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Non-binary language in Spanish? Comprehension of non-binary morphological forms: a psycholinguistic study

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There is empirical evidence in different languages on how the computation of gender morphology during psycholinguistic processing affects the construction of sex-generic representations. However, there are few experimental studies in Spanish and there is no empirical evidence about the psycholinguistic processing of morphological innovations used as non-binary forms (-x; -e) in contrast to the generic masculine variant (-o). To analyze this phenomenon, we designed a sentence comprehension task. We registered reading times, precision and response times. The results show the specialization of non-binary forms as generic morphological variants, as opposed to the generic masculine. The non-binary forms consistently elicited a reference to mixed groups of people and the response times indicated that these morphological variants do not carry a higher processing cost than the generic masculine. Contrary to what classical grammatical approaches propose, the generic masculine does not function in all cases as generic and its ability to refer to groups of people without uniform gender seems to be modulated by the stereotypicality of the role names.

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1 Introduction

1.1 Gender paradigm in Spanish

The lines of study on gender in different natural languages are numerous and diverse, and offer not only strictly grammatical but also lexicographic, pragmatic, sociolinguistic and psycholinguistic perspectives. Different languages mark grammatical gender in different ways. As a result, different taxonomies have been proposed over the years (Dixon 1987; Corbett 1991; Hellinger & Bußmann 2001; Prewitt-Freilino et al. 2012; Leaper 2014; Gygax et al. 2019). One of the most recent classifications (Gygax et al. 2019) distinguishes between five language groups: 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. Within the first group, where languages such as Spanish, German and Italian are found, gender controls grammatical agreement and both nouns that refer to animate and inanimate entities have assigned gender. For example, most role names in Spanish have gender inflection, such as *maestra* (teacher-F) and *maestro* (teacher-M) or *carpintero* (carpenter-M) and *carpintera* (carpenter-F), and inanimate objects like *la llave* (the-F key) and *el puente* (the-M bridge).

The gender paradigm in Spanish assumes a binary distinction (masculine/feminine) but exhibits a certain complexity, which has led to several attempts of systematization (Ambadiang 1999; Roca 2006; Mendívil Giró 2020). The different proposals to describe gender inflection in Spanish tend to vary in the degree of gender arbitrariness or motivation in nouns, and there is a special focus on nouns that refer to people. Most of these proposals try to organize this systematization from the understanding that gender can be defined by semantic and formal features. However, numerous studies especially point out that gender, in languages in general and in Spanish in particular, is also linked, supported and conditioned by extralinguistic factors (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Barrera Linares 2019; López 2020).

A phenomenon in which this is especially analyzed is in the gender assignment process. For nouns that refer to people, it seems undeniable that sociolinguistic and pragmatic factors are involved, as well as grammatical ones. There are epicene nouns (those nouns in which a single invariable form indistinctly refers to men and women and that do not require morphological changes to generate agreement, for example, *persona*, person, in Spanish). However, they are not a large number and most of the nouns that refer to people (and in general to animated entities) form gendered pairs, which in many studies are classified as heteronyms. The forms of these pairs can vary in the root (*mujer*, woman, and *varón*, men) or mark the gender through affixes. One option is to mark gender through derivation (*alcalde*, mayor-M, and *alcaldesa*, mayor-F), another possibility is to do it in the inflection (*enfermero*, nurse-M, and *enfermera*, nurse-F). As Ambadiang (1999) observes, gender in names referring to people tends to present a biological bias, so the gender assignment process cannot be addressed exclusively from a grammatical perspective.

There is a broad consensus that Spanish is an inherently gendered language. However, this can be understood in multiple ways. Most studies propose that what is inherent is “to carry some gender”, but there would be no inherence about which one. This debate exhibits, one more time, the complexity of the gender assignment process and to what extent this assignment would be arbitrary or motivated (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Barrera Linares 2019). Similar debates exist in other languages, French, for example (Richy & Burnett 2021).

A perspective that has been widely analyzed addresses gender inflection in terms of marked and unmarked elements. It is from this distinction that, on many occasions, the so-called “generic masculine” has been analyzed (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Márquez 2013; Barrera Linares 2019; Mendivil Giró 2020). To show that masculine is the unmarked gender in Spanish, a widely accepted definition is the one offered by Ambadiang (1999): 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; d. it is taken to refer to entities with different genders. This last case would be the one that explains the generic masculine. Instead, the feminine gender is the marked gender in Spanish: it is associated with inflection variants that must be present to assign that gender to a word.

From sociolinguistic and pragmatic perspectives, a lot of studies show a notably asymmetric function in the generic masculine and many proposals go so far as to argue that the Spanish inflectional system imposes an initial bias that systematically hides women¹ (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Márquez 2013; Barrera Linares 2019; Menegotto 2020). We want to highlight two particularly interesting issues along these lines. First, the analysis of the cases in which there is a strong asymmetry in the acceptance of a female variant (*jueza*, judge-F, *sirvienta*, servant-F, *presidenta*, president-F, *plomera*, plumber-F) and the projections of the meaning of the false gender pairs, in which the feminine variant implies a pejorative use and not simply the feminine marking (*zorra/zorro*, fox-F/fox-M, where fox-F is interpreted as ‘slut’ and fox-M as ‘cunning’; *perra/perro*, dog-F/dog-M, where dog-F is interpreted as ‘bitch’ and

¹ Biases imposed by generic masculine and gender stereotypes have also been reported in other languages, such as English (Pabst et al. 2018) and French (Richy & Burnett 2019). Both studies have analyzed syntactic structures and lexical selections appearing in natural texts as a function of the gender of the role names involved. The researchers report that there is a systematic bias in the syntactic distribution of nominal phrases according to whether they refer to women or men, and that there is a gender-dependent difference in the type of element used to generate the reference. For example, noun phrases referring to men appear more frequently than phrases referring to women, particularly in subject position and with the thematic role of agent. Particularly interesting is the comparative analysis of ambiguous gender nouns (possibly assimilable to epicene nouns in Spanish) in contrast to full masculine nouns. Their distribution is very similar to that of feminine nouns, which generates a situation in which masculine stereotypes are the default measure from which the rest of the classification and its projection to the distribution of phrases in sentences is organized. This is something similar to what happens in the description of the masculine as unmarked gender in Spanish.

dog-M as ‘buddy’). Second, the study of dialectal differences seems especially relevant for the gender paradigm. American varieties of Spanish show a consistent trend toward morphological regularization, which leads to completing the gender pair paradigm in many more cases than what Iberian Spanish speakers do and accept (Ambadiang 1999; Leaper 2014).

1.2 Effects of grammatical gender on processing and cognition

When we leave this framework of theoretical studies and focus on (psycho)linguistic processing, we need to analyze the comprehension and production of language in a broader cognitive framework. This framework must establish links with the organization of mental representations and concepts, prior world knowledge and beliefs. A classic debate is the one that occurs around the Linguistic Relativity Hypothesis (Sapir 1921; Whorf 1956), also called the Sapir-Whorf Hypothesis. This postulates that the language we speak influences or shapes thought, in some way (Sapir 1921; Whorf 1956; Lucy 1996; Zlatev & Blomberg 2015; Scotto & Pérez 2020). That is, due to the different categories and distinctions, especially semantic, that each language makes, its speakers are forced to pay attention to different aspects of the environment, which would ultimately lead them to generate alternative representations about the same world events.

In the last decade, there has been a revival of these proposals (Everett 2013; Zlatev & Blomberg 2015; Scotto & Pérez 2020) that consider different nuances of the Linguistic Relativity Hypothesis: language as an “enhancer” of thought, language as “intrusion” or “obstacle”, language as a “focuser”, language as an “inducer” and some variants of the well-known “thinking for speaking” hypothesis (Slobin 1991; 1996). Several of these perspectives have been taken up by empirical psycholinguistics studies and have managed to collect supporting evidence to endorse some type of bias or influence of linguistic forms on cognition. As part of these lines of research, we find the studies on the projection of different language morphological gender markings toward the sex-generic representations that the speakers manipulate.

Psycholinguistic research on the way people perceive gender has shown different biases associated with the particularities of gender markings in languages. These markings are not limited to grammatical elements. Instead, they are multiple, varied and operate in the discursive uses of linguistic forms and even in the way constructions are organized (Stahlberg et al. 2007; Leaper 2014; Pérez & Moragas 2020; Pinheiro & Freitag 2020).

Within this group of studies investigating the possible gender bias that the linguistic forms could entail for cognition, a phenomenon of interest is what happens to speakers of languages with obligatory gender marking and binary gender paradigms. Is the gender interpretation as arbitrary as some traditional grammatical studies assume (Ambadiang 1999; Roca 2006; Barrera Linares 2019)? Several empirical studies have suggested that representations associated with people’s sex-gender identities are projected onto other words referring to non-human entities. This suggests that there seems to be some degree of motivation for gender assignment (Konishi

1993; Flaherty 2001; Sera et al. 2002; Boroditsky et al. 2003; Phillips & Boroditsky 2003; Vigliocco et al. 2005; Segel & Boroditsky 2011; Saalbach et al. 2012; Everett 2013; Sato et al. 2017; Maciuszek et al. 2019). For example, Boroditsky, Schmidt, and Phillips (2003) asked Spanish and German speakers, both bilingual groups with English L2, to associate three features to object names possessing the opposite grammatical gender in both languages. The task was performed in English, a language in which these objects are not gender-marked, and the adjectives were classified as having more or less feminine or masculine properties by a group of English speakers. Responses reflected associations between the object grammatical gender and the qualities assigned to those objects. Participants rated grammatically masculine items in their L1 with adjectives that were considered masculine and grammatically feminine objects with more feminine adjectives. In the case of the noun 'bridge', speakers of Spanish (language in which it has masculine gender) rated it as strong, big and dangerous, while speakers of German (language in which it has feminine gender) rated it as elegant, fragile and slender.

Another phenomenon studied about gender bias in languages is the interpretation of the generic masculine in role names. In Spanish, as in other languages such as Italian, French and German, the masculine gender can also function as generic, that is, it can refer to entities with different genders. As has been highlighted, the univocal reference as generic posed by traditional grammars has been questioned from sociolinguistic and pragmatic approaches, from which the generic masculine imposes an initial bias of interpretation. Different psycholinguistic studies (Braun et al. 2005; Cacciari & Padovani 2007; Brauer 2008; Gygax & Gabriel 2008; Gygax et al. 2008; Misersky et al. 2018; Marchesini 2019; Pinheiro & Freitag 2020; Richy & Burnett 2021) suggest that the generic masculine presents such a bias and that, in many cases, it tends to be interpreted with an exclusive reference to men. This seems to interact with linguistic and nonlinguistic (the stereotypicality of role names) factors.

The bias imposed by role nouns presented in generic masculine was found in different languages and in offline and online processing. In the first case, Gygax et al. (2008) evaluated sentences with role nouns and the preference for a continuation including men or women with English, German and French speakers. They found that when role names have no gender marking, as in English, reference construction is based on stereotypicality. However, when gender marking is provided, such as the generic masculine in French and German, reference construction appears to be based only on the gender marking and unmediated by stereotypicality. Specifically, when presenting role names in generic masculine they found that those that had been previously evaluated as stereotypically feminine or neutral (Gabriel et al. 2008) also generated a reference to a group of men. In terms of online processing, Misersky, Majid, and Snijders (2018) used event-related potentials (ERPs), an electrophysiological non-invasive technique that records time-locked electroencephalographic (EEG) activity in response to stimuli. This method provides excellent temporal resolution and allows us to measure brain activity and to analyze how different

stimuli are represented and processed. Misersky et al. (2018) used this technique to determine whether generic masculine role names favored an effectively generic or specific interpretation toward a group of men. They assessed a group of German speakers and found that following the presentation of a generic masculine role name, continuations referring to a female group generated a P600. The P600 component is usually related to syntactic ungrammaticality or complexity. So, these results were interpreted as indicating that participants had difficulty with syntactic processing and integration between the generic masculine and a feminine reference.

Empirical studies in Spanish also show that the bias generated by the generic masculine is identifiable and appears to have a sustained effect on cognition. Kaufmann and Bohner (2014), with a pioneering study in Spanish, analyzed the binary form “with a bar” (*los/as*, the-M-PL/-F-PL) and two morphological innovations to generate non-binary inclusive forms (-@ and -x). In their experiment, participants were asked to read short stories and generate a word fragment completion. Although they found a weak bias in the completion, modulated by the gender identity of each participant, they found no differences due to the linguistic form used in the items. In a later study, Marchesini (2019) presented a group of participants with sentences in three conditions: generic masculine, collective nouns (the faculty, the management) and the non-binary form with [-e]. After reading each sentence, participants were asked to indicate whether the group to which the subject of the sentence referred consisted mostly of men or mostly of women. As in the previous experiments, the generic masculine presented a bias toward an exclusively masculine reference, while the non-binary form with [-e] and the use of collective nouns presented more balanced responses: half of the participants opted for a reference to a group with more women and the other half to a group with more men. In this experiment, Marchesini also measured sentence reaction times (i.e., reading time together with response time), and found that sentences with generic masculine had shorter times than the other two conditions. One possible explanation for this difference in times is that non-binary language, both direct and indirect,² involves higher processing costs. However, it is also possible that this difference is an artifact of the task. The sentences presented in the three conditions were not the same and the length of each sentence was different. Another potential problem with this study is that the stereotypicality of the role names was not controlled for; this factor could have modulated the responses. This is a point we will focus on in our study.

1.3 Non-binary forms in Spanish

For almost a decade now, initiatives have arisen in different Spanish-speaking communities to avoid the gender biases that can be projected from the binary marking of gender morphology in Spanish.

² This distinction was introduced by López (2020) and will be clarified in the next section.

Proposals on the so called “inclusive language” or gender-fair language have varied over the years (Sczesny & Formanowicz & Moser 2016; Gil & Morales 2020; Guerrero Salazar 2020; Zunino & Dvoskin 2022). Even the theoretical approach and the naming of the phenomenon have suffered changes. Initially, we used to talk about sexism in language. Nowadays, the focus has shifted to the discussion around the notion of gender and the binarism imposed by a correlation between biological sex and gender identity. This binarism clashes with the advances and discussions around sex-gender diversities around the world (Cameron 1998; Koeser & Sczesny 2014; Gil & Morales 2020).

In this regard, speakers’ spontaneous initiatives (often accompanied by institutions later on) have gone from the use of epicene nouns, collective nouns and exclusively orthographic markers such as [-@] or [-x], which had the written language as their central objective, to the use of [-e] as a non-binary gender marking, which allows the projection to the spoken language and generates stronger restrictions on concordance (Giammatteo 2020; Menegotto 2020). From this movement, then, the proposal can no longer be considered as a mere orthographic marker and it is necessary to analyze it as a linguistic phenomenon in its full dimension. Thus, the debate arises as to whether these initiatives begin to constitute true morphological innovations or not. Various debates unfold as to what degree these would be extended on the language system —beyond the extent of their widespread use— and whether this phenomenon would generate a linguistic change in the strict sense of the word (Moreno Cabrera 2008; Giammatteo 2020; Menegotto 2020).

At the present time and with a strong generational difference, the use of [-e] as a non-binary morphological form in Spanish is widespread in several Spanish-speaking communities in America and its use is also registered in Iberian Spanish (Cardelli 2018; Gasparri 2019; Giammatteo 2020; López 2020; Raiter 2020; Bonnin & Coronel 2021).

In this case, an attempt is made to modify the binary gender morphology of Spanish (-o vs -a) in those nouns and pronouns that refer to people. From there, this modification is projected to all the words that, in Spanish, must agree in gender with those nouns and pronouns (basically, determiners and adjectives). A sentence like “*Ella es una niña inteligéntísima*” (She is a very smart-F girl) requires, in Spanish, agreement between several words. Thus, the modification in gender morphology causes modifications in the language structure that are projected onto other words (*una*, a; *inteligéntísima*, very intelligent), in addition to those that provoke the reference itself (*ella*, she and *niña*, girl). To exemplify with the non-binary variant [-e], the same sentence would be: “*Elle es une niñe intelligéntissime*”.

Specifically in Argentina, the use of non-binary forms (both in oral and written language) is not only widespread but is also massively accompanied by educational, cultural and public institutions of all kinds. It is possible to find manuals, style sheets and documentation that enables

and promotes its use.³ There is even a national bill to be discussed by the National Congress⁴ that makes explicit and visible the relationship between language and the right to gender identity and diversity (Sayago 2019; Bonnin & Coronel 2021; Zunino & Dvoskin 2022). It is interesting to note that, at the present time, the form with [-@] has been lost and the use of forms with [-x] and [-e] is maintained. In the case of [-x], it is a form only admissible in written texts, so it would not have full projection to the language system. However, for writing it is usually preferred, since, among other issues, it does not require spelling modifications related to the grapheme-phoneme conversion rules that govern the Spanish orthographic system.

For example, the generic masculine in the noun phrase “*los científicos argentinos*” (the-M-PL argentine-M-PL scientists-M) could be replaced by the non-binary forms “*lxs científicxs argentinxs*” or “*les científiques argentines*”. In the second case, the orthographic change in *científiques* (scientists-NB) is necessary to maintain the correct pronunciation when that word is read. So, sometimes, it is chosen to avoid this type of modification, since the reading aloud would be the same in both cases. For oral language, of course, the variant with [-e] is the one that shows a more widespread use, although there are cases of the morpheme [-i] to mark a non-binary form in words that originally take the [-e] as a masculine mark. For example, *pibes* (children-M-PL) is the masculine form and its variant *pibis* (children-NB-PL) would be the non-binary form.

In this sense, it is worth saying that none of the already classic grammatical studies takes into account the idea of non-binary gender, a notion that it is essential to discuss for names that refer to people. This is, to a large extent, what is projected from the use of morphological innovations such as the [-x] and the [-e] in Spanish. In this sense, López (2020: 296) suggests that “beyond these collective and generic situations, the use of a grammatical gender to speak of a specific non-binary person deserves consideration”⁵ and proposes a distinction between indirect and direct non-binary language. The first type is the one that uses epicene nouns or generalizing formulas that avoid gender morphological markings. Direct non-binary language, on the other hand, proposes the use of new morphological variants that generate neologisms and morphological innovations with an explicit presence in the inflection of nouns referring to people. This second form is much more salient and, therefore, also much more resisted by certain social groups and certain linguistic approaches, especially linked to the linguistic norm and purely grammatical studies. Additionally, these uses are ostensibly projected to the agreement, generating the need to morphologically modify all the words that must agree with a noun in Spanish. Here we will focus on these morphological innovations in Spanish (-x and -e).

³ (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-Lenguaje-Inclusivo.pdf>.

⁴ 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>.

⁵ Translation provided by the authors.

1.4 The present study

The study presented here takes up some elements from works in other languages (Braun et al. 2005; Cacciari & Padovani 2007; Brauer 2008; Gygas & Gabriel 2008; Gygas et al. 2008; Misersky et al. 2018; Pinheiro & Freitag 2020) but constitutes one of the first psycholinguistic studies in Spanish that analyzes how non-binary morphological forms are processed in contrast to the generic masculine. It is an exploratory study, the first in a broader line of research, which concentrates on the analysis of the comprehension of sentences containing noun phrases referring to groups of people. Our study specifically focuses on the behavior of the three Spanish morphological forms (the two non-binary innovations [-x] and [-e] and the generic masculine [-o]) that can generate mixed or non-uniform gender identity reference to a group of people. We studied these morphological markings when they are used in noun phrases containing role names with different degrees of stereotypicality defined according to their association with a particular gender identity. Thus, role names such as *niños/niñxs/niñes* (children-M-PL/children-NB-PL/children-NB-PL) show a loose association with the gender identity of a potential referent: it is easy to represent boys and girls indistinctly. These would be cases of low stereotypicality. Alternatively, a role name such as *plomeros/plomerxs/plomeres* (plumbers-M-PL/plumbers-NB-PL/plumbers-NB-PL) is strongly associated with a masculine sex-gender identity, so the stereotypicality of this name would be high.

Likewise, what we call ‘non-binary forms’ specifically refers to new morphological variants that are also known as “inclusive language”. While *niñas* (girls-PL), in Spanish, is used to refer to groups of girls and *niños* (children-M-PL) to groups of boys and, eventually, to mixed groups of boys and girls, morphological innovations such as *lxs niñxs* (children-NB-PL) or *les niñes* (children-NB-PL) are used to refer exclusively to groups without uniform gender.

In this framework, we propose to analyze: 1. whether the generic masculine in Spanish projects generic mental representations or, conditions those representations with a bias toward the exclusive reference to men; 2. whether the non-binary morphological variants (-x and -e), adopted in Spanish as inclusive morphological variants, manage to adequately represent groups not uniform in their gender identity, and 3. whether the processing cost of making such reference during the comprehension of sentences that include non-binary form noun phrases is higher than in the case of the generic masculine form.

2 Experiment

The task was designed to analyze online psycholinguistic processing during the comprehension of sentences that included plural noun phrases referring to groups of people with non-uniform gender identities. We expected to verify which were the implicit sex-gender representations that speakers constructed as a reference for those noun phrases during comprehension.

For this purpose, we designed a sentence comprehension task involving the reading of a sentence and then presented a question about the possible reference of the noun phrase in the subject position. The answer to that question was made through a multiple-choice paradigm.

The central hypotheses we put forward for the experiment assume that: 1. there will be an effect of the stereotypicality factor of role nouns for the selection of possible referents; 2. generic masculine noun phrases will be read faster than non-binary forms, particularly the ones with low stereotypicality; 3. there will be an interaction between stereotypicality and morphology that will be reflected not only in the type of option chosen but also in the time it takes to make the choice; 4. although the selection of referents of the non-binary forms will be more consistent toward groups with non-uniform gender, the times to make that choice may show an advantage for the generic masculine form, as an unmarked form in Spanish.

Before this experiment, we conducted a normative study, based on an acceptability judgment task, to verify that the levels of stereotypicality considered *a priori* were adequate and recognized as considerably different by the community of speakers (Zunino & Stetie 2022a). The materials were organized on the basis of the two above mentioned factors and the same ones that will be described in the 2.2 Materials section of this paper. The Stereotypicality factor had three levels (low, medium, high); the Morphology factor also had three levels (-o, -x, -e). Plural noun phrases with DET + N structure were presented and participants were asked to judge their acceptability on a Likert scale from 1 to 7. This allowed us to analyze the way in which speakers judge the acceptability of noun phrases based on two factors: the level of stereotypicality of the role names involved and the type of morphology used (binary and non-binary forms to refer to groups of people with non-uniform gender identity). Like any judgment task, this experiment investigated a strategic, conscious and belief-mediated process that may exhibit different types of cultural biases. But we were especially interested, as a first step in this research, to have a measure of this type. In addition, this task allowed us to verify if the levels of stereotypicality considered *a priori* in the design were effectively projected as a determining factor for the speakers and if the items considered at each level responded adequately to that classification. The results indicated that the levels of Stereotypicality were adequate for the community of speakers of Rioplatense Spanish, for the three levels of Morphology. There was a higher level of acceptability for low stereotypicality role nouns, and that acceptability progressively decreased for medium and high levels. However, only the high and low stereotypicality levels were significantly distinguished. The middle level did not show statistically significant differences with either of the other two levels. Once the adequacy of this factor was confirmed, we began the sentence comprehension experimental study.

2.1 Participants

A total of 551 subjects participated in this task. From this sample, 36 had to be removed (participants under 18 years of age, who did not declare their age or who were not from

Argentina). Of the remaining 515 participants, 373 were women (age: $M = 34.50$; $SD = 11.70$; $\min = 19$; $\max = 98$), 123 men (age: $M = 33.90$; $SD = 12.20$; $\min = 18$; $\max = 82$) and 19 people who identified themselves as non-cisgender (age: $M = 29.30$; $SD = 8.51$; $\min = 19$; $\max = 55$). The people grouped under this last category consisted of non-binaries, non-binary girl, trans men, gay cis, none, agender, gender fluid, lesbian, demi-girl and queer. Of the total number of participants, 390 reported living in the Buenos Aires Metropolitan Area and 125 outside this area.⁶ In terms of education, 34 participants reported having completed secondary school, 101 were in a higher education program or had incomplete studies, and 380 had completed a higher education program. Finally, they were asked if they used any form of non-binary language. A group of 127 participants stated that they did not use any non-binary form, 108 that they used it little or occasionally, and 280 that they used it frequently.

2.2 Materials

Due to the fact that the medium level of Stereotypicality did not show statistically significant differences from the other two levels in a previous normative study (Zunino & Stetie 2022a), we chose to eliminate this level for the task. From the noun phrases of low and high Stereotypicality used in the normative study, we elaborated sentences with these phrases as subjects. Twelve sentences were created and presented in the three morphological variants:⁷ half of them included role names with high stereotypicality and the other half included role names with low stereotypicality. Examples for each Stereotypicality condition are presented in (1).

(1) Low stereotypicality:

Los maestros/Lxs maestrxs/Les maestres usan recursos variados durante la
 Teachers-M / Teachers-NB/Teachers-NB use a variety of resources during
alfabetización inicial.
 initial literacy.

High stereotypicality:

Los plomeros/Lxs plomexs/Les plomeres con matrícula pueden hacer
 Plumbers-M /Plumbers-NB/Plumbers-NB with license can do
trabajos en edificios y consorcios.
 works on buildings and consortiums.

For each sentence, a multiple-choice question on the comprehension of the noun phrase was constructed to indicate whether it referred to a group of women, of men or a mixed group. In addition, three more response options were added as fillers. For this purpose, we used names

⁶ This includes several provinces of Argentina.

⁷ See Supplementary file 1 for a complete list of the stimuli used.

that, in Argentina, are frequently used to refer to women or men.⁸ An example question and its response options are presented in (2).

- (2) *¿A cuál de las siguientes opciones puede referir “los maestros”?*
- Carolina.*
 - Juan.*
 - Carolina, Marta y otras mujeres.*
 - Juan, Pedro y otros varones.*
 - Juan, Marta y otras personas.*
 - Ninguna de las opciones anteriores.*

Which of the following can “the teachers-M” refer to?

- Caroline.
- John.
- Caroline, Martha and other women.
- John, Peter and other men.
- John, Martha and other people.
- None of the above options.

Specifically, we were interested in measuring the distinction between options d. and e. in (2), that is, between the option referring to a group of men and the one referring to a mixed group of people.

In addition, from the fillers used in the normative task, 18 sentences were elaborated with feminine nominal phrases. Another 12 fillers were added using the three morphological variants, but containing a different comprehension question (3). In this way, exposure to diverse sentences and questions was balanced, so as not to generate learning or training within the task.

- (3) *Lxs pintorxs prefieren trabajar con óleos para conseguir mejores texturas y relieves. ¿Qué prefieren lxs pintorxs?*
- Trabajar con óleos.*
 - Pintar con acuarelas.*
 - Usar muchos colores.*
 - Usar pinceles anchos.*
 - Realizar trazos finos.*
 - Ninguna de las opciones anteriores.*

⁸ We selected names from the list of authorized names for the jurisdiction of the City of Buenos Aires: <https://buenosaires.gob.ar/areas/registrocivil/nombres/busqueda/imprimir.php>.

Painters prefer to work with oils to achieve better textures and reliefs.

What do painters prefer?

- a. Working with oils.
- b. Painting with watercolors.
- c. Using many colors.
- d. Using wide brushes.
- e. Making fine strokes.
- f. None of the above options.

The stimuli were divided into three counterbalanced lists in which 2 items from each condition were included. Each list was composed of 42 items: 12 experimental and 30 fillers (the same for all three lists).

2.3 Procedure

The task was designed and taken using PCIBex (Zehr & Schwarz 2018), which randomly assigned a different list to each participant. In all cases, an informed consent had to be accepted to access the experiment. To have proper sociodemographic data, participants were asked to indicate gender identity, highest level of studies achieved, age, nationality, city of residence and how often they used non-binary morphological forms.⁹ Then, the instructions were introduced. They were asked to read the sentences first and then to answer a multiple choice question as quickly as possible and based on their first impression. The first screen with a fixation point was presented. Participants should press the spacebar to pass to the next screen. The second screen presented the sentence in a single line of text, black letters over a white screen. After reading the whole sentence at their own pace, participants had to press the spacebar to pass to the last screen. There, the question and multiple choice options were presented. They had to select the option by clicking on it with the mouse. The list of options (names that may be the reference for the noun phrase) were randomly ordered in each trial. Completing the task took between 10 and 20 minutes, depending on the participant.

⁹ An anonymous reviewer raised an important question about the placement of the sociodemographic survey. Particularly, the reviewer asked whether the question about the use of non-binary morphological forms, being placed before the experiment, could have biased participants' responses. This is something we have actually discussed. In this specific case, we decided to do it this way based on two major reasons. First, there are people who do not answer the questions at the end, pass them without noticing them and that means more lost data. Secondly, given the controversy generated by the topic, it seemed better to establish this point from the beginning before the data collection to avoid participants trying to demonstrate their moral positions on the subject during the online task; that would mess up the data even more. However, it was a methodologically difficult decision and we are not absolutely sure what would have been the best option.

It was clarified that they would have three training trials. Those items were followed by three more practice sentences, which were already part of the experimental task for the participants, but which were not considered for statistical analysis.

Data were collected through social media among Spanish speakers in Argentina. Participation was voluntary and the participants did not receive any compensation.

2.4 Results

For the data analysis, we took into account the reading and response times and the response types. The data were processed using R version 4.1.1 in the R Studio interface (R Core Team 2021). Taking into account the experimental hypotheses, the packages tidyverse (Wickham et al. 2019), ggplot2 (Wickham 2016), patchwork (Pedersen 2020), MASS (Venables & Ripley 2002), lme4 (Bates et al. 2015), lmerTest (Kuznetsova & Brockhoff & Christensen 2017) and sjPlot (Lüdtke 2021) were used to manipulate data, generate figures and perform different statistical tests. Data and analysis code is available at the Open Science Framework webpage: <https://osf.io/j47hv/>.

For the analysis of response times and types, we only considered those corresponding to the items answered correctly. That is, only the responses that referred to a group of men or a mixed group of people were considered. Those that referred to a single person, a group of women, or none of the options were discarded. Of the eliminated responses, none referred to a single person (neither by a typically feminine nor a typically masculine name), 36 referred to a group of women and 227 referred to “none of the above options”.¹⁰ Items discarded for incorrect answers represent 4.26% of the data.

2.4.1 Reading times

Due to the fact that the task was carried out over the Internet, it was especially difficult to control the experimental situation in which the participants were doing it. So, a lower and an upper time limit were established *a priori*. The lower limit was 300 milliseconds, while the upper

¹⁰ A more detailed analysis of those responses marked as “none of the above options” reveals that this option was mostly used to respond to sentences with non-binary language (109 responses to noun phrases with the [-e] variant and 103 to noun phrases with the [-x] variant). We considered that this was a strategy some participants used to complain about the intelligibility of the non-binary forms and the non-binary language in general, since of these 227 responses, 194 belonged to people who had declared that they did not use any form of non-binary language. Furthermore, of the 227 responses, 146 (64.32%) were from people identified as women, 79 (34.80%) from people identified as men, and 2 (0.88%) were from a person identified as non-cisgender. Of the remainder, we considered this an error due to inattention. We evaluated the possibility that, with these responses, participants may have wanted to indicate that the non-binary forms not only refer to men and women, but also to non-cisgender people, but then discarded it because the option referring to a mixed group of people included names stereotypically used for women, others used for men and the clarification “and other people”, an epicene noun without gender bias.

limit was 45,000 milliseconds for each trial. This implied removing 41 data points that were equivalent to 0.69% of the total sample. Additionally, an identification of outliers and subsequent transformation were conducted. Those measures that exceeded the two standard deviations were replaced by the mean of each participant in each condition (Ratcliff 1993; Baayen & Milin 2010; Cousineau & Chartier 2010). This involved replacing 221 data points (3.76% of the sample) for sentence reading times and 236 (4.02% of the sample) for response times.

Based on previous studies, we hypothesized that there were going to be differences due to participants' gender identity. We had participants that identified themselves as women, as men and as non-cisgender. However, there was an imbalance in the sample with respect to the Gender identity factor. As only 19 participants self-identified as non-cisgender, representing 3.68% of the sample, we chose to remove them for the statistical analyses. Moreover, Gender identity was analyzed together with the Frequency of use of non-binary forms and we found a high correlation between both. Due to the complexity of this relation and to space restrictions, we didn't include these factors in the statistical analysis (we analyzed this in detail in Zunino & Stetie 2022b), but we decided to include the differences in the figures to introduce the subject (**Figure 1**).

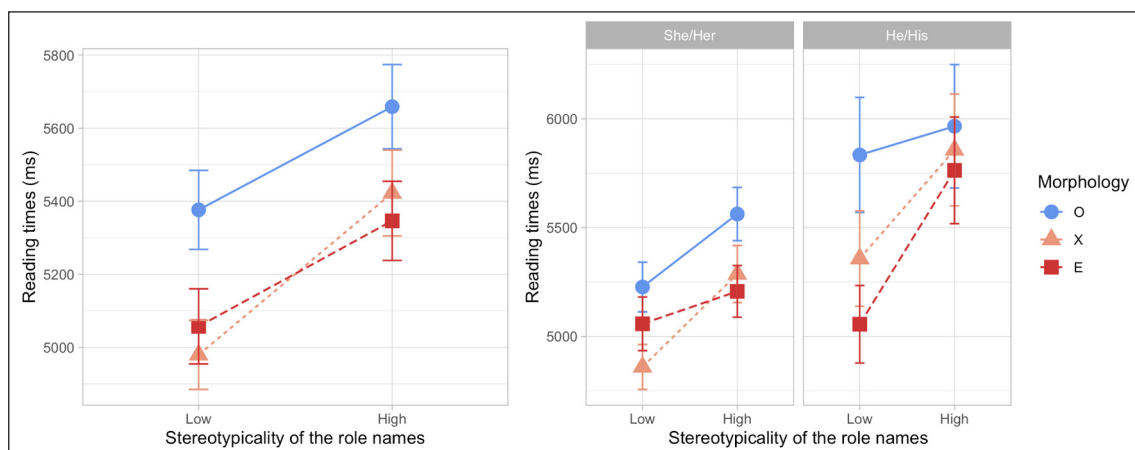


Figure 1: Left: Mean reading times by Morphology and Stereotypicality. Right: Mean reading times by Morphology, Stereotypicality and Gender identity.

Taking into account the experimental hypotheses, we fitted Linear Mixed-Effects Models (LMM). After testing assumptions of normality and homoscedasticity, we decided to perform a logarithmic transformation of reading times for data analysis (Winter 2019; Vasisht et al. 2021). Maximal models were attempted first in all analyses (Barr et al. 2013). As fixed effects, we entered Morphology and nested Stereotypicality into the model, with by-subject and by-item random intercepts and random slopes for all repeated measures for participants and items. If the model failed to converge, we then removed the random effects that accounted for the least

variance in the (nonconvergent) maximal model until convergence was achieved. The final model that converged was the following: $\log(\text{sentenceRT}) \sim \text{Morphology/Stereotypicality} + (1 + \text{Morphology}|\text{Participants}) + (1|\text{Items})$. All contrasts were coded as repeated contrasts (Schad et al. 2020).

The results, summarized in **Table 1**, show no effect of Morphology nor of nested Stereotypicality. Although participants took longer to read sentences with generic masculine than with non-binary forms (**Figure 1**), and had longer reading times for high stereotypicality role names, these differences were not statistically significant. Moreover, **Figure 1** shows a distinction between women and men: although the pattern of results is similar, women took nominally less time to read the sentences than men, in all conditions.

Fixed Effects				
<i>Predictors</i>	<i>Estimates</i>	<i>Std. Error</i>	<i>t-value</i>	<i>p-value</i>
(Intercept)	8.44	0.02	461.17	< 0.001
Morphology_X-O	-0.05	0.03	-1.68	0.093
Morphology_E-X	0.01	0.03	0.33	0.743
Morphology_O:Stereotypicality_High-Low	0.05	0.04	1.08	0.278
Morphology_X:Stereotypicality_High-Low	0.05	0.04	1.16	0.245
Morphology_E:Stereotypicality_High-Low	0.06	0.04	1.49	0.136
Random Effects				
σ^2	0.15			
τ_{00} Participants	0.09			
τ_{00} Items	0			
τ_{11} Participants.Morphology_X-O	0.02			
τ_{11} Participants.Morphology_E-X	0			

(Contd.)

ρ_{01} Participants.Morphology_X-O	-0.03			
ρ_{01} Participants.Morphology_E-O	0.24			
ICC	0.39			
$N_{\text{Participants}}$	496			
N_{Items}	36			
Observations	5653			
Marginal R^2 /Conditional R^2	0.005/0.397			

Table 1 Summary of LMM analysis for reading times.

2.4.2 Response types

As evidenced in **Figure 2**, both non-binary morphological variants (-x and -e) consistently generate an unambiguous representation and reference to mixed groups of people, regardless of the level of Stereotypicality of the role names. However, the same is not the case for the generic masculine [-o]. First, the responses obtained indicate that it does not appear to function unequivocally as generic. Second, the representation and reference it constructs seem to hinge on the level of Stereotypicality. Names with low Stereotypicality (children, teachers) generate more effectively generic representations, while those with high Stereotypicality (plumbers, blacksmiths) generate eminently masculine representations.

In addition, as shown in **Figure 3**, the representations appear to vary according to the Gender identity of the participants. Although the response types between women and men have a similar tendency, for women the preference for a masculine reference for highly stereotypical role nouns is even more marked when the noun phrase is presented with [-o] morphology.

Taking into account the experimental hypotheses, we fitted Generalized Linear Mixed-Effects Models (GLMM) with binomial distribution. Maximal models were attempted first in all analyses (Barr et al. 2013). As fixed effects, we entered Morphology and nested Stereotypicality into the model, with by-subject and by-item random intercepts and random slopes for all repeated measures for participants and items. If the model failed to converge, we then removed the random effects that accounted for the least variance in the (nonconvergent) maximal model until convergence was achieved. The final model that converged was the following: Response type \sim Morphology/Stereotypicality + (1|Participants) + (1|Items). All contrasts were coded as repeated contrasts (Schad et al. 2020). Due to the differences in response types presented in **Figures 2** and **3**, we were interested in the analyses of two subgroups: 1. the mixed responses, the

only responses enabled by the three morphological variants; 2. the generic masculine responses, the only ones that effectively enabled a response for a group of men.

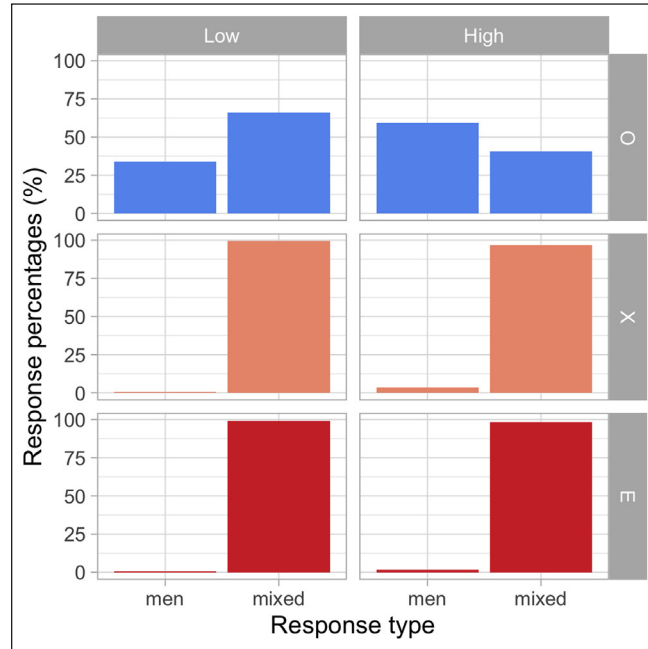


Figure 2: Response types by Stereotypicality and Morphology.

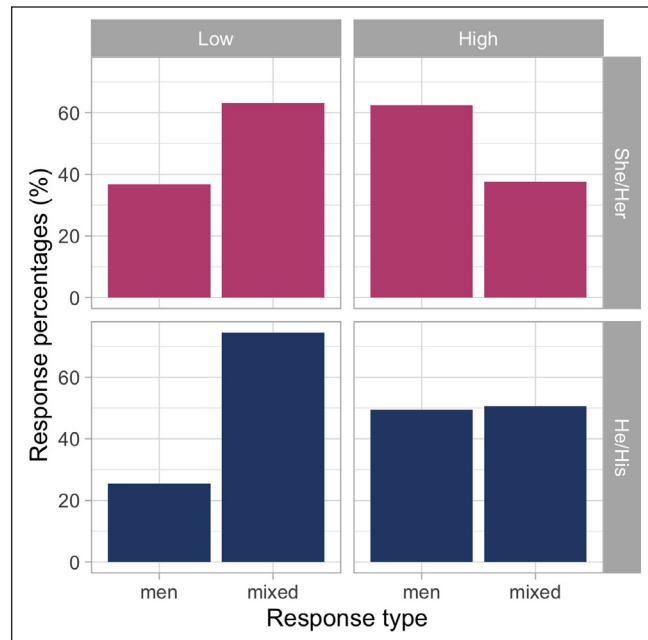


Figure 3: Response types for [-o] Morphology by Stereotypicality and Gender identity.

The results, summarized in **Table 2**, show a main effect of Morphology: there was a statistically significant difference between generic masculine and non-binary forms ($p < 0.001$). When faced with generic masculine forms, participants varied their responses between a mixed group and a group of men. However, with non-binary forms there was a consistent answer toward the mixed group option.

There was also an effect of Stereotypicality nested to the generic masculine ($p < 0.001$). For low stereotypicality role names, participants opted more for a mixed group reference. However, for high stereotypicality role names, participants opted more for a group of men answer. There was also a nested effect of Stereotypicality for the [-x] non-binary form, but we didn't consider this as, shown in **Figure 2**, there were practically no answers for the group of men option with the non-binary forms.

Fixed Effects				
<i>Predictors</i>	<i>Odds Ratios</i>	<i>Std. Error</i>	<i>z-value</i>	<i>p-value</i>
(Intercept)	97.08	21.83	20.35	< 0.001
Morphology_X-O	507.62	186.58	16.95	< 0.001
Morphology_E-X	1.21	0.48	0.47	0.636
Morphology_O:Stereotypicality_High-Low	0.13	0.04	-6.55	< 0.001
Morphology_X:Stereotypicality_High-Low	0.15	0.08	-3.34	0.001
Morphology_E:Stereotypicality_High-Low	0.42	0.23	-1.57	0.116
Random Effects				
σ^2	3.29			
τ_{00} Participants	6.28			
τ_{00} Items	0.22			
ICC	0.66			
N Participants	496			

(Contd.)

N_{Items}	36			
Observations	5653			
Marginal R^2 /Conditional R^2	0.500/0.832			

Table 2 Summary of GLMM analysis for response types.

2.4.3 Response times

For response times, the same analysis developed for reading times was used. We were interested particularly in two subgroups: the responses that were selected as referring to mixed groups of people and the group of items that presented generic masculine as gender marking. The response times for the answers that correspond to a mixed group of people are plotted in **Figure 4**. **Figure 5** shows the mean times for the different responses obtained from the noun phrases with the morphological variant [-o], the generic masculine.

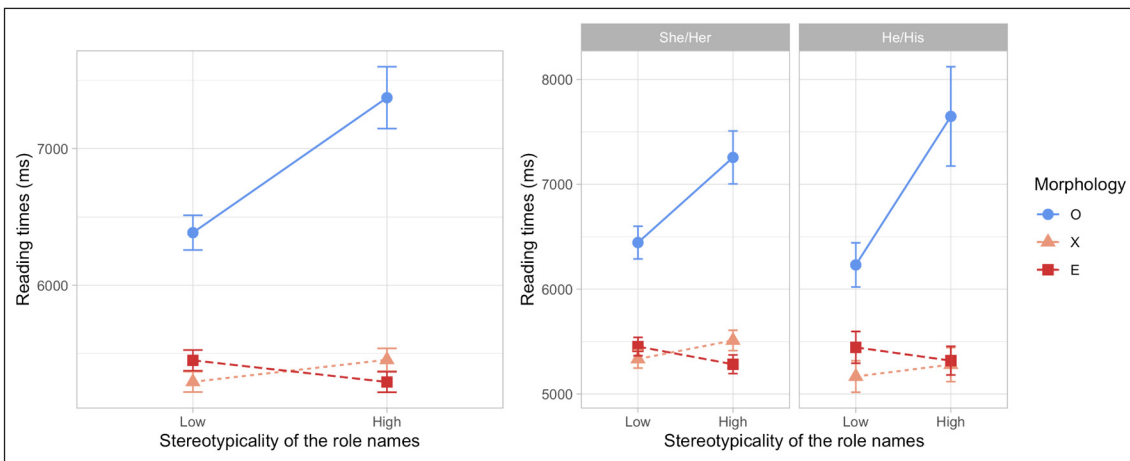


Figure 4: Left: Mean response times for mixed responses by Morphology and Stereotypicality. Right: Mean response times for mixed responses by Morphology, Stereotypicality and Gender identity.

Taking into account the experimental hypotheses, we fitted LMM. As was done for the reading times, we tested assumptions of normality and homoscedasticity and decided to perform a logarithmic transformation of response times for data analysis (Winter 2019; Vasishth et al. 2021). Maximal models were attempted first in all analyses (Barr et al. 2013). As fixed effects, we entered Morphology and nested Stereotypicality and Response type into the model, with by-subject and by-item random intercepts and random slopes for all repeated measures for participants and items. If the model failed to converge, we then removed the random

effects that accounted for the least variance in the (nonconvergent) maximal model until convergence was achieved. The final model that converged was the following: $\log(\text{responseRT}) \sim \text{Morphology}/\text{Stereotypicality}/\text{Response type} + (1|\text{Participants}) + (1|\text{Items})$. All contrasts were coded as repeated contrasts (Schad et al. 2020). To test our hypothesis we did not need a full interaction model, instead, we decided to test Stereotypicality nested in Morphology. We wanted to analyze the specific effects of Stereotypicality for each of the levels of Morphology. On the same line, we decided to test Response type as a predictor variable nested in the two other main factors: analyze the effect of Response type in each condition. The results are summarized in **Table 3**.

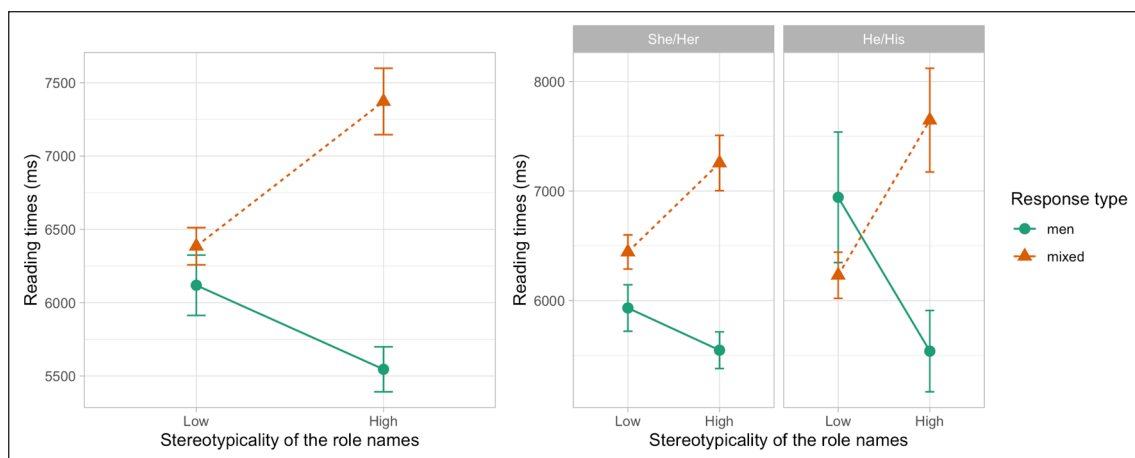


Figure 5: Left: Mean response times for morphological variant [-o] by Stereotypicality and Response type. Right: Mean response times for morphological variant [-o] by Stereotypicality, Response type and Gender identity.

Fixed Effects				
<i>Predictors</i>	<i>Estimates</i>	<i>Std. Error</i>	<i>t-value</i>	<i>p-value</i>
(Intercept)	8.54	0.03	332.78	< 0.001
Morphology_X-O	-0.1	0.05	-2.02	0.044
Morphology_E-X	0.01	0.07	0.09	0.931
Morphology_O:Stereotypicality_High-Low	-0.01	0.02	-0.39	0.697
Morphology_X:Stereotypicality_High-Low	-0.03	0.1	-0.34	0.735

(Contd.)

Morphology_E:Stereotypicality_High-Low	0.11	0.09	1.17	0.242
Morphology_O:Stereotypicality_Low:RTA_mixed-men	0.05	0.03	1.7	0.09
Morphology_X:Stereotypicality_Low:RTA_mixed-men	-0.05	0.18	-0.31	0.76
Morphology_E:Stereotypicality_Low:RTA_mixed-men	0.14	0.15	0.91	0.364
Morphology_O:Stereotypicality_High:RTA_mixed-men	0.26	0.03	9.82	< 0.001
Morphology_X:Stereotypicality_High:RTA_mixed-men	0.06	0.07	0.8	0.425
Morphology_E:Stereotypicality_High:RTA_mixed-men	-0.14	0.1	-1.41	0.159
Random Effects				
σ^2	0.15			
τ_{00} Participants	0.06			
τ_{00} Items	0			
ICC	0.28			
$N_{\text{Participants}}$	496			
N_{Items}	36			
Observations	5653			
Marginal R ² /Conditional R ²	0.025/0.301			

Table 3 Summary of LMM analysis for response times.

As shown in **Figure 4**, we found a main effect of Morphology. Participants took longer to respond to the [-o] than to the two non-binary variants ([-x] and [-e]) and this difference was statistically significant ($p = 0.044$), however no significant differences were found between the two non-binary variants ($p = 0.931$). We also found an effect of Response type nested to Stereotypicality and Morphology: for the generic masculine role names with high stereotypicality, participants took longer response times to assign a generic reference than to interpret the noun phrase as referring to a group of men only ($p < 0.001$). This is shown in **Figure 5**.

Regarding participants' Gender identity, we again found a similar pattern for both women and men, but with nominally higher reading times for men, particularly when faced with the generic masculine (see **Figure 5**).

2.5 Discussion

As presented in the Introduction to this paper, studies in Spanish on the phenomenon of so-called “inclusive language” through morphological innovations in gender inflection have been approached almost exclusively from theoretical perspectives. Within these studies, grammatical perspectives tend to be more conservative regarding the possibility of accepting new morphological forms and that these may eventually produce large-scale linguistic changes (Moreno Cabrera 2008; Mare 2018; Barrera Linares 2019). Sociolinguistic and pragmatic studies, on the other hand, tend to admit that the process of gender assignment is a complex phenomenon and that it is not entirely arbitrary in Spanish, but involves elements linked to the social matrix of each linguistic community and even to the variety of Spanish in question. In this framework, different studies indicate an ostensible imbalance between feminine and masculine gender markers (as unmarked gender) and question the generic function of the generic masculine (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Barrera Linares 2019; Menegotto 2020; Richey & Burnett 2021).

The other perspective that has had a strong development in different languages is the one that analyzes the processing of different linguistic forms and their relationship with mental representations from an experimental approach. Generally, these studies focus on language as part of human cognition and can be considered heirs to the different hypotheses on the possible relationships between language and thought. Most of this work has supported the idea that the generic masculine (especially in nouns referring to people) produces a consistent bias on sex-generic representations and stereotypes (Konishi 1993; Boroditsky et al. 2003; Phillips & Boroditsky 2003; Vigliocco et al. 2005; Leaper 2014; Sato et al. 2017; Maciuszek et al. 2019; Richey & Burnett 2019; 2021; Zunino & Stetie 2022a; 2022b). However, there are not many experimental studies conducted in Spanish.

In this study, we evaluated the processing of three morphological variants of generic in Spanish: the generic masculine [-o] and two morphological innovations [-x] and [-e], through a sentence comprehension task. We also considered two levels of stereotypicality of role names according to whether they were strongly associated with gender stereotypes or not associated at all: high and low. As previous experiments in different languages have shown (Braun et al. 2005; Cacciari & Padovani 2007; Brauer 2008; Gygax & Gabriel 2008; Gygax et al. 2008; Misersky et al. 2018; Pinheiro & Freitag 2020; Richey & Burnett 2021), our hypothesis was that the generic masculine

will show a male bias in the selection of its reference, particularly for high stereotypicality role names. We were also expecting to find an interaction between stereotypicality and morphology that will be reflected not only in the type of response chosen but also in the time it took to make the choice. Although this was the first experiment to analyze and compare non-binary variants in Spanish, we had some exploratory hypotheses. As non-binary forms are new morphological variants, we predicted that they were going to imply longer reading times, as compared to the generic masculine. However, we were also expecting them to show a more consistent reference toward groups with non-uniform gender.

To test these hypotheses, we recorded three measures: sentence reading times, the type of answer chosen within a multiple-choice paradigm, and the time it took to choose among those possible options. The question always pursued the recognition of the reference constructed for the noun phrase in the subject position. This was the noun phrase presented in the three morphological variants.

Concerning reading times, our initial hypothesis considered that the non-binary forms could imply a higher processing cost that would translate into longer reading times because they represented a morphological innovation. However, no statistically significant differences were found between the morphological variants, neither between the generic masculine and the two non-binary variants nor between the two non-binary forms. This finding refutes the results of Marchesini (2019), who found shorter processing times for the generic masculine. In our study the length of the sentences and the stereotypicality of role names were controlled for. Another difference with Marchesini (2019) was that he evaluated reading and response time together to the same extent. However, for non-binary variants, we actually found shorter reading times and response times, as we will show later.

Furthermore, there was no effect of stereotypicality for reading times. For all morphological forms, reading times for low stereotypicality were always shorter, however this difference was not statistically significant. Interestingly, there was no interaction with the morphology variable. Although the non-binary forms tested have seen their use considerably extended in recent years, we expected that for high stereotypicality role names, there would be longer reading times since they have a lower frequency of occurrence with the non-binary variants. As the variable stereotypicality was formulated in this experiment and as it had been evaluated in the normative study (Zunino & Stetie 2022a), it was closely linked to the frequency of non-binary forms. For future studies, we are interested in distinguishing more precisely the variable stereotypicality from the frequency variable, particularly for non-binary forms. However, this point will prove to be a methodological challenge, since, as far as we know, there are no precise and systematic records of the frequency of occurrence of non-binary forms in Spanish.

Second, we analyzed the references constructed from noun phrases in the different morphological variants based on the analysis of response types. In the specific case evaluated, plural noun phrases without modifiers, we found a consistent pattern toward the functioning of non-binary forms as specialized in the reference of groups with non-uniform gender, independent of the level of stereotypicality. These results support our initial hypothesis: referent selection of non-binary forms will be more consistent toward groups with non-uniform gender. Also, these results replicate the findings of Marchesini (2019). For future work, we are interested in assessing whether the reference generated by direct non-binary language (Lopez 2020) is replicated in the case of indirect non-binary language, as reported by Marchesini (2019).

In contrast, for the generic masculine the pattern found was very different: the construction of its reference is strongly modulated by the stereotypicality of the role names. These results agree with our experimental hypotheses, but require further refinement for future work. On the one hand, in the experimental studies cited and in our experiment, there is consensus that the generic masculine produces a bias toward an exclusive masculine reference (Braun et al. 2005; Cacciari & Padovani 2007; Brauer 2008; Gygax & Gabriel 2008; Gygax et al. 2008; Misersky et al. 2018; Marchesini 2019; Pinheiro & Freitag 2020; Richy & Burnett 2021). On the other hand, there are diverse findings regarding the function of role name stereotypicality in establishing such reference. For example, Gygax et al. (2008) found that role name stereotypicality modulated reference construction in languages with gender-unmarked role nouns, such as English, but not in French and German, languages with grammatical gender like Spanish. Specifically, this difference is with stereotypically feminine role names. In our study, we only consider stereotypicality in relation to masculine gender. Currently, we are developing a task involving stereotypically feminine and masculine role nouns to verify if the non-binary forms construct mixed reference in both cases or if it is modulated by this factor.

These findings present several projections related to how we can interpret the effects of role name stereotypes during language comprehension. One possible framework to analyze this is the one offered by the different proposals that accept a relatively stable relationship between thought and language. Specifically, that there are certain semantic features linked to our mental representations and our beliefs that, indeed, are projected onto our comprehension of language. This first element is not a minor approach and is part of a long tradition of debates on the specificity and encapsulation of our Language Faculty and the cognitive processes put into play to process a natural language (Fodor 1983; Chomsky 2002; Jackendoff 2011; Culbertson & Kirby 2016).

Along the same lines, these data are especially relevant for a classic discussion on the architecture of our mind/brain and proposals on the direction or restrictions of information flow (Fodor 1983; Ezquerro 1995; Jackendoff 2002; Jackendoff 2003; van Herten & Chwilla & Kolk

2006; Kuperberg 2007; Kukona 2011; Chomsky 2015; Karimi & Ferreira 2015; Zunino 2019; Stetie 2021). We could postulate that there is indeed such a strong encapsulation that splits specifically from nonspecifically linguistic information until a very late stage in the comprehension process. Or we could consider that highly abstract information such as beliefs, prior world knowledge and pragmatic information can have an early effect during comprehension and especially on the computation of very specific elements such as morpho-syntactic features. Strictly serial processing models will support some version of the first line: automatic low-order processes with a high domain specificity, with a bottom-up architecture, and without incidence of more abstract representations, for the computation of language basic levels such as morphology and syntax (Frazier & Fodor 1978; Ferreira & Clifton 1986; Frazier 1995; Traxler & Frazier 2008). For interactive and parallel models, on the other hand, the processing of basic levels, such as morpho-syntactic computations, can be influenced early by high-order information. That is, the encapsulation hypothesis is weakened and the flow of information would not only be bottom-up but also top-down (MacDonald & Pearlmutter & Seidenberg 1994; Altmann & Kamide 2007; Levy 2008; McRae & Matsuki 2013). In this framework, mental representations linked to gender stereotypes could promptly condition the semantic interpretation of sentences and affect the computation of gender morphology.

Otherwise, we can review the scene presented by these results from the inverse perspective: how much linguistic forms skew the interpretation of sentences and the establishment of references. That is, how much linguistic information conditions the construction and cognitive manipulation of our mental representations and our beliefs, specifically our stereotypical gender representations, which are unfailingly also social representations. Although our results do not allow us to establish a direct link between the morphological form of the generic masculine and a systematic bias toward an exclusive masculine interpretation that makes any other gender invisible, some indications allow establishing certain indirect conditioning, specifically in the case of nouns that refer to people. The type of response generated—and the times these responses take— indicates that the morphological form generates some effect on the interpretation and construction of a sex-generic representation associated with the noun phrase. The morphological marking, as linguistic information, could impose some kind of bias on our representations. Undoubtedly, what we can effectively show with this study is that there is an interaction between both elements: linguistic and extralinguistic information seem to articulate and condition each other during sentence comprehension and to generate an interpretation that would not be entirely determined by any of the factors. So, as was advanced in the Introduction, these findings represent empirical evidence that the generic masculine in Spanish might impose an interpretative bias toward a group of men, regardless of what classical grammatical studies postulate (Ambadiang 1999; Cabeza Pereiro & Rodríguez Barcia 2013; Márquez 2013; Barrera Linares 2019; Mendívil Giró 2020; Menegotto 2020).

The third measure we recorded was response times. On the one hand, we analyzed the times of the responses that opted for a generic or mixed group reference. As in sentence reading analysis, we found shorter times for the non-binary variants and, in this case, the difference with the generic masculine was statistically significant. This indicates that morphological innovations do not entail a higher processing cost. In contrast, the establishment of a generic reference is consistent across the different levels of stereotypicality. Moreover, it does not seem to show ambiguity and has shorter processing times. This evidence suggests that the facilitation of non-binary forms is not a mere frequency effect or associated with specific lexical forms and that we could be facing a specialization of [-x] and [-e] as unambiguous forms in Spanish to refer to groups of people of different genders. Specifically regarding the processing of non-binary morphological forms, another aim of this study was to explore whether there were any differences between the two variants (-x and -e). In none of the reported measures did we find differences between them: our results show that the two forms have similar behavior. This applies at least for written language and with plural noun phrases (DET + N). For future investigation, we are interested in extending these initial findings in two directions. On the one hand, we want to analyze spoken language processing, which is possible only for the [-e] variant. On the other hand, we will study the processing of sentences that present nominal phrases with modifiers (DET + N + ADJ) that, in Spanish, require agreement between more than two words. To deepen and specify this line of study, it would also be desirable to compare the processing of direct non-binary language with indirect non-binary forms, a distinction postulated by López (2020).

Alternatively, the response times analysis of the generic masculine shows the other side of the coin. When noun phrases' inflection is generic masculine and a mixed reference is chosen in the response, the processing times are higher and are strongly modulated by the stereotypicality of the role noun. These results contradict our initial hypothesis that the generic masculine would show a clear advantage in the time course of the process. The non-binary forms seem to generate a sort of specialization for a mixed reference. Alternatively, the generic masculine and its double possibility of reference seem to generate an obstacle during processing, which is reflected in longer response times.

The theoretical projections and consequences of these findings can be analyzed from various approaches. On the one hand, it is worth discussing the effects that a modification that changes a binary gender paradigm for a non-binary one may have for the Spanish gender paradigm. In the case of nouns that refer to people, and specifically for plural noun phrases, the forms of grammatical gender would be strictly associated, without ambiguity, with the sex-generic representation of people. The masculine would generate an unambiguous reference to men, the feminine would maintain its strict reference to women, and non-binary forms would favor an unambiguous reference (instead of the one caused by the generic masculine in Spanish) to groups of people with non-uniform gender. In this sense, it is worth mentioning that this is also an

issue related to the more general discussion about the relationship and balance between the economy of the language system units and processing economy (Frauenfelder & Schreuder 1991; Laudanna & Burani & Cermele 1994; Uriagereka 2000; Chomsky 2015). It is usually defined as an inversely proportional relation: the less economical the system is in terms of its units, the more economical it can be to process, and vice versa. In the case discussed here, a more complex system for the Spanish gender paradigm could be projected in a processing economy due to the fact that the interpretation of specialized forms eliminates competing semantic representations during comprehension.

However, these consequences would be too limited to affirm that it is a modification of the entire language system. What has been discussed so far is restricted only to the use of non-binary forms in cases of plural noun phrases that refer to groups of people. What would happen with the use of non-binary forms to refer to a specific non-binary person? What would be the case for gender markings in nouns that do not refer to people in a language with grammatical gender, such as Spanish? Undoubtedly, answering these questions will require more studies and a detailed comparative analysis of similar phenomena in other languages. We can risk that, in general terms, we could expect that changes in the nouns that refer to people—either to refer to mixed groups or to refer to individuals who perceive themselves outside the binary gender paradigm—could follow the same framework and that this pattern could be consistently distinguished from the group of nouns that do not refer to people. The inclusion of a third form of non-binary gender could be extended as a specialization that achieves an adequate and precise reference for a series of cases that at this moment, with a binary gender paradigm, do not achieve accurate reference or do not achieve reference at all.

Another line that can be projected from these findings is the one that focuses on what these results show about the comprehension process of new linguistic forms. Specifically, forms that do not involve expansion of the lexical repertoire but rather modifications in the morpho-syntactic elements to compute. Variations in the mental lexicon are common and usual. It is a dynamic store that admits inclusions and losses of lexical forms without major repercussions for the system and the Language Faculty (Emmorey & Fromkin 1988; Jarema & Libben 2007). The modifications that involve structural aspects of the language, on the other hand, cannot be analyzed in the same way and constitute phenomena of a different nature. A discussion, in this case, is how and with what ease it would be possible for a community of adult speakers to acquire the linguistic knowledge necessary to interpret new morphological forms and to project them appropriately to the computational process of morphosyntax during the comprehension of sentences of a language that they effectively recognize as their own. We are not considering the situation that would arise when being exposed to another gender paradigm in a stage of language acquisition. The data reported here indicate that comprehension and skills in responsive handling of these new forms

would require no more than being immersed in a language community that uses them with a certain frequency and consistency over a —not too long— time period. In fact, as we reported in another study (Zunino & Stetie 2021), it is not necessary for the subjects to use these forms for them to understand them. Even when they do not use them, they do not generate processing costs or ambiguity in the reference. In this scenario, both the precision of the interpretation of these new forms and the cognitive cost that they entail is assimilated to that of known forms. However, we believe that it is essential to distinguish between comprehension and production processes: we do not expect the same ease in the production of morphological innovations. This pattern is not new and is supported by studies of second language acquisition in immersion contexts —or outside of formal teaching contexts. Accurate skills for comprehension processes tend to be better and appear earlier than for production processes (White 2003; Kroll & Gullifer & Rossi 2013; Tasseva-Kurktchieva 2015). We believe, for this reason, that studies on spontaneous production and contexts of use of non-binary morphological variants in Spanish are essential to build a complete perspective of the phenomenon.

Additionally to the already discussed elements in this paper, we have introduced the potential role of another variable on the processing of generic morphological variants: the gender identity of the participants. First, there was a group of participants identified as non-cisgender who performed ostensibly differently from participants who self-identified as women or men. However, it was impossible to further analyze this subgroup due to the imbalanced sample. For future experiments, it would be desirable to include and control for this variable to be able to analyze in-depth the behavior of people who identify with non-binary genders.

As for masculine and feminine participants, we also had differences in their distribution that prevented us from running statistical analysis. However, we did include visual analysis of this variable and we found a potentially different performance. Women presented shorter reading and response times and less dispersion and variance. Simultaneously, they also showed a greater tendency to interpret the generic masculine as referring to a group of men. In an experiment with Chilean speakers, Kaufmann and Bohner (2014) also found biases in the interpretation of generic forms based on the gender identity of the participants. However, concerning the generic masculine, they found the reverse results. In a sentence completion task, men presented a more marked male bias against the generic masculine, a bias that was maintained in the non-binary variant [-x], while women responded with 50% of feminine nouns in their completion against the same non-binary variant. These results could be explained by the fact that women have a higher acceptance of non-binary forms (Jiménez Rodrigo et al. 2011; Zunino & Stetie 2022a). However, several factors are related to sociolinguistic aspects of this phenomenon and will require further investigation in future studies: attitudes and beliefs regarding gender identities, inclusive linguistic uses, and beliefs about linguistic normativity.

3 Conclusions

Within the framework offered by grammatical and cognitive studies that analyze gender in language, our study has attempted to provide empirical evidence that dialogues with both aspects, to address this phenomenon in all its complexity. On the one hand, our data have made the landscape of theoretical studies in Spanish more complex. The results support the notion that gender assignment, in cases of nouns referring to people, would be the result of a complex process and could not be attributed to an absolutely arbitrary phenomenon. On the other hand, our experiment is a first contribution to provide empirical evidence in Spanish to complete the picture of studies on language, gender and cognition in other languages. Our results conform to findings reported in other languages. In Spanish, there also seems to be a consistent bias of the generic masculine toward the representation of men, especially when role names are strongly associated with gender stereotypes. Finally, it is worth noting that our study offers a particularly original and innovative element with respect to other experimental work: the analysis of new morphological forms in Spanish, such as non-binary morphological gender markings. These first exploratory data will serve as a framework for further research on this complex phenomenon. We believe that the articulation between experimental studies and grammatical, sociolinguistic and pragmatic approaches will allow us to better understand variation in language, the underlying (psycho)linguistic processes and the socio-discursive implications of these proposals that seek to revise gender binarism in Spanish.

Supplementary files

Supplementary file 1: Materials. <https://osf.io/j47hv/>.

Abbreviations

ADJ = adjective, DET = determiner, F = feminine, M = masculine, N = noun, NB = non binary, PL = plural

Ethics and consent

This 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 Argentine 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 Argentine Habeas Data Law.

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Competing interests

The authors have no competing interests to declare.

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