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Noelia Ayelén Stetie[1,2] and Gabriela Mariel Zunino[1,2]
[1] Sede central, Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina
[2] Instituto de Lingüística, Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina

Do gender stereotypes bias the processing of morphological innovations? The case of gender-inclusive language in Spanish

Classical grammatical studies in Spanish only consider binary gender and claim that gender assignment is an arbitrary process. However, psycholinguistic evidence suggests that gender morphology, lexical semantics, and gender stereotypes condition language processing. Recently, gender-inclusive language proposals have proliferated in several languages, and in Spanish, the use of the nonbinary morphological variant [-e] has spread considerably. This article presents the results of a self-paced reading task that evaluated the influence of gender stereotypes (role names with semantic male or female bias) on the processing of this morphological innovation. There was a semantic bias effect in the first spillover word, but there were no statistically significant differences for noun phrase, wrap-up region, and total sentence reading times. The results showed that gender stereotype effect occurs relatively early and at the local level. Moreover, nonbinary morphological innovations may be specializing in the representation of mixed groups of people.

Key words: gender-inclusive language, nonbinary language, morphological innovations, gender stereotypes, language processing

Address for correspondence: Noelia Ayelén Stetie
Sede central, Consejo Nacional de Investigaciones Científicas y Técnicas, Godoy Cruz 2290, C1425FQB, Ciudad Autónoma de Buenos Aires, Argentina.
E-mail: nstetie@conicet.gov.ar

Introduction

Recent psycholinguistic research challenges the classical claim that Spanish has a binary gender system, and that gender assignment is an arbitrary process. This research has revealed the impact of lexical semantics and stereotypes on gender morphology during language processing. In parallel, gender-inclusive language proposals have expanded globally, with the nonbinary [-e] variant experiencing significant uptake in Spanish (Cabello Pino, 2020; Fábregas, 2022; Stetie et al., 2023), particularly within Argentina (Bonnin & Coronel, 2021; Bonnin & Zunino, 2024; Kalinowski, 2020; Palma et al., 2024; Pesce & Etchezahar, 2019), but there are not many empirical studies that analyze its processing.

Here, we provide an overview of the research on language and gender, focused on gender-inclusive language. First, we explain specific features of gender morphology in Spanish. Second, we comment briefly on the variety of effects that gender stereotypes can have on language. Then, we examine the study of gender-inclusive language proposals in different languages. Next, we focus on the Spanish case and its gender-inclusive language proposals. Finally, we present the current study.

Gender Morphology in Spanish

Gender morphology involves a varied scenario in crosslinguistic terms. This scenario is also complex with respect to the gender paradigms of each language. Several taxonomies have been proposed to organize this framework and specify a descriptive approach (Dixon, 1987; Gygax et al., 2019; Hellinger & Bußmann, 2001; Leaper, 2014). The most recent classification (Gygax et al., 2019) distinguishes five types of languages: grammatical gender languages, languages with a combination of grammatical and natural gender, natural gender languages, genderless languages with a few traces of grammatical gender, and genderless languages. Spanish is in the first group, in which gender controls grammatical agreement, and both nouns referring to animate entities and those with inanimate referents have assigned gender.

Specifically, in Spanish, the gender paradigm assumes a binary distinction for nouns (masculine/feminine). A discussion about gender inflection in Spanish is linked to the degree of arbitrariness or motivation of gender in nouns. Most proposals attempt to organize this systematization based on a definition of gender restricted by semantic and formal features. However, numerous investigations emphasize that gender is also conditioned by extralinguistic factors (Ambadiang, 1999; Barrera Linares, 2019; Cabeza Pereiro & Rodríguez Barcía, 2013; López, 2020; Roca, 2009).

The gender assignment process is one of the most complex phenomena in this sense. For nouns referring to people, it seems indisputable that sociolinguistic and pragmatic factors as well as grammatical ones are involved. In Spanish, most nouns that refer to people–and in general to animate entities–form gender pa-

irs, which in many studies are classified as heteronyms. There are also epicenes (nouns with a single gender-invariant form, for example *persona* "person") but they do not constitute representative cases of the gender paradigm in Spanish. Moreover, gender pairs may exhibit lexical changes in the root (*madre* "mother" and *padre* "father") or mark gender distinction through the desinence: with derivation (*poeta* "poet.M" and *poetisa* "poet.F") or inflection (*alumno* "student.M" and *alumna* "student.F"). In a known work, Ambadiang (1999) noted that gender in nouns referring to people "tends to be biological", so the process of gender assignment cannot be approached exclusively from a grammatical perspective (Ambadiang, 1999; Barrera Linares, 2019; Cabeza Pereiro & Rodríguez Barcía, 2013).

One of the foci of interest, both in Spanish and in other languages, has been the functioning of the generic masculine that derives from the classical grammatical distinction between marked and unmarked elements (Ambadiang, 1999; Barrera Linares, 2019; Cabeza Pereiro & Rodríguez Barcía, 2013; Márquez, 2013; Mendívil Giró, 2020). A definition to show that the masculine is the unmarked gender in Spanish is offered by Ambadiang (1999, p. 4860): (a) it does not require an explicit formal marking or may not present one, (b) it is the gender used by default in coordination and composition processes, (c) it is the gender used for nominalization, and (d) it is taken to refer to entities of different genders. This last case would be the one that explains the generic masculine. On the other hand, feminine gender is the marked gender in Spanish. It is associated with desinential variants that must be present to assign that gender. From sociolinguistic and pragmatic perspectives, few studies deny a notably asymmetrical function in the generic masculine and many proposals go so far as to argue that Spanish's inflectional system imposes an initial male bias that systematically hides women (Ambadiang, 1999; Barrera Linares, 2019; Cabeza Pereiro & Rodríguez Barcía, 2013; Giammatteo, 2020; Márquez, 2013; Menegatti & Rubini, 2017; Menegotto, 2020).

Effects of Gender Stereotypes in Language

A fruitful line of research in psycholinguistic studies is to understand to what extent and in what way gender stereotypes, as part of people's beliefs and prior world knowledge, condition and influence language comprehension (Carreiras et al., 1996; Duffy & Keir, 2004; Horvath et al., 2016; Lewis & Lupyan, 2020; Menegatti & Rubini, 2017; Stetie & Zunino, 2022; Zunino & Stetie, 2022). Multiple studies have analyzed gender stereotypes and how they are constructed as individual, stable, mental representations that are nevertheless strongly associated with socio-cultural factors and that can establish various links with language.

In particular, many studies have examined the influence of gender stereotypes on role names (Canal et al., 2015; Carreiras et al., 1996; Duffy & Kier, 2004; Siyanova-Chanturia et al., 2012). These studies have focused on evaluating the congruence and incongruence of implicit semantic information offered by gender stereotypes with respect to a morphological gender marking. One key point

they reported is that the effect of the information provided by gender stereotypes occurs early during comprehension. Secondly, they highlighted that the effect of incongruence may appear either on a personal pronoun or on the same role name (Carreiras et al., 1996; Duffy & Kier, 2004).

Moreover, another recent line of research in the study of the relation between gender and language focuses on the effects of the use (or nonuse) of gender-inclusive language both on mental representations associated with language comprehension and on interpersonal events, and even individual behaviors in different social settings (Horvath et al., 2016; Lewis & Lupyan, 2020; Menegatti & Rubini, 2017; Pabst et al., 2018; Sczesny et al., 2016). Studies such as those by Horvath et al. (2016), Menegatti and Rubini (2017), and Lewis and Lupyan (2020) showed that there are numerous ways in which gender stereotypes impact language and that the linguistic forms used condition gender representations and people's concrete behaviors. These studies showed that the use of gender-inclusive forms[1] mitigates the focus on previous stereotypes in which men are central in certain areas of work and power, are associated with active roles, hierarchical, and decision-making positions, and described with specific characteristics such as intelligence and proactivity.

The study of potential asymmetries in the bias generated by gender markings in languages is not new and has shown convergent results in different languages, even with very different gender paradigms. In particular, the generic masculine systematically conditions the representation of stereotypes associated with cis men, while invisibilizing representations associated with women and gender diverse people (Sczesny et al., 2016; Stetie & Zunino, 2022; Zunino & Stetie, 2022).

Proposals for Gender-Inclusive Language Across the World

In recent decades, proposals have emerged in different languages to promote gender-inclusive, gender-fair or nonsexist language (Gil & Morales, 2020; Palma et al., 2024; Sczesny et al., 2016; Zunino & Dvoskin, 2023). Currently, the discussion focuses on the notions of gender (rather than sex) and binarism as a categorization imposed by the linear relationship between biological sex and gender identity, which contradicts current advances and discussions on sex-gender diversities and dissidences (Cameron, 1998; Gil & Morales, 2020; Koeser & Sczesny, 2014; Papadopoulos, 2021). In grammatical gender languages such as Spanish, German, or French, the strategies and their study are focused on the morphological gender markings that nouns carry and are projected to other words due to agreement requirements.

The different strategies proposed and analyzed in each language generally coexist in the spontaneous use of their speakers and can be classified into three groups: feminization or duplication, neutralization, and innovation. The first one

1 Most of these studies consider gender-inclusive forms that refer to men and women but leave aside other sex-gender identities.

is based on the use of paired forms (male and female), usually with a slash, either for pronouns or inflectional desinences: he/she, *él/ella, los/as carpinteros/a*s. The second group supports the use of epicene, collective nouns or noun phrases that avoid the grammatical gender marking, so that they can be considered neutral concerning gender: people, humankind. Finally, within the innovation proposals, there are differences depending on whether they concentrate on lexical, morphological, or merely (ortho)graphic innovations. Among lexical innovations, the most common are new pronouns such as nonbinary "hen" in Swedish (Renström et al., 2022; Vergoossen et al., 2020), refunctionalizations such as singular "they" in English (Bradley et al., 2019; Camilliere et al., 2021) or compound nouns such as "policeperson" –which involves a combination of innovation and neutralization strategies– (Lindqvist et al., 2019). Among the properly morphological innovations, we can locate the non-binary variant [-e] in Spanish (Menegotto, 2020; Palma et al., 2024; Stetie & Zunino, 2022; Zunino & Stetie, 2021) and Portuguese (Miranda, 2020; Moura, 2021), which functions both in spoken and written language with systematic productivity (Fábregas, 2022)[2]. The gender asterisk in German, which although it looks like a mere graphic mark, also has an associated form of pronunciation in spoken language (Friedrich et al., 2021; Körner et al., 2022). The variant [-x] in Spanish and Portuguese or the middle dot in French (*chef·fe*), in principle, seem to function as orthographic markings without clear projection to orality[3] (Tibblin et al., 2022; Xiao et al., 2022).

In general, gender-inclusive forms are used in two ways: as a generic form when used in plural noun phrases and to refer specifically to nonbinary people. In this sense, among the research conducted on the different proposals, there is one clear element: while the use of the generic masculine does not achieve an actual generic representation, the use of gender-inclusive forms does. However, there is also another relatively consistent fact: the different gender-inclusive strategies work better when they are used in plural form and to replace a generic use than when the nonbinary forms are used to name or refer to individuals who do not perceive themselves within traditional sex-gender binarism.

In this sense, it is important to mention that generally, classic grammatical studies do not consider the notion of nonbinary gender, although it seems clear that it is essential to analyze nouns that refer to people (López, 2020). Lindqvist et al. (2019) showed that the use of existing words classified as neutral, such as epicene nouns, did not eliminate the male bias. While duplication works to make women visible in collective references, the use of innovations (pronouns, morphological variants, generic asterisk, etc.) is the only strategy that manages to break

2 For Portuguese, projection to orality is more complex because its obligatory pronunciation is identical to that of the masculine for several words (Palma et al., 2024). For this reason, other proposals have also emerged, such as the use of [-u] (Miranda, 2020).

3 The middle dot in French is seen as a contraction between the feminine and masculine forms, which is why, to the best of our knowledge, it is not used to refer to non-binary persons. In this case, other morphological innovations are used, with less widespread use, such as [-x] for the singular and [-z] for the plural (Alpheratz, 2019).

with the framework traditionally constructed by binary sex-gender distinctions.

Moreover, for Swedish, Renström et al. (2022) analyzed the use of the non-binary pronoun "hen" in its multiple functions. Here, a notable difference from the English singular "they" is that "hen" is an innovation per se, while "they" involves a refunctionalization of the existing plural pronoun. The authors found that the rejection of the pronoun "hen" is greater when it is used for nonbinary individuation than when it functions as generic, which would be explained by a resistance to conceiving dissident identities that are not framed in traditional binarism. However, for the two tasks that analyzed subliminal processes and potential hindrances in reading or processing, they did not find evidence indicating higher costs, reading difficulties, or perceptions of ungrammaticality with the use of the pronoun "hen".

In the same direction, in an eye-tracking reading task, Vergoossen et al. (2020) also found no increased processing complexity for the pronoun "hen" in any of the conditions tested. It is interesting to note that the authors found a relationship between conscious attitudes toward gender-inclusive forms reported by participants and ease of processing: people with positive attitudes toward the use of gender--inclusive forms and women visibility read all stimuli faster, not only those with nonbinary pronouns (for similar results in Spanish, see Zunino & Stetie, 2021).

Meanwhile, Bradley et al. (2019) and Camilliere et al. (2021) analyzed the singular "they" and the innovation "ze" for English, both with generic and individual functions. Bradley et al. (2019) provided evidence that "they" is accepted and recognizable by most of the speaker community, while "ze" is not massively recognized as a nonbinary variant. However, they also noted an asymmetry between the two functions of the pronoun: the use to refer to nonbinary individuals is more restricted and unstable than the generic use. On the other hand, Camilliere et al. (2021), in a task of explicit judgments on the acceptance of singular "they", showed that the perceived naturalness of the nonbinary pronoun is conditioned by the presence/absence of gender marking in the noun to which it refers and the social distance between the speaker and the referent that functions as the antecedent. Additionally, they found a strong correlation with age: younger generations showed much higher levels of innovation acceptance.

As a third example, it is worth mentioning some studies on the middle dot in French (Tibblin et al., 2022; Xiao et al., 2022) and on the gender asterisk in German (Friedrich et al., 2021; Körner et al., 2022). In these cases, a distinction also arises between generic uses and those for individual references. For French, Tibblin et al. (2022) and Xiao et al. (2022) reported that plural forms with the middle dot generated representations of groups composed equally of men and women and found a statistically significant difference with respect to the generic masculine. For German, while there is no evidence that the gender asterisk hinders the reading or comprehension process, studies showed that the generic function is significantly simpler.

Non-Binary Language in Spanish

While the phrase *gender-inclusive language* is generally used as a broad term to refer to different strategies and proposals, such as duplication, neutralization, and innovation, we use the term *nonbinary language* or *nonbinary forms* to refer explicitly to forms that can be used to refer to nonbinary individuals. Particularly for Spanish, the use of [-e] as a nonbinary morphological variant has been registered in different communities in America and Spain (Cabello Pino, 2020; Bonnin & Coronel, 2021; Bonnin & Zunino, 2024; Giammatteo, 2020; Kalinowski, 2020; López, 2020; Palma et al., 2024; Pesce & Etchezahar, 2019; Stetie et al., 2023). The strategy involves adding a third nonbinary morphological variant to the traditional Spanish binary gender paradigm (-o vs. -a) in nouns and pronouns referring to people. This modification is projected to all words that must agree with the former (mostly determiners and adjectives). A sentence such as *Ella es una niña muy animada y traviesa* ("She is a.F very lively.F and mischievous.F girl") requires the modification of several words to generate agreement in Spanish. This sentence in its nonbinary form would be *Elle es une niñe muy animade y traviese* ("They.NB is a.NB very lively.NB and mischievous.NB child.NB"). Thus, changing the morphology of certain words implies projecting modifications to the entire structure of the language. Like the strategies proposed in other languages (Bradley et al., 2019; Camilliere et al., 2021; Friedrich et al., 2021; Körner et al., 2022; Lindqvist et al., 2019; Renström et al., 2022; Vergoossen et al., 2020), Spanish nonbinary forms have two functions: generic and individual reference.

Particularly in Argentina, the use of nonbinary forms, both in oral and written language, especially in its generic function, is relatively widespread and its spontaneous use is accompanied by numerous institutional initiatives in educational and cultural spheres. It is possible to find manuals, style sheets, and official documentation that enable and promote the use of gender-inclusive forms in their different versions[4] as a way of making visible the relationship between language and rights related to gender identity and sexual diversity (Bonnin & Coronel, 2021; Palma et al., 2024; Stetie et al., 2023; Zunino & Dvoskin, 2023).

As mentioned before, although the knowledge of gender-inclusive language in Spanish, and particularly in Argentina, is widespread, systematic studies on its use are scarce. Through media and social networks, it is possible to track the use of gender-inclusive language by people of different ages, genders, levels of formal education, social groups, and locations. In a corpus study, Kalinowski (2020) found that it is used by Twitter users from all provinces of Argentina. Furthermore, in a survey of more than 600 participants, Pesce and Etchezahar (2019) found that women tend to have a higher positive evaluation of gender-inclusive language

4 For example, (Re) Nombrar. Guía para una comunicación con perspectiva de género: https://www.argentina.gob.ar/sites/default/files/guia_para_una_comunicacion_con_perspectiva_de_genero_-_mmgyd_y_presidencia_de_la_nacion.pdf; Guía para incorporar un uso inclusivo del lenguaje: http://www.unsam.edu.ar/secretarias/academica/dgyds/GUIA-LenguajeInclusivo.pdf; Proyecto de Ley: Ejercicio del derecho a la utilización del lenguaje inclusivo de género: https://www4.hcdn.gob.ar/dependencias/dsecretaria/Periodo2021/PDF2021/TP2021/3426-D-2021.pdf.

and use it more frequently than men do. In addition, they found that age also influences attitudes and use: in the lowest (18 to 23 years old) and highest (50 to 70 years old) age groups, they observed lower positive attitudes and recorded a lower frequency of use than in the intermediate age groups (24 to 49 years old). In a very recent study, Bonnin & Zunino (2024) developed a survey for Argentine teachers to analyze reported use of different morphological gender markings in different communicative contexts and the perceived use of nonbinary forms conditioned by social role in each of those communicative contexts. The authors also discussed potential conditioning by age and gender. They found that duplication was the most used gender-inclusive strategy, especially when social roles showed strong asymmetry of power and in formal written interactions. Instead, in oral interactions between teachers or in written informal contexts, participants reported using nonbinary forms. Generic masculine was not used nor perceived as a good form to refer to groups as an inclusive form.

In the framework of experimental studies on language and cognition, we have analyzed the processing of nonbinary forms in contrast to the generic masculine in cases of plural noun phrases and their interaction with the greater or lesser association with male gender stereotypes linked to certain nouns (Stetie et al., 2023; Stetie & Zunino, 2022, 2023; Zunino & Stetie, 2021, 2022). This series of studies pioneered the analysis of the comprehension of these variants in written sentences. In line with results in other languages (for a review, see Stetie & Zunino, 2022), we found that the stereotypicality of the role nouns modulates the masculine's possibility to function as generic. Furthermore, we found that nonbinary forms do not entail greater processing complexity. In fact, the results exhibited the opposite, probably because they do not generate two competing representations as can happen with the generic masculine. Hence, nonbinary forms consistently elicit a reference to mixed groups of people, regardless of the stereotypicality of the role names.

It is interesting to point out that despite nonbinary forms not being consciously accepted by all speakers, they do not produce higher processing costs. In a previous study in Spanish (Zunino & Stetie, 2022), we compared the results of strategic processes brought into play in an acceptability judgment task with those found in a comprehension task in which reading and response times were evaluated. Although, as a conscious decision, the nonbinary forms are less accepted, they do not generate difficulties or higher processing costs during sentence comprehension and even show more ease and greater accuracy in the generation of a mixed or generic reference. This aligns with experiments conducted in Swedish and English (Renström et al., 2022).

Beyond the effects found in general terms for all languages, it is worth noting that there are important differences regarding the promotion or implementation of gender-inclusive strategies in grammatical gender languages with respect to natural gender languages. Several studies have shown greater difficulty in implementation and, at times, greater resistance from speakers (Sczesny et al., 2016;

Zunino & Dvoskin, 2023; Zunino & Stetie, 2022). This may have hindered the development of empirical and experimental research on the processing of nonbinary forms in grammatical gender languages such as Spanish (Stetie et al., 2023). In the current study, we deepen a line of previous research (Stetie et al., 2023; Stetie & Zunino, 2022, 2023; Zunino & Stetie, 2021, 2022) to continue adding evidence to better understand this complex phenomenon.

The Present Study

We conducted an online sentence reading task using a psycholinguistic approach to assess the relationship between gender stereotypes, role noun semantics, and morphological gender markings during language processing. In previous experiments (Stetie & Zunino, 2022; Zunino & Stetie, 2021, 2022), we compared the processing of two non-binary forms [-x, -e] with generic masculine and only analyzed the influence of male semantic bias, that is, stereotypes related to men. In this case, we focused on studying only the processing of the nonbinary morphological innovation [-e] in role nouns and the effects that both male and female semantic biases of such role nouns might have on processing. Therefore, the experiment had one condition with two levels: male semantic bias and female semantic bias.

As previous studies have pointed out, gender stereotypes are deeply rooted in mental representations and would be part of the semantic content of lexical items. The use of binary morphology endorses this semantic bias. In contrast, based on previous research presented above, our experimental hypothesis was that nonbinary morphology might mitigate the effect of gender stereotypes on language. Moreover, we predicted that this mitigation would be less noticeable in local processes than in global semantic integration and representation processes.

Method

Participants

To form a diverse and representative sample, we recruited participants through social networks. Participation was voluntary and the participants were not compensated. A total of 301[5] Spanish speakers from Argentina participated in the

5 Our target sample consisted of 301 participants because it was a feasible number given resources and time constraints, while ensuring adequate statistical power. We conducted a post-hoc power analysis that resulted in estimates of 62.3% and 32% (for the two main measures, the first spillover word and the total reading time, respectively) given an alpha level of 0.05. Cognitive sciences in general and language studies in particular have problems in reaching the standard statistical power of 80% (Brysbaert, 2019; Jäger et al., 2020; Vasishth & Gelman, 2021). The most frequent limitations, of which our study is not exempt, are related to increasing the number of participants or items. In the first case, increasing only the number of participants to infinity does not approach power unity but instead approaches a maximum attainable power (Judd et al., 2017; Meteyard & Davies, 2020; Pek et al., 2024; Westfall et al., 2014). That is why we limited our sample to 301 participants. In the second case, increasing the number of items in language is very costly because it can alter the experimental designs and the ecology of the study. Adding more items in this study was almost impossible because not only did they have

study, but we removed fifteen participants for the final analysis because they did not meet the inclusion criteria[6].

The final sample consisted of 286 participants. They were between 18 and 76 years old (M = 32.93; SD = 12.03). From them, 181 were women (63%), 66 were men (23%), nine were nonbinary (3%) and 30 did not report their gender identities (11%)[7]. As we attempted to collect a representative sample, participants were not all first-year college students (Peterson & Merunka, 2014). In terms of educational level, 48 people have completed high school, 51 participants were college students, 160 participants completed a degree (BA or MA/MSc), and 27 people were pursuing or have completed postgraduate studies. Regarding geographical location, all participants were from Argentina, 257 of them lived in Buenos Aires and surrounding areas, and 29 in other provinces.

Materials

We designed 20 sentences with role nouns, 10 for each condition according to Semantic Bias (male vs. female). All sentences began with a noun phrase (determiner + role noun) and then a complete predicate. The only reference to gender was the nonbinary form [-e] that appeared in the subject, both in the determiner and the role noun. All sentences had a similar length: between 11 and 16 words (M = 13.50; SD = 1.28), between 28 and 32 syllables (M = 29.85; SD = 1.42), and between 85 and 90 characters (M = 87.60; SD = 1.31). For the analysis of reading times, we distinguished three interest zones: noun phrase, spillover region, and wrap-up region (see Figure 1). We also analyzed reading times for the complete sentence. Examples 1 and 2 present items with semantic female and male bias, respectively.

(1) *Les niñeres*	*desempeñan*	*tareas fundamentales*	*para*	*las familias*
Babysitters.NB	play	an essential role	for	families
con	*padres trabajadores.*			
with	working parents.			

6 Prior to data analysis and based on previous experiences conducting experiments online, we defined the inclusion criteria. We established upper- and lower-time limits for each word (100 ms and 3000 ms, respectively) to ensure that participants were paying attention to the task. Ten participants systematically did not reach the minimum time of 100 ms, which we considered the lower limit for word reading (Hartley et al., 1994). We considered that these participants read the sentences altogether instead of word by word, as was the objective of the task. Moreover, five participants also had to be removed because they performed the experiment twice.

7 Psycholinguistic experiments tend to have an imbalance in terms of participants: there is a greater tendency for women to participate in experimental research. In previous research, we included the gender identity variable as a factor in the analysis and found no statistically significant differences between men and women (Stetie & Zunino, 2022). For this reason, we decided not to consider gender and, therefore, we did not eliminate nonbinary participants or those who did not specify their gender identity from the sample, and we consider that the imbalance in the sample does not constitute a potential bias in this study.

(2) *Les marineres cuidan* *la* *trayectoria de la*
Sailors.NB take care of the trajectory of the
embarcación *y* *siguen* *las* *órdenes del capitán.*
boat and follow the captain's orders.

As mentioned above, the female or male bias of a role name is cultural knowledge. For this reason, we preselected 12 role names and, from those items, we conducted a normative study (see Stetie & Zunino, 2023). In it, we asked participants if a certain activity was more associated with men or women, as in Example 3. Based on the normative results, we selected 10 final stimuli for each level of semantic bias.

(3) Among the people who practice engineering, would you say that there are… a. all women; b. more women than men; c. the same number of women as men; d. more men than women; e. all men.

In addition, we used 100 fillers that corresponded to stimuli from two other experiments. On the one hand, we included 40 items from another experiment evaluating the relation between gender morphology and gender stereotypes. The items were elaborated with the same role names as in this task, but they included female and male morphology, as shown in Examples 4 and 5. On the other hand, we included 60 items from a relative clause attachment experiment, as shown in Example 6. To ensure that participants were paying attention to the task and that they were constructing a global representation of the sentences they read, we included comprehension questions with four response options (see Example 7) in half of the stimuli, both in the experimental and filler items. The 20 experimental items and the 100 fillers were divided into three counterbalanced lists with 40 items each, of those 40 items, 20 presented comprehension questions.

(4) *Los marineros cuidan* *la* *trayectoria de la*
Sailors.M take care of the trajectory of the
embarcación *y* *siguen* *las* *órdenes del capitán.*
boat and follow the captain's orders.

(5) *Las marineras cuidan* *la* *trayectoria de la*
Sailors.F take care of the trajectory of the
embarcación *y* *siguen* *las* *órdenes del capitán.*
boat and follow the captain's orders.

(6) *El* *presidente* *condecoró* *al* *guardia del*
The president decorated the guard of the
prisionero *que* *había robado* *el* *banco* *con* *rehenes.*
prisoner who had robbed the bank with hostages.

(7) *¿Hubo*	*rehenes*	*en*	*el*	*robo al banco?*	*a. sí;*	*b. no;*
Were there	hostages	in	the	bank robbery?	a. yes;	b. no;
c. no recuerdo;	*d. no decía.*					
c. don't remember;	d. didn't say.					

Procedure

The task was conducted on IBEX software (Internet Based Experiments: Drummond, 2013). The study was conducted online and participants were randomly assigned to one of the three lists. An informed consent form was first presented and had to be accepted to access the demographic questions and the experiment. Participants were asked to indicate their age, gender identity, highest level of education, profession, nationality, and residence.

After the demographic questions, the task and guidelines for its completion were presented. The sentences were presented in a cumulative moving-window self-paced reading paradigm: participants read sentences word by word at their own pace. After each sentence, in half of the cases, they moved to another screen where they were presented with a comprehension question with four options. Once they selected the answer, they moved to the next screen with a fixation point, at which point they could either rest or continue to the next item. They were presented with four test sentences, followed by three more practice items, which for them were already part of the experiment. The task could only be performed on a computer (no phone or tablet) with an Internet connection.

Analysis and Results

This study's objective was to analyze the incremental process involved in constructing a representation during reading sentences with a non-binary morphological innovation. For this purpose, we considered different sentence regions reading times as dependent variables. Figure 1 shows the regions corresponding to

Figure 1. *Identification of the Critical Regions: Noun Phrase, Spillover Region, Wrap-Up Region, Total Sentence.*

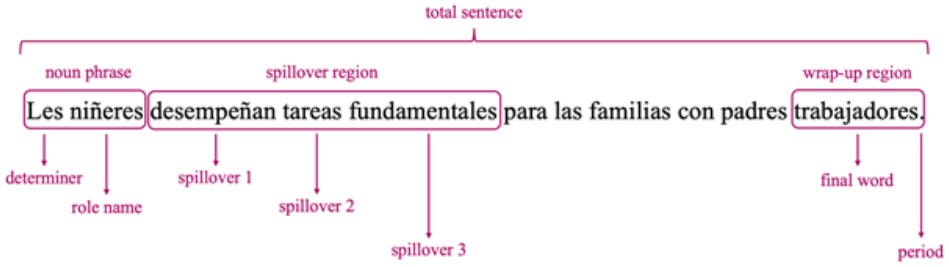
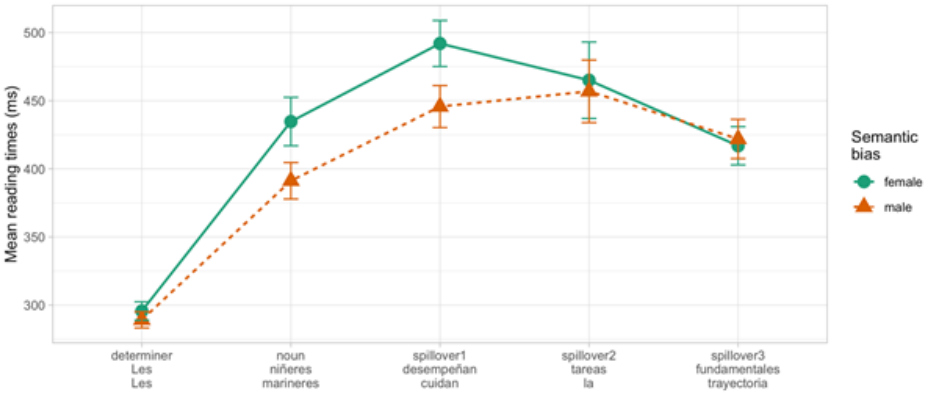


Figure 2. *Determiner, Role Noun, and Spillover Words Mean Reading Times by Semantic Bias.*



Note. Error bars represent standard errors of the mean.

the four dependent variables analyzed. First, we present the analysis of the noun phrase and spillover region reading times. Then, we analyzed the wrap-up and total sentence reading times. We organized the analysis in this way because we wanted to study two distinct underlying processes: the lexical and morphosyntactic processing of the nonbinary variant within the noun phrase, and the syntactic, semantic, and pragmatic processing involved in integrating all the information of the sentence into one global representation.

Statistical analysis was performed using R software version 4.2.2 in the R Studio interface (R Core Team, 2022) and the tidyverse (Wickham et al., 2019), lme4 (Bates et al., 2015), lmerTest (Kuznetsova et al., 2017) and MASS packages (Venables & Ripley, 2002). Data and analysis code are available at Open Science Framework: https://osf.io/kbnu9/.

For the final analysis, we discarded items that were answered incorrectly (1.66% of the data)[8]. Additionally, because the task was performed remotely without being able to control the situation in which participants were doing it, we set time limits for each trial's completion (lower limit: 1000 ms; upper limit: 30000 ms). This involved the removal of 108 data points (1.92% of the total sample).

Noun Phrase and Spillover Reading Times

First, we analyzed the time it took participants to read the noun phrase plus the three subsequent words (spillover region). As shown in Figure 2, female-biased role nouns had longer processing times, a difference present in the role noun

8 As outlined in the Materials section, half of the sentences included a comprehension question. If participants opted for one of the three incorrect answers, this was considered an error, and that trial was eliminated from the final analysis because we assumed that the participant was not paying attention while reading the sentence.

and in the first spillover word. Subsequently, the difference disappeared.

For the statistical analysis, we tested the assumptions of normality and homoscedasticity and then decided to perform a logarithmic transformation for data analysis (Winter, 2019). We coded the levels of fixed factors as scaled sum contrasts (Schad et al., 2020). The model used for the analysis included semantic bias as a fixed effect and participants and items as random effects: lmer(log(reading_time) ~ semantic bias + (1 | participants) + (1 | items). For the noun phrase (determiner + role name), the difference in reading times was not statistically significant ($\beta_{male\text{-}female} = -0.03592$, SE = 0.02439, $t = -1.473$, $p = .158$)[9]. This means that there is no evidence of an early and rapid semantic bias effect on role names with nonbinary morphology.

However, we did find an effect of semantic bias on the first spillover word ($\beta_{male\text{-}female} = -0.06679$, SE = 0.02945, $t = -2.268$, $p = .0377$). For the next two spillover words, no statistically significant differences were found according to semantic bias (spillover 2: $\beta_{male\text{-}female} = -0.006475$, SE = 0.036778, $t = -0.176$, $p = .862$; spillover 3: $\beta_{male\text{-}female} = 0.01767$, SE = 0.04478, $t = 0.395$, $p = .698$). These results show that the male-biased condition is processed faster than the female-biased condition, at least in the first spillover word.

Wrap-Up and Total Sentence Reading Times

Second, we analyzed the time participants took to read the final word and period (wrap-up region) and the total sentence reading time. Figure 3 shows the distribution of the reading times and means.

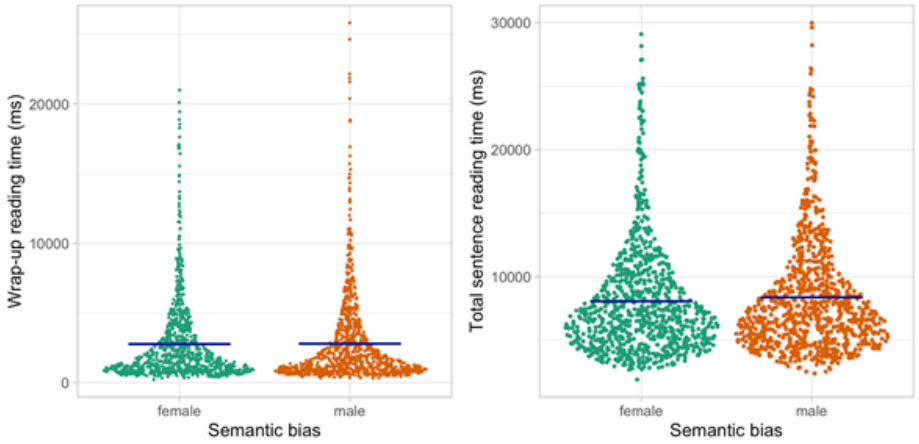
For statistical analysis, we performed the same procedures as in the previous case and used the same analysis model with the following formula: lmer(log(reading_time) ~ semantic bias + (1 | participants) + (1 | items). Neither of the two variables analyzed had a semantic bias effect (wrap-up region: $\beta_{male\text{-}female} = -0.002228$, SE = 0.05848, $t = 0.038$, $p = .97$; total sentence: $\beta_{male\text{-}female} = 0.04366$, SE = 0.02921, $t = 1.495$, $p = .152$). This could be interpreted as an absence of a semantic bias effect on the global comprehension of the sentence.

Discussion

In the current study, we presented data from an experiment assessing the effect of gender stereotypes on lexical semantics and their link to the processing of noun phrases with the nonbinary morphological innovation [-e]. We performed a cumulative moving-window self-paced reading task and manipulated the semantic bias of role nouns. We considered stereotypically female and stereotypically male role names and elaborated stimuli with the nonbinary morphologi-

9 The noun phrase time differences are generated by the noun, not the determiner: the same pattern was observed for the role noun analysis (βmale-female = -0.04649, SE = 0.03351, t = -1.387, p = .182).

Figure 3. *Distribution of Wrap-Up Region and Total Sentence Reading Times by Semantic Bias (in ms).*



Note. The blue line indicates mean values.

cal innovation [-e]. We analyzed four dependent variables: noun phrase reading time, spillover region reading time, wrap-up region reading time, and total sentence reading time. First, we discuss the results of the noun phrase and spillover region reading times. Then, we comment on the results of the wrap-up region and total sentence reading times.

First, we registered the noun phrase (determiner + role name) reading time. As shown in Figure 2, there was only a very small difference between reading times of male-biased role names and female-biased role names. This difference was not statistically significant. In principle, these results show no evidence of an effect of semantic bias on the nonbinary form, which might be interpreted in line with previous studies that find a mitigation effect of gender-inclusive language over the stereotypicality bias of role names (Körner et al., 2022; Lindqvist et al., 2019; Tibblin et al., 2022; Xiao et al., 2022; Stetie & Zunino, 2022; Zunino & Stetie, 2021, 2022). Some studies have reported immediate effects on role nouns (Carreiras et al., 1996; Duffy & Kier, 2004), however, we understand that a higher-order semantic effect generated by the occurrence of stereotypical information may not be registered so early, but, instead, exhibited during processing in following words.

Therefore, we analyzed the spillover region (the three words following the noun phrase) reading time. As commented before, the first spillover word has the same time pattern as that role noun. However, this quickly changes, since for the second and third words, there are no differences due to semantic bias. The semantic bias effect found in the first spillover word might indicate the incidence of stereotypes in language processing, as noted in previous research (Canal et al., 2015; Carreiras

et al., 1996; Duffy & Kier, 2004; Siyanova-Chanturia et al., 2012). We did not find such an early effect as reported in other studies, but we understand that it is a finding compatible with the line established by those studies. Above all, it is worth highlighting that this effect seems to operate during lexical and local processing and not on the integration of information for a global representation of the whole sentence, since the effect disappears quickly in the next word. We will return to this point after discussing the wrap-up and total sentence reading times results.

We consider two factors that could explain the longer reading times for the female-biased condition. On the one hand, nonbinary forms are used more frequently in some high-frequency words (Bonnin & Coronel, 2021; Kalinowski, 2020), which generally have a male or neutral bias. Therefore, it could be that female-biased role names have a lower frequency of occurrence with nonbinary forms and that this projects a higher processing cost during reading. As noted, gender-inclusive language and nonbinary morphological innovations appear to have more widespread use in the plural and, in general, in reference to a group composed of men and women, and not necessarily people of nonbinary identity (Bradley et al., 2019; Camilliere et al., 2021; Renström et al., 2022). In this sense, gender-inclusive language seems to be used as a feminization strategy and, hence, there is a need to apply it especially to stereotypically male role names, replacing the generic masculine. Currently, we do not have corpus studies that register the different uses of nonbinary forms that would allow us to accurately discern between the different connotations and we believe that it is necessary to move forward in this direction.

On the other hand, the various role name representations could operate in different ways. Could it be that a male stereotype is more representable than a female stereotype? In other words, not only morphology but also stereotypical mental representations of gender may operate as by default normative groups (Lindqvist et al., 2019; Siyanova-Chanturia et al., 2012, 2015). In this sense, the existence of the semantic bias effect after the role noun, in the first spillover word, is notable. We assume that this effect is not linked to the difficulty generated by the nonbinary morphology itself, but rather an effect linked to semantic bias. Our hypothesis is that the generic or unmarked feature is not characteristic of the morphological variants but of the gender representation associated with that role noun. Names associated with men would operate as semantically unmarked, generating a default representation that is easier to process, even when there is a specific morphological marking indicating that the reference should be to mixed groups of people (Lindqvist et al., 2019; Siyanova-Chanturia et al., 2012, 2015). However, as in the present study, we only tested nonbinary role names, we cannot evaluate this hypothesis.

Second, we analyzed the wrap-up region (last word and period) and the total sentence reading times, which allowed us to evaluate the syntactic, semantic and pragmatic processing involved in integrating all the sentence information into a coherent representation. These results support our initial hypothesis that nonbi-

nary morphology mitigates the effect of gender stereotypes on language (Körner et al., 2022; Lindqvist et al., 2019; Stetie & Zunino, 2022; Tibblin et al., 2022; Xiao et al., 2022; Zunino & Stetie, 2021, 2022). Moreover, as we postulated, this mitigation is stronger on global semantic integration and representation processes than at the noun phrase local level. As the results showed, there was no semantic bias effect on the wrap-up region and the total sentence reading time; the semantic bias effect was only present in the first spillover word. Further studies are required to rigorously understand the interaction between gender stereotypes and nonbinary morphological innovations. However, our results align with previous research that claimed that nonbinary innovations are the only gender-inclusive strategy that manages to break the androcentric world view and diminish male bias (Lindqvist et al., 2019; Sczesny et al., 2016).

Despite the limitations of our study, such as the fact that we only included stereotypically biased role names and we did not compare the [-e] against the binary morphology, it tries to fill a blank and is a first step to better understand Spanish nonbinary morphological innovation. As there is little research on how gender-inclusive language is processed, we need to conduct exploratory studies, like the present one, to obtain based line measures to which we can compare future research on the topic. Therefore, this study opens up opportunities for researchers wanting to conduct similar experiments involving nonbinary forms, in Spanish and in other languages.

Last but not least, the results presented have implications not only for language research itself but also for the social perception of gender. They contribute to the debate of whether gender-inclusive language leads to balanced mental representations of genders, whether it makes discriminatory behavior less likely and whether it hinders language comprehension. These are at the center of public debates and policies around non-binary language and we think it is important to add empirical data to the ongoing discussions.

Conflict of Interest Disclosure

The Authors report there are no competing interests to declare.

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Research Ethics Statement

The study was conducted with voluntary, anonymous, and unpaid participation of adults. Each participant could stop the task at any time they wished. The study was under the support of Argentina's Habeas Data Law. The University of Buenos Aires does not request authorization from the Ethics Committee when

the tasks are not invasive, nor require access to medical records or personal identification data and the participants are of legal age. However, the Institute of Linguistics of the University of Buenos Aires has approved by the Ethics Committee of the institution the documents that must be used as informed consents and this format was the one used in this study, which ensures data protection under the Argentina's Habeas Data Law.

Data Availability Statement

Data and analysis code are available in a public repository: https://osf.io/kbnu9/.

Authorship Details

Noelia Ayelén Stetie: research concept and design, collection and/or assembly of data, data analysis and interpretation, writing the article, critical revision of the article, final approval of the article. Gabriela Mariel Zunino: research concept and design, collection and/or assembly of data, data analysis and interpretation, writing the article, critical revision of the article, final approval of the article.

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