The cross-linguistic influence on L2 learners' ability to use morphosyntactic cues predictively.

A psycholinguistic study on German grammatical gender acquisition by Greek native speakers.

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Abstract

German and Greek are both Indo-European languages that realize grammatical gender and indeed they have similar grammatical gender systems, they both realize three genders (masculine, feminine, neuter). They pose some similarities concerning gender agreement as well. However, the lexical gender between these two languages differs a lot. The purpose of this study is to examine first, whether L2 learners of German with Greek as their first language are able to use German grammatical gender predictively. Secondly, it was also examined to what extent the differences associated with L1-L2 lexical gender are going to affect their ability to make gender-based predictions in their L2. An experimental condition providing lexical cues (i.e., numeral) as informative cues was added, so that a comparison between the L2ers' predictive ability based on morphosyntactic cues compared to lexical cues, can be investigated. The research questions of the study were examined by means of a speeded picture-selection task. Gender Assignment Tasks and a proficiency test were also included to investigate the influence of proficiency and knowledge of grammatical gender on the L2ers' ability to use gender predictively. Besides the L2ers' group, a control group of German native speakers also participated. The results suggest that L2ers were not able to use grammatical gender in their L2 predictively across the board of the gender trials, although they did successfully use the lexical cues to predict upcoming words. Although proficiency did not significantly interact with L2ers' performance at the task, their knowledge of grammatical gender did significantly affect their performance, leading to faster Reaction Times.

Keywords

Grammatical gender, Prediction, Second Language Acquisition, Gender Assignment, Picture Selection

Contents

1.Introduction

Grammatical gender is a morphosyntactic feature that can be found in many Indo-European languages, for example, Greek, German, French, Spanish, Swedish, and others. Yet, it is not a necessary linguistic feature, in the sense that there are languages that do not realize it at all, for example, English. Grammatical gender is associated with distinguishing nouns into different classes (Corbett, 1991). According to Carroll (1989), grammatical gender is mainly a lexical feature. However, grammatical gender does not only have a lexical aspect, assignment but also a syntactic one, agreement (Corbett, 1991). Although native speakers rarely make mistakes in grammatical gender (Corbett, 1991), second language learners (henceforth L2 learners, or L2ers) face difficulty acquiring this feature (Grüter et al., 2012).

It is known from previous research that native speakers have the ability to use grammatical gender predictively and facilitate processing in both online and offline tasks (for example Guillelmon & Grosjean, 2001; Johnson Fowler & Jackson, 2017). Also, a number of studies suggest that L2 learners are also capable of using grammatical gender predictively (for example Hopp 2013, Covey et al. 2018). However, as many studies show (for example Hopp, 2013 and Kaan, 2014) L2ers' predictive ability is strongly dependent on their overall mastery of lexical gender and their proficiency, two factors that tend to correlate (Dussias et. al, 2013; Hopp, 2013). Generally, grammatical gender poses difficulty to learners, even the advanced ones, and the difficulty is mainly associated with lexical gender assignment, rather than agreement (Grüter et al. 2017).

L2 learners' ability to predict upcoming words using morphosyntactic cues is a topic that has gained great interest in the field of Bilingualism. Many recent studies show that indeed L2 learners can use morphosyntactic cues to predict upcoming words (for example Grüter et al., 2012; Hopp, 2013; Covey et al., 2018). The current study attempts to contribute to this discussion by examining the influence of the properties of the first language (L1) on the predictive use of gender cues in L2. In particular, the study examines whether (dis-)similarity at the level of lexical gender impacts the online use of gender. Thus, we examined whether advanced German L2 learners with Greek as their L1 can

use the gender of their L2 predictively, with a design that systematically manipulates the similarity between lexical gender in L1 Greek and L2 German.

According to the findings of Hopp & Lemmerth (2018), the predictive ability in the L2 is influenced by the properties of the L1. This study, however, investigated both the differences with regard to gender agreement, and gender assignment. Hence, it would be interesting to investigate the cross-linguistic effects in a language pair where the agreement mechanisms are similar, but lexical gender is different. And this is the question that the current study addresses by systematically manipulating the lexical gender of the nouns in the stimuli.

Dussias et al. (2013) investigated L2ers' ability to use gender predictively in their L2 by examining two participant groups, one with English as their L1, a -gender language, and one with Italian as their L1, a +gender language. They found that greater results were achieved by highly proficient learners with English as their L1. The learners with L1 Italian were not that proficient and so were able to use gender predictively, but their ability was restricted to the feminine gender. The language that Dussias et al. (2013) examined was Spanish, a language closely related to Italian. Hence, it would be interesting to address similar research questions by examining languages that are not that closely related. And this is the main contribution of the present study, which examines the cross-linguistic influence of the properties of the L1 Greek on one's ability to use gender predictively in one's L2 German.

Covey et al. (2018) investigated the predictive use of Hindi grammatical gender by L2ers with English as their L1 by systematically manipulating Informativeness as a factor. The current study uses similar methodological tools but contributes to the general discussion by adding the factor of L1-L2 lexical gender (dis-)similarity. Moreover, Hopp (2013) found that L2ers' ability to use grammatical gender predictively is strongly associated with their knowledge of lexical gender. For this reason, a gender assignment task has been included in the current study to examine its effect on participants' ability to use grammatical gender predictively.

As studies like McDonald (2006) and Grüter et al. (2012) show late L2ers' difficulties with grammatical gender are associated with the demands deriving from online

processing, and/or production. This is the reason why the current study examines native speakers' and L2ers' predictive ability by means of an online productive task.

2. Literature Review

The present study examines the ability of L2ers to use morphosyntactic cues predictively in their L2, and how the corresponding properties of their L1 affect this ability. Hence, advanced L2ers of German are examined in their ability to use the German grammatical gender in a predictive manner, and how the differences with regards to gender assignment in their L1 (Greek) will affect this ability. Of central interest for the present study are the mechanisms that L2ers use to acquire grammatical gender, and the previous studies about the L2ers' predictive ability, to which I will refer in detail in the sections below. Also, since I am investigating the cross-linguistic influence, of great importance are the similarities and differences between the two grammatical gender systems in question (German, Greek), which are presented in detail in chapter 3 under the title Theoretical Framework.

2.1 Grammatical Gender acquisition

Grammatical gender is a feature that poses difficulty even to the most proficient learners (see for example (Grüter et al., 2012). This might be connected to grammatical gender having both a lexical and a syntactical aspect. The lexical aspect of gender, the so-called gender assignment is the target classification of the noun to the gender class (e.g from German *"Brücke"* (bridge) → feminine); and the syntactical aspect, the so-called gender agreement, the +morphosyntactic realization of the feature on agreement targets, such as articles (e.g from German ***die***.FEM *schöne Brück**e.***FEM (the beautiful bridge) (Hopp & Lemmerth, 2018).

The question of whether learners, with -gender L1, can acquire gender in their L2 to native-like levels has been addressed by many previous studies (for example Franceschina, 2005; White et al., 2004). Franceschina (2005) found that native-like performance in gender tasks by learners is associated with the existence of gender in their

L1. Other studies (for example Guillelmon & Grosjean, 2001) underscore the role of age of acquisition on native-like gender mastery. The current study focused on a group of learners who have a +gender L1 (Greek) and are considered late learners of German, the second language under investigation.

2.2 Predictive use of grammatical gender

It is clear from previous research that native speakers have the ability to use the grammatical gender in a predictive manner (Lew-William, Fernald 2007). However, whether the L2ers share the same ability is a central question in the field of SLA. Grüter et al. (2017) suggest that L2ers have a REDUCED ABILITY to GENERATE EXPECTATIONS (henceforth, RAGE) underlining their difficulty to make predictions; this is the reason why L2ers rely less on predictive processing than native speakers do (Grüter et al., 2017). On the other hand, based on the good performance that L2ers showed during processing in some studies (Hopp, 2013; Dussias et al., 2013), Kaan (2014) suggested that the mechanisms which the L2ers and the native speakers use to predict the upcoming words are qualitatively the same. They underscore the crucial role that proficiency and L1-L2 similarity play in L2ers' ability to use informative cues predictively.

Grüter et al. (2012) examined advanced English-natives L2 learners of Spanish by means of threetasks, looking-while-listening, elicited production, and sentence-picture matching. They replicated White et al's (2004) results that high-proficient L2ers can achieve native-like performance in offline tasks regardless of the properties of their L1. However, their results show that L2 learners' difficulties are more persistent at the level of lexical gender, which might explain learners' inability to use gender predictively.
They provide as an explanation of their findings that infants and adults use different mechanisms during learning. More specifically, they claim that infants acquire the determiner and the noun as a chunk, creating a strong node between them, which the late learners are no longer capable of doing. These findings are compatible with a proposal by McDonald (2006) that late L2 learners' difficulties with grammatical features derive from processing difficulties caused by low working memory capacity for L2, difficulty decoding, and insufficient processing of L2.

The findings of Grüter et al. (2012) study replicated those by Lew-Welliams & Fermald (2007) and Lew-Williams & Fernald (2010) with more proficient learners. Lew-Williams & Fernald (2007) investigated whether Spanish-learning children can use gender-marked determiners (i.e., articles) in a facilitative manner to interpret the noun phrase by means of an eye-tracking study. Although the Reaction Times (henceforth RTs) among adults and children showed some differences, the pattern was the same, in the sense that both groups were able to use the grammatical gender information to facilitate processing. Lew-Williams & Fernald (2010) used the same methodological tools as in Lew-Williams & Fernald (2007) but included a group of adult non-native Spanish speakers. As the results show, native Spanish speakers of all age groups were able to use grammatical gender in a facilitative manner, whereas the adult non-native speakers did not seem to have this ability, since their RTs did not show any significant variation between the same- and the different gender trials. These findings are in line with those of Grüter et al. (2012).

An early study that examined learners' predictive ability in their L2 is the one by Guillelmon & Grosjean (2001), which examined whether bilinguals can use the grammatical gender predictively as native speakers do. The participants consisted of a bilingual group and native speakers control group; they divided the bilingual group into two subgroups of early and late bilinguals depending on the age of their first exposure to L2, French. Late bilinguals did more gender-related errors, compared to the early bilinguals, who did not make any. The participants listened to a sentence consisting of a determiner, an adjective, which was the same throughout the experimental paradigm, and a noun, and were asked to repeat as quickly as possible the word after the adjective *(jolie(e) [nice])*. They manipulated informativeness in the sense that the determiners were either congruent, grammatically correct; incongruent, violating agreement; or neutral, meaning no gender cue. The determiners used in the first two conditions (the congruent, and incongruent one) were the *le (the.*MASC*)* and *la (the.*FEM*)* and *leur (their*.NEUT*)*.

Faster RT at the congruent condition indicates that one can use the grammatical gender in a facilitative manner. Only the monolinguals and the early bilinguals showed facilitation at congruent conditions. The sensitivity to the agreement violation (incongruent condition) showed the same pattern. Importantly, late bilinguals did not show any effect, neither facilitation at the congruent condition nor hindrance at the incongruent condition. Their results showed that they could not use gender information to facilitate processing and that they were insensitive to gender agreement violations.

Undoubtfully Guillelmon & Grosjean's (2001) study made a great contribution to the general discussion about the age effects on SLA. However, they examined participants' proficiency solely by means of a self-evaluation of their proficiency, meaning that there was no objective measure, which makes it difficult to identify to which extent proficiency influenced the results.

The same topic was investigated, more recently, by Hopp (2013) investigated the predictive use of gender in L1 and L2 German by means of both a production and comprehension task, tapping into gender assignment and agreement. They chose German because of their opaque gender morphology. Importantly, Hopp (2013) paid special attention to the participant's knowledge of gender. Their results showed that learners who showed higher results on the gender assignment tasks were the ones who successfully used the grammatical gender predictively.

The study of Dussias et al. (2013) contributed to the general discussion of L2ers' predictive ability mainly by adding a participant group of learners with +gender L1. More specifically, they used an eye-tracking study to examine whether English-Spanish and Italian-Spanish L2 speakers are capable of using the grammatical gender to facilitate real-time sentence processing. They included to their experiment syntactically complicated sentences too, to distract their participants from the article noun node. They found that Spanish monolinguals and high-proficient English-Spanish L2 speakers were able to use the grammatical gender as a facilitative cue, whereas the Italian-Spanish L2 speakers, whose level was closer to this of the low-proficient English-Spanish L2 learners, had partially this ability, restricted to the feminine gender. Low-proficient English-Spanish L2 speakers did not have this ability at all. Their results suggest that one's ability to use grammatical gender in a facilitative manner derives both from one's proficiency and the existence of gender parameter in one's L1. However, Italian and Spanish overlap lexically to a large extent, and in the masculine gender where more differences are to be observed Italian participants scored poorly (Dussias et al., 2013). Nevertheless, it remains an open question if L2 speakers can still use grammatical gender predictively when their two languages share the gender parameter but do not overlap lexically, which the current study addresses.

Adding to the existing body of literature, Johnson Fowler & Jackson (2017) used a visual priming task to investigate the ability of L1 English-L2 German speakers to use morphosyntactic and semantic information in a facilitative manner to predict the upcoming words in a sentence. They manipulated the lexical and syntactical information they provided during the prime phase, in such a way so that to find out whether the participants can rely on semantical and gender cues to facilitate processing when provided with the required information. Importantly, they used different determiners in the prime and the experimental condition, the indefinite, and the definite article respectively, to avoid the replication of the exact same sentence and rule out the possibility that participants had just been relying on their short-term memory. The results of the first experiment suggest that both groups (native speakers and L2ers) could use gender cues to facilitate their processing, yet the effect on the native speakers' group was greater. However, since in the experimental condition, the only gender-marked component is the definite article, this possibility could not be completely ruled out.

They then run a second experiment with a different participant group. Through this experiment, they aimed to check the first experiment's result for a new population and also scrutinize the possibility that participants were relying on their short-term memory. For this experiment, they used two types of sentences: sentences with and without a gender-marked adjective. The results replicated those of the first experiment when it came to sentences that consisted of gender mismatch and adjective. The results of the other condition, the one without the gender-marked adjective could not be very clear, mostly because the indefinite article in German is invariable between masculine and neuter (Johnson Fowler & Jackson, 2017). Thus, the absence of adjectives in this experiment made it impossible to distinguish between masculine and neuter nouns and took away the necessary distance between the determiner and the noun.

Another important study is the one by Hopp & Lemmerth (2018) which investigated the lexical and syntactical congruency among the gender systems of bilingual participants' two languages. They, hence, examined adult L2 speakers of German with Russian as their mother tongue. German and Russian especially differ on the realization of grammatical gender since German realizes gender in prenominal articles whereas Russian in nominal suffixes. As their results show in the syntactic congruent conditions the L2 learners were able to use grammatical gender predictively irrespectively to congruency at the

assignment level or proficiency level. This study manipulated both the syntactical aspect of grammatical gender, agreement, and lexical gender. Therefore, it would be interesting to investigate the cross-linguistic effects in a language pair where the agreement mechanisms are similar, but it is only the gender assignment that differs a great deal, and this is the question the present study addresses.

In a particularly notable and recent study, Covey et al. (2018), investigated the predictive use of a morphosyntactic cue (gender-marked adjective) during processing by L2 English-Hindi learners and English-Hindi bilinguals by means of a speeded picture selection task and found that both groups were able to use grammatical gender cues to facilitate processing. Covey et al. (2018) divided their stimuli into two conditions, one with canonical and one with noncanonical morpheme; the canonical ending morphemes for Hindi nouns are (*-a*) for the masculine and (*-i*) for the feminine, there are also many high-frequent nouns that do not bear these morphemes. The presented items per trial were always matched for canonicity. Participants were presented with "same-gender" and "different-gender" trials; only in the latter ones were they able to facilitate their answers based on gender cues. Participants were asked to choose the correct picture corresponding to a question auditorily and visually presented to them, and they had to make their conclusion as quickly as possible. Answers before the onset of the noun and after the offset of the gender-marked adjective are solely based on the gender cues, and hence provide unambiguous evidence that they used this morphosyntactic information predictively. Most of the answers were given after the onset of the noun but the Reaction Times of both the L2 learners and the bilinguals were faster in the "different-gender" trials which indicates the predictive use of gender cues. Bilinguals, however, showed a facilitation effect only for the feminine gender, which according to the authors is associated with the fact that the masculine is perceived as the "default" gender for Hindi, and thus the effect is greater for the feminine gender, which is the marked form. Worth mentioning is the fact that Hindi is the only grammatically gendered language in the linguistic background of all participants.

The current study replicates the rationale of this study but also adds the factor of the cross-linguistic influence. The difference between the current study and Covey et al. (2018) is that the participants of this study have already acquired the grammatical gender parameter already from their L1, which might imply that they will be able to use it in both their

languages predictively, but what is interesting here is whether the properties of the first language will hinder this ability when the properties between the two languages are not only different but completely reversed.

There is evidence from previous research (for example White et al. 2004) that L2ers rely on a default gender during gender processing, and tend to overgeneralize it. This is also supported by the findings of Covey et al. (2018). Another mechanism that learners rely on to target both gender assignment and agreement is overt morphological cues. This is supported by the findings of Alarcón (2010), who examined L2es of Spanish of all proficiency levels. Furthermore, Varlokosta (2011) found that Greek native speakers rely on overt morphological cues to use gender predictively in their L1. The fact that the language investigated by the present study, German has an opaque gender system, and hence there are no overt morphological cues on which one could rely to facilitate processing is of great interest.

Summary

A selection of studies concerning grammatical gender acquisition, and the learner's ability to use morphosyntactic cues, such as the grammatical gender, to facilitate processing has been presented. The aim of the current study is to investigate not only whether L2ers posse the ability to use the grammatical gender predictively in their L2 but also the extent to which this ability is affected by the properties of the L1. For this reason, studies that examined the cross-linguistic influence on SLA have been also presented. These topics have been discussed to provide justification for the current study design, which attempts to answer not only the question of whether L2ers can use the grammatical gender predictively but also the influence of their L1's properties on this ability.

The design of the current study aims to contribute to the discussion about the cross-linguistic influence on the L2ers' ability to use morphosyntactic cues predictively. By using this language pair, Greek and German, which interferes with respect to gender assignment a great deal, this study will contribute to the general discussion of how an already existent parameter affects the acquisition of this parameter in the L2. The selected language pair, Greek and German, interferes a great deal with respect to the gender assignment. Hence, the design of this study will contribute to the general discussion about

how the properties of an already acquired parameter through the L1 will affect the acquisition of the same parameter in the L2 when there is lexical gender (dis-)similarity.

3. Theoretical Framework

Among this study's research questions is the cross-linguistic influence on the L2ers' ability to use grammatical gender predictively. More concretely, this study investigates how differences in the lexical gender between Greek and German affect the grammatical gender processing in L2. Here we provide a succinct description of the grammatical gender systems of Greek and German and pinpoint their similarities and differences.

3.1 Grammatical Gender in Greek

Greek is a morphologically rich language that distinguishes three gender categories, two numbers, and four cases. According to Ralli (2002), gender assignment in Greek derives from morphology. Greek is a language with a formal gender system according to Corbett's (1991) categorization.

With regard to assignment, Greek nouns, adjectives, and determiners are marked for gender, and so are categorized into three gender values: masculine, feminine, and neuter, (Ralli, 2002). Notable for the current study design, Greek and German share the same gender distinction, i.e., masculine, feminine, and neuter. Varlokosta (2011) examined whether Greek native speakers can use morphological information to predict the gender of real and novel nouns, and she found that Greek native speakers could use morphological information, especially those borne by the suffix. Therefore, generally Greek nouns' gender is highly predictable based on morphological cues.

In terms of agreement, within the same noun phrase, all declinable modifiers need to agree with the noun in gender, number, and case. More specifically the adjective reflects almost always those properties (Holton et al., 2004, p. 83). This rule applies in both number conditions, singular and plural. For example, a phrase consisting of an article, adjective, and a noun in nominative singular: *o omorfos kipos* (the.MASC.SG nice.MASC.SG garden.MASC.SG) and the same phrase in nominative plural: i omorfi kipi (the.MASC.PL

nice.MASC.PL garden.MASC.PL). Importantly for the current study design, in the question the participants were presented with i.e., *wo ist der/die/das gelbe* NOUN*?* (where is the.MASC/FEM/NEUT yellow NOUN), the gender is morphosyntactically realized on the article, whereas the adjective is unmarked for gender. In the corresponding sentence in Greek gender is morphosyntactically realized both on the article, the adjective, and the suffix of the noun, for example, *pu ine o/i/to kitrin-os/i/o* NOUN? (where is the.MASC/FEM/NEUT yellow.MASC/FEM/NEUT NOUN?)

According to Kavoukopoulos' corpus analysis, in terms of frequency, 42% of Greek nouns are feminine, 32% neuter, and 23% masculine (Kavoukopoulos, 1996, in Tsimpli & Hulk, 2013).

3.2 Grammatical Gender in German

German nominal paradigm is distinguished into three gender categories, two number categories, and four cases (Hopp, 2013). According to Lang & Zifonun (1996), gender categorization is arbitrary and to a high extent opaque. Although morphological and semantical patterns are to be observed, there are many exceptions that concern even high-frequent words (Hopp, 2013).

However, according to Corbett (1991), gender is predictable to a large extent for German nouns based on "semantic, morphological, and phonological factors" (Corbett, 1991, p. 49). Based on morphological patterns like the suffixes *-ung*, *-heit*, *-keit*, *-erei*, *-schaft*, and *-keit* that are associated with feminine gender, Corbett (1991) concludes that the suffix might determine the gender to some extent. More specifically, nouns with the suffix *-ung*, *-heit/keit* are feminine, whereas nouns with the suffix *-ling* are masculine and those which have *-ge* as a prefix and *-e* as a suffix are neuter (Lang & Zifonun, 1996). Also, concerning the phonological factors which can determine the gender, the schwa-ending bisyllabic nouns are mainly feminine, despite the fact that some very frequent exceptions like *Auge* (eye.NEUT) and *Käse* (cheese.MASC) are to be observed (Hopp, 2013, p. 40). Regarding the semantic factors which often determine gender, some patterns are to be observed, for example, all the noun components of the semantic field of color are neuters (Corbett, 1991), whereas alcoholic drinks are masculine, and fruits feminine (Lang & Zifonun,

1996). In compound words, it is the last word, with all its affixes, that determines the gender of the whole word (Corbett, 1991).

In general, grammatical gender is clearly marked on determiners and adjectives, yet in the case of the indefinite article, the masculine and neuter morphology coincide, for instance:

> "ein.MASC/NEUT interessanter.MASC Film.MASC,
> eine.FEM interessante.FEM Zeitung.FEM,
> ein.MASC/NEUT interessantes.NEUT Buch.NEUT
> "The interesting film"" (Kupisch et al., 2013, p. 157).

In this case, the adjective ending bears the grammatical gender information (-er / -es). With respect to gender agreement, German adjectives are not always marked for gender. Whether they will be marked or not depends on their syntactic position and role. As Corbett (1991) states adjectives in German reflect gender "only when in the right syntactic configuration" (Corbett, 1991, p. 124). For example, "*warm-er Tee*" but "*der Tee ist warm*" in the first example, where the determiner is missing and the adjective bears all the necessary gender information, but in the second example it serves the role of a predicate adjective and is thus unmarked for gender (Corbett, 1991, p. 124). As a result, in instances like the first example, the adjective will show variation according to the gender it agrees with, whereas in the case of the second instance, it will not.

In German the gender frequency shows the reverse pattern compared to Greek as approximately 50% of the nouns are masculine, 30% feminine, and 20% neuter (Bauch 1971, as in Hopp (2013)).

Comparing the two systems one can observe that with regards to gender agreement, the main difference allies with the syntactic position that the adjective needs to have in order to bear gender information; in Greek, adjectives are always marked for gender, regardless of their syntactic role, whereas in German the adjectives agree with the noun only in certain syntactic positions. A difference is that in Greek the plural paradigm is variable according to the three genders, whereas the German one is invariable. Another difference with regards to the gender assignment is mainly associated with the frequency each gender is used, the frequency pattern is reversed; and with the fact that the Greek gender

system is morphologically salient, whereas the German one is mainly opaque, despite some semantical and morphological patterns that do exist.

4. The present study

The present study aims to explore how differences with regard to lexical gender between L2ers' first and second language affect their ability to use grammatical gender in their L2 predictively. For this reason, we examined L2ers of German with Greek as their L1 on their ability to use grammatical gender predictively in their L2, German. The present study consists of a speeded picture-selection task, followed by two gender assignment tasks, and a proficiency test. The stimulus material of the main experiment, the speeded picture-selection task, is manipulated for informativeness (trials with gender cues, trials without gender cues); and lexical gender similarity between the two languages (trials with overlapping lexical gender in Greek and German, and trials with reversed lexical gender between the two languages). Trials providing a number cue were also added in order to access participants' lexical speed and examine its effect on their predictive ability.

The research questions that the present study addresses are the following:

"RQ1: Are L2ers of German with L1 Greek able to use gender predictively in their L2 when there is a total similarity with regards to lexical gender between the two languages?

RQ2: Are L2ers of German with L1 Greek able to use gender predictively in their L2 when lexical gender in the trials is completely reversed?

RQ3. How do Proficiency in German, overall knowledge of lexical gender, and speed of lexical access impact L2 learners' ability to use grammatical gender predictively?"

4.1 Predictions

4.1.1 RAGE hypothesis

According to the RAGE hypothesis (Grüter et al., 2017), L2ers face difficulty generating expectations based on gender cues and hence lack the ability to use grammatical gender

predictively. According to Grüter et al. (2012), this is due to L2 learners' establishing weaker links between abstract gender nodes and nouns, due to differences between L1 and L2 acquisition. A finding suggesting that L2ers are not able to use grammatical gender predictively, even when they know the lexical gender of the target nouns, would support the RAGE hypothesis.

4.1.2 Knowledge of Lexical Gender and Proficiency

According to Hopp (2013) and Kaan (2014), L2ers have the ability to use grammatical gender predictively and indeed with qualitatively similar mechanisms. However, this ability is strongly affected by L2ers' overall knowledge of grammatical gender and overall language proficiency (although the two tend to correlate). Findings indicating that L2ers can indeed use grammatical gender predictively and that their ability is significantly correlated with their overall knowledge of grammatical gender and their proficiency would be in line with Kaan's (2014) proposal.

5. Method

5.1 Speeded picture-selection task

5.1.1 Participants

All participants were recruited through personal contacts, word of mouth, and Facebook posts in groups of German expats, students of German language and literature in Greek Universities, and German language learners. They did not receive any form of compensation for their participation.

Nineteen advanced late learners of German with Greek as their L1 gave their consent to participate in the study. Two participants were excluded from analyses due to an early age of acquisition of German (2 and 3 years old, respectively). Thus, the final sample includes seventeen L2 participants (13 females and 4 males). None of the participants was raised in a bilingual household. Participants' mean age at the time of testing was ~33 years old (range 26 – 49). The mean age of participants' first exposure to German is ~15

years old (range 7-45). All but one participant acquired German through explicit instruction in Greece. One participant acquired German by attending a German primary school at the age of 7 years old. The mean age at which participants reported having acquired German to the point they could form complex sentences was ~20 years old (range: 7-48). According to the background questionnaire, participants rated their proficiency on average 7,64 on a scale of 1-10 (range: 6-9). Thirteen participants reported having lived in a German-speaking country for 6,86 years on average (range: 0,5 – 25 years).

Moreover, 8 native German speakers were recruited as a control group (7 females). Participants' mean age at the time of testing was 38 years old (range 25 – 56). The native German speakers had not been exposed to another language with grammatical gender up to the age of 9-14 years old, in which some of them started acquiring Italian or French as a second language. German native speakers have been retrieved mainly from posts on Facebook groups with German expatriates living in Sweden and other countries, as well as from personal contacts. As a result, they all speak more languages and have a rather multilingual background.

According to the background questionnaire, the contexts in which bilingual participants use daily German are the following. Most participants use German while reading and/or interacting with friends.

5.1.2 Materials

A speeded picture-selection task was chosen to tap into the participants' online use of grammatical gender. In order to select the pictures for the main task, a picture naming study was carried out. The purpose of the naming task was to ensure that German native speakers would name the pictures in the intended way.

6 native speakers of German gave their written consent to participate in the naming task. The task was conducted online, through an end-to-end encrypted Zoom meeting. The participants were presented with pictures on a PowerPoint presentation, and they were

asked to name them together with the definite article. Before the actual task, they were provided with two examples and had the chance to practice.

The pictures were derived from a free online clipart website and were all black and white and scaled at 550x550 pixels in size. Since the study specifically manipulates L1-L2 similarity at the level of lexical gender, the selection of the pictures was determined by whether or not the nouns had the same lexical gender in the two languages. In total 81 words were tested in norming; of which 44 have the same gender in the two languages and 37 have different gender between the two languages. The created gender pairings are 9 and as follows:

Table 1: Table of the pairings made at the same- and different-gender trials.

Same–gender pairings		Different–gender pairings	
German gender	**Greek gender**	**German gender**	**Greek gender**
Masculine	Masculine	Masculine	Feminine
Feminine	Feminine	Masculine	Neuter
Neuter	Neuter	Feminine	Masculine
		Feminine	Neuter
		Neuter	Masculine
		Neuter	Feminine

9 of the 81 total nouns were extra alternatives, which were used in case any of the nouns were proved to be problematic. All pictures had more than 83,33% naming consistency, as per the naming task, which means that at least 5 out of the total of 6 participants assigned the intended word. Two nouns had a lower score and were both completely excluded from the experiment and replaced by alternatives.

Moreover, since grammatical gender is of great importance for the present study we checked for dialectical variation, by means of an online corpus that consists of many lexicons of all German varieties, (woerterbuchnetz.de last retrieved, March 2023). This showed that, for example, the word for ”radio” *(Das Radio)* had different gender in one or more German varieties and were hence moved to the filler condition. Words with different genders across varieties of German were used as fillers.

5.1.3 Experimental conditions

The experiment includes 8 conditions: four experimental, and four control conditions. The experimental conditions, i.e., the gender trials, were created according to the two main factors, informativeness, and lexical gender similarity between L1-L2.

The sentences were formed in the following way:
Gender-trial sentence example:

(1) Wo ist **die** rote Tür?
Where is.PRS **the.FEM** red.INV door?

Where is the red door?

In the first two experimental conditions (C1, C2) the lexical gender of the nouns is the same for German and Greek, meaning that these experimental conditions are +gender similarity. The gender-marked article bears the gender cue. In Condition 1, the target and the competitor are of the same gender, which makes the trials same-gender and thus uninformative, meaning that the participants cannot use the gender-marked article in a facilitative manner to make their picture selection. In Condition 2 the target and the competitor have different lexical gender, which makes the trials different-gender, and thus informative, meaning that the participants can rely on the gender cue to facilitate their picture selection. The adjective between the article and the noun is unmarked for gender, creating the necessary distance between the informative cue and the target noun.

In the latter two experimental conditions (C3, C4) the lexical gender of the nouns interferes between German and Greek, meaning that in these experimental conditions are -gender similarity. Condition 3 is a same-gender trial, where gender is uninformative with respect to the upcoming noun, whereas Condition 4 is a different-gender trial, so the participants hear a gender cue to the upcoming noun. This means, that Condition 3 does not provide a gender cue on which the participant can rely to facilitate their picture selection, whereas Condition 4 does provide a gender cue on the gender-marked article. Importantly, lexical gender in Conditions 3 and 4 is completely reversed. For instance, in

the following trial *"Herz – Axt"* (heart – axe) the first noun, which is also the target *(Herz)* is Feminine in German and Neuter in Greek, while the second noun *(Axt)* is Neuter in German and Feminine in Greek. Thus, if bilingual participants experience L1 interference, they might make a prediction according to their L1's properties, which would lead to a wrong answer. In that case, their RTs should be significantly slower than in Conditions 1 and 2.

Examples of the sentences across the experimental conditions are provided below, together with the pictures used:

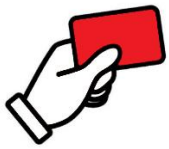
(2) Example from Condition 1 (+L1-L2 gender similarity and uninformative)

Question:

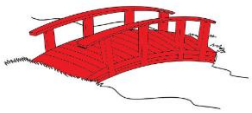
Wo	*ist*	***die***	*rote*	*Karte?*
Where	is.PRS	**the.FEM**	red.INV	card?

"Where is the red card?"

Pictures:



Picture 1: Target noun: *die Karte* (the.FEM card)



Picture 2: Competitor noun: *die Brücke* (the.FEM bridge)

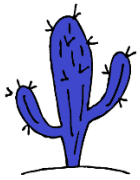
(3) Example from Condition 2 (+L1-L2 gender similarity and informative)

Question:

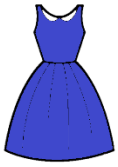
Wo	*ist*	***der***	*blaue*	*Kaktus?*
Where	is.PRS	**the.MASC**	blue.INV	Cactus?

"Where is the blue cactus?"

Pictures:



Picture 1: Target noun: *der Kaktus* (the.MASC cactus)



Picture 2: Competitor noun: *das Kleid* (the.NEUT dress)

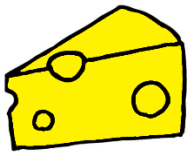
(4) Example from Condition 3 (-L1-L2 gender similarity and uninformative)

Question:

Wo	*ist*	***der***	*gelbe*	*Käse?*
Where	is.PRS	**the.MASC**	yellow.INV	cheese?

"Where is the yellow cheese?"

Pictures:



Picture 1: Target noun: *der Käse* (the.MASC cheese). Neuter in Greek

Picture 2: Competitor noun: *der Bus* (the.MASC bus). Neuter in Greek

(5) Example from Condition 4 (-L1-L2 gender similarity and informative)

Question:

Wo	*ist*	*die*	*grüne*	*Gabel?*
Where	is.PRS	the.FEM	green.INV	fork?

"Where is the green fork?"

Pictures:

Picture 1: Target noun: *die Gabel* (the.FEM fork). Neuter in Greek

Picture 2: Competitor noun: *das Herz* (the.NEUT heart). Feminine in Greek

We included two control conditions: one manipulating number, in line with Hopp (2013), which we take as a measure of the participant's speed of lexical access; and the second one manipulating color, in line with Covey et al. (2018). Both control conditions are expected to provide information about the RTs of the participants when they are provided with salient lexical cues in contrast to the experimental conditions where the informative cues are morphosyntactic (grammatical gender). It is clear from previous studies that one's processing speed does affect such study designs (McDonald, 2006; Hopp, 2013; Kaan, 2014); it is thus beyond necessary for those control conditions to be added.

The same pattern of informative–uninformative conditions was followed also at the control conditions. The difference is that the cue to the noun was not gender, but number and color respectively. Condition 5 was an uninformative condition, i.e. the number of the depicted objects was the same in both pictures, and Condition 6 the number of depicted objects differed between the two pictures, and hence in this case the participants were able to use the number cue to predict the noun. The number of objects presented to the participants varied from two to four in each picture. One can find in the appendix all the lists with the materials used and the way they were organized. The materials used for the number conditions involved nouns with the same grammatical gender between the two languages, with the only difference being that in these conditions we also included

nouns with natural gender, i.e., animals, which we specifically excluded from the experimental conditions. The nouns used for the number conditions were treated the same way as the nouns used at the above-mentioned gender conditions, meaning their dialectical variation and frequency were thoroughly checked and taken into consideration. The sentences were formed in the following way:

Number-trial sentence example:

(6) Wo sehen Sie **drei** gelbe Hunde?
Where see.PL you **three** yellow dogs?

Where do you see three yellow dogs?

The second control condition, in line with Covey et al. (2018), was mainly used to distract the participants from the goal of the study. Hence, these two conditions used color as a cue, which the participants could use to select the picture. These conditions included both singular and plural objects, but the only informative cue was color. Responses for these latter Conditions (C7 and C8) were not taken into consideration. In the control conditions (C7 and C8) we used singular and plural sentences so that there are sentences mimicking both the gender trials and the number trials.

Color-trials sentence examples:

Singular sentence example:

(7) Wo ist das **rote** Flugzeug?
Where is.PRS the.NEUT **red** airplane?

Where is the red airplane?

Plural sentence example:

(8) Wo sehen Sie drei **grüne** Sterne?
Where see.PL you three **green** stars?

Where do you see three green stars?

Examples of the sentences across the control conditions are provided below, together with the pictures used:

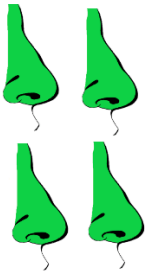
(9) Example from Condition 5 (Uninformative number condition)
Question:

Wo	*sehen*	*Sie*	***vier***	*grüne*	*Kassetten?*
Where	see.PL	you.PL	**four**	green	cassettes?

"Where do you see four green cassettes?"

Pictures:

Picture 1: Target picture: *vier Kssetten* (four cassettes)



Picture 2: Competitor picture: *vier Nasen* (four noses)

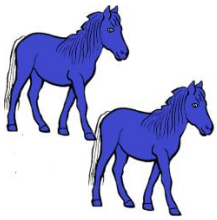
(10) Example from Condition 6 (Informative, number condition)

Question:

Wo	*sehen*	*Sie*	***zwei***	*blaue*	*Pferde?*
Where	see.PL	you.PL	**two**	blue	horses?

"Where do you see two blue horses?"

Pictures:



Picture 1: Target picture: *zwei Pferde* (two horses)

Picture 2: Competitor picture: *vier Waagen* (four scales)

(11) Example from Condition 7 (same-noun trials, color condition)

Question:

Wo	*sehen*	*Sie*	*drei*	***gelbe***	*Häuser?*
Where	see.PL	you.PL	three	**yellow**	houses?

"Where do you see three yellow houses?"

Pictures:

Picture 1: Target picture: *drei gelbe Häuser* (three yellow houses)

Picture 2: Competitor picture: *drei grüne Häuser* (three green houses)

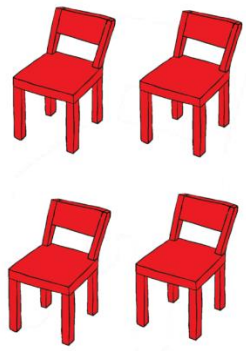
(12) Example from Condition 8 (different-noun trials, color condition)

Question:

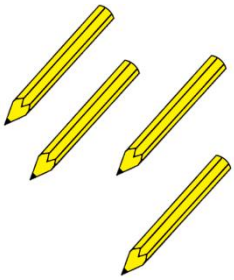
Wo	*sehen*	*Sie*	*vier*	***rote***	*Stühle?*
Where	see.PL	you.PL	four	**red**	chairs?

"Where do you see four red chairs?"

Pictures:



Picture 1: Target picture: *vier rote Stühle* (four red chairs)



Picture 2: Competitor picture: *vier gelbe Bleistifte* (four yellow pencils)

5.1.4 Lexical Properties

The nouns were matched with regard to frequency. For frequency control the SUBTLEX-DE, according to Brysbaert et al. (2011) is among the most reliable tools for measuring word frequency in German. An important advantage that this tool opposes is that it measures differently the frequency of the words in their singular and plural form, which is of great importance for the current study. We then compared the frequency per condition using t-tests. The table below summarizes the t-tests conducted and their results.

The phrase "target word" refers to the words, which correspond to the pictures that the participants were asked to choose each time; and the phrase "competitor word" refers to the words that were represented by the other picture on the screen, which was not supposed to be selected by the participants. As evident in the tables below, the word frequency is matched in all instances.

Table 2: T-test results of experimental conditions 1 and 2.

Condition 1	Condition 2	C1 VS. C2	C1 VS. C2

Target word VS Competitor word	Target word VS Competitor word	Target VS Target	Competitor VS Competitor
0,63	0,77	1	1

Table 3: T-test results of experimental conditions 3 and 4.

Condition 3	Condition 4	C3 VS. C4	C3 VS. C4
Target word VS Competitor word	Target word VS Competitor word	Target VS Target	Competitor VS Competitor
1	1	1	1

Table 4: T-test results of experimental conditions, that manipulate number, 5 and 6.[1]

Condition 5	Condition 6	C5 VS. C6	C5 VS. C6
Target word VS Competitor word	Target word VS Competitor word	Target VS Target	Competitor VS Competitor
0,9	0,92	1	1

The participants were presented with an audio stimulus asking them to choose between one of the two pictures presented on the screen. Sentence examples from the gender and number conditions respectively, are presented below:

Gender-trial sentence example:

(13) Wo ist **das** rote Bett?
Where is.PRS **the.NEUT** red.INV bed?

Where is the red bed?

Number-trials sentence example:

(14) Wo sehen Sie **zwei** grüne Kleider?
Where see.PRS you.PL **two** green dresses?

Where do you see two green dresses?

The sentences were recorded at the Multilingualism Laboratory at Stockholm University and were read by a male native speaker of German. For the recording, the software

[1] The last row of the tables 2-4 refers to the T-test results of the words' frequency.

Audacity was used. Then, the editing of the audio files was done using *Praat* (Boersma & Weenink, 2021). The intensity of all audio files was scaled at 75 dB. Moreover, since the grammatical gender is the central topic of the present study, we also measured the exact timestamp of the onset and offset of the determiner, as well as the onset of the noun, in each sentence, using *Praat*. This information is crucial for the interpretation of the results.

5.1.4 Procedure

The experiment took place online. The specific language combination examined would have made it difficult to run the experiment at the lab of Stockholm University. The participants were tested individually. They were sent the link for the experiment together with instructions, and an individual participant number, which they needed for completing the background questionnaire after the end of the experiment. The experiment was administered through *Psychopy* (Peirce et al., 2019).

Participants first read an information sheet that explained in detail the procedure and the way their data would be processed. A copy of this information sheet had been forwarded to their email. To the bilingual participants, the information sheet was sent both in German and Greek. The participants were not able to continue with the experiment unless they gave their informed consent.

The task was a time-constrained picture-selection task. Participants listened to a question in German that asked them to select one of two pictures. First, a fixation cross appeared on the screen for 100ms. Then the two pictures appeared on screen for 300ms. After that an auditory question like "*Wo ist der/die/das gelbe* [NOUN]?" (Where is the yellow [NOUN]?) started. Four color adjectives were used: red, yellow, green, and blue. After the onset of the audio question, the participants were able to use the arrow keys to choose between the right or the left picture on the screen. For the number condition the question followed the structure "*Wo sehen Sie zwei/drei/vier gelbe* [NOUN]? (Where do you see two/three/four yellow [NOUN]?), but the same color adjectives as in the two other experimental conditions were used.

The color adjective in the question was gender-unmarked and they provided distance (i.e., time) between the determiner and the target noun so that learners would be better able to show their predictive abilities, and how those were impacted by L1-L2 similarity. The use of gender-unmarked adjectives is in line with Covey et al. (2018) and (Hopp & Lemmerth, 2018). The participants were explicitly told that they did not have to wait until the end of the question to provide their answer. Any correct answer that would be given after the offset of the gender cue and *before* the onset of the noun would provide unambiguous evidence that the participant successfully used the gender information predictively.

Before the actual experiment began, participants had the chance to practice with two practice trials; the first one provided them with feedback, and the second one did not, just like in the actual experiment. The participant's RTs were recorded from the onset of the question until the participant provided an answer.

After the experiment, the participants were asked to match the nouns with the corresponding article. Those were the Gender Assignment Tasks, explained in detail below. This way, information about the participants' knowledge of German lexical gender was provided. Trials where the participants did not know the correct gender were excluded from the data analysis, in line with Hopp (2013) and Covey et al. (2018).

Besides the main experiment presented above, the participants completed a proficiency test, LexTALE, more information of which is given below.

Last but least, after the experiment, the participants were automatically forwarded to a Google form in order to complete a background questionnaire. They had given their informed consent for the completion of this questionnaire at the beginning of the experiment when they gave their consent for the whole experiment. They were instructed not to use their name when completing the background questionnaire, but a participant number, which they were provided with.

5.2 Gender Assignment Tasks (GATs)

Participants were tested on the lexical gender of the target and competitor nouns. After the main experiment, i.e., the picture-selection task, two Gender Assignment Tasks (hence GAT) took place. The L2 learners completed two GATs, one in German and one in Greek, whereas the monolingual participants completed only the first one, in German.

In the German GAT, participants were presented with a noun and the three German definite articles (der, die, das); they then had to use their mouse to choose the correct article for the presented noun. Before the actual task, the participants had the chance to practice in a short practice trial. This task was not timed, and the participants were explicitly instructed to take as much time as they needed to make their choice.

The second GAT, which was completed only by the L2 learners in Greek was a task that combined both the GAT and a picture-naming (norming) task. More specifically the participants, in this task, were presented with the pictures that were used in the picture-selection task, in black and white, and were asked to name the pictures in Greek including the definite article in the answer. They were asked to type their answer. They were presented with an example and then had the chance to practice in a short practice trial. This task was not timed, and the participants were explicitly instructed to take their time in order to give their answers.

5.3 Proficiency Test

Lastly, all participants undertook a proficiency test. For this purpose, the German version of the LexTALE test was used. The LexTALE is a standardized proficiency test, for its English version, (Lemhöfer & Broersma, 2012). The German version, although not yet standardized has been created based on the English version. The LexTALE is a lexical decision task. It has been chosen due to its two important advantages. First, it is a short test, it takes approximately 10 minutes to complete. Moreover, it targets lexical knowledge, which is relevant to the grammatical gender, that the present study examines.

5.3.1 Procedure

The LexTALE was the last part of the experiment. For this task, the participants were presented with a word on screen, and they had to decide whether it is a word of German

language or not. In order to make their decision they needed to use their mouse to press either the "*ja*" (yes) or "*nein*" (no) on the screen. The participants took the test only once and it was not timed. They were explicitly instructed to take as much time as they need to make their decision. The material used was downloaded by LexTALE's official website (www.lextale.com, last retrieved, March 2023). The first three words were foil and were not used in the analysis, nor were taken into consideration for the calculation of the score. As for the instructions, the original instructions of the German version of LexTALE were used, which are in German. The order in which the words were presented was fixed, sequential, and the same for all participants.

6. Results

6.1 Proficiency Test

The score on LexTale was calculated as follows (Lemhöfer & Broesma 2012):

$$\frac{((\text{number of correctly identified words}/40*100) + (\text{number of correctly identified non-words}/20*100))}{2}$$

The proficiency scores of the native speakers group ranged from 72, 5 % to 100%, averaging 82,34%. The proficiency scores of the L2ers ranged from 45% to 75%, averaging 63,61.

According to the original English LexTALE, scores from 60% or above indicate upper intermediate users of a language, whereas scores from 80% or above indicate advanced users of a language. According to this, most of the L2ers who partook in the study are upper-intermediate users of German.

6.2 Gender Assignment Task (GAT)

The mean score in the German GAT was 98,21% for native speakers (range: 90,48% - 100%), and 81,10% (range: 50% - 100%) for L2 learners.

The second GAT was held in Greek and at this task, participants were asked to name the presented objects including the definite article. The purpose of this task was mainly to norm the stimuli for their naming and assigned determiner. Nouns showing great variation either for the nouns that participants assigned to, or the determiners would have been evidence that these stimuli need to be excluded from the analysis. The noun and the determiner that participants assigned to all the nouns were on target, as a result, no stimuli and hence trials needed to be excluded from the analysis.

6.3 Speeded picture-selection task

6.3.1 Accuracy

All participants scored above 90,75% on the picture-selection task; native speakers scored above 94,45%; and L2ers above 90,75%.

Trials, where the participants did not choose the correct picture, were excluded from the analysis, resulting in 2,66% of data loss for the native speakers' group; and 3,32% of data loss for the L2ers' group.

Data points that included answers which were provided before the onset of the determiner were excluded from the analysis as they are considered too early. Also, the trials with RTs 2.5 standard deviations above/below the mean for each condition were removed individually for each participant. Exclusion of too-early and too-late answers lead to less than 2% data loss. After the picture-selection task, the participants took a GAT. The trials for which they assigned the wrong gender either to the target or the competitor noun were removed from the analysis, resulting in data loss of 491 trials in total (26,73% of all trials) for the L2ers group and to less than 3% of all trials for the native speaker group. The final number of the trials analyzed is 1343 trials for the L2ers group and 806 for the native speakers' group.

6.3.2 Predictive ability

One of the research questions of the present study has to do with the ability one has to use lexical gender predictively in one's second language. Unambiguous evidence that one is able to do, would be provided by correct answers given after the offset of the determiner and before the onset of the noun. In line with Covey et al. 2018, between the determiner and the noun, there was a gender-unmarked adjective, which provided participants with some distance, i.e., time, to make their decision based on the informative cue of the determiner. In order to examine the participants' predictive ability, we subtracted the time of the noun onset from the participants' raw RT. Negative results to this subtraction indicate that the participant made a correct selection before the onset of the noun, so they provide unambiguous evidence that the participants were able to use lexical gender predictively, whereas positive RTs indicate that the participant made their selection after they heard the noun. Although positive RTs do not provide unambiguous evidence of predictive use of the gender cue, faster RTs at the informative conditions are associated with facilitation from the informative cue, that is the gender-marked article at the gender conditions. The percentage of the trials that yield a negative number and thus indicate unambiguous evidence of prediction is reported here, solely for the informative conditions, because these provided the participants with the informative cues on which they could rely and provide their answer before the onset of the noun. Across all the participants the negative numbers at the informative gender conditions were 84 out of a total of 684 trials, meaning 12.28%. When measuring the negative numbers in the native speakers' group, we got 63 negative numbers out of a total of 270, meaning 23.33%; and when measuring the negative number in the L2 learners' group, we got 21 out of 414, meaning 5.07%.

6.3.3 Gender Conditions: Conditions 1-4

The main factors analyzed with respect to the dependent variable (i.e., RT) are Group (L1 German, L1 Greek), Informativeness (Informative, Uninformative), and Gender Similarity (Similar, Dissimilar). In line with Hopp (2013), the effect of informativeness was measured not only in gender trials, where the grammatical gender was the informative cue but also in number trials, where a numeral was the informative cue i.e., a lexical cue.

The data were analyzed using mixed effects models (Baayen et al., 2008) by means of the lmer4 package in R Studio, version 2022.02.0 (*R Core Team*, 2020). First, Group (native speakers vs. L2ers) and Condition (uninformative vs. informative) were entered as fixed effects and a two-way interaction was allowed between them. This first model collapses across Gender Similarity. We chose a simpler model for the initial analysis, focusing on the impact of Informativeness and its interaction with Group. The preliminary analysis does not take into consideration the similarity in the lexical gender between Greek and German. In order to prevail main effects, the levels of Group (native speakers vs. L2ers) and Condition (uninformative vs. informative) were contrast coded with values of -0.5 or 0.5. More specifically the contrast values for Group were coded as follows: native-speakers -0.5 and L2ers 0.5; and for Condition, the contrast coding was: uninformative -0.5 and informative 0.5. Item and Subject were entered as random effects; by-subject random slopes for Condition were also included. The R code reads as follows: lmer(log_RT ~ Group * Condition + (1 | Item) + (Condition | Subject). The dataset to which the above code was applied consisted of all the gender-condition trials, collapsing across lexical gender similarity between German and Greek.

The model revealed a significant main effect of Group; the Group1 estimate (as presented in Table 5 below) indicates that the native speakers' RTs were faster than the ones of the L2ers. The model also revealed a significant effect of Condition with informative conditions leading to faster RTs; however, this effect was limited to the native speakers' group. The interaction between Group and Condition showed that the main effect of Condition only emerged in the L1 group, and this interaction is statistically significant.

Table 5: Mixed-models analysis, when Group and Condition are treated as fixed effects with respect to the gender trials.

	Estimate	Std. Error	t value	p value
(Intercept)	0.91094	0.01876	48.550	2e-16
Group1	0.14723	0.03573	4.120	0.00037
Condition1	-0.06154	0.01969	-3.126	0.00297
Group1:Condition1	0.10247	0.03203	3.199	0.00374

Figure 1 below shows the effect of Informativeness in the native speakers' RTs with faster RTs for the informative conditions. However, the L2ers did not show sensitivity to the effect of informativeness.

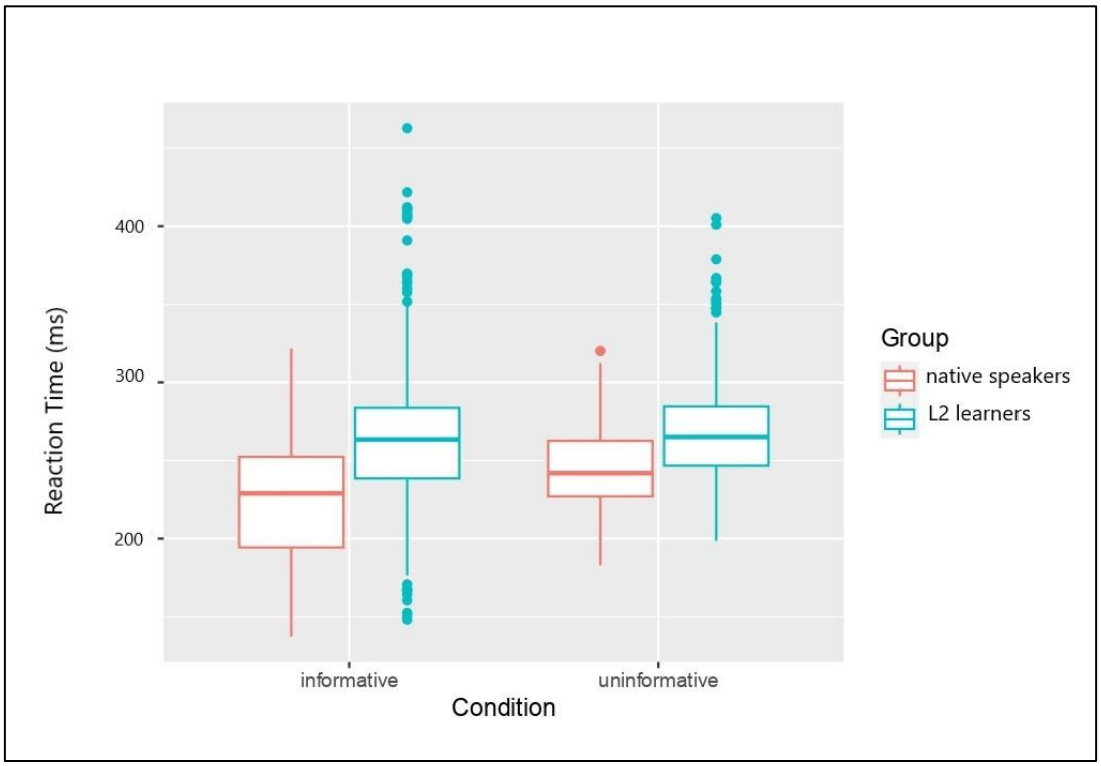


Figure 1: Box-plot over the distributions of RT with respect to condition and group for the gender conditions.

6.3.4 Gender Similarity as a Factor

The effect of the third fixed factor, Gender Similarity, on the dependent variable, i.e., RT was then examined. Here, Group (native speakers vs. L2ers) Condition (uninformative vs informative) and Gender Similarity (similar vs dissimilar) were entered as fixed factors, and interaction between them was allowed. They were contrast coded with values -0.5 or 0.5. More specifically the contrast values for Group were coded as follows: native-speakers -0.5 and L2ers 0.5; for Condition, the contrast coding was: uninformative -0.5 and informative 0.5; and for Gender similarity the contrast codes were -0.5 similar and 0.5 dissimilar. Item and subject were entered as random effects; by-subject random slopes for Condition were also included. Hence, the R code reads as follows: lmer log(RT_clean)

~ Group * Condition * Gender_similarity + (1 | Item) + (Condition | Subject). The dataset used consisted solely of data from the gender trials. Gender similarity was not examined in number trials since all the nouns included there share the same grammatical gender between the two German and Greek.

Table 6: Mixed-models analysis, when Group Condition and Gender Similarity are treated as fixed effects for the gender trials.

	Estimate	Std. Error	t value	p value
(Intercept)	0.91101	0.01876	48.557	2e-16
Group1	0.14778	0.03583	4.125	0.000366
Condition1	-0.06121	0.01950	-3.139	0.002900
Gender_similarity1	0.01460	0.01288	1.134	0.260730
Group1:Condition1	0.10218	0.03202	3.192	0.003808
Group1:Gender_similarity1	0.01868	0.01292	1.466	0.148399
Condition1:Gender_similarity1	0.02789	0.02574	1.083	0.282236
Group1:Condition1:Gender_similarity1	-0.01512	0.02579	-0.586	0.557737

In line with the results of the previous model, the main effect of Group is significant leading to faster RTs for the native speakers' group. The model also revealed a significant effect of Condition with informative conditions leading to faster RTs; however, this effect was limited to the native speakers' group. Gender similarity did not affect the RTs significantly. The interaction between Group and Condition showed that the main effect of Condition only emerged in the L1 group, and this interaction is statistically significant. The interaction between Group and Gender similarity indicates that the L2 learners were affected by Gender-similarity to a greater extent than the native speakers, however, this was only marginally significant. The two-way interaction between Condition and Gender Similarity, as well as the three-way interaction between Group, Condition, and Gender similarity, were not significant.

Gender similarity affects L2ers to a greater extent compared to native speakers, and for this reason, we did a follow-up analysis including data solely from L2erns. For this model, the factors of overall proficiency in German and knowledge of lexical gender in German were also examined. Here, condition (uninformative vs informative), gender similarity

(similar vs dissimilar), and knowledge of lexical gender in German (GAT) were entered as fixed factors, and interaction between them was allowed. They were contrast coded with values -0.5 or 0.5. More specifically the contrast values for Condition were coded as follows: uninformative -0.5 and informative 0.5; and for Gender similarity the contrast codes were -0.5 similar and 0.5 dissimilar. Furthermore, as fixed effect was entered the overall proficiency score (LexTALE). Since LexTALE and GAT are continuous factors, they were centralized, using the z-scores in R. Item and subject were entered as random effects. Hence, the R code reads as follows: lmer log(RT_clean) ~ Condition * Gender_similarity *GAT_z_score + Lextale_z (1 | Item) + (1 | Subject). The dataset used consisted solely of the L2ers' data from the gender trials.

Table 7: Mixed-models analysis, when Condition and Gender Similarity are treated as fixed effects for the L2ers' gender trials.

	Estimate	Std. Error	t value	p value
(Intercept)	0.973991	0.017768	54.817	2e-16
Condition1	-0.019585	0.016029	-1.222	0.2260
Gender_similarity1	0.022265	0.016090	1.384	0.1710
GAT_z_score	-0.033975	0.014947	-2.273	0.0382
Lextale_z	0.012776	0.015648	0.816	0.4274
Condition1:Gender_similarity1	0.014044	0.032053	0.438	0.6627
Condition1:GAT_z_score	-0.008492	0.008719	-0.974	0.3304
Gender_similarity1:GAT_z_score	0.001250	0.009094	0.137	0.8907
Condition1:Gender_similarity1:GAT_z_score	0.024941	0.017417	1.432	0.1526

When we examined the effect of Condition, Gender-similarity, Proficiency, and GAT score in the L2ers' group exclusively a non-significant effect of condition was found; meaning that informative trials lead to faster RTs but not significantly. Moreover, Gender-similarity showed an effect on L2ers' RTs, leading to slower RTs in the dissimilar-gender trials, however, this effect is not significant. Figure 2 below visualizes this effect. Overall proficiency in German (Lextale) did not significantly affect L2ers' RTs. On the other hand, great performance at the GAT did indeed reduce L2ers' RTs significantly. The interaction between Condition and Gender-similarity did not reach

significance. The three-way interaction between Condition, Gender similarity, and GAT did not reach significance either.

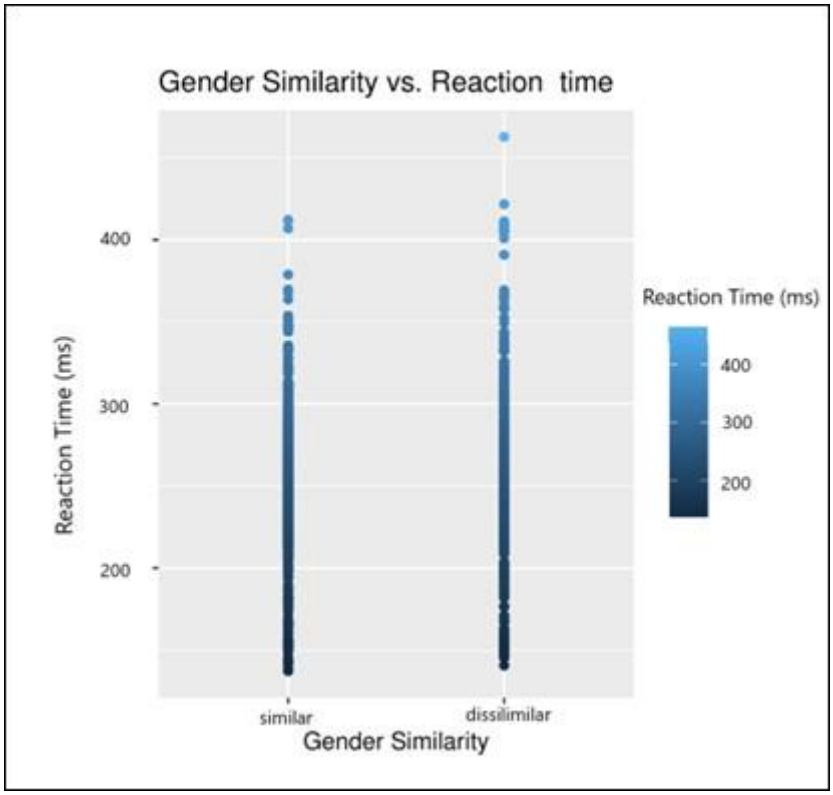


Figure 2: Plot showing the effect of gender similarity on Reaction Times.

In order to further examine the effect of overall proficiency in German on L2ers' ability to use German lexical gender predictively, we did a follow-up analysis using Condition and Overall Proficiency (Lextale) as factors and allowing the interaction between them. The factor of Condition (uniformative, informative) was contrast coded as follows: uninformative -0.5 and informative 0.5. Since Lextale is a continuous factor, it was centralized, using the z-scores in R. Item and subject were entered as random effects. The R code reads as follows: log(RT_clean) ~ Condition * Lextale_z + (1 | Item) + (1 | Subject). The dataset used consisted solely of the L2ers' data from the gender trials.

Table 8: Mixed-models analysis, when Condition and Gender Similarity are treated as fixed effects for the L2ers' gender-trials.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.982987	0.019019	51.685	<2e-16

Condition1	-0.019846	0.016021	-1.239	0.220
Lextale_z	0.001677	0.016661	0.101	0.921
Condition1:Lextale_z	-0.011022	0.008643	-1.275	0.203

In line with the previous analyses, neither the main effect of Condition nor the effect of Overall German Proficiency affected significantly the RTs. Importantly, given that the interaction between Condition and Overall Proficiency did not reach significance, we can safely conclude that Overall German Proficiency did not affect the predictive use of lexical gender.

6.3.5 Number Conditions: Conditions 5-6

In order to examine the use of lexical cues (i.e., number) in online lexical retrieval, we ran mixed-effects models with Group (native speakers vs. L2ers) and Condition (uninformative vs. informative) as fixed effects. A two-way interaction was allowed between them. In order to prevail main effects, the levels of Group (native speakers vs. L2ers) and condition (uninformative vs. informative) were contrast coded with values of -0.5 or 0.5. More specifically the contrast values for Group were coded as follows: native-speakers -0.5 and L2ers 0.5; and for Condition the contrast coding was: uninformative -0.5 and informative 0.5. Item and subject were entered as random effects. The R code reads as follows: lmer(log_RT ~ Group * Condition + (1 | Item) + (1 | Subject). The dataset to which the above code was applied consisted of all the number-condition trials.

Table 9: Mixed-models analysis, when Group Condition and Gender Similarity are treated as fixed effects for the number trials.

	Estimate	Std. Error	t value	p value
(Intercept)	1.12676	0.02104	53.556	2e-16
Group1	0.09189	0.03586	2.562	0.0169
Condition1	-0.27970	0.02430	-11.512	1.58e-13
Group1:Condition1	0.02717	0.02058	1.320	0.1872

The main effect of Group is statistically significant and suggests slower RTs for the L2ers across conditions. The main effect of Condition at the number-condition trials is significant across the two participant groups. This means that both groups, native speakers

and L2ers showed sensitivity to Informativeness leading to faster RTs in the informative condition, relative to the uninformative one. The interaction between Group and Condition did not reach significance.

As visualized in the boxplot below, L2ers exhibited slower response times compared to native speakers across all conditions. However, they demonstrated sensitivity to Informativeness as evidenced by faster RTs in the informative condition.

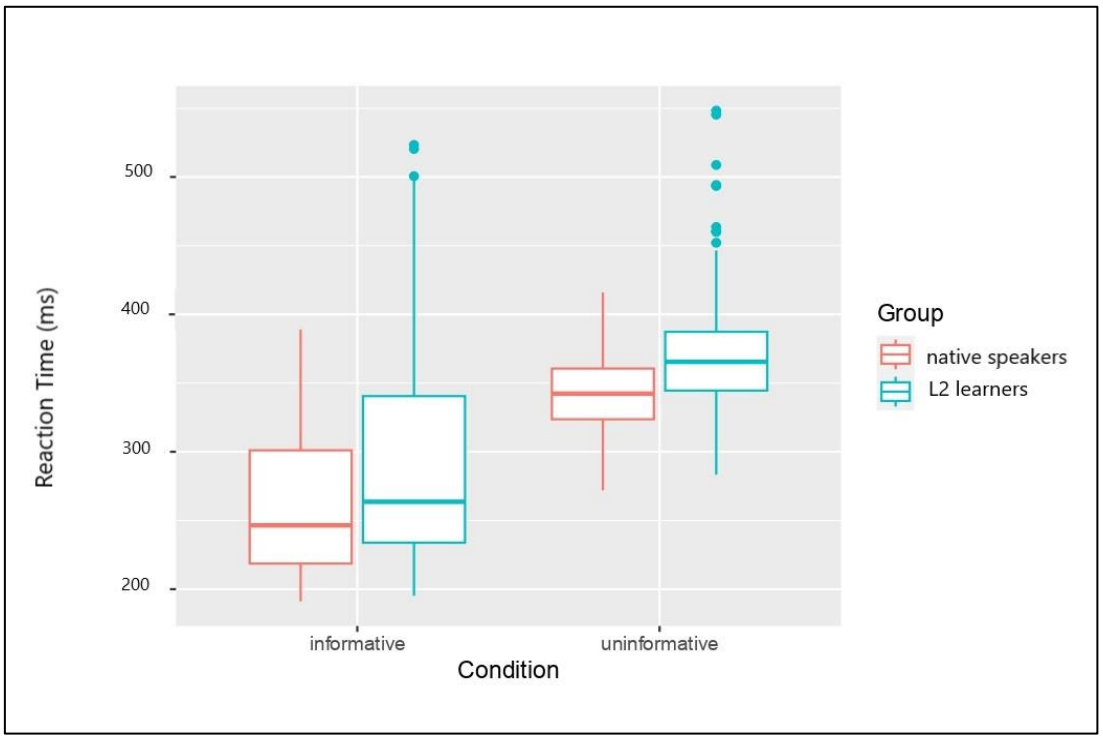


Figure 3: Box-plot over the distributions of RT with respect to condition and group for the number conditions.

Covey et al. (2018) measured the effect that participants' speed of lexical access had on the facilitation due to the gender cue. They did so by examining the correlation between the facilitation effect of gender and lexical access speed. In order to find the facilitation effect of gender, they subtracted the mean RT in the informative trials from the mean RT in the uninformative trials. Additionally, the mean RT in the informative condition with numerals was used as a measure of lexical access speed. Since our study included only eight native speakers, conducting a correlation test within their group to obtain reliable results was not feasible. Therefore, we focused on examining the effect of lexical access speed on the facilitation effect of gender specifically within the L2ers' group. Our results

(r(15)= 0.26, p= 0.31) suggest that there is no significant correlation between lexical access speed and the facilitation effect of gender, for this group.

7. Discussion

The objective of the present study is to examine the predictive use of gender by L2ers in their L2, as well as the influence of their L1's properties on this ability. Therefore, we examined L2ers of German with L1 Greek in their ability to use gender in their L2 predictively when lexical gender between L1 and L2 is similar and when it is dissimilar. To examine that, we manipulated Informativeness, meaning that we created trials that provided participants with a gender cue and trials which did not. We also manipulated Gender Similarity, which means that we used nouns, which have similar lexical gender between German and Greek, and nouns that have dissimilar lexical gender between German and Greek.

The gender-marked element of the sentence (i.e., the one bearing the gender cue) was the article, between which and the target noun, a gender-unmarked adjective interfered with providing the necessary distance, i.e., time. Answers given after the offset of the gender-marked determiner and *before* the onset of the target noun provide unambiguous evidence of the predictive use of gender. The percentage of the answers given before the onset of the target noun was quite low; 23,33% for the native speakers' group and 5,07% for the L2ers' group. This finding in is line with Covey et al. (2018). However, regardless of this percentage, faster RTs in the informative trials compared to those in the uninformative ones, provide evidence of facilitation from the gender cue, and this is where the current study and its analysis focus.

The first research question is associated with L2ers' predictive ability when the lexical gender between their languages coincides, *"RQ1: Are L2ers of German with L1 Greek able to use gender predictively in their L2 when there is a total similarity with regards to lexical gender between the two languages?"*. In other words, were L2ers able to obtain faster RTs at the informative trials when the lexical gender between their L1 Greek and their L2 German was similar? First, we investigated this by examining the influence of Informativeness on native speakers' and L2ers' RTs, using a model which collapses

across Gender Similarity. Based on our findings, it can be concluded that native speakers exhibited a robust sensitivity to Informativeness, as indicated by a significant decrease in the RTs at the informative trials. This finding is in line with previous studies examining prediction based on morphosyntactic cues for the L1, and also SLA studies (Covey et al., 2018; Guillelmon & Grosjean, 2001). Moreover, native speakers did have faster RTs than L2ers in all experimental conditions, which is supported by the fact that the main effect of Group is significant. This finding is in line with previous studies (for example White et al. 2004). L2ers did not show sensitivity to informativeness, since their RTs for the informative cues were not significantly faster than those for the uninformative ones. Those findings indicate that L2ers are not capable of using morphosyntactic cues like grammatical gender predictively, which is not in line with previous studies like Covey et al. (2018) or Hopp (2013).

The second research question investigates how differences in L1-L2 lexical gender affect one's ability to use gender predictively in one's L2, *"RQ2: Are L2ers of German with L1 Greek able to use gender predictively in their L2, when lexical gender in the trials is completely reversed?"* In order to examine this, we manipulated the presented pictures (between which the participants needed to make their selection) in that way so that have completely reversed lexical gender values. To address this question, we examined informativeness in relation to gender similarity. Our results suggest that Gender Similarity did not significantly affect RTs. However, the interaction between Group and Gender Similarity showed that L2ers were affected to a greater extent by Gender Similarity compared to native speakers, but this interaction was only marginally significant.

Gender Similarity is an important factor for L2ers but not for native speakers, therefore we did a follow-up analysis investigating the Gender Similarity effect solely on L2ers' dataset. This follow-up analysis showed no significant effect of Gender Similarity on L2ers' RTs, nor did it significantly interact with Informativeness. Depending on the way the factors were contrast coded (-0.5 for similar gender and 0.5 for dissimilar trials), the positive estimate of the Gender Similarity effect indicates slower RTs for trials in which the L1-L2 lexical gender is dissimilar, which means that the numeral results go in the right direction, as also visualized in Figure 2. However, there is no interaction with

Informativeness, meaning that the L2ers did not use gender predictively, across the board in gender-trials.

Moreover, according to Hopp (2013) and Kaan (2014), proficiency, and overall knowledge of lexical gender play a crucial role in the L2ers' predictive ability. Therefore, our third research question addresses these questions, together with the effect of the speed of lexical access on L2ers' predictive ability, *"RQ3: How do Proficiency in German, overall knowledge of lexical gender, and speed of lexical access impact L2 learners' ability to use grammatical gender predictively?"* According to Hopp (2013), a factor that affects L2ers' ability to use gender predictively is overall knowledge of lexical gender. This is the reason why, all the trials for which the participants did know the grammatical gender, both of the target noun and the competitor, have been removed from the analysis. Yet, when examining the main effect of the knowledge of grammatical gender, we found a significant main effect of the overall knowledge of lexical gender on RTs, indicating that greater performance on GATs leads to significantly faster RTs. However, the interaction of overall knowledge of lexical gender with Informativeness was not statistically significant, nor was the three-way interaction between Informativeness, Gender Similarity, and overall knowledge of lexical gender. This finding is in line with previous studies, for example, Hopp (2013) and Covey et al. (2018).

When we first examined the effect of German proficiency on RTs we did not find any significant effect. However, since it is proven from previous research (Hopp, 2013; Kaan, 2014) to be a crucial factor in one's ability to use gender predictively, we did a follow-up analysis on the effect of German proficiency on RTs, allowing the interaction between Proficiency and Informativeness. In line with our previous findings, German proficiency did not significantly affect the RTs. Importantly, the interaction between Informativeness and German Proficiency did not reach significance either, which leads us to the safe conclusion that German Proficiency did not affect the predictive use of lexical gender. This finding does not confirm Kaan's (2014) theory, according to which the L2ers' predictive ability is qualitatively similar to the native speakers' but strongly dependent on L2ers' proficiency. Hopp (2013) has also found a strong effect of proficiency on L2ers' predictive ability, which is not in line with the findings of the current study. This could be associated with the fact that the L2ers who participated in the present study were not advanced, but upper intermediate speakers. A replication of the present study with larger

sample size and more advanced L2ers could provide better insight into the main effect of proficiency.

In line with Hopp (2013) and Covey et al. (2018), we included in the present study's design trials which examined the effect of informativeness of lexical cues (i.e., nominal). The inclusion of such an experimental condition would give us an insight into whether the L2ers are able to make predictions in their L2 using salient lexical cues, and also provide us with information about participants' processing speed. For the number conditions we did observe a significant main effect of group, native speakers were faster than the L2ers, but we also found that both groups were sensitive to Informativeness, which lead to significantly faster RTs for the informative condition compared to the uninformative one for both groups. The finding associated with L2ers' ability to use lexical cues predictively is in line with a few previous studies (White et al. 2004; Covey et al. 2018).

Covey et al. (2018) used the information they got from the informative number condition on participants' speed of lexical access to measure the correlation between participants' speed of lexical access and the facilitation effect of gender. Since, in our study participated only 8 native speakers, a correlation test for their group would not lead to any reliable results, so we run this correlation test solely for the group of the L2ers. Our findings suggest no significant correlation between the speed of lexical access and the facilitation effect of gender. Potentially, a larger group with a higher proficiency level would show greater facilitation from the gender cue and would let us get an insight into the effect of lexical access speed on this.

Our findings showed that L2ers did not show effect of informativeness in gender-trials, but they did show a great effect in number-trials, which suggests that they can make predictions in their L2, but only when relying on lexical cues. Although we included in the analysis solely the trials for which all participants provided correct answers and knew the grammatical gender of both the target and the competitor noun, they were not able to use gender predictively. Worth mentioning here is the fact that there was a gender-unmarked adjective between the determiner and the target noun provided the participants with some time to process the gender cue and give their answer. This finding is in line with Grüter et al. (2012) and (2017) and supports the RAGE hypothesis according to

which L2ers do not rely on morphosyntactic cues to facilitate processing, especially in on-line production tasks.

On the other hand, our findings did not support Kaan's (2014) theory according to which at advanced proficiency levels, L2ers' predictive use of gender is qualitatively similar to this of native speakers. We did not find a strong effect of German proficiency on our L2ers' RTs nor an interaction with Informativeness, indicating that we did not find an effect of proficiency on the predictive use of gender. Worth mentioning is the fact that the L2ers who participated in our study were, according to the LexTALE threshold, upper intermediate users, rather than advanced. For this reason, further examination of a bigger and more proficient participant group is required in order to challenge Kaan's (2014) theory and draw more reliable conclusions on this matter.

Overall lexical knowledge of gender is another factor that significantly influences the L2ers' predictive use of gender, as mentioned by Hopp (2013). Our findings are in accordance with this, as we observed a significant decrease in RTs for the participants who performed well on the Gender Assignment Task. However, since the interaction between overall lexical knowledge of gender and Informativeness did not reach significance, we cannot conclude the extent to which it has affected L2ers' predictive ability. A follow-up study with a larger sample size and more proficient participants would be required so that this interaction is further investigated.

Previous studies (for example White et al., 2014; Covey et al. 2018) showed that L2ers mainly rely on a default gender and tend to overgeneralize it. Our analysis focused on the effect of main effects of Informativeness and Gender Similarity, without examining whether there was a preference or more accurate answers associated with a specific lexical gender. Importantly, our stimuli were balanced across the lexical genders, meaning that in a follow-up study examining the possible use of a default gender, the dataset of the current study could be used.

8. Conclusion

The results from this study suggest that native speakers have been faster while processing gender information compared to L2ers, which is in line with previous studies (for example White et al. 2004). Moreover, native speakers showed greater sensitivity to Informativeness than L2ers, by achieving significantly faster RTs at the trials providing gender cues, compared to trials that did not.

The main contribution of the present study to the general discussion about L2ers' ability to use gender predictively is associated with the influence of L1 properties on this ability. For this reason, L1-L2 lexical gender similarity was systematically manipulated. However, when examining the effect of Gender Similarity on L2ers' RTs we found no significant effect. The same finding was observed when examining the interaction between Gender Similarity and Informativeness which indicates that L2ers were not able to use gender predictively across the board in the gender trials. This finding confirms Grüter et al.'s (2017) RAGE hypothesis. More specifically, L2ers cannot rely on the information they get from the gender cues, which indicates that they fail to generate expectations and use gender predictively.

At the same time, L2ers were able to use the lexical cues (i.e., numerical) in a facilitative manner, since our findings indicate a significant effect from Informativeness for the number-trials. This finding provides yet another evidence that RAGE theory is confirmed by the present study's findings. Moreover, we found no significant correlation between L2ers' lexical access speed and the facilitation effect of gender, which is not in line with Covey et al. (2018).

Hopp (2013) found that participants' knowledge of grammatical gender genders plays a crucial role in their ability to use the grammatical gender predictively. The present study included a Gender Assignment Task to examine the effect of grammatical gender knowledge on L2ers' predictive ability. In line with Hopp's (2013) results, we found that indeed great performance at the GAT is associated with slower Reaction Times at the production task.

According to Kaan (2014) and Hopp (2013) proficiency plays a crucial role in L2ers' ability to use gender predictively. However, this is not supported by the findings of the present study. We did not find a significant effect of German proficiency on L2ers' RTs, nor a significant interaction between proficiency and Informativeness. Yet, given that the participants of the present are considered upper intermediate speakers rather than advanced, according to the LexTALE threshold, further investigation of the influence of proficiency on a more proficient and larger L2ers' group is required in order to draw safer conclusions on that matter.

The current study has not argued to examine whether L2ers tended to prefer a specific lexical gender over the others and use it as a default, as observed in other studies (for example Covey et al. 2018, and Dussias et al. 2013). However, the same dataset could be used for further investigation in that regard as well. One potential extension of the present study would be to use the existing dataset to examine the potential use of default lexical gender by the L2ers. Additionally, a larger group of more proficient learners would need to be tested. The sample of the current study is limited to 17 learners, whose level of proficiency was upper intermediate, leading to inconclusive findings in many regards. Another potential extension of this study would be linked to an examination of a larger group of participants that could be divided into more sub-groups depending on the proficiency lever, which would provide a better insight with regards to the effect of proficiency and -potentially- gender similarity as factors.

References

Alarcón, I. V. (2010). Gender Assignment and Agreement in L2 Spanish: The Effects of Morphological Marking, Animacy, and Gender. *Studies in Hispanic and Lusophone Linguistics*, *3*(2), 267-299. https://doi.org/10.1515/shll-2010-1076

Baayen, R., Davidson, D., & Bates, D. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*(4), 390–412.

Boersma, P., & Weenink, D. (2021). *Praat: Doing phonetics by computer*. www.praat.org

Brysbaert, M., Buchmeier, M., Conrad, M., & Jackobs, A. M. (2011). The Word Frequency Effect: A Review of Recent Developments and Implications for the Choice of Frequency Estimated in German. *Experimental Psychology*, *58*(5), 412–424.

Carroll, S. (1989). Second-Language Acquisition and the Computational Paradigm*. *Language Learning*, *39*(4), 535–594. https://doi.org/10.1111/j.1467-1770.1989.tb00902.x

Corbett, G. G. (1991). *Gender* (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9781139166119

Covey, L., Gabriele, A., & Fiorentino, R. (2018). Can learners use morphosyntactic cues to facilitate processing? Evidence from a study of gender agreement in Hindi. *Language Acquisition*, *25*(3), 327–337. https://doi.org/10.1080/10489223.2017.1359272

Dussias, P. E., Valdés Kroff, J. R., Guzzardo Tamargo, R. E., & Gerfen, C. (2013). When Gender And Looking Go Hand In Hand: Grammatical Gender Processing

In L2 Spanish. *Studies in Second Language Acquisition*, *35*(2), 353–387. https://doi.org/10.1017/S0272263112000915

Franceschina, F. (2005). *Fossilized Second Language Grammars: The acquisition of grammatical gender* (Vol. 38). John Benjamins Publishing Company. https://doi.org/10.1075/lald.38

Grüter, T., Lew-Williams, C., & Fernald, A. (2012). Grammatical gender in L2: A production or a real-time processing problem? *Second Language Research*, *28*(2), 191–215. https://doi.org/10.1177/0267658312437990

Grüter, T., Rohde, H., & Schafer, A. J. (2017). Coreference and discourse coherence in L2: The roles of grammatical aspect and referential form. *Linguistic Approaches to Bilingualism*, *7*(2), 199–229. https://doi.org/10.1075/lab.15011.gru

Guillelmon, D., & Grosjean, F. (2001). The gender marking effect in spoken word recognition: The case of bilinguals. *Memory & Cognition*, *29*(3), 503–511. https://doi.org/10.3758/BF03196401

Holton, D., Mackridge, P., & Philippaki-Warburton, I. (2004). *Greek: An essential grammar of the modern language*. Routledge. http://site.ebrary.com/id/10166608

Hopp, H. (2013). Grammatical gender in adult L2 acquisition: Relations between lexical and syntactic variability. *Second Language Research*, *29*, 33–56.

Hopp, H., & Lemmerth, N. (2018). Lexical And Syntactic Congruency In L2 Predictive Gender Processing.. *Studies in Second Language Acquisition*, *40*(1), 171–199. https://doi.org/10.1017/S0272263116000437

Johnson Fowler, C., & Jackson, C. N. (2017). Facilitating morphosyntactic and semantic prediction among second language speakers of German. *Journal of*

Cognitive Psychology, *29*(8), 883–901. https://doi.org/10.1080/20445911.2017.1353517

Kaan, E. (2014). Predictive sentence processing in L2 and L1: What is different?*. *Linguistic Approaches to Bilingualism*, *4*(2), 257–282. https://doi.org/10.1075/lab.4.2.05kaa

Kupisch, T., Akpinar, D., & Stöhr, A. (2013). Gender assignment and gender agreement in adult bilinguals and second language learners of French. *Linguistic Approaches to Bilingualism*, *3*(2), 150–179. https://doi.org/10.1075/lab.3.2.02kup

Lang, E., & Zifonun, G. (Eds.). (1996). Prinzipien für die Genuszuweisung im Deutschen. In *Deutsch—Typologisch* (pp. 473–491). De Gruyter. https://doi.org/10.1515/9783110622522-021

Lemhöfer, K., & Broersma, M. (2012). Introducinf LexTALE: A quick and valid Lexical Test for Advanced Learners of English. *Behavior Research Methods*, *44*(2), 325–343.

Lew-Williams, C., & Fernald, A. (2007). Young Children Learning Spanish Make Rapid Use of Grammatical Gender in Spoken Word Recognition. *Psychological Science*, *18*(3), 193–198. https://doi.org/10.1111/j.1467-9280.2007.01871.x

Lew-Williams, C., & Fernald, A. (2010). Real-time processing of gender-marked articles by native and non-native Spanish speakers. *Journal of Memory and Language*, *63*(4), 447–464. https://doi.org/10.1016/j.jml.2010.07.003

McDonald, J. L. (2006). Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language*, *55*(3), 381–401. https://doi.org/10.1016/j.jml.2006.06.006

Peirce, J. W., Gray, J. R., Simpson, S., MacAskill, M. R., Höchenberger, R., Sogo, H., Kastman, E., & Lindeløv, J. (2019). PsychoPy2: Experiments in behavior made easy. *Behavior Research Methods 51(1),* 195-203.

R Core Team. (2019). R: A language and environment for statistical computing. https://www.Rproject.
org/.

Ralli, A. (2002). The role of morphology in gender determination: Evidence from Modern Greek. *Linguistics*, *40*(3), 519-551. https://doi.org/10.1515/ling.2002.022

Tsimpli, I. M., & Hulk, A. (2013). Grammatical gender and the notion of default: Insights from language acquisition. *Lingua, 137*, 128–144. https://doi.org/10.1016/j.lingua.2013.09.001

Varlokosta, S. (2011). The role of morphology in grammatical gender assignment: A psycholinguistic study in Greek. In A. Galani, G. Hicks, & G. Tsoulas (Eds.), *Linguistik Aktuell/Linguistics Today* (Vol. 178, pp. 321–350). John Benjamins Publishing Company. https://doi.org/10.1075/la.178.17var

White, L., Valenzuela, E., Kozlowska–Macgregor, M., & Leung, Y.-K. I. (2004). Gender and number agreement in nonnative Spanish. *Applied Psycholinguistics*, *25*(01), 105-133. https://doi.org/10.1017/S0142716404001067

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Appendix A.

List of the sentences and the target, and competitor nouns. In red is highlighted the informational cue.

Condition	Item Number	Sentence	Target noun	Competitor noun
1	1	Wo ist das rote Bett?	das Bett	das Glas
1	2	Wo ist der gelbe Kreis?	der Kreis	der Turm
1	3	Wo ist die grüne Tür?	die Tür	die Karte
1	4	Wo ist das blaue Schiff?	das Schiff	das Hemd
1	5	Wo ist der rote Spiegel?	der Spiegel	der Kreis
1	6	Wo ist die gelbe Brücke?	die Brücke	die Kirche
1	7	Wo ist das grüne Glas?	das Glas	das Schiff
1	8	Wo ist der blaue Turm?	der Turm	der Kaktus
1	9	Wo ist die rote Karte?	die Karte	die Brücke
1	10	Wo ist das gelbe Hemd?	das Hemd	das Bett
1	11	Wo ist der grüne Magnet?	der Magnet	der Drucker
1	12	Wo ist die blaue Nase?	die Nase	die Tür
1	13	Wo ist das rote Fenster?	das Fenster	das Kleid
1	14	Wo ist der gelbe Kaktus?	der Kaktus	der Spiegel
1	15	Wo ist die grüne Krawatte?	die Krawatte	die Tasche
1	16	Wo ist das blaue Auto?	das Auto	das Buch
1	17	Wo ist der rote Eimer?	der Eimer	der Knoten
1	18	Wo ist die gelbe Kirche?	die Kirche	die Schraube
2	19	Wo ist das grüne Bett?	das Bett	der Turm
2	20	Wo ist der blaue Kreis?	der Kreis	das Glas
2	21	Wo ist die rote Tür?	die Tür	das Hemd
2	22	Wo ist das gelbe Schiff?	das Schiff	die Karte
2	23	Wo ist der grüne Spiegel?	der Spiegel	die Kirche
2	24	Wo ist die blaue Brücke?	die Brücke	der Kreis
2	25	Wo ist das rote Glas?	das Glas	der Kaktus
2	26	Wo ist der gelbe Turm?	der Turm	das Schiff
2	27	Wo ist die grüne Karte?	die Karte	das Bett
2	28	Wo ist das blaue Hemd?	das Hemd	die Brücke
2	29	Wo ist der rote Magnet?	der Magnet	die Tür
2	30	Wo ist die gelbe Nase?	die Nase	der Drucker
2	31	Wo ist das grüne Fenster	das Fenster	der Spiegel
2	32	Wo ist der blaue Kaktus?	der Kaktus	das Kleid
2	33	Wo ist die rote Krawatte?	die Krawatte	das Buch
2	34	Wo ist das gelbe Auto?	das Auto	die Tasche
2	35	Wo ist der grüne Eimer?	der Eimer	die Schraube
2	36	Wo ist die blaue Kirche?	die Kirche	der Knoten
3	37	Wo ist das rote Sofa?	das Sofa	das Gehirn
3	38	Wo ist der gelbe Käse?	der Käse	der Bus
3	39	Wo ist die grüne Axt?	die Axt	die Gabel
3	40	Wo ist das blaue Herz?	das Herz	das Zelt
3	41	Wo ist der rote Topf?	der Topf	der Schrank

3	42	Wo ist die gelbe Sonne?	die Sonne	die Rakete
3	43	Wo ist das grüne Gehirn?	das Gehirn	das Kreuz
3	44	Wo ist der blaue Teller?	der Teller	der Käse
3	45	Wo ist die rote Gabel?	die Gabel	die Flasche
3	46	Wo ist das gelbe Rad?	das Rad	das Herz
3	47	Wo ist der grüne Fernseher?	der Fernseher	der Topf
3	48	Wo ist die blaue Ananas?	die Ananas	die Sonne
3	49	Wo ist das rote Kreuz?	das Kreuz	das Sofa
3	50	Wo ist der gelbe Bus?	der Bus	der Teller
3	51	Wo ist die grüne Flasche?	die Flasche	die Axt
3	52	Wo ist das blaue Zelt?	das Zelt	das Rad
3	53	Wo ist der rote Schrank?	der Schrank	der Fernseher
3	54	Wo ist die gelbe Rakete?	die Rakete	die Ananas
4	55	Wo ist das grüne Sofa?	das Sofa	der Teller
4	56	Wo ist der blaue Käse?	der Käse	das Sofa
4	57	Wo ist die rote Axt?	die Axt	das Zelt
4	58	Wo ist das gelbe Herz?	das Herz	die Axt
4	59	Wo ist der grüne Topf?	der Topf	die Ananas
4	60	Wo ist die blaue Sonne?	die Sonne	der Topf
4	61	Wo ist das rote Gehirn?	das Gehirn	der Käse
4	62	Wo ist der gelbe Teller?	der Teller	das Kreuz
4	63	Wo ist die grüne Gabel?	die Gabel	das Herz
4	64	Wo ist das blaue Rad?	das Rad	die Gabel
4	65	Wo ist der rote Fernseher?	der Fernseher	die Rakete
4	66	Wo ist die gelbe Ananas?	die Ananas	der Fernseher
4	67	Wo ist das grüne Kreuz?	das Kreuz	der Bus
4	68	Wo ist der blaue Bus?	der Bus	das Gehirn
4	69	Wo ist die rote Flasche?	die Flasche	das Rad
4	70	Wo ist das gelbe Zelt?	das Zelt	die Flasche
4	71	Wo ist der grüne Schrank?	der Schrank	die Sonne
4	72	Wo ist die blaue Rakete?	die Rakete	der Schrank
5	73	Wo sehen Sie zwei rote Kleider?	2 Kleider	2 Ohren
5	74	Wo sehen Sie drei gelbe Drucker?	3 Drucker	3 Magneten
5	75	Wo sehen Sie vier grüne Kassetten?	4 Kassetten	4 Nasen
5	76	Wo sehen Sie zwei blaue Ohren?	2 Ohren	2 Autos
5	77	Wo sehen Sie drei rote Knoten?	3 Knoten	3 Eimer
5	78	Wo sehen Sie vier gelbe Taschen?	4 Taschen	4 Krawatten
5	79	Wo sehen Sie zwei grüne Bücher?	2 Bücher	2 Fenster
5	80	Wo sehen Sie drei blaue Frösche?	3 Frösche	3 Hunde
5	81	Wo sehen Sie vier rote Schrauben?	4 Schrauben	4 Waagen
5	82	Wo sehen Sie zwei gelbe Pferde?	2 Pferde	2 Handys
5	83	Wo sehen Sie drei grüne Engel?	3 Engel	3 Elefanten
5	84	Wo sehen Sie vier blaue Socken?	4 Socken	4 katzen

5	85	Wo sehen Sie zwei rote Brote?	2 Brote	2 Pferde
5	86	Wo sehen Sie drei gelbe Hunde?	3 Hunde	3 Engel
5	87	Wo sehen Sie vier grüne Waagen?	4 Waagen	4 Socken
5	88	Wo sehen Sie zwei blaue Handys?	2 Handys	2 Brote
5	89	Wo sehen Sie drei rote Elefanten?	3 Elefanten	3 Frösche
5	90	Wo sehen Sie vier gelbe Katzen?	4 Katzen	4 Kassetten
6	91	Wo sehen Sie zwei grüne Kleider?	2 Kleider	3 Magneten
6	92	Wo sehen Sie drei blaue Drucker?	3 Drucker	2 Fenster
6	93	Wo sehen Sie vier rote Kassetten?	4 Kassetten	2 Autos
6	94	Wo sehen Sie zwei gelbe Ohren?	2 Ohren	4 Nasen
6	95	Wo sehen Sie drei grüne Knoten?	3 Knoten	4 Krawatten
6	96	Wo sehen Sie vier blaue Taschen?	4 Taschen	3 Eimer
6	97	Wo sehen Sie zwei rote Bücher?	2 Bücher	3 Hunde
6	98	Wo sehen Sie drei gelbe Frösche?	3 Frösche	2 Brote
6	99	Wo sehen Sie vier grüne Schrauben?	4 Schrauben	2 Handys
6	100	Wo sehen Sie zwei blaue Pferde?	2 Pferde	4 Waagen
6	101	Wo sehen Sie drei rote Engel?	3 Engel	4 Katzen
6	102	Wo sehen Sie vier gelbe Socken?	4 Socken	3 Elefanten
6	103	Wo sehen Sie zwei grüne Brote?	2 Brote	3 Engel
6	104	Wo sehen Sie drei blaue Hunde?	3 Hunde	2 Pferde
6	105	Wo sehen Sie vier rote Waagen?	4 Waagen	2 Ohren
6	106	Wo sehen Sie zwei gelbe Hadys?	2 Handys	4 Socke
6	107	Wo sehen Sie drei grüne Elefanten?	3 Elefanten	4 Kassetten
6	108	Wo sehen Sie vier blaue Katzen?	4 Katzen	3 Frösche
7	109	Wo ist das rote Flugzeug?	das rote Flugzeug	das grüne Flugzeug
7	110	Wo sehen Sie drei grüne Stühle?	3 grüne Stühle	3 gelbe Stühle
7	111	Wo ist die blaue Tastatur?	die blaue Tastatur	die rote Tastatur
7	112	Wo sehen Sie drei gelbe Mäuse?	3 gelbe Mäuse	3 blaue Mäuse
7	113	Wo ist der rote Bleistift?	der rote Bleistift	der grüne Bleistift
7	114	Wo sehen Sie drei grüne Fahrräder?	3 grüne Fahrräder	3 gelbe Fahrräder
7	115	Wo ist der gelbe Koffer?	der gelbe Koffer	der rote Koffer
7	116	Wo sehen Sie drei rote Zähne?	3 rote Zähne	3 blaue Zähne
7	117	Wo ist die gelbe Glühbirne?	die gelbe Glühbirne	die grüne Glühbirne
7	118	Wo sehen Sie drei blaue Zahnbürsten?	3 blaue Zahnbürsten	3 gelbe Zahnbürsten

7	119	Wo ist das grüne Radio?	das grüne Radio	das rote Radio
7	120	Wo sehen Sie drei blaue Eis?	3 blaue Eis	3 grüne Eis
7	121	Wo ist die rote Rose?	die rote Rose	die blaue Rose
7	122	Wo sehen Sie drei grüne Sterne?	3 grüne Sterne	3 gelbe Sterne
7	123	Wo ist der blaue Tisch?	der blaue Tisch	der rote Tisch
7	124	Wo sehen Sie drei gelbe Häuser?	3 gelbe Häuser	3 grüne Häuser
7	125	Wo ist der grüne Baum?	der grüne Baum	der blaue Baum
7	126	Wo sehen Sie drei blaue Computer?	3 blaue Computer	3 gelbe Computer
8	127	Wo sehen Sie zwei gelbe Flugzeuge?	2 gelbe Flugzeuge	2 grüne Tastaturen
8	128	Wo sehen Sie vier rote Stühle?	4 rote Stühle	4 gelbe Bleistifte
8	129	Wo sehen Sie zwei rote Tastaturen?	2 rote Tastaturen	2 blaue Stühle
8	130	Wo sehen Sie vier blaue Mäuse?	4 blaue Mäuse	4 rote Flugzeuge
8	131	Wo sehen Sie zwei grüne Bleistifte?	2 grüne Bleistifte	2 gelbe Mäuse
8	132	Wo sehen Sie vier blaue Fahrräder?	4 blaue Fahrräder	4 gelbe Zähne
8	133	Wo sehen Sie zwei grüne Koffer?	2 grüne Koffer	2 blaue Glühbirne
8	134	Wo sehen Sie vier blaue Zähne?	4 blaue Zähne	4 grüne Radios
8	135	Wo sehen Sie zwei grüne Glühbirnen?	2 grüne Glühbirnen	2 rote Fahrräder
8	136	Wo sehen Sie vier grüne Zahnbürsten?	4 grüne Zahnbürsten	4 blaue Koffer
8	137	Wo sehen Sie zwei gelbe Radios?	2 gelbe Radios	2 rote Eis
8	138	Wo sehen Sie vier rote Eis?	4 rote Eis	4 blaue Zahnbürsten
8	139	Wo sehen Sie zwei blaue Rosen?	2 blaue Rosen	2 grüne Tische
8	140	Wo sehen Sie vier gelbe Sterne?	4 gelbe Sterne	4 rote Bäume
8	141	Wo sehen Sie zwei gelbe Tische?	2 gelbe Tische	2 rote Rosen
8	142	Wo sehen Sie vier rote Häuser?	4 rote Häuser	4 gelbe Sterne
8	143	Wo sehen Sie zwei gelbe Bäume?	2 gelbe Bäume	2 grüne Computer
8	144	Wo sehen Sie vier rote Computer?	4 rote Computer	4 blaue Häuser

Appendix B.

List of the glosses used in this paper:

FEM. – Feminine gender
INV. – Invariable
MASC. – Masculine gender
NEUT. – Neuter gender
PL. – Plural
PRS. – Present
SG. – Singular

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