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The Role of Grammatical Gender and Gender Stereotypes in Noun Processing: The Tug of War in Greek

Despoina Chalyvidou[1], Andrea Weber[1]

[1] *Faculty of Humanities, University of Tübingen, Tübingen, Germany.*

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Corresponding Author: Despoina Chalyvidou, Faculty of Humanities, University of Tübingen, Eberhard-Karls-Universität Tübingen, Wilhelmstraße 50, 72074 Tübingen, Germany. E-mail: d.chalyvidou@uni-tuebingen.de

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Abstract

The present study examined the interaction of grammatical gender and gender stereotypes in Modern Greek. Native Greek adults were primed with Greek occupational nouns of common gender (i.e., nouns that are used for both male and female characters) with a masculine ending and a stereotypically male or female bias (e.g., *iðravlikós* 'plumber' and *esθitikós* 'beautician'), followed by a masculine or feminine pronoun target (*aftós* 'he' or *aftí* 'she'), forming stereotypically congruent (*iðravlikós – aftós,* 'plumber – he', *esθitikós – aftí,* 'beautician - she') and incongruent (*iðravlikós – aftí,* 'plumber – she', *esθitikós – aftós,* 'beautician - he') prime-target pairs. The participants' task was to decide the gender of the pronoun, and their response times were measured. An effect of congruency was found for masculine pronouns, with slower response times when the masculine pronoun had been primed with a stereotypically female role noun. No such effect of congruency was found for feminine pronouns. This suggests that not only gender stereotypicality but also the morphological form of the noun influenced processing in Greek role nouns. Specifically, apparent morphosyntactic cues, albeit being uninformative about referential gender, seemingly generated a male bias and mitigated the impact of gender stereotypes associated with female-biased role nouns in prime-target pairs involving a feminine pronoun, reflecting an interaction between grammatical form and stereotype.

Keywords

grammatical gender, gender stereotypes, role noun, language processing, nouns of common gender

Highlights

- Interaction between grammatical gender and gender stereotypes during language processing in Greek.
- Processing cost when the masculine pronoun was primed with a stereotypically female role noun.
- Slower response times for stereotypically male role nouns in the incongruent condition, with no notable impact on response times for stereotypically female stimuli.
- For Greek common gender nouns denoting occupations that are morphologically marked as masculine, morphosyntactic cues can mitigate the impact of gender stereotypes associated with female-biased role nouns.
- Word form can shape the gender inferences associated with role nouns.

According to social cognitive theories, the main categories into which individuals are grouped are ethnicity, age, and gender (Fiske, 1998). One of these categories, gender, can be expressed in grammatical form. Grammatical gender has been deemed "the most puzzling of the grammatical categories" (Corbett, 1991, p. 1) and can be defined as a type of noun categorization. In most European languages, grammatical gender takes two or three gender values, namely masculine, feminine, and neuter, but there are languages with more noun classes, such as Babungo, which has 14 noun classes (Alvanoudi, 2015). With respect to their grammatical gender system, languages can be categorized into three main groups: grammatical gender languages (e.g., German, Italian, Greek, French), in which nouns can be morphologically marked for gender and govern agreement with other words such as determiners and pronouns, natural gender languages (e.g., English), in which nouns are never marked for gender and the gender of the referent can only become apparent by the use of pronouns, and genderless languages (e.g., Turkish, Finnish), in which neither nouns nor pronouns are specified for gender and any kind of gender information is solely conveyed through lexical means (Misersky et al., 2014). The group to which each language belongs impacts the processing of gender-related information conveyed by nouns. Specifically, in natural gender languages and genderless languages, people tend to make gender inferences using semantic information such as stereotypical beliefs, that is, generalized beliefs about the likelihood of a specific role being held by a female or a male (Hellinger & Bußmann, 2001; Misersky et al., 2014). Thus, encountering a role noun commonly linked with men in English, such as *judge*, often prompts the evocation of male characters for speakers of English, while stereotypically female nouns like *secretary* or *nurse* frequently evoke female characters (Oakhill et al., 2005; Siyanova-Chanturia et al., 2012). In grammatical gender languages, on the other hand,

grammatical cues can guide gender assignment (e.g., Carreiras et al., 1996; Esaulova et al., 2014). In German *der Sänger* ('the$_{masc}$ singer$_{masc}$'), for example, both the masculine gender of the determiner and the masculine suffix *-er* of the noun will evoke a male character for German speakers, while *die Sängerin* ('the$_{fem}$ singer$_{fem}$'), with a feminine determiner and a feminine suffix, will evoke a female character. It should be noted that in most grammatical gender languages masculine can be used as the unmarked gender, contrary to the marked feminine gender (Gygax et al., 2019). Therefore, while *die Sängerin* ('the$_{fem}$ singer$_{fem}$') can exclusively be used for a female singer, *der Sänger* ('the$_{masc}$ singer$_{masc}$') indeed denotes a male singer but can also, in principle, be used to refer to male and female singers in general, particularly when used in the plural form.

The present study is concerned with so-called common gender nouns in grammatical gender languages. Common gender nouns, which mainly denote professions, are nouns that are used for both male and female characters, but they are represented by one surface form for both sexes/genders. The form can adhere to either a masculine declension pattern (e.g., Italian, *ministro* 'minister$_{masc/fem}$'), a feminine declension pattern (e.g., Spanish *astronauta* 'astronaut $_{masc/fem}$'), or can have an ungendered suffix (e.g., Italian *esordiente* 'beginner $_{masc/fem}$'; Corbett, 1991). In the case of gender-marked declension patterns, the grammatical pattern may be congruent with gender stereotypes or not. This potential interaction between grammatical gender and gender stereotypes lies at the heart of the present study. Greek is one example of a grammatical gender language with nouns of common gender that on the surface can follow a masculine inflection pattern but that are used for both male and female referents. For example, the noun *δikiγóros* ('lawyer') can refer to both male (*o δikiγóros*, 'the$_{masc}$ lawyer') and female characters (*i δikiγóros* 'the$_{fem}$ lawyer'), but the suffix *-os* is typical of a masculine noun. Thus, in Greek it is not only possible to have common gender nouns that are stereotypically male and resemble a masculine form (e.g., *ilektrolóγos,* 'electrician'), but also to have common gender nouns that are stereotypically female and resemble a masculine noun in form (e.g., *esθitikós,* 'beautician'). As we will see in the following review of previous research, the processing of forms whose morphosyntactic surface form might contradict the stereotype they convey is not yet fully understood.

Grammatical Gender

One of the pivotal functions of linguistic gender regarding human reference is to convey various types of gendered messages (Hellinger & Bußmann, 2001). While biological or natural gender usually determines gender assignment for animate entities, inanimate objects often receive gender assignments arbitrarily (e.g., German *der Park*, 'the$_{masc}$ park', Dutch *het park*, the$_{neut}$ park'). However, the gender assignment of animate entities can also be arbitrary. For instance, the German and Greek noun for a girl (German *das Mädchen*, Greek *to korítsi,* 'the$_{neut}$ girl'), is neuter in its grammatical form despite the noun referring to a female. Likewise, morphological criteria can be ambiguous, notably

in nouns of common gender and epicenes. Common gender nouns belong to more than one gender class and can refer to individuals of either sex/gender. They usually take two different sets of agreement based on semantic and pragmatic purposes, depending on the sex/gender of the intended referent (Corbett, 1991). They can have an ungendered suffix, that is, an ending that is neither typical of a masculine or feminine noun (e.g., Italian *l'assistente*, 'the$_{masc/fem}$ assistant', Spanish *l'estudiante*, 'the$_{masc/fem}$ student'), or may be encountered in a masculine or feminine morphological form, such as the Greek *o/i iatrós* 'the$_{masc/fem}$ doctor', whose suffix is a typical masculine one, or the Spanish *l'artista,* 'the$_{masc/fem}$ artist', with a typical feminine suffix. Contextual information significantly influences the processing of nouns in this case (Cacciari et al., 2011). For example, Italian speakers perceive referents of common gender nouns as female or male based on biasing information in the context, leading to different reading times on subsequent pronouns that are congruent or incongruent with these biases (Cacciari et al., 2011). On the other hand, epicenes are nouns that "denote sexed beings but which do not differentiate them according to sex" (Corbett, 1991, p. 68). In other words, they have a fixed morphological marking for masculine or feminine gender, they can take only one set of agreement based on their grammatical gender, and yet they can refer to beings of either sex/gender (Corbett, 1991). The Italian *la vittima* 'the$_{fem}$ victim$_{fem}$', for instance, is morphologically marked as feminine, it follows the declension pattern of feminine gender, and can be used for both male and female victims. The processing of epicenes, contrary to common gender nouns, is primarily influenced by grammatical gender cues, reflected by shorter reading times for pronouns matching the epicene in gender (Cacciari et al., 2011).

When unambiguous, the morphosyntactic aspect of grammatical gender has been found to profoundly influence language processing. Gender agreement, when nouns agree in gender with modifying elements, like determiners, adjectives, and pronouns, has demonstrated this impact. For instance, a masculine noun has to agree in gender with its preceding determiner (*eine Sängerin*, 'a$_{fem}$ singer$_{fem}$') and adjective (*gute Sängerin*, 'good$_{fem}$ singer$_{fem}$'), and any anaphor that refers to it should agree in gender too (the feminine pronoun *sie*, 'she', when the preceding noun was *Sängerin*, 'singer$_{fem}$'). Most studies examining agreement have found an effect of violation, such that incongruent combinations, like a masculine noun preceded by a feminine definite article (e.g., Spanish *la$_{fem}$ piano$_{masc}$*, 'the$_{fem}$ piano$_{masc}$'), a masculine noun followed by a feminine adjective (e.g., Spanish *faro$_{masc}$ alta$_{fem}$*, 'high$_{fem}$ lighthouse$_{masc}$') or followed by an incongruent pronoun (e.g., German *der$_{masc}$ Bus$_{masc}$...sie*, 'the$_{masc}$ bus$_{masc}$...she...') are harder to process, as evidenced by longer response times and reduced accuracy in lexical decision tasks, longer reading times, or even a distinct brain response in ERP studies (e.g., Caffarra & Barber, 2015; Caffarra et al., 2015). Studies have also found that the effect of a violation is more pronounced for transparent nouns with suffixes that reliably indicate gender (e.g., *-o* for masculine and *-a* for feminine in Spanish) compared to opaque ones, which do not

signal a particular gender, such as the Spanish *coche*$_{masc}$, 'car' (e.g., Caffarra & Barber, 2015; Caffarra et al., 2015).

Grammatical Gender in Greek

Greek is a grammatical gender language in which all nominal categories, i.e., nouns, adjectives, determiners, and pronouns, bear a gender feature that can take three values: masculine, feminine, or neuter. As in most grammatical gender languages, gender assignment to animate entities, such as animals and human beings, is based on semantic criteria [±male] [±female]. For example, *ándras* 'man' is masculine, whilst *jinéka* 'woman' is feminine. Apart from semantic criteria, morphology plays a crucial role in assigning gender, since grammatical gender is associated with noun suffixes (Alvanoudi, 2015). For example, all masculine nouns end in *-s* (*pólemos* 'war', *patéras* 'father'), most feminine nouns end in a vowel (*téxni* 'art', *mitéra* 'mother'), and most neuter nouns end in *-o*, *-a*, *-ma,* or *-i* (*θéatro 'theater'*, *trávma 'wound'*, *pedí 'child' ;* Holton et al., 2004). As in most Indo-European grammatical gender languages, masculine forms are the unmarked, determine agreement in contexts where both masculine and feminine nouns are found and can be used generically, as in the phrase "*o fititís éxι to δikéoma na…", 'the*$_{\text{masc}}$ student$_{\text{masc}}$ has the right to…', which is used for all students regardless of their sex/gender (Pavlidou, 2003).

Despite overt gender marking in the majority of Greek nouns, there are a number of nouns denoting professions that are 'of common gender': they follow the declension pattern of masculine nouns, and they can refer to male or female individuals (e.g., *o/i próeδros* 'the$_{\text{masc/fem}}$ president; Alvanoudi, 2015; Holton et al., 2004). Given that their surface form is always masculine, the sex/gender of the referent can be specified through agreement with a related constituent, such as an article, another noun, or a pronoun (Alvanoudi, 2015). The use of nouns of common gender can be considered a remnant of the diaglossic past of Greece, with the existence of two varieties: *katharevousa,* a more prestigious variety which bore similarities to Ancient Greek, and *dhimotiki*, people's spoken language (Pavlidou, 2003). When women entered positions previously held by men, the new forms that would be used for female professionals were designated using *katharevousa*, and as a result, two-gendered forms were applied, following the inflection paradigm of Ancient Greek (e.g., *o/i filóloγos,* 'the$_{\text{masc/fem}}$ philologist', *o/i arxeolóγos,* 'the$_{\text{masc/fem}}$ archaeologist), or simply, the existing masculine forms were used for females too, i.e., *o/i tamías,* 'the$_{\text{masc/fem}}$ cashier' (Pavlidou, 2003). When *dhimotiki* was established as the official language, the existence of those words proved to be problematic, as most demotic nouns have two distinct forms with respect to the sex/gender of the referent (*kaθijtís,* 'male professor' vs. *kaθijítria,* 'female professor', *bakális,* 'male grocer' vs. *bakálisa,* 'female grocer'). Hence, the use of demotic feminine suffixes for the formation of feminine occupational titles was proposed, however, these suggestions have not been

adopted, especially with regard to prestigious professions, such as *prítanis,* 'rector' and *isangeléas,* 'attorney' (Lampropoulou & Georgalidou, 2017).

Stereotypical Gender

The influence of gender stereotypes has long been a major area of interest in the fields of linguistics and social psychology (e.g., Banaji & Hardin, 1996; Cacciari & Padovani, 2007; Misersky et al., 2014; Oakhill et al., 2005). Researchers have employed various methods to investigate the activation of gender stereotypes in language processing, focusing on the processing of nouns that denote specific roles or positions (Gygax et al., 2021). Most of these studies found an automatic activation of gender stereotypes during language processing. When encountering stereotypical words like *surgeon* or *nurse*, individuals promptly associate them with a male or female referent based on prevalent normative ratings (Banaji & Hardin, 1996; Kennison & Trofe, 2003). Disrupting these biases, such as with a male nurse or a female surgeon, incurs processing costs (Oakhill et al., 2005; Reynolds et al., 2006). In Reynolds et al. (2006), for example, participants read stereotypically congruent and incongruent versions of the Sanford surgeon story (Sanford, 1985), and comprehension difficulty was reported to be greater for the incongruent version (female surgeon) than for the congruent one (female nurse). Many linguistic studies examining the influence of gender stereotypes used priming tasks, in which participants are presented with two subsequent words, a prime and a target, and have to make a lexical decision about the target (Banaji & Hardin, 1996; Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012). Response times for the target decision are the main dependent variable. For example, a stereotypical role noun is used as a prime, it is followed by a feminine or masculine pronoun target (e.g., *mechanic – she*) and participants have to decide the gender of the pronoun, or in a word association task, participants have to decide whether prime and target can refer to the same individual (e.g., *mechanic – uncle*). Typically, an effect of congruency is found, with fewer correct responses and prolonged response times for stereotypically incongruent prime-target pairs in comparison to congruent prime-target pairs (Banaji & Hardin, 1996; Cacciari & Padovani, 2007; Oakhill et al., 2005; Siyanova-Chanturia et al., 2012). Even when studies tried to strategically suppress gender stereotypes, they revealed a persistent albeit reduced influence, reaffirming their automatic activation (Gygax et al., 2012; Oakhill et al., 2005). Similarly, gender stereotypes also appear to be activated immediately when they are encountered in discourse and not just as words in isolation (e.g., Kennison & Trofe, 2003; Reynolds et al., 2006). This has been primarily examined with reading and sentence evaluations tasks, in which the participants' task is to assess whether the second sentence is a sensible continuation of the first one. For example, participants are presented with a stereotypical role noun in the first sentence, followed by a sentence that matches or mismatches the stereotype (e.g., "The secretary distributed an urgent memo. He/She made it clear that work would continue as normal"; Kennison & Trofe, 2003,

p.361). Again, stereotype violations hindered processing in these studies, as indicated by longer reading times for incongruent stimuli (see Carreiras et al., 1996; Kennison & Trofe, 2003; Reynolds et al., 2006, for studies carried out in English).

The Interplay Between Grammatical Gender and Gender Stereotypes

In grammatical gender languages, gender-related information can be conveyed grammatically, in addition to conceptually. Whether grammatical gender or stereotypical gender information is more influential in these languages has been investigated in several studies, revealing a complex relation between these two information sources (Esaulova et al., 2014; Irmen & Roßberg, 2004). For example, the ambiguity of grammatical gender information seems to play a role. More specifically, if grammatical gender is unambiguous with regard to the referent of a noun, such as in morphologically gender-marked role nouns (e.g., Spanish *el carpintero*, 'the$_{masc}$ carpenter$_{masc}$', *la enfermera*, 'the$_{fem}$ nurse$_{fem}$'), then mainly grammatical gender appears to guide processing (e.g., Carreiras et al., 1996 for Spanish) and also appears to be activated earlier than stereotypical gender information (Esaulova et al., 2014). In contrast, when grammatical gender cues are ambiguous, that is, not informative about referential gender, as is the case with grammatically unmarked nouns of common gender (e.g., Italian *il/la governante*, 'the$_{masc/fem}$ housekeeper') or epicenes (e.g., the German *Putzhilfen* 'cleaning help$_{fem}$', which is grammatically feminine but is used for individuals of either sex/gender), gender inferences are drawn based on stereotypical beliefs (Cacciari & Padovani, 2007; Irmen & Roßberg, 2004; Siyanova-Chanturia et al., 2012, 2015), and grammatical gender information is activated only in later stages of processing (Irmen, 2007). It is worth mentioning that the unmarked status and generic use of masculine forms, as discussed previously, appear to result in an asymmetrical processing of the two genders, such that for feminine role nouns, cues to referent gender are integrated immediately in the mental representation of gender, whereas masculine forms are integrated later, as shown in tasks involving pronoun resolution in German (Esaulova et al., 2014; Irmen & Schumann, 2011). However, findings about its relation to the activation of stereotypes have not been unanimous. Irmen and Schumann (2011), for example, found a smaller processing cost when masculine nouns were paired with a typically female role noun as compared to a faster and bigger processing cost when feminine nouns were encountered in incongruent continuations. On the other hand, Esaulova et al. (2014) found an equal processing cost in cases of stereotypical incongruence for both masculine and feminine role nouns.

The Present Study

Previous research that has looked at the relation between grammatical and stereotypical gender information in grammatical gender languages has either used nouns in plural

forms, which can be used to refer to individuals of both sexes/genders (e.g., Gygax et al., 2008; Irmen & Roßberg, 2004; Lévy et al., 2014), words that are morphologically marked for gender (e.g., Carreiras et al., 1996; Esaulova et al., 2014), or nouns of common gender with no morphological marking (Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012, 2015). In all these studies, the grammatical information provided was either uninformative about sex/gender, such as in the German epicene *Putzhilfen*,'cleaning help', lacking grammatical gender cues but containing female and male stereotypes (e.g., Italian *il/la falegname*, 'the$_{masc/fem}$ carpenter', stereotypically associated with men, yet morphologically unmarked; see Cacciari & Padovani, 2007), or it was juxtaposed with stereotypical information that contradicted grammatical gender norms in transparent nouns, whose suffixes convey reliable information regarding referential gender ("*Die Elektrikerin…er…*", 'The$_{fem}$ electrician$_{fem}$…he', as in Esaulova et al., 2014). However, none of the situations directly tested the relevance of grammatical information when stereotypical information aligned or diverged. Greek serves as an ideal platform to explore the direct interaction of these two information sources in linguistically legal contexts. This is because it has role nouns of common gender that, while appearing morphologically masculine, can refer to both male and female individuals (e.g., *o/i ilektrolóγos*, 'the$_{masc/fem}$ electrician', *o/i esθitikós*, 'the$_{masc/fem}$ beautician'). For these nouns, stereotypical gender and grammatical gender information can match (e.g., *o ilektrolóγos*, 'the$_{masc}$ electrician') or mismatch (*e.g., i ilektrolóγos*, 'the$_{fem}$ electrician'), yet the forms are grammatically correct in Greek.

The present study goes beyond previous research by investigating the processing of common gender occupational nouns in Modern Greek and by assessing how apparent grammatical gender, expressed through the masculine surface form of role nouns, influences the activation of gender stereotypes that are associated with the role nouns. A semantic priming task, modeled on the one used by Cacciari and Padovani (2007), was employed: Greek nouns of common gender denoting stereotypically male and female occupations were used as primes, and the Greek third person masculine and feminine pronouns (*aftós,* 'he', and *aftí*, 'she') were used as targets. The prime - target combinations were either stereotypically congruent (e.g., *iðravlikós – aftós*, 'plumber – he', *esθitikós – aftí*, 'beautician – she') or incongruent (e.g., *iðravlikós – aftí*, 'plumber – she', *esθitikós – aftós*, 'beautician – he'). The participants' task was to decide the gender of the target pronoun and gender decision latencies were measured. If stereotypes play the primary role in processing, then decision latencies should mainly be influenced by the stereotypical gender of the role nouns, with all incongruent prime-target pairs resulting in slower response times. If, however, morphosyntactic cues mainly impact processing, then the apparent masculine morphology of the nouns under study should lead to male-biased processing such that decision latencies for masculine target pronouns should be faster than for feminine pronouns regardless of stereotypical information. Finally,

if both information sources interact, then an effect of congruency between prime and target should be observed that is further modulated by grammatical information.

Method

Participants

Seventy native speakers of Greek (47 females, 22 males; mean age: 27.7, range: 18–35) participated in the online experiment. A crucial requirement for participation was having been brought up in Greece. All participants were recruited through the University of Tübingen email circular and were paid according to the standards of the university via a gift card lottery. Recruitment, payment, and procedure followed the standard *LingTüLab*'s ethical consent practices, approved by the DFG (German Research Foundation). Eleven participants (15.7%) were excluded from the final analyses for various reasons: one participant had not been raised in Greece (n = 1), one participant failed to complete the demographics questionnaire (n = 1), and nine participants had an error rate exceeding 25% on experimental items (n = 9), resulting in a final sample of 59 participants (41 females, 18 males; mean age: 27.7).

Materials

Thirty-six Greek role nouns denoting occupations were chosen as experimental primes. All primes were nouns of common gender (e.g., *i/o maéstros,* 'the$_{fem}$/the$_{masc}$ conductor'). That is, they could refer to both females and males, but in the absence of context, such as a gender-marked determiner or an attributive adjective, they were not informative about referential gender. Contrary to most Greek nouns, which have distinct masculine and feminine forms when they refer to males and females respectively, the selected common gender nouns had a masculine surface form, indicated by a suffix that is typically used in masculine nouns (i.e., *-os).* Eighteen of the nouns were stereotypically associated with men (e.g., *maéstros,* 'conductor'), and 18 were female-biased (e.g., *kozmetolóyos,* 'cosmetician'). The nouns were on average 11.03 characters long (10.6 and 11.5 for male-biased and female-biased nouns, respectively).

Twenty-eight of the 36 role nouns were taken from Misersky et al. (2014), who collected norms of male and female stereotypicality for a large number of role nouns across several languages including Italian, German, English, and French. Stereotypicality of role nouns was quite consistent across languages in their study, thus serving as a robust basis for our research in Greek. From their dataset, we selected 28 words that received high and stable ratings of male and female stereotypicality and translated them into Greek. A key prerequisite for the selection was that the Greek translations corresponded to common gender nouns following the masculine inflection pattern described above. The remaining eight role nouns were obtained from two reputable dictionaries of Modern

Greek: the Dictionary of Standard Modern Greek (Institute of Modern Greek Studies, 1998) and the Dictionary of Modern Greek Language (Babiniotis, 2002). This selection of 36 role nouns consisted of nouns which had performed best in a small pre-test rating study with a total of 80 occupational nouns. To ensure that our complete set of selected role nouns associated well with males or females in a Greek cultural context, eight native Greek-speaking members of the English department at the University of Tübingen evaluated the stimuli in a rating task similar to the one used in Misersky et al. (2014): they were asked to estimate the likelihood of 80 occupational nouns representing a male or a female on a 5-point Likert scale, with 1 indicating an association with male representation and 5 signifying an association with female representation. The 80 nouns comprised the 28 nouns taken from Misersky et al. (2014), and 52 additional nouns selected after dictionary trawls, of which we selected those with the lowest and highest stereotypicality ratings (the mean rating for the stereotypically male nouns was 1.5, while for the stereotypically female nouns the mean rating was 4.1, $p < .001$). Participants in the rating study did not take part in the main priming experiment.

Each of the 36 experimental noun primes, in its singular form with no preceding determiner, was paired with two singular third person pronouns (*aftós,* 'he', and *aftí,* 'she') that functioned as targets in the experiment, forming prime-target pairs that were either congruent in terms of stereotypical gender (e.g., *maéstros-aftós,* 'conductor-he') or incongruent (e.g., *maéstros-aftí,* 'conductor-she'). Examples of experimental stimuli across conditions can be seen in Table 1.

Table 1

Examples of Experimental Stimuli

Condition	Example	Translation
Congruent: male prime-masculine target	*maéstros – aftós*	conductor – he
Incongruent: female prime-masculine target	*kozmetolóyos – aftós*	cosmetician – he
Congruent: female prime-feminine target	*kozmetolóyos – aftí*	cosmetician – she
Incongruent: male prime-feminine target	*maéstros – aftí*	conductor – she

In addition, 54 nouns were chosen as filler primes, each denoting a common object: half of them were grammatically feminine (e.g., *i kasetína,* 'the$_{\text{fem}}$ pencil case') and half were grammatically masculine (e.g., *o markaδóros,* 'the$_{\text{masc}}$ marker'). We made sure that the filler items would differ from the experimental ones with regard to their morphological status, as they were either grammatically masculine or grammatically feminine nouns, which was reflected in their transparent suffixes (*-s* for masculine nouns and *-a/-i* for feminine ones). The filler prime nouns were paired with the singular third person pronouns *aftós,* 'he', or *aftí,* 'she', with 27 of the pairs being grammatically congruent (e.g., *kasetína – aftí,* 'pencil case – she') and 27 being grammatically incongruent (e.g.,

markaδóros – aftí, 'marker – she'), distributed equally across pronoun type. Based on the complete set of stimuli, two lists were constructed, to which participants were randomly assigned. Both lists contained all 90 prime-target pairs (36 experimental pairs and 54 filler pairs) in pseudo-random order with conditions being evenly distributed across lists. That is, experimental nouns that were followed by a masculine pronoun in list A were followed by a feminine pronoun in list B, and vice versa. This ensured that each role noun was encountered in both the congruent and incongruent condition across the two separate lists, and each participant encountered male-biased and female-biased role nouns in the congruent and incongruent condition. Experimental prime-target pairs were always followed by at least one filler prime-target pair.

Procedure

The experiment was built using Gorilla Experiment Builder (www.gorilla.sc) and designed and run as an online, self-administered experiment (Anwyl-Irvine et al., 2020). Instructions in Greek appeared on the screen before the experiment started. The instructions told participants that they would see a noun on the computer screen directly followed by the appearance of the pronoun *aftós,* 'he', or *aftí,* 'she'. Their task was to read the noun carefully and then to decide the gender of the pronoun quickly and accurately. Participants were instructed to press the "J" button if the gender of the target pronoun was masculine, and the "F" button, if the pronoun was feminine. The assignment of the J/F buttons was consistent across participants. To familiarize participants with the task, five practice trials using congruent and incongruent prime-target pairs of grammatically masculine and feminine nouns were presented first. None of the practice nouns appeared in the actual experiment. In each trial of the priming experiment, a fixation point (i.e., a printed '+') appeared centered on the screen for 500ms. Then the prime noun, in lowercase black font with font size 70, was displayed in the center of the screen for 600ms, followed by a blank screen for 300ms. After that, the target pronoun, also in lowercase black font with font size 70, appeared centered on the screen and remained there until participants provided a response. A time limit of 4000ms was set; if no response was provided by that time, the next prime noun appeared. Response times for key presses were measured from the onset of the presentation of the target pronoun. After half of the prime-target pairs of a list, participants could take a short break. Both experimental halves contained an equal number of masculine and feminine pronouns.

After the priming task was completed, participants had to indicate for a list of Greek nouns that contained some of the experimental nouns if the nouns had appeared in the priming task or not. This task had previously been announced to the participants. Its sole purpose was to ensure that participants would keep reading the nouns carefully throughout the priming task. Next, participants were presented again with the role nouns of the priming task and had to rate the likelihood of each noun referring to a female or a male on a 7-point scale using a slider. The experiment concluded with a short

questionnaire, in which participants could fill out information about their age, gender, and language background.

Results

R (R Core Team, 2023) was used to conduct the analyses. Responses with response times (RTs) longer than 1700ms and shorter than 150ms were considered outliers and removed from the analyses, resulting in an exclusion of 2.2% of the data.

The primary focus of our study was to investigate the interplay between stereotypical gender information and grammatical gender information. More specifically, we were interested in the extent to which processing of female and masculine pronouns in Greek is influenced by preceding role nouns of common gender that have a masculine surface form but are either stereotypically female or male. Mean raw RTs for the four conditions of the experiment can be found in Table 2. As can be seen in the table, mean RTs in the congruent condition were shorter than in the incongruent condition for the masculine pronoun but no such difference can be seen for the feminine pronoun. The inverse RTs are also presented in the table; this transformation scales the inverse response times by 1000 and negates them (inverseRT = −1000RT) to bring the values into a more manageable range. The graph in Figure 1 represents untransformed RTs for readability purposes.

Table 2

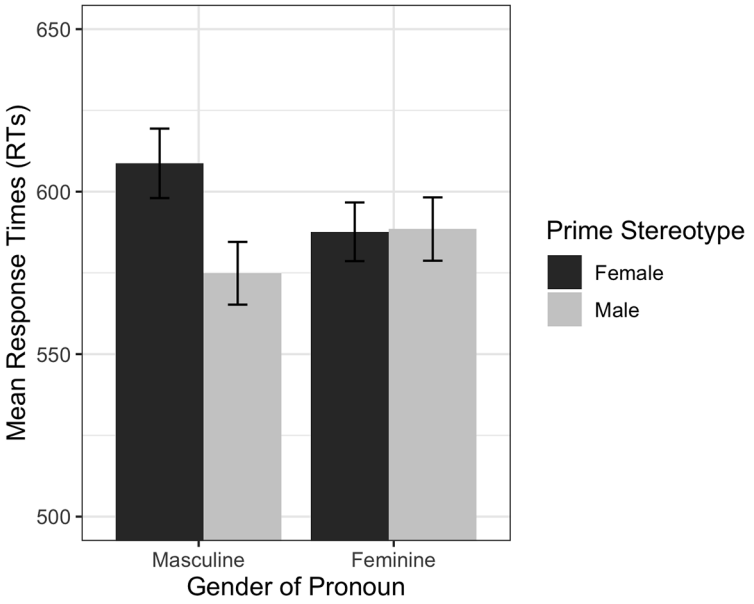
Mean Raw RTs and Mean Inverse RTs (in ms) With Standard Deviations in Parentheses

	Masculine Pronoun (*aftós*)		**Feminine Pronoun (*aftí*)**	
Prime stereotype	**RT**	**inverse RT**	**RT**	**inverse RT**
Female	609 (237)	-1.836 (0.56)	588 (201)	-1.872 (0.55)
Male	575 (217)	-1.942 (0.62)	589 (216)	-1.883 (0.55)

In the analyses, inverse RTs, transformed using the MASS package (Venables & Ripley, 2002), rather than raw RTs, were used because they fitted best to a normal distribution. Our linear mixed effects analyses using the lme4 package (Bates et al., 2015) examined the relationship between the gender of the target pronoun (masculine, feminine) and the stereotype conveyed by the prime (male, female) on inverse RTs. In our model, *prime stereotype* (male and female, sum-coded as 0.5 and -0.5, respectively) and *gender of the target pronoun* (masculine, feminine, sum-coded as 0.5 and -0.5, respectively) were entered as fixed effects, while intercepts for *participants and items* were included as random effects.

Figure 1

Mean Response Times in Decision of Gender of the Target Pronoun



Note. Mean raw RTs in decision of gender of the target pronoun (masculine vs. feminine) when it was preceded by a stereotypically female or male role noun prime. The error bars represent the standard error (SE) of the mean RTs for each condition.

Overall, there was neither a significant main effect of *prime stereotype* (t = -1.989, p = .055), nor of *gender of the target pronoun* (t = -0.478, p = .634). However, the interaction between *prime stereotype* and *gender of the target pronoun* was significant (t = -2.62, p = .009). The output of the LMER model is summarized in Table 3. The lmerTest package was used to calculate p-values (Kuznetsova et al., 2017).

The significant interaction between *prime stereotype* and *gender of the target pronoun* warranted further analyses. First, we examined gender decision latencies on inverse RTs for trials involving a masculine target pronoun preceded by either a male role noun (congruent) or a female role noun (incongruent). The effect of *prime stereotype* was significant (t = -3.051, p = .004), such that, for masculine pronouns, RTs in the congruent condition (e.g., *iðravlikós – aftós*, 'plumber – he') were significantly faster than in the incongruent condition (e.g., *nipiaɣoɣós – aftós*, 'kindergarten teacher - he'). Next, we carried out an analysis for trials with a feminine target pronoun preceded by either a female role noun (congruent) or a male role noun (incongruent). No significant effect of *prime stereotype* was found in this comparison (t = -0.102, p = .919), indicating that RTs to female pronouns were neither faster nor slower following a congruent (e.g., *nipiaɣoɣós*

- *aftí,* 'kindergarten teacher – she') or incongruent role noun (e.g., *iðravlikós - aftí,* 'plumber - she'). Thus, *prime stereotype* elicited a significant effect for prime-target pairs comprising a masculine target pronoun, but no such effect was found when the target pronoun was feminine.

Table 3

LMER Result Summary

Fixed Effects	**Estimate**	***SE***	***t***	***Pr(>|t|)***
(Intercept)	-1.881	0.046	-41.175	< 0.0001***
Prime stereotype	-0.059	0.03	-1.989	0.055
Gender of the target pronoun	-0.01	0.02	-0.478	0.634
Prime stereotype x Gender of the target pronoun	0.11	0.042	-2.62	0.009**
Random Effects	**Variance**	***SD***		
Participant (Intercept)	0.109	0.33		
Items (Intercept)	0.004	0.065		

***$p < .001$. **$p < .01$.

Discussion

The aim of the present study was to investigate the interaction of grammatical gender and stereotypical gender in the processing of Greek nouns of common gender denoting a profession. In contrast to most Greek role nouns that have distinct masculine and feminine forms based on the sex/gender of the referent, the nouns under scrutiny were of common gender (i.e., the nouns can be used for both male and female characters) but always followed an inflection pattern that is typical for masculine nouns in Greek. The occurrence of role nouns of common gender that resemble a masculine form but can be female-biased or male-biased in terms of stereotypicality is noteworthy. This attribute of Greek sets the current study apart from previous research, which has mostly examined morphologically unmarked nouns of common gender (Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012, 2015).

In the present study, Greek occupational nouns of common gender with a masculine ending and a stereotypically male or female bias (e.g., *iðravlikós,* 'plumber' and *esθitikós,* 'beautician'), were followed by a masculine or feminine pronoun target (*aftós* 'he' or *aftí,* 'she'), forming stereotypically congruent (*iðravlikós – aftós,* 'plumber – he', *esθitikós – aftí,* 'beautician - she') and incongruent (*iðravlikós – aftí,* 'plumber - she', *esθitikós – aftós,* 'beautician - he') prime-target pairs. Adult native speakers of Greek took part in the priming study and had to decide the gender of the pronoun (see Cacciari & Padovani, 2007, for a similar experimental design). Consistent with the previous literature, we found that gender stereotypes were being activated when a stereotypical role noun

was encountered: even though the main effect of the prime stereotype did not reach significance (p = .055), a trend emerged suggesting faster response times for congruent prime-target pairs. That is, gender decision latencies were slower when participants had been presented with incongruent prime-target pairs than with congruent ones. This finding corroborates to some extent the findings of previous research with respect to the automatic and early activation of gender stereotypes when grammatical gender is unmarked (e.g., Banaji & Hardin, 1996; Cacciari & Padovani, 2007; Oakhill et al., 2005; Siyanova-Chanturia et al., 2012, 2015), but also when it is morphologically marked (e.g., Carreiras et al., 1996; Esaulova et al., 2014; Irmen & Roßberg, 2004). However, when we examined response times for each pronoun separately, we found that the stereotype conveyed by the prime was only significant for masculine pronoun targets and not for feminine pronouns.

Perhaps the most important finding of the current study is that the surface forms of the nouns seemingly influenced the activation of gender stereotypes during language processing. Participants in the present study encountered stereotypical role nouns that looked morphologically masculine, even when they conveyed a female bias. This masculine form appears to reinforce the male stereotype, which is why congruent pairs with male role nouns and masculine pronouns had the fastest response times. Conversely, female stereotypes resulted in the longest response times when paired with masculine pronouns. However, when comparing congruent and incongruent pairs with the feminine pronoun, response times were comparable. This suggests that the masculine form generally brings a male bias, but there is a specific interaction between grammatical form and stereotype when it comes to the feminine pronoun, in line with previous research examining the processing of generic masculine (e.g., Gygax et al., 2008; Irmen & Roßberg, 2004; Lévy et al., 2014). This pattern indicates that surface forms significantly impact language processing, as illustrated by research on the processing of epicenes (Cacciari et al., 2011). Native Italian speakers read sentences with epicene antecedents followed by a personal pronoun referring to the epicenes. Reading times were faster when the epicene and the pronoun were of the same gender, indicating that pronoun resolution was driven by grammar (Cacciari et al., 2011). This might explain the difference between our findings and those obtained by Cacciari and Padovani (2007), who used Italian unmarked nouns of common gender as primes and found a congruency effect for both masculine and feminine target pronouns, with longer response times for incongruent stimuli compared to congruent irrespective of the gender of the target pronoun.

The lack of a congruency effect for feminine pronouns in our study can be interpreted as evidence of a male-biased reading of the prime nouns, based on form rather than stereotype: female-biased stereotypes did not have a strong influence on the grounds that the masculine form of the noun made participants perceive them as masculine and the conveyed bias was mitigated. While in the case of the male-biased role nouns both grammar and stereotypicality were in agreement and led to male-biased processing, the

stereotypically female nouns were always inconsistent with their apparent masculine noun form. These results seem to be in accord with the results of studies that examined the impact of generic masculine forms on processing and challenged its generic interpretation, as they found that masculine grammatical gender can be more easily associated with males (e.g., Misersky et al., 2019). When testing the interplay of masculine plural forms and gender stereotypes, previous findings are contradictory: on the one hand, there has been evidence that the masculine plural form leads to male-dominant mental representations of gender, overriding the impact of stereotypes in the case of female-biased role nouns, as in our study (e.g., Gygax et al., 2008; Irmen & Roßberg, 2004), while there are studies who have found that the male bias generated by the grammatical form is less pronounced in the case of female-stereotyped nouns (e.g., Gygax et al., 2012; Lévy et al., 2014).

An alternative explanation for this pattern of congruency effect for masculine pronouns but not for feminine pronouns could be a lack of a female stereotype effect, which might result from asymmetrical stereotype processing, as seen in previous research (Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012). Indeed, some studies have found that stereotypicality can affect processing differently in the case of female-biased words compared to male-biased ones. Specifically, female referents have been shown to be more readily associated with stereotypically male roles, while the reverse is not as prevalent (Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012). This leads to longer response times and larger negativity in brain responses for incongruent pairs involving stereotypically female roles compared to male-biased role nouns. However, Cacciari and Padovani (2007), using a very similar design in Italian with common gender nouns unmarked for gender, found a congruency effect for both masculine and feminine pronouns, and in line with them, we ensured that all nouns had been rated clearly and consistently in terms of stereotypicality. Consequently, we consider this explanation less likely for our results, however, it cannot be ruled out. Furthermore, the observed asymmetrical stereotype processing could also be attributed to androcentrism, which places men as the normative group, used as exemplar (Bailey et al., 2019). This androcentric perspective deems men as more typical than women, making them the default representation for categories that include both females and males, thereby reinforcing a male bias (Bailey et al., 2019). Another possible explanation is the unequal distribution of masculine and feminine suffixes throughout the experiment, with a prominence of masculine suffixes for both experimental items and fillers. This imbalance could have reinforced a male-biased processing tendency, potentially affecting the generalizability of our findings. Future studies should aim to balance the exposure to masculine and feminine forms to further investigate the impact of grammatical gender and stereotypes on language processing.

An issue that was not addressed in this study is whether the role nouns stereotypically associated with males or females reflect true gender ratios. Like many studies on

the linguistic processing of gender stereotypes, ours relies on normative ratings from pre-tests, where participants estimate the gender composition of roles (Kennison & Trofe, 2003; Misersky et al., 2014). These estimations often correlate with true gender ratios, as shown by Garnham et al. (2015), who found that people can accurately estimate the gender ratio for role names. This exposure to gendered occupations influences participants' performance in behavioral tasks. In our study, faster responses to congruent gender stimuli might result from this exposure. However, no congruency effect was observed for female-biased nouns, even though some occupations such as *esθitikós* ('beautician') and *vrefokómos* ('daycare worker') are predominantly held by women. Future research should aim to accurately distinguish between stereotypes and true gender ratios in psycholinguistic studies. Another limitation of the current study is the lack of counterbalancing in the assignment of the "J" and "F" buttons to masculine and feminine pronouns, respectively, which may have introduced a bias based on this specific configuration. Such a bias could affect how participants process and respond to the pronouns, thus impacting the study's findings. However, the low error rate suggests that participants were able to process the pronouns accurately, attenuating concerns regarding the influence of the button assignment.

Our findings accentuate the pivotal role of grammatical/morphosyntactic gender in drawing gender inferences during language processing and complement existing studies reporting similar results, emphasizing the disadvantage that women can have in language. Specifically, our findings resonate with research exploring the lack of feminine variants for certain occupations, which is considered one of the sources of bias traced in grammatical gender languages (see Gygax et al., 2019, for a more thorough analysis). Data from previous studies suggest that the use of masculine occupational titles leads to male-biased representations (Horvath & Sczesny, 2016; Körner et al., 2022), while it also appears to impact children's occupational interests and perception of professional success of women and men (e.g., Vervecken et al., 2013). In contrast, the adoption of alternative forms, such as the gender star form (e.g., *Athlet*innen*) or pair forms (e.g., *infirmiers et infirmières*, 'male and female nurses'), can attenuate the gender bias and increase the visibility of female jobholders (Horvath & Sczesny, 2016; Körner et al., 2022; Vervecken et al., 2013). In some languages, the use of additional feminine forms has been proposed (e.g., by using a suffix that is typical for feminine nouns). Yet, linguistic feminization has been found to be controversial, as the feminine terms might be perceived as having lower social status and making women sound less suitable for certain positions in some languages (e.g., Formanowicz et al., 2013, for Polish). Despite this controversy, their use has become increasingly popular and has been adopted in various languages, including German and French (Horvath & Sczesny, 2016; Westveer et al., 2018). Such forms have recently also been proposed in Greek, at least for some of the common gender occupational nouns, for example, *i epistimónisa*, 'the female scientist', instead of *i epistímonas* (e.g., Pavlidou et al., 2015). Even though the use of masculine forms appears

to dominate in administrative official documents in ministries, prefectures, city councils, and universities, there is a slight increase in the use of feminine forms, especially by university students (Lampropoulou & Georgalidou, 2017; Pavlidou et al., 2015). More research is needed to examine the use of these forms and in which ways they affect processing and gender inferences in future generations.

Conclusion

The present study was designed to examine the interplay of grammatical gender and gender stereotypes in the processing of morphologically marked occupational nouns of common gender in Greek. Our findings provide evidence for an interaction between grammatical gender and stereotypical information during language processing. Specifically, apparent morphosyntactic cues, albeit being uninformative about referential gender, seemingly mitigated the impact of gender stereotypes associated with female-biased role nouns in prime-target pairs involving a feminine pronoun, reflecting an interaction between grammatical form and stereotype.

The findings we obtained underscore the influence of word forms on language processing and suggest the need for strategies to promote gender-fair language. One limitation of the current study is the examination of gender as a binary category, investigating gender attitudes as female-biased or male-biased, as done in most relevant research (Cacciari & Padovani, 2007; Siyanova-Chanturia et al., 2012, 2015). If the debate is to be moved forward, a better understanding of the non-binary nature of gender needs to be developed, with a greater focus on the use of gender-inclusive forms to represent individuals who do not identify as male or female. Recent studies have investigated gender-fair language techniques, suggesting the use of non-cisgender methods that can be used by researchers (e.g., Ansara & Hegarty, 2014), for instance, the use of singular 'they' (Bradley, 2020; Moulton et al., 2022) and gender-neutral pronouns (Lindqvist et al., 2019; Tavits & Pérez, 2019). Moreover, other factors that could impact role noun processing and stereotypes, such as educational and socioeconomic background, must be understood better to broaden the approach to the topic that can be taken in the future. Determining the parameters that affect the activation of gender stereotypes during language processing will help us to find ways to modulate the resulting gender biases.

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Author Contributions: *Despoina Chalyvidou*—Conceptualization | Methodology | Writing – original draft | Formal analysis | Data curation | Visualization. *Andrea Weber*—Conceptualization | Methodology | Writing – review & editing | Supervision.

Ethics Statement: Research has been approved by the Deutsche Gesellschaft für Sprachwissenschaft (DGFS). Informed consent has been obtained from all respondents prior to their participation in the study.

Data Availability: The data related to the priming task and the codebook can be found in the OSF (see Chalyvidou & Weber, 2023b),

Supplementary Materials

For this article, the following Supplementary Materials are available:

- Pre-registration (see Chalyvidou & Weber, 2023a)
- The data related to the priming task and the codebook (see Chalyvidou & Weber, 2023b)

Index of Supplementary Materials

Chalyvidou, D., & Weber, A. (2023a). *The role of grammatical gender and gender stereotypes in noun processing: The tug of war in Greek* [Pre-registration]. OSF Registries. https://doi.org/10.17605/OSF.IO/PCZS4

Chalyvidou, D., & Weber, A. (2023b). *The role of grammatical gender and gender stereotypes in noun processing: The tug of war in Greek* [Data, codebook]. OSF. https://osf.io/uqezk

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Appendix

Table A1

Stereotypically Male and Stereotypically Female Role Nouns Used as Primes in the Priming Task

Stereotypical gender	Role noun	Rating (1 = mostly male, 5 = mostly female)
Male	αξιωματικός [aksiomatikós] (military officer)	1.75
	αστυνομικός [astinomikós] (police officer)	1.75
	δήμαρχος [δímarxos] (mayor)	1.63
	δασοφύλακας [δasofílakas] (forest ranger)	1.5
	εισαγγελέας [isangeléas] (prosecutor)	2.0
	εργολάβος [eryolávos] (building contractor)	1.25
	ηλεκτρολόγος [ilektrolóγos] (electrician)	1.0
	μαέστρος [maéstros] (orchestra conductor)	1.38

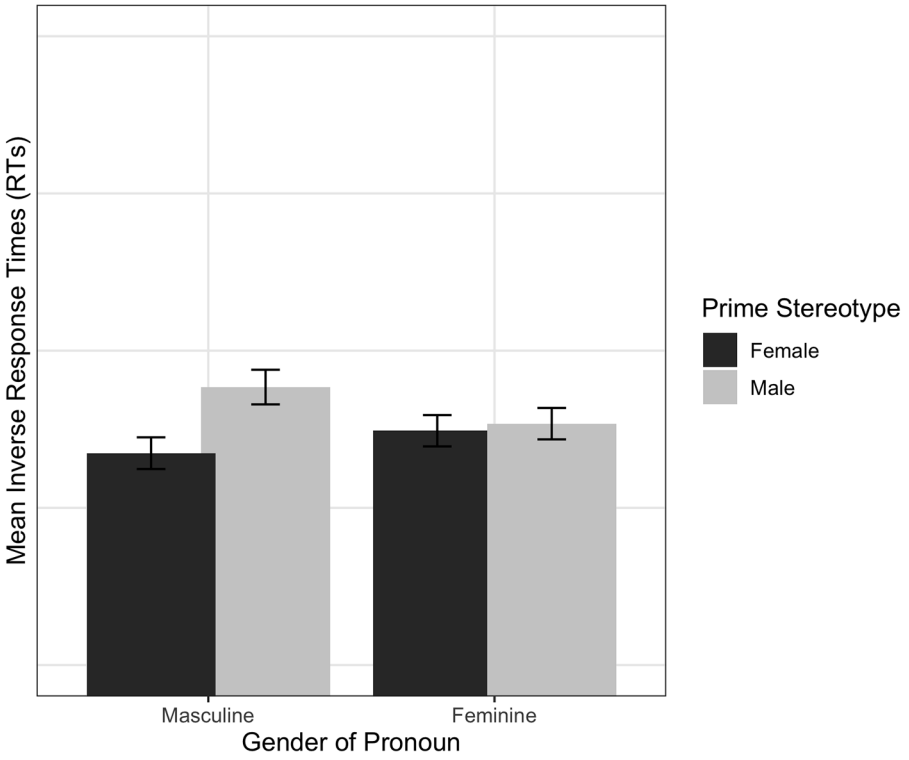
Stereotypical gender	Role noun	Rating (1 = mostly male, 5 = mostly female)
	μαθηματικός [mathimatikós] (mathematician)	2.13
	μηχανικός [mixanikós] (engineer)	1.25
	ξενοδόχος [ksenoδóxos] (hotel manager)	2.4
	πιλότος [pilótos] (pilot)	1.13
	συμβολαιογράφος[simvoleoγráfos] (notary)	2.13
	ταχυδρόμος [taxiδrómos] (courier)	1.4
	τερματοφύλακας [termatofílakas] (goalkeeper)	1.13
	τραυματιοφορέας[travmatioforéas] (paramedic)	1.25
	υδραυλικός [iδravlikós] plumber	1.0
	χειρουργός [xiruγós] surgeon	1.75
Female	αεροσυνοδός [aerosinoδós] (flight attendant)	4.5
	αισθητικός [esθitikós] (beautician)	5.0
	βιβλιοθηκάριος [vivlioθikários] (librarian)	3.63
	βιβλιοθηκονόμος[vivlioθikonómos] (librarian)	3.63
	βρεφοκόμος [vrefokómos] (daycare worker)	4.63
	βρεφονηπιοκόμος[vrefonipiokómos] (childminder)	4.63
	γραμματέας [γramatéas] (secretary)	4.63
	γλωσσολόγος [γlosolóγos] (linguist)	3.75
	δακτυλογράφος [δaktiloγráfos] (typist)	4.13
	διαιτολόγος [δietolóγos] (dietician)	3.75
	διατροφολόγος [δiatrofolóγos] (nutrionist)	3.9

Stereotypical gender	Role noun	Rating (1 = mostly male, 5 = mostly female)
	ενδυματολόγος enδimatolόgos] (costume designer)	4.0
	κοσμετολόγος [kozmetolόgos] (cosmetologist)	4.5
	μελλοντολόγος [melondolόgos] (fortune teller)	3.63
	νηπιαγωγός [nipiaγogós] (kindergarten teacher)	4.75
	ποδολόγος [poδolόgos] (podiatrist)	3.25
	στενογράφος [stenoγráfos] (stenographer)	4.13
	ταμίας [tamías] (cashier)	3.9

Note. For each word, the original Greek word is written in the first line, followed by the transliterated form in brackets. The English translation is provided in the second line.

Figure A1

Mean Inverse RTs in Decision of Gender of the Target Pronoun (Masculine vs. Feminine) When it Was Preceded by a Stereotypically Female or Male Role Noun Prime



Note. The error bars represent the standard error (SE) of the mean inverse RTs for each condition.

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