frontiers | Frontiers in Language Sciences

TYPE Original Research
PUBLISHED 05 January 2026
DOI 10.3389/flang.2025.1721806

OPEN ACCESS

EDITED BY
Seana Coulson,
University of California, San Diego,
United States

REVIEWED BY
Alba Casado,
University of Granada, Spain
Ruixue Wu,
Leiden University, Netherlands

*CORRESPONDENCE
Noelia Ayelén Stetie
✉ nstetie@uba.ar

RECEIVED 09 October 2025
REVISED 29 November 2025
ACCEPTED 30 November 2025
PUBLISHED 05 January 2026

CITATION
Stetie NA, Tzinavos Muñoz SM, Tomé Cornejo C and Zunino GM (2026) The puzzle of linguistic variation: a grammatical maze for studying gender processing in two diatopic varieties of Spanish.
Front. Lang. Sci. 4:1721806.
doi: 10.3389/flang.2025.1721806

The puzzle of linguistic variation: a grammatical maze for studying gender processing in two diatopic varieties of Spanish

Noelia Ayelén Stetie[1,2]*, Sofía María Tzinavos Muñoz[3], Carmela Tomé Cornejo[3] and Gabriela Mariel Zunino[1,2]

[1]Instituto de Lingüística, Facultad de Filosofía y Letras, Universidad de Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina, [2]Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Ciudad Autónoma de Buenos Aires, Argentina, [3]Universidad de Salamanca, Salamanca, Spain

Recent advances in psycholinguistics have increasingly recognized the importance of linguistic variation as central to understanding language processing. Gender represents an interesting area for analysis, as it allows us to observe the interactions between linguistic and socio-cultural phenomena during language processing. Particularly, Spanish is a paradigmatic language for studying this phenomenon, as it features grammatical gender and exhibits documented diatopic differences in its use and conceptualization. We seek to examine: (a) the impact of different types of information related to gender (grammatical vs. stereotypical) and (b) potential differences within Spanish-speaking communities. We conducted a G(rammatical)-maze task in which we considered three independent variables: grammatical gender, stereotypical (gender) bias and linguistic community. We manipulated two independent variables with two levels each to design the experimental items: stereotypical bias of the role nouns (female, male), grammatical gender (feminine, masculine). The task involved 277 Spanish speakers from Argentina ($N = 143$) and Spain ($N = 134$). Our results of the G-maze task replicate the documented (in)congruence pattern reported in prior research: the highest processing cost appears in the condition with male-biased role nouns with feminine morphology (*herreras*, female blacksmith). This indicates an asymmetry in the gender incongruence effect: the incongruence is more prominent in the case of male-biased role nouns with feminine morphology. As an unexpected finding, our results show a significant difference in the pronoun processing between the two Spanish diatopic varieties. We pose some possible interpretations due to syntactic and semantic factors, however it would be necessary to test it with an experiment specifically designed for that purpose. Finally, due to the results of some previous studies, we analyzed potential differences conditioned by gender identity. We found that, for both communities, men show a stronger asymmetric incongruence effect. This pattern could be interpreted as a greater difficulty for men to represent women in stereotypically male roles, such as *camioneras* (female truck drivers). Taken as a whole, our results highlight the value of psycholinguistic approaches to intra-linguistic variation, particularly in understanding how linguistic and sociocultural factors influence real-time comprehension across diatopic varieties.

KEYWORDS

intra-linguistic variation, diatopic variation, grammatical gender, gender stereotypes, Rioplatense Spanish, European Spanish

1 Introduction

Recent advances in psycholinguistics have increasingly recognized the importance of linguistic variation, both cross-linguistic and intra-linguistic, as central to understanding language processing (Crain et al., 2010; Kroll et al., 2021; Blasi et al., 2022). While much attention has been given in recent years to individual differences in language comprehension (Kaiser and Ender, 2021; Verspoor et al., 2021), a crucial dimension remains underexplored: the processing of diatopic variation. Examining how speakers of the same language from different linguistic communities process language offers valuable insights into the cognitive underpinnings of language variation and the complex articulation between language processing, world knowledge and sociocultural factors.

Within this framework, gender represents a fertile area for analysis, as it allows for the evaluation of linguistic phenomena related to grammatical gender, both at the lexical and syntactic levels, and also enables the study of gender stereotypes and their relationship to social gender. Particularly, Spanish is a paradigmatic language for studying this phenomenon, as it features grammatical gender and exhibits documented diatopic differences in its use and conceptualization (Urrutia Cárdenas and Ramírez Luengo, 2004; Fábregas, 2024). In the following sections, we first provide a brief grammatical overview of gender in Spanish, highlighting current knowledge regarding its diatopic variation. We then examine the relationship between grammatical gender and gender stereotypes in the psycholinguistic processing of gender and present current evidence on variation in this area.

1.1 Gender morphology in the Romance languages: the case of Spanish

The grammatical status of the gender category is a particularly controversial topic in the formal study of natural languages, as it directly impacts whether morphology and syntax are to be considered independent levels, with different combinatorial systems and primitives (Corbett, 1991; Kramer, 2015; Picallo, 2016; Fábregas, 2022, 2024). According to Fábregas (2022), the controversy around grammatical gender lies in three basic aspects: (1) the presence or absence of gender features in languages does not affect the presence or absence of other grammatical properties; (2) gender shows idiosyncratic behavior in relation to the factors that languages employ to assign gender to nouns, as well as in the number of gender values that can be attested; (3) total or partial mismatches are frequent, alongside other exceptional agreement patterns (e.g., those shown in Spanish by adverbs like *mucho* (much) as modifiers of comparative adjectives inside determiner phrases that contain mass nouns or nouns like *intención* in *mucha mejor intención* (much$_{[fem]}$ better intention), Fábregas and Pérez, 2008).

Romance languages are gendered languages: every noun, animate and inanimate, falls into at least two classes, explicitly called masculine and feminine, and generates agreement with other word classes such as adjectives and determiners (Corbett, 1991; Kramer, 2015; Gygax et al., 2019). Indeed, the predominant systems in these languages are binary, although in many of them one can attest, to varying degrees, the partial survival of the old Latin neuter with morphosyntactic repercussions. This occurs, e.g., in Sardinian, Romansh, or in the ambigeneric nouns of Italian—systematically masculine in the singular but feminine in the plural—showing a clear parallel with the tripartite systems of other Romance languages, such as Romanian or certain Italian dialects like Canepinese (Loporcaro, 2018). Typologically more anomalous are the quadripartite systems, such as those found in Neapolitan and other Italian dialects. These systems include an additional neuter expressing the notion of mass in contrast to the masculine, which is conceptually linked to the "neuter of matter" attested in Asturian and other varieties of northern Iberia (Fernández Ordóñez, 2007; Loporcaro, 2018).

The gender paradigm in Spanish falls within the binary systems of the Romance languages, such that nouns only display two values: masculine (*el libro*, *el chico*) or feminine (*la mesa*, *la chica*). Despite its apparent simplicity, its analysis faces a series of internal problems, among them its very nature, given that it exhibits properties of both derivational and inflectional processes (Ambadiang, 1999; Serrano Dolader, 2010; Giammatteo, 2020; Mendívil Giró, 2020; Fábregas, 2022, 2024). In contrast to pairs like *abogado/abogada* (lawyer$_{[masc]}$/lawyer$_{[fem]}$) or *gato/gata* (cat$_{[masc]}$/cat$_{[fem]}$), where gender difference is semantically predictable and the denotation of the noun remains unchanged—as is typical of inflection—other facts point in a different direction. The existence of unpredictable meanings—*naranjo/naranja* (orange tree/orange); *gorro/gorra* (wool cap/cap)—the possibilities of ellipsis (cf. Picallo, 2016; Fábregas, 2024), the diatopic, diachronic and even idiolectal variation in the gender value of certain nouns (see Section 1.1.1), the asymmetries in the identification of gender marking in nouns (cf. Fábregas, 2022) or the existence of nouns with a special feminine marker—*baronesa* (baroness), *sacerdotisa* (priestess)—suggest that gender is a lexical feature, belonging therefore to the domain of derivation. To address this problem, beyond considering gender as an inflectional morpheme interpreted derivationally in some noun pairs like *naranjo/naranja* (Serrano Dolader, 2010), it has been proposed that gender is a complex syntactic object divided into two distinct areas: gender as a nominal classifier contributes to delimiting the class of entity denoted by the noun within the area where the noun is defined as a predicate, while gender as a functional feature belongs to the area where the formal features involved in agreement operations are introduced, contributing to denote an individual rather than a class of individuals, projecting above the classifiers (Fábregas, 2022, 2024).

Fábregas proposal (2022; 2024) aligns with that of Roca (2005), Escandell-Vidal (2020), and Mendívil Giró (2020) in considering the feminine as the only marked[1] value in the gender paradigm (a proposal that goes back to Harris, 1991), which validates the generic interpretation of the masculine, whereby its use does not

1 Here we are addressing the notion of linguistic marking, that refers to the existence of an asymmetry in the distribution of a certain property, for example morphological, as in the case of grammatical gender, in a given set of linguistic elements (Croft, 1996). In Spanish, as in many other languages from different linguistic families, the masculine fulfils the function of unmarked gender, while the feminine fulfils that of marked gender.

exclude female members of the set. However, beyond such internal analyses, numerous studies have highlighted the connection of gender with extralinguistic factors, especially in nouns referring to people, in which grammatical gender is typically connected to biology and social gender (Ambadiang, 1999; Cabeza Pereiro and Rodríguez Barcia, 2013; López, 2020). Likewise, empirical evidence has shown that the generic masculine is often interpreted as specific, that is, as referring exclusively to male individuals (see Section 1.2), as occurs in other languages with grammatical gender (Menegatti and Rubini, 2017; Schmitz, 2023). In this sense, as Arias Barredo (1995, cited in López-Cortés, 2024) argues, if grammatical gender is associated with experiential content—in this case, biological or social gender—it should not be defined as a purely grammatical category.

1.1.1 Grammatical gender in Spanish: a matter of variation?

From a grammatical perspective, variation in noun gender may affect, in the case of inanimate nouns, the gender value they exhibit and, in the case of animate nouns, both the number of available gender markers and the gender class to which the noun belongs.

Thus, the gender value of certain inanimate nouns shows considerable variation across diachronic varieties—*puente* (bridge), feminine in Old Spanish (*la puente*), but masculine in present-day Spanish (*el puente*)—across diatopic varieties—*tanga* (thong), feminine in most American varieties (*la tanga*), but masculine in Spain (*el tanga*; cf. RAE and ASALE, 2025)—and even among speakers within the same geographic area, as in the case of traditionally so-called ambiguous nouns, such as *el mar/la mar* (the sea; cf. Del Barrio, 2023; RAE and ASALE, 2025). In this regard, Capilla-Martín (2024) argues that, in nouns with gender fluctuation, the masculine form predominates, as is generally the case with inanimate nouns in Spanish. Although in the fifteenth and sixteenth centuries the etymological feminine was the more frequent form in vacillating pairs such as *el/la color* (color), *el/la calor* (heat), *el/la énfasis* (emphasis), *el/la hojaldre* (puff pastry), *el/la honor* (honor), *el/la fin* (end) or *el/la origen* (origin), from the seventeenth century onward the masculine began to compete visibly and ultimately prevailed, especially from the eighteenth century onwards. According to her findings, the consolidation of the masculine gender first took place in administrative and scientific domains, while the feminine tended to become dialectalised or was relegated to literary registers, so that gender assignment was closely tied to the speaker's prestige, among other sociocultural factors (Capilla-Martín, 2024). The same pattern of masculine prevalence is observed in the case of loanwords in general and Anglicisms in particular (Díaz Hormigo, 2022; Capilla-Martín, 2024).

On the other hand, there are also purely geographical differences in some nominal derivatives, among others, instrument nouns (*tostador*$_{[masc]}$/*tostadora*$_{[fem]}$, toaster), place nouns (*piecero*$_{[masc]}$/*piecera*$_{[fem]}$, footboard) or participial nouns. For instance, in American Spanish varieties, the participial nouns *llamada*$_{[fem]}$ and *llamado*$_{[masc]}$ (call) alternate, while in European Spanish varieties only the feminine form is used. The same occurs with the Spanish noun for change, which is feminine in Spain (*vuelta*), but predominantly masculine in America (*vuelto*; cf. RAE and ASALE, 2025).

As for animate nouns, two specific cases of variation stand out. First, some Spanish-speaking communities have proposed the incorporation of the suffix [-e] as a new non-binary gender marker (*niñ-e,* child$_{[non-binary]}$), so that their system includes an additional nominal classifier that grammaticalises the feature [human], in contrast to varieties that lack this form (cf. Fábregas, 2022, 2024). This would give rise to a grammatical system with nouns of three endings—*hijo/hija/hije* (son/daughter/child)—and personal pronouns with four forms—*él/ella/elle/ello* (he/she/they$_{[sing]}$/it)—in which the masculine forms refer exclusively to male individuals (Menegotto, 2020). Although this usage is currently documented in different diatopic varieties of Spanish, it is not yet a widespread or systematic feature, it is conditioned by sociolinguistic factors (Bonnin and Coronel, 2021) and it shows different degrees of vitality across the Spanish-speaking world, much like other proposals for gender-inclusive language (Cabello Pino, 2020; Soler Montes, 2023; Stetie et al., 2023). In general terms, this morphological innovation is more established in American Spanish than in European Spanish (Cabello Pino, 2020). Specifically, Argentina and Chile are the countries where the use of the morpheme [-e] is most widespread, with the distinction that in Argentina its spontaneous adoption by speakers is also reinforced by institutional initiatives (Stetie et al., 2023).

Second, when naming professional roles traditionally occupied by men, these geographic areas are more inclined toward feminine marking with [-a], forming generic pairs such as *médico/médica*, *juez/jueza*, while in European Spanish there is some rejection of these feminine forms, even among women themselves working in these fields, and a greater tendency to use common gender forms (*la médico*, *la juez*; Ambadiang, 1999; Urrutia Cárdenas and Ramírez Luengo, 2004; Escandell-Vidal, 2018; Alfano and Voghera, 2023). Likewise, differences are observed in nouns generally used as epicenes in Spain, such as *bebé* (baby) or *ídolo* (idol), which, however, are attested with feminine in [-a] in certain regions of Spanish America, such as the Río de la Plata (*beba, ídola*; RAE and ASALE, 2025).

Taken together, these cases of variation highlight, on the one hand, the grammatical status of gender as a complex syntactic object, as described in Section 1.1, and, on the other hand, the influence of sociocultural factors in its configuration, particularly in the case of animate nouns. As discussed in the following sections, gender interpretation is also not uniform across the Spanish-speaking world, and differences in its processing have been found in relation to diatopic variation (see Section 1.2.1).

1.2 Gender in interaction: (in)congruence between stereotypes and morphology

Several researchers have observed that gender stereotypes may play a crucial role in the process of language comprehension (Carreiras et al., 1996; Duffy and Keir, 2004; Kreiner et al., 2008; Canal et al., 2015; Molinaro et al., 2016; Sato and Athanasopoulos, 2018; Lewis and Lupyan, 2020; Stetie and Zunino, 2022; Zunino and Stetie, 2022; Zunino et al., 2025a). That influence is particularly

salient in the construction of mental—or situation—models (Johnson-Laird, 1983; Van Dijk and Kintsch, 1983) that takes place during discourse interpretation.

Gender stereotypes are understood as the stable cognitive representations that constitute an individual's personal beliefs. Generally, they are linked to professions, occupations, and social roles (Stetie and Zunino, 2023), meaning they depend not only on internal factors but also on sociocultural ones (Lindvall-Östling et al., 2020). Furthermore, they are also related to other types of constructs referring to age, race, or social class (Zemore et al., 2000). This means that, beyond empirical characteristics, people tend to assume other types of learned and internalized information that affects their vision and comprehension of the world (Sato and Athanasopoulos, 2018). Within this framework, language is not merely a transmitter of thought, but rather a fundamental component in the processes of categorization and environmental perception (Gelman, 2004; Motschenbacher, 2014; Mecit et al., 2022; Zunino et al., 2025a).

In the domain of psycholinguistics, numerous experiments investigate the role of gender stereotypes in language processing from diverse perspectives. A prominent strand of research focuses on the interpretation of an anaphoric personal pronoun appearing after a role noun (Carreiras et al., 1996; Duffy and Keir, 2004; Kreiner et al., 2008; Canal et al., 2015). This approach has yielded highly relevant insights, particularly concerning the integration of stereotypical gender information into mental models during language comprehension. Carreiras et al. (1996) showed that, in both Spanish and English, this process occurs early, automatically and unconsciously, and, moreover, it exerts a strong influence on participants' cognitive processing. Nevertheless, they found different results for the two languages. In Spanish, grammatical gender is morphologically marked through inflections on nouns and determiners, whereas English lacks grammatical gender. Although processing was more difficult in both languages when grammatical gender and gender stereotype did not align, in Spanish, the cues to a referent's gender arise not only from the stereotypical representations associated with each role noun, but also from explicit morphological markers. Consequently, processing difficulties emerged at the role noun (*la futbolista*, the footballer$_{[fem]}$) but did not remain at the posterior pronoun (*ella*, she), in contrast to English. These findings suggest that there are qualitative differences in how gender information is processed depending on its source, grammatical vs. stereotypical (Carreiras et al., 1996; Canal et al., 2015).

Following the pioneering study by Carreiras et al. (1996) and using other experimental methods such as eye-tracking (Duffy and Keir, 2004; Kreiner et al., 2008), EEG-ERP (Canal et al., 2015), gender priming (Casado et al., 2023) or self-paced reading (Stetie and Zunino, 2023), a common effect was identified. It involved a phenomenon that we will refer as the (in)congruence effect, which presents a dual manifestation: the gender congruence effect, which occurs when the congruence between the stereotypical bias and the grammatical gender information facilitates processing, and the gender incongruence effect, which occurs when the discrepancy between the two hinders processing (Carreiras et al., 1996; Duffy and Keir, 2004; Zunino and Stetie, 2022; Stetie and Zunino, 2023). This effect is highly complex and manifests differently across languages. The specific way the (in)congruence between the two elements (grammatical gender and stereotypical bias) is processed varies widely, as evidenced by research within this framework: it can manifest within the role noun itself or between one grammatically marked element and another stereotypically biased element, such as a determiner, role noun, adjective, anaphoric or cataphoric pronoun, or even visually presented objects or faces. The nature of this manifestation depends, among other things, on the characteristics of the language studied (languages with grammatical gender, like the Romance languages are not the same as languages with natural gender, like English) and the processing task evaluated.

Specifically in the case of Spanish, the (in)congruence effect has been subject of considerable debate. Casado et al. (2023), for instance, examined lexical activation in Spanish using a gender-priming paradigm and found that the gender congruence effect caused a faster processing of congruent targets. Other studies have explored the interaction between grammatical gender and stereotypical bias, particularly in words referring to inanimate entities (Zunino et al., 2025a). From a psycholinguistic perspective, these findings reinforce the theoretical claim that feminine gender operates as the marked form, not only in grammatical terms, but also indicating that women's stereotypes might be socially marked too (Zemore et al., 2000; Siyanova-Chanturia et al., 2012; Hentschel et al., 2019; Zunino et al., 2025b). Nevertheless, the evidence is far from conclusive: the debate remains open as to whether incongruence invariably leads to greater processing costs than congruence, whether the alignment or misalignment of the female stereotype generates the same effect as that of the male stereotype and whether this effect manifests uniformly across languages (Siyanova-Chanturia et al., 2012; Porkert et al., 2024).

A separate dimension of this topic focuses on the generic masculine in Spanish which, as mentioned before (see Section 1.1), is traditionally defined as the unmarked gender and default form, but not always interpreted as genuinely generic: research has shown that the Spanish inflectional system holds an asymmetrical function that tends to hide women by generating an initial stereotypical male bias (Kaufmann and Bohner, 2014; Anaya-Ramírez et al., 2022; Zunino and Stetie, 2022; Stetie and Zunino, 2023; Heap, 2024; Vela-Plo et al., 2025). In this sense, Horvath et al. (2016) demonstrated that the use of paired forms increased the visibility of women, mitigating the androcentric representations projected by the generic masculine during language comprehension. In this same vein, López-Cortés (2024) stipulated that, generally, masculine plural nouns referring to people were interpreted as exclusive in most cases, except when they involved nouns strongly associated with feminine stereotypes. Even more recent is the work by Vela-Plo et al. (2025), in which various gender encoding strategies in European Spanish were tested. They concluded that masculine forms resulted in lower visibility of female referents in contrast to different gender-fair language strategies (gender splits, epicenes, and [-e] ending forms).

As can be seen, cultural and social aspects play a fundamental role in the construction of our mental models and, consequently, also notably affect the way we use and process language. Therefore,

we might expect differences in gender processing in different linguistic communities with speakers of the same language.

1.2.1 Gender on role names in Spanish: a matter of variation?

Beyond the cross-linguistic variation observed in the (in)congruence effect, evidence also points to intra-linguistic variation in how this effect manifests. As described in Section 1.1.1, there are documented differences in the realization of grammatical gender between American and European varieties of Spanish, particularly affecting role nouns. Furthermore, the findings discussed in Section 1.2 show that grammatical gender processing may be conditioned by gender stereotypes, whose construction exhibits a certain degree of variability not only across different communities but also among individuals within the same community (Zemore et al., 2000; Molinaro et al., 2016; Menegatti and Rubini, 2017; Lindvall-Östling et al., 2020). These considerations suggest the possibility of effects associated with two main dimensions: (1) diatopic variation and (2) social variation, understood both in terms of potential modulations across linguistic communities shaped by specific sociocultural contexts and in relation to individual factors, such as speakers' gender identity.

So far, research on grammatical gender processing has not usually focused on analyzing different varieties within the same language and only a few studies have explicitly addressed intra-linguistic variation. Notably, Stetie et al. (2023) examined the processing of binary and non-binary forms in Argentina and Chile through a sentence-reading task involving role nouns. Their findings revealed that the stereotypical bias of the role noun had a greater impact than the morphological gender marking, though distinct patterns emerged across the two communities: while in Argentina, male-biased role nouns were read faster than female-biased ones across morphological conditions, in Chile only the male-biased role nouns showed no differences between the two binary morphological variants. Non-binary [-e] forms led to localized processing difficulties but did not hinder overall comprehension in either variety, consistent with evidence from other languages (Vergoossen et al., 2020; Friedrich et al., 2021; Körner et al., 2022; Renström et al., 2022), although differences were observed when analyzing the articulation of participants' gender identity and the linguistic community. In a recent study, Zunino et al. (2025a) explored the interaction between grammatical gender and stereotypical bias in three linguistic communities (Argentina, Chile, and Spain) using a conscious judgment task to assess how inanimate nouns were associated with men or women. The results showed that grammatical gender influences the evaluation of neutral items (lacking stereotypical associations), with notable differences across communities, while semantic bias predominates in stereotyped items. In European Spanish, a more balanced effect of binary gender morphology was observed—both masculine and feminine forms generated some bias—whereas the American varieties showed a marked difference specifically with feminine morphology. Moreover, particularly when there was congruence between stereotypical bias and morphology, female-biased items received higher ratings in Argentina and Chile, while male-biased items did not vary across linguistic communities. This suggests that female stereotypical bias, like feminine morphological marking, may function as a specifically marked element in American communities, but not in European Spanish, which is consistent with the proposal that in Rioplatense Spanish the masculine and feminine morphology have become more specialized as exclusively masculine and exclusively feminine, respectively (Stetie et al., 2025; Zunino et al., 2025a).

Furthermore, although few systematic studies analyze how speakers' gender identity affects the processing of gendered language, some works explored this dimension from different perspectives. Sczesny et al. (2004) found that leadership stereotypes were more strongly associated with men than with women in three different countries (Australia, Germany, and India). Hentschel et al. (2019) observed that North American men and women differ in the way they describe others and themselves, finding, e.g., that women tend to characterize themselves within more stereotypical parameters compared to how they describe other women, whereas men showed the opposite pattern. In Spain, García-González et al. (2019) reported that women perceive higher levels of inequality in academic and scientific institutions than men, a finding that aligns with data from other European countries. It has also been proposed that gender identity and ideology, particularly through engagement with feminist and queer movements, notably influence the perception of grammatical gender (Vela-Plo et al., 2025). From a neurocognitive perspective, Wang et al. (2019) demonstrated that men and women exhibit different neural correlates in tasks related to gender stereotypes, suggesting differences in the role of the medial prefrontal cortex in controlling implicit stereotypes.

Particularly in Spanish, some studies indicate that participants' gender identity can modulate gender processing, but it is still not clear in which direction this influence occurs. Zunino et al. (2025a) explored how gender identity conditions overt conscious judgments about inanimate nouns with different stereotypical bias and grammatical gender and their results indicate that, both in neutral items and in items with a female bias, a specific effect emerges among female participants. Women displayed a feminizing bias in neutral items with feminine grammatical gender and in items stereotypically associated with their own gender identity. In contrast, men tended to assimilate these judgments only when female stereotypical bias aligned with morphological marking. Casado et al. (2023) reported that women tend to be more sensitive to gender congruence effects than men and similar effects were also reported for Italian (Siyanova-Chanturia et al., 2012; Pesciarelli et al., 2019) and linked to a potentially heightened sensitivity to grammatical violations and stronger language-related skills (Siegel, 2001). However, Kaufmann and Bohner (2014), in a short-story completion paradigm, found that participants' own gender shaped their responses, with men generally exhibiting a stronger male bias than women.

It remains unclear how participants' gender identity influences gender processing: whether women or men generally amplify stereotypical biases or whether each gender primarily reinforces biases aligned with their own identity. Moreover, it is also not clear if these effects differ depending on the type of task measured and, consequently, on the type of process evaluated, which go from conscious and strategic to subliminal and automatic processes.

2 Research questions and hypotheses

This research is framed within the broad area of study of intra-linguistic variation in language processing and we focus particularly on variation in gender processing across linguistic communities. As stated in Section 1, there are documented linguistic differences between Rioplatense and European Spanish around grammatical gender (Urrutia Cárdenas and Ramírez Luengo, 2004; Fábregas, 2024; Alfano and Voghera, 2023; Stetie et al., 2025; Tzinavos Muñoz et al., 2025; Zunino et al., 2025a), which make these two varieties particularly well-suited for examining the psycholinguistic processing of intra-linguistic variation. In addition, another source of linguistic variation in gender processing appears to be the gender identity of the participants (Kaufmann and Bohner, 2014; Casado et al., 2023; Zunino et al., 2025a).

There are not only differences between the two communities at the linguistic level but also at the sociocultural level, which is projected to the formation of social gender and gender stereotypes (Zemore et al., 2000; Gelman, 2004; Cuddy et al., 2015; Menegatti and Rubini, 2017; Lindvall-Östling et al., 2020). Although we acknowledge that gender indices may not be representative or rigorous enough to verify subtle cultural differences, given that there are no previous studies that analyze specific cultural differences around gender between the communities studied here, we used the Gender Inequality Index (GII), that belongs to the United Nations Development Programme (2024), to analyze potential differences between the communities of both countries. Last data available is for 2023: Argentina shows a GII of 0.264; Spain exhibits a GII of 0.044. As a lower GII value indicates lower inequality between women and men, we can see that the indices suggest the potential for sociocultural differences between both communities, which may influence gender stereotype perception. However, when compared using the World Economic Forum's Global Gender Gap Index (World Economic Forum, 2024), both countries present a more similar profile: Spain ranks 10th with a score of 0.797, while Argentina ranks 32nd with a score of 0.772. In this index, higher scores also indicate greater gender parity.

The research question we pose is whether these linguistic and sociocultural differences between these two Spanish speaking communities can condition language comprehension and generate differences in the real-time processing of sentences. In this context, we were interested in examining, on the one hand, the impact of different types of information related to gender (grammatical vs. stereotypical) and, on the other hand, potential differences within Spanish-speaking communities. To study this, we conducted a G(rammatical)-maze task (Forster et al., 2009; Zunino, 2025) in which we considered three independent variables: grammatical gender, stereotypical (gender) bias and linguistic community. In this task, participants had to process sentences with a role noun (professions) and then with a personal pronoun that implied retrieving the antecedent of that previous role noun. In this way, we evaluated gender processing at two locations: an initial noun phrase and a pronoun with anaphoric reference.

To reach an adequate comparative scene between the two linguistic communities, we first developed normative studies with two tasks to determine the role nouns to use in the G-maze study: a gender association judgment, with the objective of verifying the association of role nouns with gender stereotypes, but without explicitly involving the lexical form; and an acceptability judgment of noun phrases, to analyze the degree of acceptability of noun phrases with the explicit lexical forms.

For this experiment we formulated four main hypotheses. First, both male and female stereotypical bias role nouns were expected to generate processing difficulty when presented in a condition incongruent with their grammatical gender marking (e.g., *maestros*, teacher$_{[masc]}$; *herreras*, blacksmith$_{[fem]}$); however, some differences due to linguistic community (Rioplatense Spanish vs. European Spanish) were expected showing the interplay between language, culture and cognition. Second, we expected the (in)congruence effect to appear not only on the noun but also on the pronoun where the reference constructed on the noun is recovered, since, unlike Carreiras et al. (1996), the plural form in our stimuli enables a multiple referent interpretation. Third, we anticipated similar processing costs at the pronoun region across linguistic communities, suggesting that the underlying mechanisms of grammatical gender processing operate comparably despite diatopic differences. Finally, as an exploratory hypothesis, we expected to find processing differences depending on participants' gender identity.

3 Materials and methods

3.1 Participants

The task involved 277 Spanish speakers from Argentina (N = 143) and Spain (N = 134). After applying the exclusion criteria (exceeding the pre-established time limit of 40 min for task completion or making errors in more than 50% of the trials), we excluded 24 participants: 14 took more than 40 min to complete the task and 10 made mistakes in more than 50% of the trials. Of the remaining 253, 131 (67 women, 59 men, 4 non-binary and 1 person that did not indicate their gender identity) were speakers of Rioplatense Spanish that lived in Argentina (age: M = 39.34; SD = 15) and 122 (76 women, 45 men and 1 non-binary) were speakers of European Spanish that lived in Spain (age: M = 32.35; SD = 16.85), which conformed a very equilibrated sample. To achieve maximum homogeneity, participants were recruited from specific regions (Buenos Aires and surrounding areas for Rioplatense Spanish and Castilla y León and surrounding areas for European Spanish) and we confirmed that Spanish was their first language and that their primary residence was in the selected regions. Participants were between 18 and 81 years old and all had completed high school. Participation was voluntary and it did not involve any compensation.

Our study relied on robust samples, both in terms of size and qualitative characteristics (Buchstaller and Khattab, 2013; Vasishth, 2023; Berghoff and Bylund, 2025). We paid particular attention to avoiding WEIRD samples (Henrich et al., 2010; Apicella et al., 2020), whose biases may limit the generalizability of our findings. Instead, we aimed for a representative sample, which is especially crucial when investigating the impact of gender biases.

3.2 Materials

To design the G-maze items, we selected 20 nouns from previous normative studies (see Section 3.2.1), with either female[2] or male stereotypical bias, which followed a 2 × 2 factorial design. We manipulated two independent variables with two levels each to design the experimental items: stereotypical bias of the role nouns (female, male), grammatical gender (feminine, masculine). As we already stated, we were also interested in looking for differences according to linguistic variety and participant's gender identity. Although these two independent variables were not manipulated for the design of the experimental items, the former implied that we had to adapt the items to each Spanish variety.

Following the design of previous studies on gender processing, we assessed participants' interpretation of a personal pronoun appearing after a role noun (Carreiras et al., 1996; Duffy and Keir, 2004; Kreiner et al., 2008; Canal et al., 2015) and focused the attention in the (in)congruence effect. We designed 40 sentences in total, like examples (1) and (2), distributed across 4 counterbalanced lists. Each sentence began with a role noun that belonged to one of four possible conditions, depending on the interaction between grammatical gender and stereotypical bias: female bias and feminine morphology (congruent), female bias and masculine morphology (incongruent), male bias and masculine morphology (congruent), male bias and feminine morphology (incongruent). All noun phrases were in plural and, in all sentences, we used past tense and similar length, with mean length controlled by condition: between 13 and 16 words ($M = 13.68$; $SD = 0.80$), and in all cases there were 4 or 5 words ($M = 4.23$; $SD = 0.44$) between the role noun and the pronoun. We defined two regions of interest: the role noun and the personal pronoun that appeared in the second clause, allowing us to evaluate the processing cost associated with gender (in)congruence at different points during sentence processing.

(1) female stereotypical bias (congruent/incongruent morphology):

Las/os maestras/os ordenaron las sillas del aula; ellas/os prepararon todo para el primer día de clases.

The$_{[fem/masc]}$ teachers$_{[fem/masc]}$ arranged the chairs in the classroom; they$_{[fem/masc]}$ prepared everything for the first day of school.

(2) male stereotypical bias (congruent/incongruent morphology):

Los/as herreros/as soldaban la nueva reja metálica; ellos/as hacían un excelente trabajo coordinado.

The$_{[masc/fem]}$ blacksmiths$_{[masc/fem]}$ welded the new metal fence; they$_{[masc/fem]}$ did an excellent job in coordination.

In the G-maze task, participants have to choose between two options at each word of the sentence (Forster et al., 2009; Zunino, 2025; see Section 3.3). The distractor, i.e., the incorrect option, was carefully designed according to the following four criteria: (a) length in phonemes had to be controlled, allowing for a difference of up to one phoneme between target and distractor; (b) it had to be grammatically incompatible with completing the sentence at that point; (c) it had to match the grammatical category of the target word (content words or function words); (d) beyond the general grammatical category, we also balanced lexical type: for target verbs, in half of the cases the distractor was also a verb (though contextually incompatible) and in the other half it was a noun, while for target nouns, half of the distractors were nouns and half were not. Criterion (c) applied to all words except for personal pronouns, because several function words could replace them and continue the sentence appropriately. Therefore, we chose to use a one-syllable noun as a distractor for all pronouns. In (3) we present the distractor sentence for the experimental item presented in (1). As can be seen in the example, the distractor sentence is not a sentence in itself, but rather a set of words that serve as distractors from the target sentence, which is indeed a sentence.

(3) *x-x-x cortinado conversó del techo tus paño; pan reconozco palco las de cuando pez la blusas.*

Although the items were the same for both Spanish varieties, minor lexical adaptations were necessary due to diatopic variation. For example, while the role noun *partera* (midwife or accoucheur) is typical in Rioplatense Spanish, their European Spanish equivalent is *matrona*. This point also highlights the importance of considering dialect-specific features in the design of psycholinguistic tasks (Freitag and Soto, 2023; Zunino et al., 2025a). Conducting comparative studies between diatopic varieties of Spanish requires addressing complexities that may be overlooked due to the apparent similarity between varieties and could introduce unintended biases. Our normative studies in both Spanish varieties helped ensure that potential differences observed in processing stem from cognitive factors rather than methodological artifacts.

Additionally, we used 48 distractors that corresponded to the stimuli from another experiment, as illustrated in (4). We organized all the items into four lists with 22 items each: 10 experimental and 12 fillers.

(4) Eduardo miró al representante de la jugadora que estaba relativamente cubierto por la red.

Eduardo looked at the$_{[masc]}$ representative$_{[masc]}$ of the$_{[fem]}$ player$_{[fem]}$ that was relatively covered$_{[masc]}$ by the net.

3.2.1 Normative studies

To select the female-biased and male-biased role nouns, we conducted normative studies that included two tasks: a gender association judgment and an acceptability judgment of noun phrases. To ensure that the materials were suitable for both varieties of Spanish, we conducted the normative studies with speakers of both varieties. Although the items were the same for both Spanish varieties, as in the G-maze task, minor lexical adaptations were necessary due to diatopic variation, such as the case of *verdulero* and *frutero* (greengrocer) in Rioplatense and European Spanish, respectively.

The first task had the objective of verifying the association of role nouns from different professions with gender stereotypes, but without explicitly involving the lexical form, to avoid frequency

2 As presented in Section 3.2.1, the initial design was for one of the conditions to be male-biased role nouns and the other female-biased role nouns. However, as can be seen in Table 3, some of the role nouns, particularly in the European Spanish linguistic community, do not strictly have a female bias, but rather a non-male bias.

10.3389/flang.2025.1721806

TABLE 1 Examples of items for task 1 of the normative studies.

Target item	A priori stereotype	Eliciting item
Maestros (teachers)	Female	*Entre las personas que enseñan en escuelas, dirías que hay…* (among people who teach in schools, would you say there are…)
Herreros (blacksmiths)	Male	*Entre las personas cuyo oficio es la herrería, dirías que hay…* (among people whose profession is blacksmithing, you would say there are…)
Arquitectos (architects)	Neutral	*Entre las personas que se especializan en diseñar casas, dirías que hay…* (among people who specialize in designing houses, would you say there are…)

TABLE 2 Examples of items for task 2 of the normative studies.

Target item with fem. morphology	Target item with masc. morphology	A priori stereotype
Las maestras	*Los maestros*	Female
Las herreras	*Los herreros*	Male
Las arquitectas	*Los arquitectos*	Neutral

effects. Participants judged the distribution of women and men within each role using a Five-point Likert scale: all men, more men than women, same quantity of men and women, more women than men, all women. In half of the items, the scale was reversed. We selected 35 role nouns, classified *a priori* as female, male or neutral. Gender morphology was not manipulated in this task, but each item could form a gender pair through explicit gender marking. Each item included an eliciting phrase to test gender associations while avoiding biases linked to morphological marking or lexical frequency. In Table 1, we present examples for each target type.

The second task aimed to evaluate the acceptability of noun phrases explicitly containing the lexical forms later used in the G-maze task. As no prior normative data compared both Spanish varieties and given that we cannot rely on lexical frequency data, it was necessary to carry out this acceptability test for the isolated noun phrases. Participants rated acceptability on a Five-point Likert scale: totally acceptable, pretty acceptable, acceptable, slightly acceptable, not acceptable; with half of the items presented in reverse order. The same items from the first task were used, but each appeared in two morphology conditions (feminine and masculine), adding an independent variable to the design. In Table 2, we present examples for each target type.

Both tasks were administered online using PCIbex (Zehr and Schwarz, 2018) with a between participant design. Items were distributed in three counterbalanced lists, so no participant saw each item more than once and every participant was exposed to all conditions. In addition, the order of the options changed randomly to prevent automatic responses due to systematic display. The task could be performed on any electronic device with Internet connection and its completion took between 5 and 10 min depending on the participant. Figures 1, 2 show examples of how each task looked.

A total of 267 participants (113 Rioplatense and 154 European speakers) took part in the study, including both tasks. They were between 18 and 73 years old ($M = 37.6$; $SD = 13.3$). The ample age range was a key factor to have a representative sample. The results of both tasks guided the selection of the 20 final role nouns used to design the experimental stimuli of the G-maze task. We used the first task to choose the role nouns and the second task to confirm that those lexical forms plus the determiner in both grammatical genders (e.g., *los maestros*, the$_{[masc]}$ theachers$_{[masc]}$, and *las maestras*, the$_{[fem]}$ teachers$_{[fem]}$) were acceptable.

Table 3 presents the final role nouns chosen for each stereotypical bias and indicates the percentage of predominantly female or predominantly male responses, as appropriate, for speakers of each Spanish variety. If male responses reached 51% or more for one item, this item was classified as male-biased; if female responses reached 51% or more for one item, this was classified as female-biased. As shown in Table 3, we did not reach this percentage with all female items and, as we needed at least 10 to form a complete experimental condition for the G-maze task, we implemented another criterion. We decided to organize one group of male items, as previously described, and one group of items without male bias, where we considered all strictly female-biased items plus items that showed more than 25% of female responses and reached 80% of the total responses with neutral responses (this means that for those items there were less than 20% male responses). Furthermore, all these items received more than 60% acceptability responses in the second task, confirming that they were an appropriate selection for the subsequent design of the G-maze items.

Finally, we would like to point out that the results of these two tasks already show two important effects that will also be observed in the analysis of the G-maze results and which we will return to in Section 5: an asymmetry effect between stereotypes and diatopic differences. Regarding the latter, the results revealed variation in stereotype attribution across linguistic communities. In other words, although gender stereotypes can be defined as pan-cultural (Gibbons, 2000), they also vary to some degree between different linguistic communities (Zemore et al., 2000; Gelman, 2004; Cuddy et al., 2015; Menegatti and Rubini, 2017; Lindvall-Östling et al., 2020). Regarding the former, male stereotypes exhibit greater strength and consistency than female stereotypes: role nouns associated with men elicit very strong judgments toward the male bias, while those associated with women were more often judged as neutral rather than distinctly female. For a more detailed analysis of both tasks, see Tzinavos Muñoz et al. (2025) and Stetie et al. (2025) and data and analysis code available at Open Science Framework (OSF): https://osf.io/y8vkc/.

TABLE 3 Selected role nouns for the G-maze task according to the results of task 1 of the normative studies.

Female bias	RS female %	ES female %	Male bias	RS male %	ES male %
Maestros	89.7	51.7	*Bomberos*	100	100
Pedagogos	82.1	69.0	*Mineros*	100	100
Astrólogos	79.5	39.6	*Mecánicos*	100	100
Bibliotecarios	77.1	58.1	*Herreros*	100	97.7
Parteros/matrones	74.3	83.7	*Carpinteros*	100	96.2
Secretarios	71.8	69.0	*Camioneros*	100	95.3
Enfermeros	69.2	90.6	*Sepultureros*	94.9	90.6
Psicólogos	64.1	56.6	*Ingenieros*	94.3	65.1
Ginecólogos	37.1	37.2	*Marineros*	91.4	83.7
Peluqueros	28.2	41.4	*Cirujanos*	69.2	54.7

RS, Rioplatense Spanish; ES, European Spanish.

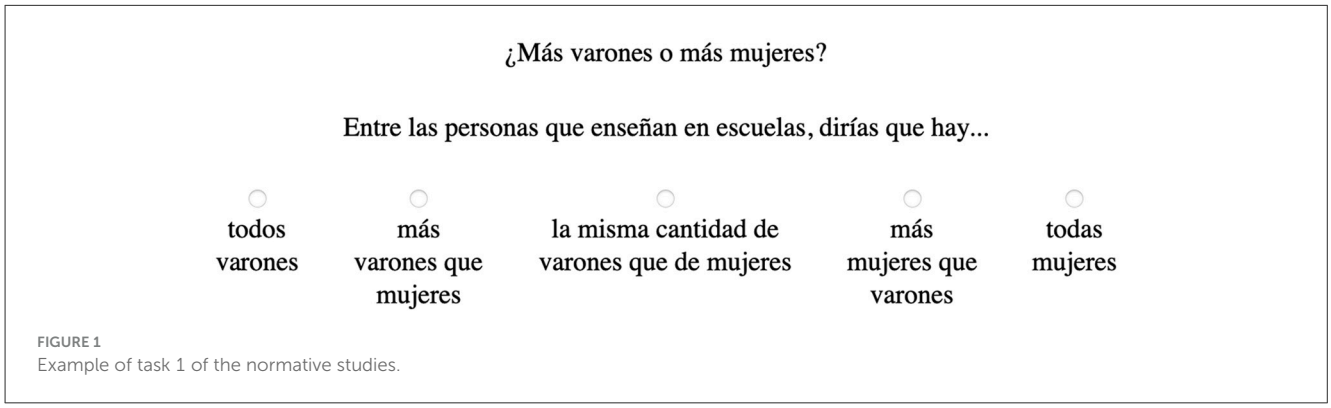

FIGURE 1
Example of task 1 of the normative studies.

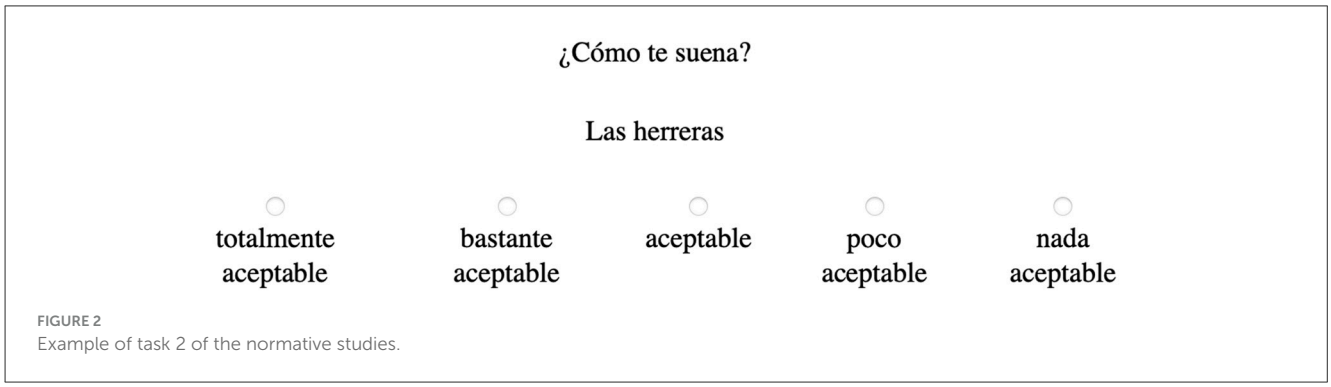

FIGURE 2
Example of task 2 of the normative studies.

3.3 Procedure

The task was programmed and conducted on the PCIbex platform (Zehr and Schwarz, 2018). First, we presented an informed consent that had to be accepted to access the demographic data questions and the experiment. Participants were asked to indicate their age, gender identity, highest level of education achieved, first language and linguistic variety, nationality and city of residence. One of the four counterbalanced lists was randomly assigned to each participant, so no one saw the same item twice.

The G-maze task consists in selecting one of two items (one word and one distractor) presented on a screen in order to form a complete sentence, as shown in Figure 3. At their own pace, participants selected which word was the adequate one on each screen to construct the sentence. The experiment began with four practice sentences, and to help participants understand the dynamics of the task, they were given feedback, i.e., they were informed if they had selected an incorrect option and were allowed to correct their choice. After the practice, two training sentences followed, which participants perceived as already part of the task,

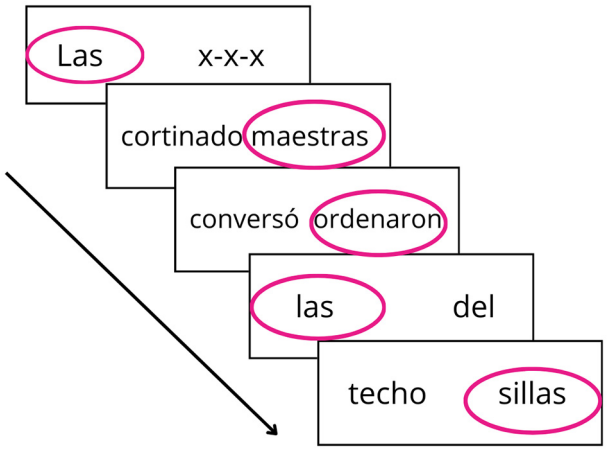

FIGURE 3
Representation of the G-maze task.

though they were not included in the data analysis. In all cases, participants saw two words at the center of the screen, as shown in Figure 3. At the end of each sentence, a fixation point appeared in the middle of the screen for 500 ms before moving on to the next item. If they selected the distractor word, a message appeared indicating they had made an error. In addition, since the task was very demanding, we included three mandatory breaks during which participants could take as much time as they needed.

The task could only be performed on a computer with an Internet connection. Participants were recruited through social media and through seminars and lectures. Completing the task took approximately 15 min depending on the participant.

4 Results

We considered two dependent variables: role nouns reaction times and pronouns reaction times. We did not consider spillover regions as the maze technique significantly reduces this type of effect (Forster et al., 2009; Zunino, 2025). Statistical analysis was performed using R software version 4.4.2 in the R Studio interface (R Core Team, 2024). We used the following packages: tidyverse (Wickham et al., 2019), lme4 (Bates et al., 2015), lmerTest (Kuznetsova et al., 2017), sjPlot (Lüdecke, 2024), MASS (Venables and Ripley, 2002) and car (Fox and Weisberg, 2019). Data and analysis code are available at OSF: https://osf.io/y8vkc/.

In addition to the exclusion criteria previously mentioned, for the final analysis, we checked for outliers and discarded items that were answered erroneously. Regarding the first point, we considered two cuts for outliers: (a) first, we eliminated 58 extreme data points (those with reaction times of less than 100 ms or more than 3,500 ms per word), which represented 2.87% of the total sample; (b) then, as is the standard in the literature, we considered 2.5 standard deviations for each participant in each condition to detect outliers and made a possible imputation (Baayen and Milin, 2010; Cousineau and Chartier, 2010), however we did not find any data point outside this limit. Regarding the second point, we discarded trials where at least one error had been made, regardless of whether it was in the two words we wanted to analyze (the role noun and the pronoun) and this implied eliminating a total of 508 data points (20.07% of the data). Although this number may seem high, in G-maze tasks the error rate is generally high due to the demanding nature of the task (Forster et al., 2009; Zunino, 2025).

Finally, although there is conflicting evidence regarding possible differences in gender processing based on participants' gender identity (Kaufmann and Bohner, 2014; Casado et al., 2023; Zunino et al., 2025a), we were also interested in evaluating this variable in our sample. Since the European Spanish sample was slightly unbalanced in terms of participants' gender identity, we drew a subsample that was gender-balanced to conduct this analysis.

Below, we report the results of the two dependent variables analyzed in the total sample and then report the analysis of the gender-balanced subsample.

4.1 Role noun reaction times

First, we analyzed the role noun reaction times. We did not include the determiner reaction times in this analysis as we did not expect any differences on this measure, although we acknowledged that it plays an important role as it is where grammatical gender information begins to be computed, due to agreement in Spanish (Fábregas, 2024). Furthermore, as it was the first word in the sentence, there was no distractor word competing with it, only x-x-x, as can be seen in Figure 3. However, in Figure 4, we did include the determiner to show that in fact there were no differences across conditions.[3] As shown in Figures 4, 5, we find a similar pattern in both linguistic communities, although with some specificities: the condition that had the longest reaction times was role nouns with male bias and feminine morphology (incongruent condition), while the one with the shortest reaction times was the congruent masculine condition (male bias and masculine morphology). Moreover, in the Rioplatense Spanish sample, there do not appear to be major differences between the other conditions, whereas in the European Spanish sample, there are.[4]

For the statistical analysis, we tested the assumptions of normality and homoscedasticity based on Linear Mixed Models (LMM) and decided to perform a logarithmic transformation for data analysis (Winter, 2019; Vasishth et al., 2021). We coded the levels of fixed factors as scaled sum contrasts (Schad et al., 2020). The models used for the analysis included Linguistic community, Stereotypical bias and Grammatical gender as fixed effects and Participants and Items as random effects. We used nested models to test specific planned comparisons, which allowed us to avoid omnibus analyses and calculations of interactions irrelevant to our hypotheses.

3 In Supplementary materials, we included an analysis of the determiner reaction times, which confirms that there are no statistically significant differences between the different conditions evaluated.

4 In Supplementary materials, we included another figure detailing the reaction times for each role noun, which allows us to pinpoint even smaller differences between the two linguistic communities.

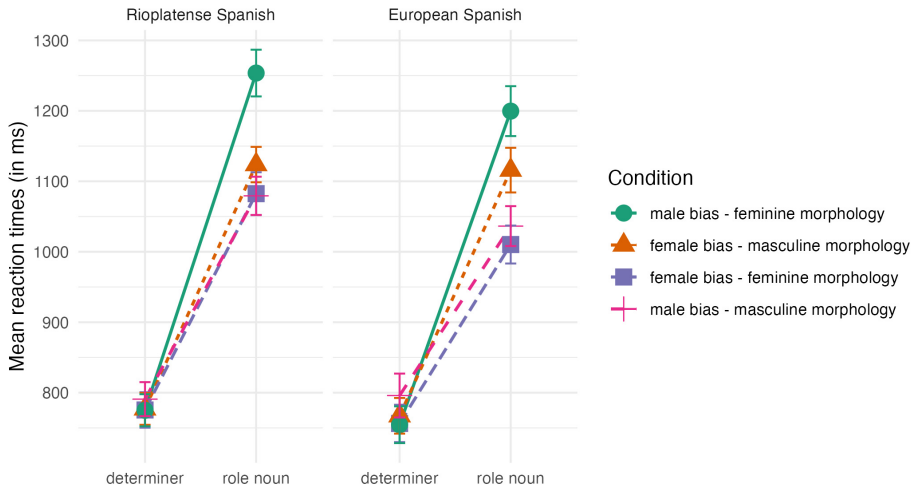

FIGURE 4
Mean determiner and role noun reaction times by linguistic community, stereotypical bias, and grammatical gender. Error bars represent standard errors of the mean.

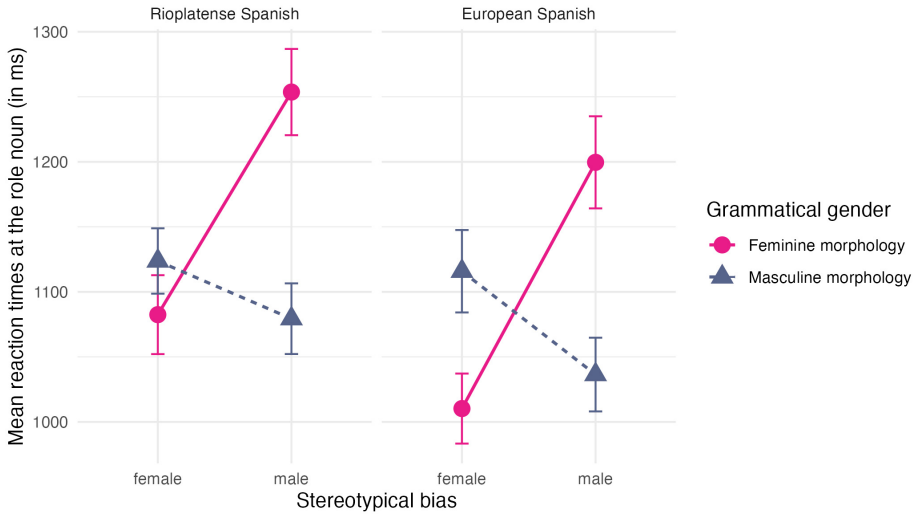

FIGURE 5
Mean role noun reaction times by linguistic community, stereotypical bias, and grammatical gender. Error bars represent standard errors of the mean.

The resulting model, chosen by AIC between convergent models, was: lmer(log(reaction_time) ~ Linguistic community / Stereotypical bias / Grammatical gender + (1 | Participants) + (1 | Items)). The results for each variable are presented in Table 4.

As shown in Table 4, we found no statistically significant differences between the two Spanish varieties, nor regarding stereotypical bias. However, we did find an effect of grammatical gender nested within stereotypical bias in both linguistic communities. For Rioplatense Spanish, there was a statistically significant effect of grammatical gender only in role nouns with male bias, while for European Spanish this effect was present in both male-biased and female-biased role nouns.

4.2 Pronoun reaction times

Second, we analyzed the pronoun reaction times. As shown in Figure 6, there are differences in patterns between the two linguistic communities. While in the Rioplatense Spanish sample there do not appear to be any differences between conditions, in the European Spanish sample there is a clear pattern differentiated according to the variables of grammatical gender and stereotypical bias: participants had shorter reaction times for pronouns with feminine morphology and for those in sentences with male-biased role nouns.

For statistical analysis, we performed the same procedures as in the previous case. We also used LMM, but in this case we nested

the variables differently, as we considered that grammatical gender would have a more marked effect on the pronoun, given that the stereotypical bias was not a characteristic of the pronoun *per se*, but of the role noun present in the first clause of the sentence. Thus, the formula for the resulting model was: lmer(log(reaction_time) ~ Linguistic community / Grammatical gender / Stereotypical bias + (1 | Participants) + (1 | Items)). The results for each variable are presented in Table 5.

TABLE 4 Summary of LMM analysis for role noun reaction times by linguistic community, stereotypical bias, and grammatical gender.

Predictors	Estimates	*SE*	*t*	*p*
(Intercept)	6.95	0.02	380.61	**<0.001**
Linguistic community	−0.04	0.03	−1.33	0.185
$Linguistic_{Rioplatense}$/ stereotypical bias	0.04	0.02	1.59	0.117
$Linguistic_{European}$/ stereotypical bias	0.04	0.03	1.74	0.085
$Linguistic_{Rioplatense}/Bias_{female}$/ grammatical gender	0.04	0.03	1.08	0.285
$Linguistic_{European}/Bias_{female}$/ grammatical gender	0.08	0.04	2.11	**0.038**
$Linguistic_{Rioplatense}/Bias_{male}$/ grammatical gender	−0.12	0.03	−3.46	**<0.001**
$Linguistic_{European}/Bias_{male}$/ grammatical gender	−0.14	0.04	−4.01	**<0.001**
Random effects				
σ^2	0.08			
$\tau_{00\ part}$	0.05			
$\tau_{00\ item}$	0.00			
ICC	0.43			
N_{part}	253			
N_{item}	40			
Observations	1,965			
Marginal R^2/Conditional R^2	0.026/0.445			

Bold values highlight statistically significant results.

The results in Table 5 reinforce what was noted from Figure 6: there are no statistically significant differences between conditions in the Rioplatense Spanish sample, but there are in the European Spanish sample. Particularly, European Spanish participants had longer reaction times for pronouns with masculine morphology than feminine morphology, and for pronouns that appeared in sentences with female-biased role nouns rather than male-biased.

4.3 Gender identity as a factor: reaction times in gender-balanced subsample

To generate the gender-balanced subsample, we took the limit of 45 men from the sample of European Spanish speakers and matched all other groups to 45. We did this by randomly selecting 45 participants from each group.[5] Likewise, to make this comparison, we did not consider participants with non-binary gender identities, as there were only five of them, which represented only 1.98% of the sample, and statistical comparisons require balanced groups. Therefore, the gender-balanced subsample consisted of a total of 180 participants: 90 (45 men and 45 women) from Rioplatense Spanish and 90 (45 men and 45 women) from European Spanish.

In Figure 7 we show the mean reaction times for role nouns. As can be seen, the patterns between the two gender identity groups within each linguistic community are similar, but some differences are accentuated: in all cases, there are differences in feminine morphology depending on stereotypical bias—shorter

5 For a detailed look at this process, see Supplementary materials.

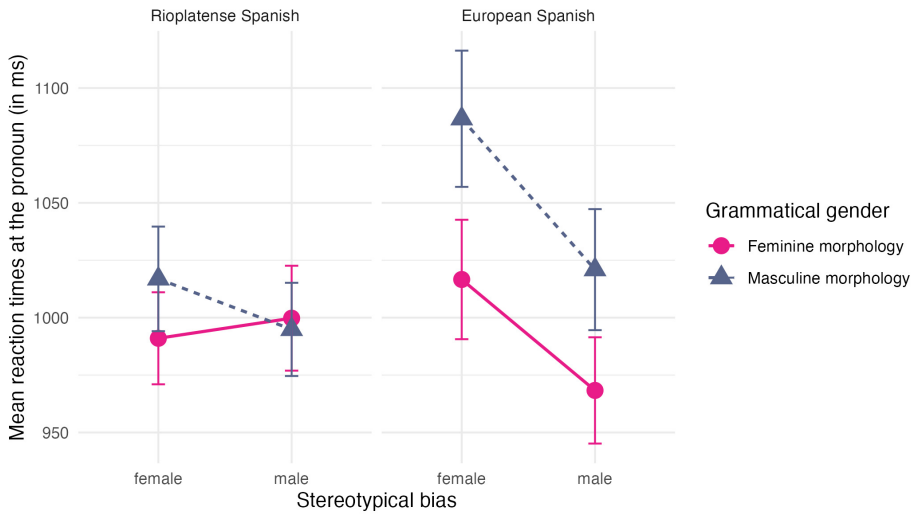

FIGURE 6
Mean pronoun reaction times by linguistic community, stereotypical bias, and grammatical gender. Error bars represent standard errors of the mean.

TABLE 5 Summary of LMM analysis for pronoun reaction times by linguistic community, grammatical gender, and stereotypical bias.

Predictors	Estimates	*SE*	*t*	*p*
(Intercept)	6.87	0.02	420.72	**<0.001**
Linguistic community	0.02	0.03	0.55	0.581
$\text{Linguistic}_{\text{Rioplatense}}$/ grammatical gender	0.01	0.02	0.55	0.586
$\text{Linguistic}_{\text{European}}$/ grammatical gender	0.05	0.02	2.58	**0.011**
$\text{Linguistic}_{\text{Rioplatense}}$/ $\text{grammatical gender}_{\text{feminine}}$/ stereotypical bias	−0.01	0.03	−0.36	0.721
$\text{Linguistic}_{\text{European}}$/ $\text{grammatical gender}_{\text{feminine}}$/ stereotypical bias	−0.06	0.03	−2.01	**0.047**
$\text{Linguistic}_{\text{Rioplatense}}$/ $\text{grammatical gender}_{\text{masculine}}$/ stereotypical bias	−0.01	0.03	−0.31	0.758
$\text{Linguistic}_{\text{European}}$/ $\text{grammatical gender}_{\text{masculine}}$/ stereotypical bias	−0.06	0.03	−2.04	**0.045**
Random effects				
σ^2	0.05			
$\tau_{00\ \text{part\_id}}$	0.05			
$\tau_{00\ \text{item}}$	0.00			
ICC	0.49			
$N_{\text{part\_id}}$	253			
N_{item}	40			
Observations	1,965			
Marginal R^2/Conditional R^2	0.007/0.498			

Bold values highlight statistically significant results.

reaction times for the congruent condition and longer for the incongruent condition—in contrast, masculine morphology does not seem to be affected by stereotypical bias, except for men from the European Spanish sample.

We performed a statistical analysis following the same steps and criteria defined in Section 4.1 and used a LMM with the following formula: lmer(log(reaction_time) ∼ Linguistic community / Gender identity / Stereotypical bias / Grammatical gender + (1 | Participants) + (1 | Items)). The results for each variable are presented in Table 6. From this analysis, four main factors stand out. First, in the Rioplatense Spanish sample, there are differences depending on gender identity, whereas in the European Spanish sample not, however this effect is transversal, since in the Rioplatense Spanish sample the performance pattern is similar between women and men, the only difference is that men had longer reaction times in all conditions. Second, for both women and men from both linguistic communities, although considering that in the case of the Rioplatense Spanish men this difference is marginally significant, the stereotypical bias has different effects, with longer reaction times for the male-biased role nouns. Third, in the female-biased role nouns, there are no statistically significant differences between the two grammatical gender conditions in either group of subjects. Lastly, the differences in grammatical gender are present only in the male-biased role nouns in the men from both samples, not in the female participants.

In addition to the role noun, we also analyzed the pronoun reaction times in this subsample. As shown in Figure 8. We found that feminine morphology implies shorter reaction times. This pattern is repeated for all groups of participants, except for men from the Rioplatense Spanish sample, which, in turn, is consistent with what we observed in Figure 7 regarding role nouns. Likewise, we can also observe that the difference in stereotypical bias is more or less marked in each group of participants, with women from both linguistic communities showing the most marked differences: while it appears that there are no differences according to the stereotypical bias among women from Rioplatense Spanish, there is a more marked difference among women from European Spanish.

We performed a statistical analysis following the same steps and criteria defined in Section 4.2 and used a LMM with the following formula: lmer(log(reaction_time) ∼ Linguistic community / Gender identity / Grammatical gender / Stereotypical bias + (1 | Participants) + (1 | Items)). The results for each variable are presented in Table 7. The only statistically significant comparisons are for women from European Spanish, where there are differences in stereotypical bias nested in both grammatical gender conditions, i.e., both pronouns, those with feminine morphology and those with masculine morphology, that appear in sentences with female-biased role nouns, had longer reaction times. This implies that the pattern we observe in Figure 6 and Table 5 (Section 4.2) for European Spanish speakers could be driven by the behavior of women in that group.

5 Discussion

In this paper, we analyzed data from a G-maze task and two normative studies that evaluated intra-linguistic variation in language processing linked to different dimensions related to gender. We evaluated the (in)congruence effect by analyzing the influence and interaction of grammatical information and stereotypical information related to gender. We also wanted to evaluate potential intra-linguistic variation by analyzing two Spanish-speaking communities (Rioplatense and European) and two gender identities (women and men). From the G-maze task we obtained two dependent variables: the role noun reaction times and the pronoun reaction times. We structured the discussion around three main points of analysis that group the different hypotheses and reflect the organization of the results: the role noun, the pronoun and the potential gender identity differences.

5.1 The role noun: asymmetric (in)congruence effect

Regarding the role noun, we identified four key points. First, conducting normative studies in both Spanish linguistic communities was essential to an adequate experimental design. Additionally, the first task of the normative studies also allowed us to identify emerging differences between linguistic communities:

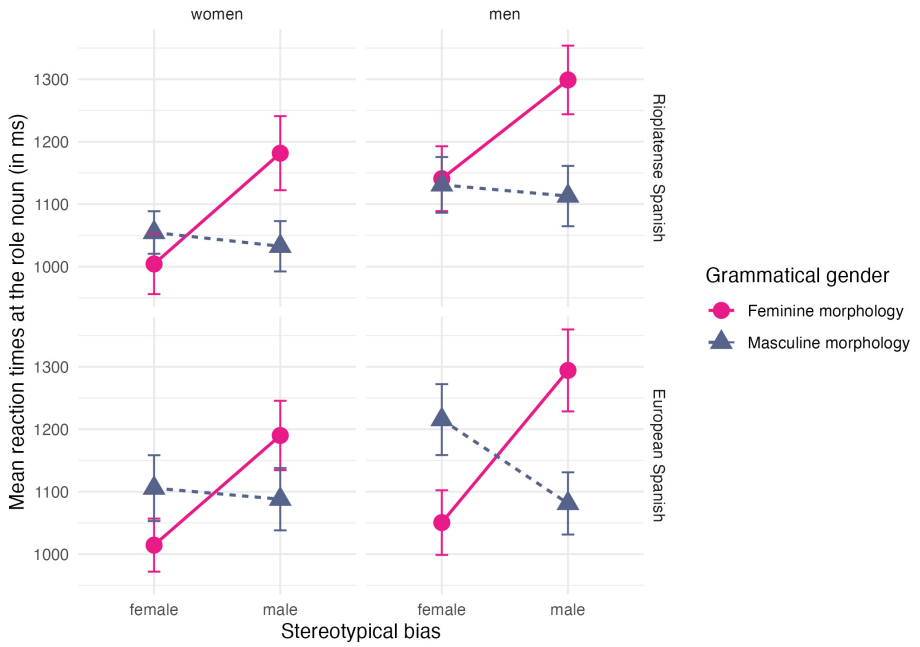

FIGURE 7
Mean role noun reaction times by linguistic community, gender identity, stereotypical bias, and grammatical gender in the gender-balanced subsample. Error bars represent standard errors of the mean.

the female bias was less marked for European Spanish speakers, i.e., we found very few role nouns with a strong female bias in this community. Therefore, in this community the female bias condition ended up being a non-male bias condition, rather than a female bias. In contrast, in Rioplatense Spanish the role nouns included in this condition were mostly female-biased. On the other hand, the normative studies allowed us to identify differences due to sociocultural factors in both linguistic communities, such as the example of *carniceros* (butchers$_{[masc]}$). The remarkable difference in stereotypicality in this case was probably due to a contrast between the two cultures (Tzinavos Muñoz et al., 2025).

Second, the results of the G-maze task replicate the documented congruence pattern reported in prior research in Spanish (Carreiras et al., 1996; Casado et al., 2023): when grammatical gender aligns with stereotypical bias, the linguistic forms are processed faster, although this difference was not statistically significant in the case of the female (in)congruent conditions for the Rioplatense Spanish speakers. In other words, the congruence effect holds across both linguistic communities for male-biased role nouns, but not for those with a female bias, which will indicate an asymmetrical congruence effect for the Rioplatense Spanish sample. That is, in this group we did not find differences across grammatical genders for female-biased role nouns. If this was explained solely by the generic use of the masculine grammatical gender, this difference would have been seen in both communities, but it only occurred among speakers of Rioplatense Spanish. Therefore, we consider this pattern may be related to two specific differences between the two linguistic communities. On the one hand, the fact that the use of the non-binary [-e] form is more widespread in Rioplatense Spanish may have contributed to a partial ongoing reconfiguration of the gender system. This innovation introduced an additional grammatical gender variant that may have conditioned the interpretation of the morphological variants, simultaneously introducing variability that dampened automatic processing effects and raising conscious awareness of gender associations. On the other hand, the broader sociocultural context of gender representation in both communities may play a role, as the social salience of the female stereotypes differ between the two communities, as we reported in the normative studies.

Third, the other side of this is the incongruence effect, which our findings also replicate. Of particular interest, and consistent with previous findings (Siyanova-Chanturia et al., 2012; Stetie and Zunino, 2023), is the fact that the highest processing cost appears in the condition with male-biased role nouns with feminine morphology (*herreras*, blacksmith$_{[fem]}$). This indicates an asymmetry in the gender incongruence effect: the incongruence is more prominent in the case of male-biased role nouns with feminine morphology. This pattern has two explanations that complement each other and are linked to different dimensions of analysis. On the one hand, the fact that the incongruence effect of female-biased role nouns with masculine morphology is not so prominent may be due to the generic function that the masculine grammatical gender effectively has in Spanish (Ambadiang, 1999; Roca, 2005; Escandell-Vidal, 2020; Giammatteo, 2020; Mendívil Giró, 2020; Fábregas, 2022, 2024). On the other hand, this particular incongruent pattern was previously linked to the notion that female stereotypes may be more socially marked (Eagly and Kite, 1987; Siyanova-Chanturia et al., 2012; Stetie and Zunino, 2023; Zunino et al., 2025b) than male stereotypes.

These last two points, how the effects of congruence and incongruence are presented in our data, show that the male bias seems to function as a key constraint: it is in this condition that

TABLE 6 Summary of LMM analysis for role noun reaction times by linguistic community, gender identity, stereotypical bias, and grammatical gender in the gender-balanced subsample.

Predictors	Estimates	*SE*	*t*	*p*
(Intercept)	6.95	0.04	190.531	**<0.001**
Linguistic community	−0.04	0.05	−0.93	0.353
$Linguistic_{Rioplatense}$/ gender identity	0.21	0.06	3.171	**0.002**
$Linguistic_{European}$/ gender identity	0.04	0.07	0.63	0.531
$Linguistic_{Rioplatense}$/ gender $identity_{women}$/ stereotypical bias	0.16	0.05	3.34	**0.001**
$Linguistic_{European}$/ gender $identity_{women}$/ stereotypical bias	0.14	0.05	2.82	**0.005**
$Linguistic_{Rioplatense}$/gender $identity_{men}$/ stereotypical bias	0.05	0.05	1.07	0.288
$Linguistic_{European}$/ gender $identity_{men}$/ stereotypical bias	0.17	0.05	3.39	**<0.001**
$Linguistic_{Rioplatense}$/ gender $identity_{women}$/ $Bias_{female}$/ grammatical gender	0.09	0.05	1.90	0.059
$Linguistic_{European}$/ gender $identity_{women}$/ $Bias_{female}$/ grammatical gender	0.06	0.05	1.20	0.230
$Linguistic_{Rioplatense}$/ gender $identity_{men}$/ $Bias_{female}$/ grammatical gender	−0.06	0.05	−1.16	0.250
$Linguistic_{European}$/ gender $identity_{men}$/ $Bias_{female}$/ grammatical gender	0.10	0.05	1.91	0.057
$Linguistic_{Rioplatense}$/ gender $identity_{women}$/ $Bias_{male}$/ grammatical gender	−0.09	0.05	−1.90	0.059
$Linguistic_{European}$/ gender $identity_{women}$/ $Bias_{male}$/ grammatical gender	−0.08	0.05	−1.71	0.090
$Linguistic_{Rioplatense}$/ gender $identity_{men}$/ $Bias_{male}$/ grammatical gender	−0.13	0.05	−2.84	**0.005**
$Linguistic_{European}$/ gender $identity_{men}$/ $Bias_{male}$/ grammatical gender	−0.18	0.05	−3.78	**<0.001**
Random effects				
σ^2	0.08			
$\tau_{00\ part\_id}$	0.05			
$\tau_{00\ item}$	0.00			
ICC	0.42			
N_{part_id}	180			
N_{item}	40			
Observations	1,410			
Marginal R^2/Conditional R^2	0.037/0.445			

Bold values highlight statistically significant results.

extreme values occur, with greater facilitation in the case of the male-masculine congruent condition and greater difficulty in the case of the male-biased role nouns with feminine morphology. This pattern reinforces our hypothesis that the masculine condition operates as the default or unmarked variable, both grammatically and socially. We want to stress that while the male representation functions as the cognitive default—i.e., the most usual and stable association—this does not equate to it being a neutral generic form; instead, as we have already pointed out, it indicates a biased default category that actively privileges the male representation (Kaufmann and Bohner, 2014; Anaya-Ramírez et al., 2022; Zunino and Stetie, 2022; Stetie and Zunino, 2023; Heap, 2024; Vela-Plo et al., 2025). The masculine form, even at the level of social stereotypes, thus appears to function as the unmarked or default category, generating more stable and systematic associations, whereas the feminine form exhibits greater variability (Siyanova-Chanturia et al., 2012; Stetie and Zunino, 2023; Tzinavos Muñoz et al., 2025; Zunino et al., 2025b).

The last point we want to address is the differences between linguistic communities. In the G-maze task, the only observable difference between the two communities occurs in the case of female-biased role nouns: while in Rioplatense Spanish we find no differences here between the two grammatical genders, in European Spanish we do. Interestingly, this contrasts with what we observed in the normative studies: in Rioplatense Spanish, female stereotypes were more pronounced than in European Spanish. We interpret this apparent contradiction by focusing on the dissociation between conscious and automatic processes. In other words, our interest is in the differences that arise in different tasks depending on the processes involved—implicit vs. non-implicit—(Zunino and Stetie, 2022). The stronger and explicit female stereotypes reported in Rioplatense Spanish could suggest greater conscious awareness of gender roles in this community. However, the lack of an effect in the same female stereotypes in the G-maze task for Rioplatense Spanish speakers suggests that this awareness does not translate into a significant automatic difficulty during sentence processing.[6] Since the normative studies included acceptability judgments tasks, which rely on conscious and strategic processes, and the G-maze task, which, despite requiring a conscious choice to continue the sentence, engage automatic and subliminal mechanisms, this dissociation constitutes a promising area for further research on the links between conscious and subliminal processes in language processing and potential intra-linguistic differences. This observed difference in

6 Actually, this is not the first time we have found differences between tasks involving different types of underlying processes. For instance, regarding [-e] and [-x] non-binary forms in Spanish, we previously observed a dissociation between conscious and automatic processing (Zunino and Stetie, 2022). In acceptability judgments, which involve strategic processes mediated by beliefs and the linguistic norm, the generic masculine was rated as more acceptable to refer to mixed groups. However, in a sentence comprehension task, which inquires about automatic processes and implicit representations, the non-binary forms [-e] and [-x] consistently elicited a reference to mixed groups, whereas the generic masculine did not.

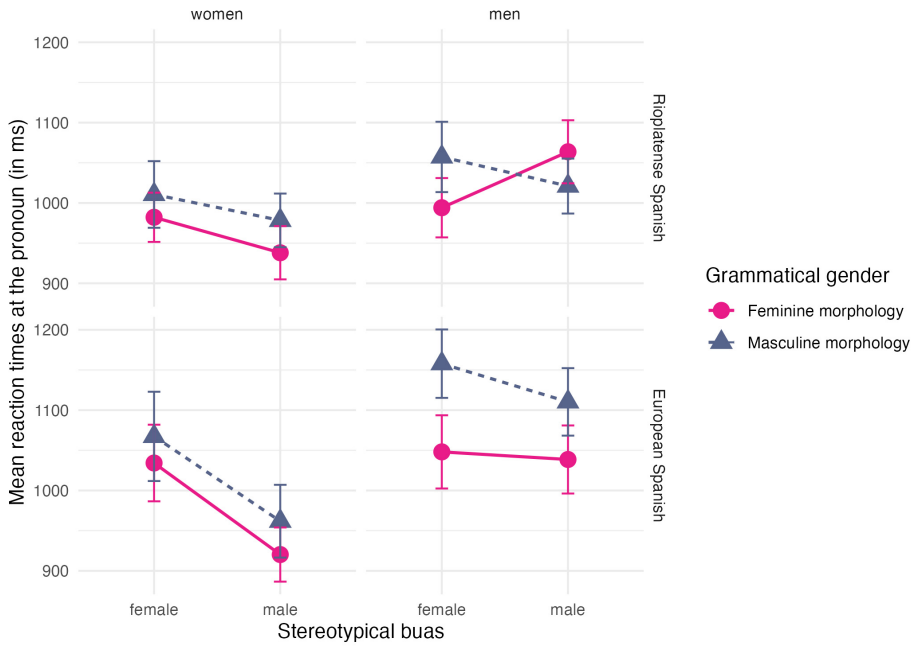

FIGURE 8
Mean pronoun reaction times by linguistic community, gender identity, stereotypical bias, and grammatical gender in the gender-balanced subsample. Error bars represent standard errors of the mean.

how the female stereotypes are processed provides empirical support for the initial contextual data presented in Section 2 (Gender Inequality and Global Gender Gap Indices), which also alerted us to potential, though complex, sociocultural differences between the two communities. Crucially, this complex pattern of results demonstrates that the relationship between quantitative indices and language processing is not straightforwardly linear, suggesting a more intricate and complex scenario.

5.2 The pronoun: unexpected diatopic variation in reference assignment

Regarding the pronoun, we found a statistically significant difference between the two linguistic communities, which was not in the direction we expected based on our experimental hypothesis. We will first discuss the results pattern for Rioplatense Spanish and then for European Spanish.

In the Rioplatense Spanish sample we found no effects of neither grammatical gender nor stereotypical bias. This suggests that any processing effect arising from (in)congruence between stereotypical bias and grammatical gender may have been resolved earlier in the sentence, likely at the role noun. These results are consistent with what was reported by Carreiras et al. (1996), although in their study they used singular role nouns and pronouns. In our case, we expected an (in)congruence effect to emerge given that plural pronouns require constructing a plural reference, i.e., representing a group of people performing the activity, which could more readily invite the interpretation of the masculine form as generic, potentially triggering gender processing effects. However, our findings suggest that by the time the anaphoric pronoun is processed, stereotypical biases no longer exert any measurable influence. This contrasts with languages such as English, which lack grammatical gender and mark it only in singular pronouns, where studies using this experimental paradigm have found statistically significant differences (Carreiras et al., 1996; Duffy and Keir, 2004; Kreiner et al., 2008; Canal et al., 2015).

In contrast, the European Spanish showed distinct processing patterns at the pronoun. There was both an effect of grammatical gender and stereotypical bias. Of the two grammatical gender conditions, pronouns with feminine morphology had shorter reaction times. It is important to note that, in comparison, the masculine morphology condition is the only one that, due to the use of the generic masculine, allows for another possible interpretation. Moreover, the longest reaction times occurred for grammatical masculine pronouns when they followed female-biased role nouns, which was also the most costly condition at the role noun itself (see Section 5.1). This is actually the only condition in which the masculine pronouns are ambiguous between a generic interpretation and a men-only interpretation, which could explain the higher reaction times. In fact, this pattern suggests that, although the masculine form is grammatically unmarked, its processing is not necessarily easier or less costly, as it introduces ambiguity between a generic interpretation and a men-only interpretation.

The contrast in pronoun processing between the two Spanish varieties may reflect two underlying factors related to how coreference is established. In other words, the underlying cognitive process activated by pronoun comprehension appears to differ fundamentally between Rioplatense Spanish and European Spanish, suggesting that the variation in pronoun processing times

TABLE 7 Summary of LMM analysis for pronoun reaction times by linguistic community, gender identity, grammatical gender, and stereotypical bias in the gender-balanced subsample.

Predictors	Estimates	*SE*	*t*	*p*
(Intercept)	6.86	0.03	221.90	**<0.001**
Linguistic community	0.05	0.04	1.11	0.267
$\text{Linguistic}_{\text{Rioplatense}}$/gender identity	0.01	0.06	0.15	0.885
$\text{Linguistic}_{\text{European}}$/gender identity	0.05	0.06	0.86	0.390
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{women}}$/grammatical gender	−0.02	0.04	−0.64	0.524
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{women}}$/grammatical gender	0.03	0.04	0.79	0.429
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{men}}$/grammatical gender	0.03	0.04	0.79	0.432
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{men}}$/grammatical gender	0.07	0.04	1.87	0.063
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{women}}$/$\text{grammatical gender}_{\text{feminine}}$/stereotypical bias	−0.05	0.04	−1.26	0.208
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{women}}$/$\text{grammatical gender}_{\text{feminine}}$/stereotypical bias	−0.11	0.04	−2.80	**0.006**
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{men}}$/$\text{grammatical gender}_{\text{feminine}}$/stereotypical bias	0.06	0.04	1.65	0.100
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{men}}$/$\text{grammatical gender}_{\text{feminine}}$/stereotypical bias	−0.03	0.04	−0.70	0.487
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{women}}$/$\text{grammatical gender}_{\text{masculine}}$/stereotypical bias	−0.01	0.04	1.42	0.157
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{women}}$/$\text{grammatical gender}_{\text{masculine}}$/stereotypical bias	−0.08	0.04	−2.18	**0.030**
$\text{Linguistic}_{\text{Rioplatense}}$/$\text{gender identity}_{\text{men}}$/$\text{grammatical gender}_{\text{masculine}}$/stereotypical bias	−0.00	0.04	−0.00	0.998
$\text{Linguistic}_{\text{European}}$/$\text{gender identity}_{\text{men}}$/$\text{grammatical gender}_{\text{masculine}}$/stereotypical bias	−0.05	0.04	−1.29	0.199
Random effects				
σ^2	0.05			
$\tau_{00\ \text{part\_id}}$	0.05			
$\tau_{00\ \text{item}}$	0.00			
ICC	0.50			
$N_{\text{part\_id}}$	180			
N_{item}	40			
Observations	1,410			
Marginal R^2/Conditional R^2	0.030/0.511			

Bold values highlight statistically significant results.

reflects different underlying processes across the two diatopic varieties. One interpretation of this asymmetry is that Rioplatense Spanish may have undergone a shift toward a more specific men-only reading of masculine forms, thus reducing their potential for generic interpretation. In contrast, speakers of European Spanish may still accept masculine morphology in stereotypically feminine contexts as a valid generic, which could explain the longer processing times observed. To confirm this hypothesis, however, it would be necessary to test it with an experiment specifically designed for that purpose.

This differential pattern prompted us to further explore how speakers of each variety interpreted the referential scope of the pronoun and a preliminary analysis point toward an initial contrastive reading among Spanish participants, interpreted as disjoint reference, topic shift or focalization, which calls for further experimental research (García-Alcaraz and Bel, 2014; Ranson, 2023; Leonetti, 2024).

Although from a psycholinguistic perspective, various studies have shown cross-linguistic differences in the interpretation of null subjects and overt subject pronouns, even among consistent null-subject languages such as Spanish, Italian, and Greek (Filiaci et al., 2013; Torregrossa et al., 2015; Leonetti Escandell and Torregrossa, 2024), to our knowledge, diatopic varieties of Spanish have not yet been systematically considered, despite the extensive attention this phenomenon has received in grammatical and sociolinguistic studies.

In this regard, diatopic differences in the frequency of overt subject pronouns are noteworthy: European and Mexican Spanish tend to exhibit the lowest rates of overt subject pronouns, whereas Caribbean Spanish displays markedly higher rates (Enríquez, 1984; Cameron, 1992; Toribio, 2000; Martínez-Sanz, 2011; Otheguy and Zentella, 2012; Carvalho et al., 2015; Posio, 2018). In the case of Argentina, Barrenechea and Alonso (1977, cited in Martínez-Sanz, 2011) reported a proportion of explicit subjects of 36% for Buenos Aires, higher than in European Spanish, where rates range from 12% to 27% (see Martínez-Sanz, 2011), with a coincidence of 21% in the studies of Enríquez (1984) and Cameron (1992).

The factors conditioning subject pronoun expression are broadly consistent across varieties (Martínez-Sanz, 2011; Posio, 2018), including, among others, grammatical person and number, referent shift, referential continuity, verbal aspect, lexical frequency or type of verbal predicates (Cameron, 1992; Serrano and Aijón, 2010; Otheguy and Zentella, 2012; Erker and Guy, 2012; Posio, 2018; Limerick, 2021). However, no satisfactory explanation has yet been offered for the differing proportions of overt subject pronouns or for the distinct hierarchies observed among the conditioning factor groups. Proposed explanations for these differences include contact with English (Otheguy and Zentella, 2012) and functional compensation resulting from phonological weakening and the neutralization of the agreement distinction between second- and third-person plural (Hochberg, 1986; Posio, 2018). These processes are thought to induce a typological drift toward overt-subject systems, as has been observed in other languages, like Modern Russian or Brazilian Portuguese (Holmberg et al., 2009; Saab, 2016; Madariaga, 2022). In particular, it has been argued that American varieties—especially Caribbean ones—display features reminiscent of partial null-subject languages (Toribio, 2000; Frascarelli and Jiménez-Fernández, 2019).

Despite grammatical studies documented and analyzed this phenomenon from a theoretical perspective, as far as we know, there are no experimental studies that analyze the potential projection of these syntactic and semantic differences to the language processing dimension, specifically in different varieties of Spanish. In this sense, our results represent a particularly relevant finding, which initiates a possible research path to analyze systematicities within the framework of both intra-linguistic and cross-linguistic variation, e.g., between Romance languages such as Portuguese, Italian and Spanish, which seem to exhibit different paradigms of subject explicitation.

5.3 Gender identity and gender processing: do systematic differences exist?

Lastly, we analyzed how participants' gender identity might affect language processing in this particular context. As we mentioned in Section 1.2.1, previous research on this topic is unclear: although several studies found differences based on participants' gender identity, these differences are not systematic, and our results are no exception.

When we analyze the processing pattern for the role nouns conditioned by gender identity, we find differences only for men: there is a statistical difference between both grammatical gender conditions for male-biased items. Women, on the other hand, do not exhibit this pattern; and this is observed in both communities. In other words, for both communities, men show a stronger asymmetric incongruence effect. This pattern could be interpreted as a greater difficulty for men to represent women in stereotypically male roles, such as *camioneras* (truck drivers$_{[fem]}$).

Analyzed in line with the findings reported in Zunino et al. (2025a), it is possible to consider this pattern as a complement to that which showed women with greater tendency to mark as associated with women words with feminine grammatical gender. Women seem to reinforce the female bias-feminine morphology congruence, while men seem to specially reject the male bias-feminine morphology incongruence.

These differences between men and women can also be interpreted in relation to the specific task and, more precisely, to the type of psycholinguistic process being measured. Our hypothesis is that the diversity of patterns observed regarding which group tends to reinforce gender stereotypes—or, in other words, for whom these stereotypes exert a stronger effect—may depend on whether the task involves conscious and strategic processes, such as acceptability judgment tasks, or automatic and subliminal processes, such as reading tasks. From this perspective, this distinction may constitute another dimension of variation in linguistic processing conditioned by participants' gender identity. However, this hypothesis should be tested through an experimental design specifically considered to address it.

As for the pronoun, both linguistic communities should be analyzed separately. For speakers of Rioplatense Spanish, just as there were no differences in the overall sample, there are also no statistically significant differences due to participants' gender identity. In contrast, for European Spanish, we did find some differences. However, as we explained in Section 5.2, these differences seem to be linked to diatopic aspects of variation in the use and interpretation of pronouns which were not considered in our experimental design. In other words, we have a confounding variable in the sample that was not properly identified and, therefore, does not allow us to adequately interpret the data.

6 Conclusions

Our findings replicate the previously documented (in)congruence pattern in gender processing and highlights a clear asymmetry: the highest processing cost emerged when male-biased role nouns appeared with feminine morphology. When comparing role nouns and pronouns, we observed that in the latter the (in)congruence effect did not persist, which suggests that it was resolved earlier in the sentence, likely at the role noun. This result was made particularly evident through the G-maze task, which minimizes potential spillover effects and allows for the localized assessment of processing effects. In addition, we observed an unexpected intra-linguistic difference in pronoun processing between Rioplatense and European Spanish speakers. Finally, the analysis considering participants' gender identity revealed that, in both varieties, men exhibited a stronger asymmetric incongruence effect, suggesting a greater difficulty in representing women in stereotypically male roles.

These results highlight the value of psycholinguistic approaches to intra-linguistic variation, particularly in understanding how linguistic and sociocultural factors influence real-time comprehension across diatopic varieties. Our research shows that intra-linguistic studies can enrich our understanding of language processing and reveal subtle cognitive differences shaped by language use, and, in doing so, they also contribute to the refinement of psycholinguistic models and their application to diverse linguistic populations and point to new directions for studying language processing in diverse populations.

Data availability statement

All data and scripts are available at the Open Science Framework in this repository: https://osf.io/y8vkc/.

Ethics statement

The requirement of ethical approval was waived by the Universidad de Buenos Aires and the Universidad de Salamanca for the studies involving humans in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

NS: Investigation, Visualization, Conceptualization, Formal analysis, Methodology, Writing – original draft, Data curation. ST: Writing – original draft, Investigation, Data curation. CT: Investigation, Data curation, Funding acquisition, Conceptualization, Writing – original draft. GZ: Project administration, Methodology, Data curation, Conceptualization, Funding acquisition, Supervision, Investigation, Formal analysis, Writing – review & editing.

Funding

The author(s) declared that financial support was received for this work and/or its publication. This work has been funded by the European Union through the MultiLingualGender project (MSCA Staff Exchanges, Horizon Europe, Grant Agreement No. 101182959).

Acknowledgments

A similar experimental design, although with different materials adapted to other varieties of Spanish, was used for a study currently under development, in collaboration with colleagues from the Universidad Complutense de Madrid (responsible researchers José Hinojosa Poveda and Miriam Aguilar) and the University of Alberta (responsible researchers Juhani Järvikivi and Dalia Cristerna Roman).

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://osf.io/y8vkc/.

References

Alfano, I., and Voghera, M. (2023). "Le scelte delle donne nei nomi di professione in italiano e spagnolo," in *El trabajo me pone alas, in Scritti in Omaggio a Rosa Maria Grillo*, eds. D. Crivellari, G. Nuzzo, and V. Ripa (Salerno: Officine Pindariche), 241–260.

Ambadiang, T. (1999). "La flexión nominal: género y número," in *Gramática Descriptiva de la Lengua Española*, dirs. I. Bosque and V. Demonte (Madrid: Espasa Calpe), 4843–4914.

Anaya-Ramírez, A., Grinstead, J., Rivera, M. N., Melamed, D., and Reig-Alamillo, A. (2022). The interpretation of Spanish masculine plural NPs: are they perceived as uniformly masculine or as a mixture of masculine and feminine? *Appl. Psycholinguist.* 43, 1257–1274. doi: 10.1017/S0142716422000352

Apicella, C., Norenzayan, A., and Henrich, J. (2020). Beyond WEIRD: a review of the last decade and a look ahead to the global laboratory of the future. *Evol. Human Behav.* 41, 319–329. doi: 10.1016/j.evolhumbehav.2020.07.015

Baayen, R. H., and Milin, P. (2010). Analyzing reaction times. *Int. J. Psychol. Res.* 3, 12–28. doi: 10.21500/20112084.807

Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* 67, 1–48. doi: 10.18637/jss.v067.i01

Berghoff, R., and Bylund, E. (2025). Diversity in research on the psychology of language: a large-scale examination of sampling bias. *Cognition* 256:106043. doi: 10.1016/j.cognition.2024.106043

Blasi, D. E., Henrich, J., Adamou, E., Kemmerer, D., and Majid, A. (2022). Over-reliance on English hinders cognitive science. *Trends Cogn. Sci.* 26, 1153–1170. doi: 10.1016/j.tics.2022.09.015

Bonnin, J. E., and Coronel, A. A. (2021). Attitudes toward gender-neutral Spanish: acceptability and adoptability. *Front. Sociol.* 6:629616. doi: 10.3389/fsoc.2021.629616

Buchstaller, I., and Khattab, G. (2013). "Population samples", in *Research methods in linguistics*, eds. R. J. Podesva and D. Sharma (Cambridge, MA: Cambridge University Press), 74–95. doi: 10.1017/CBO9781139013734.006

Cabello Pino, M. (2020). Esbozo de una bibliografía crítica sobre -x- y -e como alternativas al masculino genérico en español (2014-2019). *Tonos Digital* 39.

Cabeza Pereiro, M. C., and Rodríguez Barcia, S. (2013). Aspectos ideológicos, gramaticales y léxicos del sexismo lingüístico. *Estudios Filológicos* 52, 7–27. doi: 10.4067/S0071-17132013000200001

Cameron, R. (1992). *Pronominal and null subject variation in Spanish: constraints, dialects, and functional compensation* (Dissertation). University of Pennsylvania, Philadelphia, PA, United States.

Canal, P., Garnham, A., and Oakhill, J. (2015). Beyond gender stereotypes in language comprehension: self sex-role descriptions affect the brain's potentials associated with agreement processing. *Front. Psychol.* 6:1953. doi: 10.3389/fpsyg.2015.01953

Capilla-Martín, M. (2024). *El género gramatical en español: factores determinantes en la asignación de género en sustantivos inanimados* (PhD thesis). Universidad Autónoma de Madrid, Madrid. Available online at: https://repositorio.uam.es/bitstream/handle/10486/718497/capilla_martin_mar.pdf?sequence=1 (Accessed October 8, 2025).

Carreiras, M., Garnham, A., Oakhill, J., and Cain, K. (1996). The use of stereotypical gender information in constructing a mental model: evidence from English and Spanish. *Q. J. Exp. Psychol.* 49, 639–663. doi: 10.1080/713755647

Carvalho, A. M., Orozco, R., and Shin, N. L. (2015). *Subject Pronoun Expression in Spanish. A Cross-Dialectal Perspective*. Washington, DC: Georgetown University Press.

Casado, A., Sá-Leite, A. R., Pesciarelli, F., and Paolieri, D. (2023). Exploring the nature of the gender-congruency effect: implicit gender activation and social bias. *Front. Psychol.* 14:1160836. doi: 10.3389/fpsyg.2023.1160836

Corbett, G. G. (1991). *Gender*. Cambridge, MA: Cambridge University Press. doi: 10.1017/CBO9781139166119

Cousineau, D., and Chartier, S. (2010). Outliers detection and treatment: a review. *Int. J. Psychol. Res.* 3, 58–67. doi: 10.21500/20112084.844

Crain, S., Khlentzos, D., and Thornton, R. (2010). Universal grammar versus language diversity. *Lingua* 120, 2668–2672. doi: 10.1016/j.lingua.2010.03.005

Croft, W. (1996). *Typology and Universals*. Cambridge, MA: Cambridge University Press.

Cuddy, A. J., Wolf, E. B., Glick, P., Crotty, S., Chong, J., and Norton, M. I. (2015). Men as cultural ideals: Cultural values moderate gender stereotype content. *J. Pers. Social Psychol.* 109, 622–635. doi: 10.1037/pspi0000027

Del Barrio, F. (2023). A fork in the road: grammatical gender assignment to nouns in Spanish dialects. *Languages* 8:257. doi: 10.3390/languages8040257

Díaz Hormigo, M. T. (2022). Loanword neology: the morphological adaptation of gender in lexical neologisms borrowed from English. *Rev. Lingüíst. Leng. Apl.* 17, 49–58. doi: 10.4995/rlyla.2022.16758

Duffy, S. A., and Keir, J. A. (2004). Violating stereotypes: eye movements and comprehension processes when text conflicts with world knowledge. *Mem. Cogn.* 32, 551–559. doi: 10.3758/BF03195846

Eagly, A. H., and Kite, M. E. (1987). Are stereotypes of nationalities applied to both women and men? *J. Pers. Social Psychol.* 53, 451–462. doi: 10.1037//0022-3514.53.3.451

Enríquez, E. V. (1984). *El pronombre personal sujeto en la lengua española hablada en Madrid*. Madrid: Consejo Superior de Investigaciones Científicas, Instituto Miguel de Cervantes.

Erker, D., and Guy, G. (2012). The role of lexical frequency in syntactic variability: variable subject personal pronoun expression in Spanish. *Language* 88, 526–557. doi: 10.1353/lan.2012.0050

Escandell-Vidal, M. V. (2018). "Reflexiones sobre el género como categoría gramatical. Cambio ecológico y tipología lingüística," in *De la lingüística a la semiótica: trayectorias y horizontes del estudio de la comunicación*, ed. M. Ninova (Sofia: Universidad S. Clemente de Ojrid), 49–69.

Escandell-Vidal, M. V. (2020). En torno al género inclusivo. *IgualdadES* 2, 223–249. doi: 10.18042/cepc/IgdES.2.08

Fábregas, A. (2022). Género inclusivo: una mirada gramatical. *Cuad. Investig. Filol.* 51, 25–46. doi: 10.18172/cif.5292

Fábregas, A. (2024). *The Fine-Grained Structure of the Lexical Area. Gender, Appreciatives and Nominal Suffixes in Spanish*. Amsterdam: John Benjamins. doi: 10.1075/ihll.39

Fábregas, A., and Pérez, I. (2008). Gender agreement on adverbs in Spanish. *J. Port. Linguist.* 7:25. doi: 10.5334/jpl.126

Fernández Ordóñez, I. (2007). Del Cantábrico a Toledo: el "neutro de materia" hispánico en un contexto románico y tipológico (continuación). *Rev. Hist. Leng. Esp.* 2, 29–81. doi: 10.54166/rhle.2007.02.02

Filiaci, F., Sorace, A., and Carreiras, M. (2013). Anaphoric biases of null and overt subjects in Italian and Spanish: a cross-linguistic comparison. *Lang. Cogn. Process.* 29, 825–843. doi: 10.1080/01690965.2013.801502

Forster, K. I., Guerrera, C., and Elliot, L. (2009). The maze task: measuring forced incremental sentence processing time. *Behav. Res. Methods* 41, 163–171. doi: 10.3758/BRM.41.1.163

Fox, J., and Weisberg, S. (2019). *An {R} Companion to Applied Regression*. Thousand Oaks, CA: Sage.

Frascarelli, M., and Jiménez-Fernández, Á. (2019). Understanding partiality in pro-drop languages: an information-structure approach. *Syntax* 22, 162–198. doi: 10.1111/synt.12184

Freitag, R., and Soto, M. (2023). Processamento da variação linguística: desafios para integrar aquisição, diversidade e compreensão em um modelo de língua. *Rev. Estudos Linguagem* 31, 397–431. doi: 10.17851/2237-2083.31.2.397-431

Friedrich, M. C. G., Drössler, V., Oberlehberg, N., and Heise, E. (2021). The influence of the gender asterisk ("gendersternchen") on comprehensibility and interest. *Front. Psychol.* 12:760062. doi: 10.3389/fpsyg.2021.760062

García-Alcaraz, E., and Bel, A. (2014). "The acquisition of co-referential properties of pronouns in bilingual and L2 Spanish speakers," in *Online Proceedings Supplement of the 39th Annual Boston University Conference on Language Development*.

García-González, J., Forcén, P., and Jimenez-Sanchez, M. (2019). Men and women differ in their perception of gender bias in research institutions. *PLoS ONE* 14:e0225763. doi: 10.1371/journal.pone.0225763

Gelman, S. A. (2004). Psychological essentialism in children. *Trends Cogn. Sci.* 8, 404–409. doi: 10.1016/j.tics.2004.07.001

Giammatteo, M. (2020). El género gramatical en español y la disputa por el género. *Cuarenta Naipes* 3, 177—198.

Gibbons, J. L. (2000). "Gender development in cross-cultural perspective," in *The Developmental Social Psychology of Gender*, eds. T. Eckes and H. M. Trautner (New York, NY: Psychology Press), 403–430.

Gygax, P., Elminger, D., Zufferey, S., Garnham, A., Sczesny, S., von Stockhausen, L., et al. (2019). A language index of grammatical gender dimensions to study the impact of grammatical gender on the way we perceive women and men. *Front. Psychol.* 10:1604. doi: 10.3389/fpsyg.2019.01604

Harris, J. W. (1991). The exponence of gender in Spanish. *Linguist. Inq.* 22, 27–62.

Heap, D. (2024). Los masculinos no tan "genéricos": estudios empíricos sobre interpretaciones en español y en francés. *Círc. Ling. Apl. Comun.* 97, 195–230. doi: 10.5209/clac.79361

Henrich, J., Heine, S. J., and Norenzayan, A. (2010). The weirdest people in the world? *Behav. Brain Sci.* 33, 61–83. doi: 10.1017/S0140525X0999152X

Hentschel, T., Heilman, M. E., and Peus, C. V. (2019). The multiple dimensions of gender stereotypes: a current look at men's and women's characterizations of others and themselves. *Front. Psychol.* 10:376558. doi: 10.3389/fpsyg.2019.00011

Hochberg, J. G. (1986). Functional compensation for/s/deletion in Puerto Rican Spanish. *Language* 62, 609–621. doi: 10.1353/lan.1986.0041

Holmberg, A., Nayudu, A., and Sheehan, M. (2009). Three partial null-subject languages: a comparison of Brazilian Portuguese, Finnish and Marathi. *Stud. Linguist.* 63, 59–97. doi: 10.1111/j.1467-9582.2008.01154.x

Horvath, L. K., Merkel, E. F., Maass, A., and Sczesny, S. (2016). Does gender-fair language pay off? The social perception of professions from a cross-linguistic perspective. *Front. Psychol.* 6:2018. doi: 10.3389/fpsyg.2015.02018

Johnson-Laird, P. N. (1983). *Mental Models. Towards a Cognitive Science of Language, Inference, and Consciousness*. Cambridge, MA: Harvard University Press.

Kaiser, I., and Ender, A. (2021). Intra-individual variation in adults and children: measuring and conceptualizing individual dialect–standard repertoires. *Linguist. Vanguard* 7:s220200032. doi: 10.1515/lingvan-2020-0032

Kaufmann, C., and Bohner, G. (2014). Masculine generics and gender-aware alternatives in Spanish. *IZGOnZeit. Onlinezeitschrift des Interdisziplinären Zentrums für Geschlechterforschung (IZG)* 3, 8–17.

Körner, A., Abraham, B., Rummer, R., and Strack, F. (2022). Gender representations elicited by the gender star form. *J. Lang. Soc. Psychol.* 41, 553–571. doi: 10.1177/0261927X221080181

Kramer, R. (2015). *The Morphosyntax of Gender*. Oxford: Oxford University Press. doi: 10.1093/acprof:oso/9780199679935.001.0001

Kreiner, H., Sturt, P., and Garrod, S. (2008). Processing definitional and stereotypical gender in reference resolution: evidence from eye-movements. *J. Mem. Lang.* 58, 239–261. doi: 10.1016/j.jml.2007.09.003

Kroll, J. F., Takahesu Tabori, A., and Navarro-Torres, C. (2021). Capturing the variation in language experience to understand language processing and learning. *Lang. Interact. Acquis.* 12, 82–109. doi: 10.1075/lia.20018.kro

Kuznetsova, A., Brockhoff, P. B., and Christensen, R. H. B. (2017). lmerTest package: tests in linear mixed effects models. *J. Stat. Softw.* 82, 1–26. doi: 10.18637/jss.v082.i13

Leonetti Escandell, V., and Torregrossa, J. (2024). The interpretation of null and overt subject pronouns in Spanish compared to Greek and Italian. *Glossa J. Gen. Linguist.* 9, 1–25. doi: 10.16995/glossa.9725

Leonetti, M. (2024). Pronombres sin antecedente. *ReGrOC* 8, 17–36. doi: 10.5565/rev/regroc.96

Lewis, M., and Lupyan, G. (2020). Gender stereotypes are reflected in the distributional structure of 25 languages. *Nat. Hum. Behav.* 4, 1021–1028. doi: 10.1038/s41562-020-0918-6

Limerick, P. P. (2021). First-person plural subject pronoun expression in Mexican Spanish spoken in Georgia. *Stud. Hisp. Lusoph. Linguist.* 14, 411–432. doi: 10.1515/shll-2021-2050

Lindvall-Östling, M., Deutschmann, M., and Steinvall, A. (2020). An exploratory study on linguistic gender stereotypes and their effects on perception. *Open Linguist.* 6, 567–583. doi: 10.1515/opli-2020-0033

López, Á. (2020). Cuando el lenguaje excluye: consideraciones sobre el lenguaje no binario indirecto. *Cuarenta Naipes. Revista de Cultura y Literatura* 3, 295–312.

López-Cortés, N. (2024). ¿Valor genérico o específico? Un estudio de cuestionarios sobre la percepción del género gramatical masculino. *Rev. Investig. Lingüíst.* 27, 151–171. doi: 10.6018/ril.618591

Loporcaro, M. (2018). *Gender from Latin to Romance: History, Geography, Typology*. Oxford: Oxford University Press. doi: 10.1093/oso/9780199656547.003.0007

Lüdecke, D. (2024). *sjPlot: Data Visualization for Statistics in Social Science*. Available online at: https://CRAN.R-project.org/package=sjPlot (Accessed October 8, 2025).

Madariaga, N. (2022). On partial null subject languages: why pro-drop in Brazilian Portuguese and Russian became similar but not identical. *Rev. Estud. Linguagem* 30. doi: 10.17851/2237-2083.30.4.1896-1935

Martínez-Sanz, C. (2011). *Null and overt subjects in a variable system: the case of Dominican Spanish* (PhD dissertation). University of Ottawa, Ottawa, ON, Canada.

Mecit, A., Lowrey, T. M., and Shrum, L. J. (2022). Grammatical gender and anthropomorphism: "It" depends on the language. *J. Pers. Soc. Psychol.* 123, 503–517. doi: 10.1037/pspa0000309

Mendívil Giró, J. L. (2020). El masculino inclusivo en español. *Rev. Esp. Lingüíst.* 50, 35–64. doi: 10.31810/RSEL.50.1.2

Menegatti, M., and Rubini, M. (2017). "Gender bias and sexism in language," in *Oxford Research Encyclopedia of Communication*. doi: 10.1093/acrefore/9780190228613.013.470

Menegotto, A. (2020). Español 2G y español 3G: propiedades morfosintácticas y semánticas del lenguaje inclusivo. *Cuarenta Naipes* 3, 207–232.

Molinaro, N., Su, J., and Carreiras, M. (2016). Stereotypes override grammar: social knowledge in sentence comprehension. *Brain Lang.* 155–156, 36–43. doi: 10.1016/j.bandl.2016.03.002

Motschenbacher, H. (2014). Grammatical gender as a challenge for language policy: the (im)possibility of non-heteronormative language use in German versus English. *Lang. Policy* 13, 243–261. doi: 10.1007/s10993-013-9300-0

Otheguy, R., and Zentella, A. C. (2012). *Spanish in New York. Language Contact, Dialectal Leveling, and Structural Continuity*. Oxford: Oxford University Press. doi: 10.1093/acprof:oso/9780199737406.001.0001

Pesciarelli, F., Scorolli, C., and Cacciari, C. (2019). Neural correlates of the implicit processing of grammatical and stereotypical gender violations: a masked and unmasked priming study. *Biol. Psychol.* 146:107714. doi: 10.1016/j.biopsycho.2019.06.002

Picallo, M. C. (2016). "Género y número," in Enciclopedia de Lingüística Hispánica, coord. *J. Gutiérrez Rexach* 630–639. doi: 10.4324/9781315713441-56

Porkert, J., Siyanova-Chanturia, A., Loerts, H., Schüppert, A., and Keijzer, M. (2024). N400 or P600? A systematic review of ERP studies on gender stereotype violations. *Lang. Linguist. Compass* 18:e12530. doi: 10.1111/lnc3.12530

Posio, P. (2018). "Properties of pronominal subjects," in *The Cambridge Handbook of Spanish Linguistics. Cambridge Handbooks in Language and Linguistics*, ed. K. L. Geeslin (Cambridge, MA: Cambridge University Press) 286–306. doi: 10.1017/9781316779194.014

R Core Team (2024). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

RAE and ASALE (2025). *Nueva gramática de la lengua española, edición revisada y ampliada*. Madrid: Espasa.

Ranson, D. L. (2023). "Los pronombres personales" in *Sintaxis del español*, eds. G. Rojo, V. Vázquez Rozas, and R. Torres Cacoullos (New York, NY: Routledge), 414–426. doi: 10.4324/9781003035633-35

Renström, E. A., Lindqvist, A., and Gustafsson Sendén, M. (2022). The multiple meanings of the gender-inclusive pronoun hen: predicting attitudes and use. *Eur. J. Soc. Psychol.* 52, 71–90. doi: 10.1002/ejsp.2816

Roca, I. M. (2005). La gramática y la biología en el género del español (1.ª parte). *Rev. Esp. Lingüíst.* 35, 17–44.

Saab, A. (2016). "On the notion of partial (non-)pro-drop in Romance," in *The Morphosyntax of Portuguese and Spanish in Latin America*, eds. M. A. Kato and F. Ordóñez (Oxford: Oxford University Press), 49–77. doi: 10.1093/acprof:oso/9780190465889.003.0003

Sato, S., and Athanasopoulos, P. (2018). Grammatical gender affects gender perception: evidence for the structural-feedback hypothesis. *Cognition* 176, 220–231. doi: 10.1016/j.cognition.2018.03.014

Schad, D., Vasishth, S., Hohenstein, S., and Kliegl, R. (2020). How to capitalize on a priori contrasts in linear (mixed) models: a tutorial. *J. Memory Lang.* 110:104038. doi: 10.1016/j.jml.2019.104038

Schmitz, D. (2023). Instances of bias: the gendered semantics of generic masculines in German revealed by instance vectors. *Zeitschrift Sprachwissenschaft* 43, 295–325. doi: 10.1515/zfs-2024-2010

Sczesny, S., Bosak, J., Neff, D., and Schyns, B. (2004). Gender stereotypes and the attribution of leadership traits: a cross-cultural comparison. *Sex Roles* 51, 631–645. doi: 10.1007/s11199-004-0715-0

Serrano Dolader, D. (2010). "El género en los sustantivos: ¿flexión y/o derivación?," in *La gramática del sentido: léxico y sintaxis en la encrucijada*, eds. J. F. Val and M. Horno (Zaragoza: Prensas Universitarias), 49–270.

Serrano, M. J., and Aijón, M. A. (2010). El hablante en su discurso: expresión y omisión del sujeto de "creo". *Oralia Análisis discurso oral* 13, 7–38. doi: 10.25115/oralia.v13i.8100

Siegel, R. B. (2001). She the people: the nineteenth amendment, sex equality, federalism, and the family. *Harv. L. Rev.* 115:947. doi: 10.2307/1342628

Siyanova-Chanturia, A., Pesciarelli, F., and Cacciari, C. (2012). The electrophysiological underpinnings of processing gender stereotypes in language. *PLoS ONE* 7:e48712. doi: 10.1371/journal.pone.0048712

Soler Montes, C. (2023). "Mapa dialectal del lenguaje inclusivo en el mundo hispánico. Variación lingüística en las construcciones gramaticales de género en registros formales del español escrito," in *Representaciones críticas en el sistema sexo/género: entre lo transnacional y lo local*, eds. R. Martínez Carrasco and I. Villanueva Jordán (Valencia: Editorial Universitat Politècnica de València), 131–154.

Stetie, N. A., Martínez Rebolledo, C., and Zunino, G. M. (2023). Diversidad de género y variación lingüística en el español de América: procesamiento de estereotipos y morfología de género en Argentina y Chile. *Rev. Estud. Linguagem* 31, 636–687. doi: 10.17851/2237-2083.31.2.636-687

Stetie, N. A., Tzinavos, S., and Zunino, G. M. (2025). Aceptabilidad asimétrica entre estereotipos de género y género gramatical: un estudio en dos variedades de español. *Clepsydra Revista Internacional Estudios Género Teoría Feminista* 29. doi: 10.25145/j.clepsydra.2025.29.05

Stetie, N. A., and Zunino, G. M. (2022). Non-binary language in Spanish? comprehension of non-binary morphological forms: a psycholinguistic study. *Glossa J. Gen. Linguist.* 7, 1–38. doi: 10.16995/glossa.6144

Stetie, N. A., and Zunino, G. M. (2023). Estereotipos y morfología de género en nombres de rol: un estudio psicolingüístico. *Lexis* 47, 678–716. doi: 10.18800/lexis.202302.006

Toribio, A. J. (2000). Setting parametric limits on dialectal variation in Spanish. *Lingua* 110, 315–341. doi: 10.1016/S0024-3841(99)00044-3

Torregrossa, J., Bongartz, C., and Tsimpli, I. M. (2015). Testing accessibility: a cross-linguistic comparison of the syntax of referring expressions. *Linguist. Soc. Am. Annu. Meet.* 6, 1–4. doi: 10.3765/exabs.v0i0.3046

Tzinavos Muñoz, S. M., Stetie, N. A., and Tomé Cornejo, C. (2025). Diferencias en la carga de estereotipicidad de género en nombres de rol: un estudio comparativo entre hablantes de español de Argentina y España. *Clepsydra Revista Internacional Estudios Género Teoría Feminista* 29. doi: 10.25145/j.clepsydra.2025.29.08

United Nations Development Programme (2024). Gender inequality index. *The Human Development Report*. Available online at: http://hdr.undp.org/en/content/gender-inequality-index-gii

Urrutia Cárdenas, H., and Ramírez Luengo, J. L. (2004). El morfema de género en el español de América. *Bol. Filol.* 40, 263–284.

Van Dijk, T., and Kintsch, W. (1983). *Strategies of Discourse Comprehension*. New York, NY: Academic Press.

Vasishth, S. (2023). Some right ways to analyze (psycho) linguistic data. *Annu. Rev. Linguist.* 9, 273–291. doi: 10.1146/annurev-linguistics-031220-010345

Vasishth, S., Schad, D., Bürki, A., and Kliegl, R. (2021). *Linear Mixed Models in Linguistics and Psychology: A Comprehensive Introduction*. Available online at: https://vasishth.github.io/Freq_CogSci/ (Accessed October 8, 2025).

Vela-Plo, L., De Pedis, M., and Ortega-Andrés, M. (2025). Is there a woman in los candidatos? Gender perception with masculine "generics" and gender-fair language strategies in Spanish. *Languages* 10:175. doi: 10.3390/languages10070175

Venables, B. N., and Ripley, B. D. (2002). *Modern Applied Statistics with S, 4th Edn*. New York, NY: Springer. doi: 10.1007/978-0-387-21706-2

Vergoossen, H. P., Pärnamets, P., Renström, E. A., and Gustafsson Sendén, M. (2020). Are new gender-neutral pronouns difficult to process in reading? The case of hen in Swedish. *Front. Psychol.* 11:574356. doi: 10.3389/fpsyg.2020.574356

Verspoor, M., Lowie, W., and De Bot, K. (2021). Variability as normal as apple pie. *Linguist. Vanguard* 7: s220200034. doi: 10.1515/lingvan-2020-0034

Wang, S., Wang, J., Guo, W., Ye, H., Lu, X., Luo, J., et al. (2019). Gender difference in gender bias: transcranial direct current stimulation reduces male's gender stereotypes. *Front. Hum. Neurosci.* 13:403. doi: 10.3389/fnhum.2019.00403

Wickham, H., Averick, M., Bryan, J., Chang, W., D'Agostino McGowan, L., François, R., et al. (2019). Welcome to the tidyverse. *J. Open Source Softw.* 4:1686. doi: 10.21105/joss.01686

Winter, B. (2019). *Statistics for Linguists: An Introduction using R*. New York, NY: Routledge. doi: 10.4324/9781315165547

World Economic Forum (2024). *Global Gender Gap Report 2024.* Retrieved from https://www3.weforum.org/docs/WEF_GGGR_2024.pdf

Zehr, J., and Schwarz, F. (2018). *PennController for Internet Based Experiments (IBEX)*. doi: 10.17605/OSF.IO/MD832

Zemore, S. E., Fiske, S. T., and Kim, H. J. (2000). "Gender stereotypes and the dynamics of social interaction," in *The Developmental Social Psychology of Gender*, eds. T. Eckes and H. M. Trautner (Hove: Psychology Press), 221–256.

Zunino, G. M. (2025). *"La prueba de laberinto (Maze task)," in Métodos experimentales para la lingüística hispánica*, eds. O. Loureda, M. Teucher, C. Cruz Rubio, O. Ivanova, C. Fernández Pérez, and C. Gerolmini Lezama (Madrid: Routledge).

Zunino, G. M., Aguilar, M., Stetie, N. A., Martínez Rebolledo, C., and Hinojosa Podeva, J. A. (2025a). Dresses and ties: the effect of grammatical gender and stereotypical semantic bias in three Spanish-speaking communities. *Lang. Cogn.* 17:e35. doi: 10.1017/langcog.2025.4

Zunino, G. M., Gagliardi, G., Stetie, N. A., and Miola, E. (2025b). *Female Truck Drivers and Male Babysitters? Interactions between Gender Stereotypes and Grammatical Gender in Spanish and Italian: A Psycholinguistic Proposal*. Linguistik Online.

Zunino, G. M., and Stetie, N. A. (2022). Binary or non-binary? Gender morphology in Spanish: differences dependent on the task. *Alfa Rev. Lingüíst.* 66:e14546. doi: 10.1590/1981-5794-e14546