lexical entries results in positive transfer, facilitation of L2 learning and low error rates as regards true cognates. As to false cognates, it results in negative transfer, slowdown of learning and high error rates (Odlin, 1989; Kirsner, Lalor and Hird, 1993; Meara, 1993).

The error rate difference between cognates and noncognates in the present experiment suggests that most probably only a weak link is formed between the L2 lemma and the appropriate gender node in cognates. This weak link poses no problem in the case of gender-congruent cognates. Because of the heavy reliance of L2 cognates

[9] In fact, Kirsner, Lalor and Hird (1993) have proposed that L2 cognates are represented and stored as variants of their L1 translations, with morphology being the only distinctive feature between L1 and L2 cognate items.

on the representations of their L1 counterparts, activation of the gender node can be achieved using the existing and strong L1 lemma-to-gender link. In the case of gender-incongruent cognates the situation is reversed. The target gender node receives only a small amount of activation by the weak L2 gender-to-lemma link and it will take longer to surpass (if at all) the higher level of activation of the non-target gender node activated by the strong L1 lemma-to-gender link. As a result, the gender of the L2 word would be readily accessible for gender-congruent cognates, and it may even be comparatively inaccessible for gender-incongruent cognates, thus explaining the larger gender-congruency effect of error rates in cognates. What is important for present purposes is that the larger effect in cognates is obtained precisely because of the existence of a language-shared set of gender nodes (i.e. the target of the mappings from the L1 and L2 lemmas is the same). Finally, it is interesting that this effect is observed even with advanced L2 learners. It appears that strong connections that are assumed to develop between L1 and L2 cognates during the early stages of L2 learning seem to be long-lasting (cf. Paradis' (1985, 1987) Subset Hypothesis).

Alternatively or in combination with the previous explanation, the lemmas of L1 cognates and their gender information may be activated more strongly than those of L1 noncognates as a result of extra activation coming partly from the semantic level and partly from the phonological/orthographic level which overlap more in cognates than noncogates.[10] For example, van Hell and Dijkstra (2002) and Dijkstra and van Hell (2003) provide evidence that L1 words that are cognates with their L2 translation are accessed and processed faster than L1 noncognates even in exclusively L1 contexts (i.e. in an L1 word association and lexical decision task), on the condition that learners are highly proficient in L2. Similarly, Gollan and Acenas (2004) found that bilinguals experienced significantly less TOTs with cognate than noncognate names in their dominant language, relative to monolinguals who did not show any cognate advantage.

Overall, the pattern of results suggests that the L1 and L2 gender systems are not separate but interrelated in the bilingual mental lexicon during language production. Nouns with the same gender have a common representation of their gender feature across languages – at least for pairs of languages that have symmetrical gender systems, i.e. share number and type of gender values. This L1–L2 interaction in terms of gender information pertains to both cognate and noncognate nouns.

[10] The activation flow from the phonological/orthographic level back to the lemma level (via the lexical/lexeme level) assumes interactive processing, that is, activation flow in both directions between adjacent levels of a model (Dell, 1986; Dell and O'Seaghdha, 1991; Harley, 1993).

Appendix A: Gender agreement targets in Greek and German

Agreement Targets	Greek	German
Definite determiner	√	√
	ο, η, το "the"	der, die, das "the"
Indefinite determiner	√	√
	ένας, μία, ένα "a"	ein, eine, ein "a"
Adjective		
attributive	√	√
	μεγάλ**ος**, -**η**, -**ο*** "big"	groß**er**, -**e**, -**es**** "big"
	νέ**ος**, -**α**, -**ο** "new"	(strong declension)
	γλυκ**ός**, -**ιά**, -**ό** "sweet"	groß**er**, -**e**, -**es** "big"
	μακρ**ύς**, -**ιά**, -**ύ** "long"	(mixed declension)
	ταχ**ύς**, -**εία**, -**ύ** "fast"	groß**e**, -**e**, -**e** "big"
	μαβ**ής**, -**ιά**, -**ί** "mauve"	(weak declension)
	υγι**ής**, -**ής**, -**ές** "healthy"	
	πλήρ**ης**, -**ης**, -**ες** "full"	
	ζηλιάρ**ης**, -**α**, -**ικο** "jealous"	
	φαγ**άς**, -**ού**, -**άδικο**/**ούδικο** "glutton"	
	καβγατζ**ής**, -**ού**, -**ήδικο** "quarrelsome"	
	επείγ**ων**, -**ουσα**, -**ον** "urgent"	
	ευγνώμ**ων**/-**ονας**, -**ων**/-**ονας**, -**ον** "grateful"	
predicative	√	×
	μεγάλ**ος**, -**η**, -**ο** "big", etc.	

Appendix A: (Cont.)

Agreement Targets	Greek	German
Numerals		
some cardinals	√	×***
	τρ**εις**, τρ**εις**, τρ**ία** "three"	
all ordinals	√	√
	δέκατ**ος**, -**η**, -**ο** "tenth"	zehnt**er**, -**e**, -**es** "tenth"
Personal pronoun		
full form	√	√
	(only 3RD PERSON SG & PL)	(only 3RD PERSON SG)
	αυτ**ός**, -**ή**, -**ό** "he, she, it"	er, sie, es "he, she, it"
weak (clitic) form	√	**n.a.**
	τος, τη, το	
Possessive pronoun	√	√
	του, της, του (only 3RD PERSON SG)	mein, mein**e**, mein "my"
	"his, her, its"	mein**er**, -**e**, -**s** "mine"
	δικ**ός**, -**ή**, -**ό** μου "mine"	
Demonstrative pronoun	√	√
	αυτ**ός**, -**ή**, -**ό** "this"	dies**er**, -**e**, -**es** "this"
	τούτ**ος**, -**η**, -**ο** "this"	jen**er**, -**e**, -**es** "that"
	εκείν**ος**, -**η**, -**ο** "that"	der, die, das "that"
	τέτοι**ος**, -**α**, -**ο** "such"	derjenige, die-, das- "that"
	τόσ**ος**, -**η**, -**ο** "so much/many"	solch**er**, -**e**, -**es** "such"
Indefinite pronoun	√	√
	κάποι**ος**, -**α**, -**ο** "someone"	jed**er**, -**e**, -**es** "every, everyone"
	κανείς/κανένας, καμιά, κανένα	manch**er**, -**e**, -**es** "many a"
	"anyone, no-one"	kein(**er**), -**e**, -**es** "no, no-one"
Interrogative pronoun	√	√
	ποι**ος**, -**α**, -**ο** "who, which?"	welch**er**, -**e**, -**es** "which, what?"
	πόσ**ος**, -**η**, -**ο** "how much?"	
Reflexive pronoun	√	×
	(only 3RD PERSON SG)	
	ο εαυτός του, της, του	
	"himself, herself, itself"	
Relative pronoun	√	√
	ο οποί**ος**, -**α**, -**ο** "who, which"	der, die, das "who, which"
	όποι**ος**, -**α**, -**ο** "whoever"	welch**er**, -**e**, -**es** "which"
	όσ**ος**, -**η**, -**ο** "as much/many as"	
Participle	√	√
	φημισμέν**ος**, -**η**, -**ο** "famous"	berühmt**er**, -**e**, -**es** "famous"

√ = (gender) agreement applies
× = (gender) agreement does not apply
n.a. = not available
*Like nouns, Greek adjectives belong to a number of declensions. An example from each declension is provided.
**In German, adjectives and other lexical categories that function like adjectives (e.g. numerals, participles) follow different declensions, depending on whether they are preceded by a definite determiner (weak declension), an indefinite determiner (mixed declension) or no determiner (strong declension).
***Apart from *ein*(*s*)*, eine, ein* "one" that declines like the indefinite determiner.

Appendix B: The experimental material

NONCOGNATE STIMULI							
L1–L2 GENDER-CONGRUENT				L1–L2 GENDER-INCONGRUENT			
L1 Nouns	g	L2 Translation	g	L1 Nouns	g	L2 Translation	g
καθρέφτης "mirror"	m	Spiegel	m	λουλούδι "flower"	n	Blume	f
διακόπτης "switch"	m	Schalter	m	ζώνη "belt"	f	Gürtel	m
κάβουρας "crab"	m	Krebs	m	καναπές "sofa"	m	Sofa	n
κύκλος "circle"	m	Kreis	m	πίνακας "painting"	m	Bild	n
σκύλος "dog"	m	Hund	m	βουνό "mountain"	n	Berg	m
πόρτα "door"	f	Tür	f	καρδιά "heart"	f	Herz	n
σημαία "flag"	f	Fahne	f	χάρτης "map"	m	Karte	f
σκάλα "ladder"	f	Leiter	f	δέντρο "tree"	n	Baum	m
αράχνη "spider"	f	Spinne	f	μαϊμού "monkey"	f	Affe	m
μύτη "nose"	f	Nase	f	μήλο "apple"	n	Apfel	m
σπίτι "house"	n	Haus	n	χέρι "hand"	n	Hand	f
φύλλο "leaf"	n	Blatt	n	ήλιος "sun"	m	Sonne	f
βιβλίο "book"	n	Buch	n	δρόμος "street"	m	Strasse	f
αυγό "egg"	n	Ei	n	ρόδα "wheel"	f	Rad	n
χαρτί "paper"	n	Papier	n	φωτιά "fire"	f	Feuer	n

COGNATE STIMULI							
L1–L2 GENDER-CONGRUENT				L1–L2 GENDER-INCONGRUENT			
L1 Nouns	g	L2 Translation	g	L1 Nouns	g	L2 Translation	g
γορίλας "gorilla"	m	Gorilla	m	ομελέττα "omelette"	f	Omelett	n
ελέφαντας "elephant"	m	Elefant	m	σκελετός "skeleton"	m	Skelett	n
κάκτος "cactus"	m	Kaktus	m	ανανάς "pineapple"	m	Ananas	f
πλανήτης "planet"	m	Planet	m	μπουφές "buffet"	m	Büfett	n
θρόνος "throne"	m	Thron	m	καμήλα "camel"	f	Kamel	n
μάσκα "mask"	f	Maske	f	βάζο "vase"	n	Vase	f
βόμβα "bomb"	f	Bombe	f	μπάλα "ball"	f	Ball	m
λάμπα "lamp"	f	Lampe	f	μύλος "mill"	m	Mühle	f
κιθάρα "guitar"	f	Gitarre	f	τσιγάρο "cigarette"	n	Zigarette	f
μπανάνα "banana"	f	Banane	f	κανόνι "cannon"	n	Kanone	f
μπάνιο "bathroom"	n	Bad	n	πάρκο "park"	n	Park	m
τηλεσκόπιο "telescope"	n	Teleskop	n	κροκόδειλος "crocodile"	m	Krokodil	n
πακέτο "packet"	n	Paket	n	άγκυρα "anchor"	f	Anker	m
μικρόφωνο "microphone"	n	Mikrophon	n	λεοπάρδαλη "leopard"	f	Leopard	m
στάδιο "stadium"	n	Stadion	n	κανάλι "canal"	n	Kanal	m

g = gender

Appendix C: Breakdown of the data lost per category and per condition

Single Noun block							
	% Total Lost[a]	**% Total Long[b]**	% Outliers[c]	%2.5s Cut-Off[d]	**% Total Error[e]**	% Wrong Noun[f]	% Other Error[g]
Noncognates							
CON	**10.7**	**6.5**	5.9	0.6	**4.3**	3.2	1.1
INC	**10.2**	**6.1**	5.6	0.6	**4.1**	2.3	1.9
Cognates							
CON	**6.7**	**4.6**	4.6	0	**2.0**	1.9	0.2
INC	**8.7**	**5.2**	4.6	0.6	**3.5**	3.5	0
Total Mean[h]	**9.1**	**5.6**	5.2	0.4	**3.5**	2.7	0.8

[a]Mean percentage of total lost data from all categories in each condition. The %Total Lost is the sum of %Total Long and %Total Error (and the sum of %Outliers, %2.5s Cut-Off, %Wrong Noun and %Other Error) in each condition. Slight variation in the figures reported in the %Total Error column and the actual sum of the percentages in the rest of the cells in each row is due to variation in rounding to the nearest tenth.
[b]Mean percentage of data lost due to long responses, i.e. responses 2.5 standard deviations over a participant's or an item's mean and responses over the 2.5s Cut-Off. The %Total Lost is the sum of %Outliers and %2.5s Cut-Off. Slight variation in the figures reported in the %Total Long column and the actual sum of the percentages in the %Outliers and %2.5s Cut-Off cells in each row is due to variation in rounding to the nearest tenth.
[c]Mean percentage of data lost to responses 2.5 standard deviations over a participant's or an item's mean.
[d]Mean percentage of data lost to responses over the 2.5s Cut-Off.
[e]Mean percentage of total data lost to erroneous responses. The %Total Error is the sum of %Wrong Noun and %Other Error in each condition. Again slight variation in the figures reported in the %Total Error column and the actual sum of the percentages in the %Wrong Noun and %Other Error cells in each row is due to variation in rounding to the nearest tenth.
[f]Mean percentage of data lost to responses including a wrong noun or the wrong form of the target noun.
[g]Mean percentage of data lost to other erroneous responses (e.g. pause, no response, etc.).
[h]Mean percentage of total lost data over all conditions in each category. Slight variation in the figures reported in the %Total Mean row and the actual mean of the percentages in the rest of the cells in each column is due to variation in rounding to the nearest tenth.

Appendix C: (Cont.)

ADJECTIVE + NOUN BLOCK									
	% Total Lost[a]	**% Total Long**[b]	% Outliers[c]	%2.5s Cut-Off[d]	**% Total Error**[e]	% Wrong Noun[f]	% Wrong Gender[g]	% Pause[h]	% Other Error[i]
Noncognates									
CON	**18.9**	**5.6**	2.8	2.8	**13.3**	2.4	6.1	4.1	0.7
INC	**19.3**	**6.5**	2.4	4.1	**12.8**	0.4	8.9(7)	2.6	0.9
Cognates									
CON	**14.4**	**4.8**	3.7	1.1	**9.6**	0.2	4.4	1.7	3.3
INC	**29.3**	**5.4**	2.0	3.3	**23.9**	0	17.4 (12.2)	2.8	3.7
Total Mean[j]	**20.5**	**5.6**	2.7	2.8	**14.8**	0.7	9.2	2.8	2.2

[a]Mean percentage of total lost data from all categories in each condition. The %Total Lost is the sum of %Total Long and %Total Error (and the sum of %Outliers, %2.5s Cut-Off, %Wrong Noun, %Wrong Gender, %Pause and %Other Error) in each condition. Slight variation in the figures reported in the %Total Error column and the actual sum of the percentages in the rest of the cells in each row is due to variation in rounding to the nearest tenth.

[b]Mean percentage of data lost due to long responses, i.e. responses 2.5 standard deviations over a participant's or an item's mean and responses over the 2.5s Cut-Off. The %Total Lost is the sum of %Outliers and %2.5s Cut-Off. Slight variation in the figures reported in the %Total Long column and the actual sum of the percentages in the %Outliers and %2.5s Cut-Off cells in each row is due to variation in rounding to the nearest tenth.

[c]Mean percentage of data lost to responses 2.5 standard deviations over a participant's or an item's mean.

[d]Mean percentage of data lost to responses over the 2.5s Cut-Off.

[e]Mean percentage of total data lost to erroneous responses. The %Total Error is the sum of %Wrong Noun, %Wrong Gender, %Pause and %Other Error in each condition. Again slight variation in the figures reported in the %Total Error column and the actual sum of the percentages in the %Wrong Noun, %Wrong Gender, %Pause and %Other Error cells in each row is due to variation in rounding to the nearest tenth.

[f]Mean percentage of data lost to repaired and non-repaired responses including a wrong noun.

[g]Mean percentage of data lost to repaired and non-repaired responses with a wrong gender as realised in the ending of the adjective. The rates in parentheses indicate the mean percentage of (repaired and non-repaired) "wrong gender – L1 CON" responses (responses containing a wrong adjective ending that was congruent with the gender of the L1 translation of the target L2 noun).

[h]Mean percentage of data lost to pauses (including filled or silent pauses before a) the adjective, b) the ending of the adjective and c) the noun).

[i]Mean percentage of data lost to other erroneous responses (e.g. wrong adjective, no response, etc.).

[j]Mean percentage of total lost data over all conditions in each category. Slight variation in the figures reported in the %Total Mean row and the actual mean of the percentages in the rest of the cells in each column is due to variation in rounding to the nearest tenth.

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