The scope of grammatical gender in Spanish: Transference to the conceptual level

Alba Casado [a,*], Alfonso Palma [b,c], Daniela Paolieri [b,c]

[a] *Institute of Psychology, Jagiellonian University, Krakow, Poland*
[b] *Mind, Brain, and Behavior Research Center, (CIMCYC), University of Granada, Granada, Spain*
[c] *Department of Experimental Psychology, University of Granada, Granada, Spain*

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ABSTRACT

The aim of the present study was to explore under what circumstances we could observe a transference from grammatical gender to the conceptual representation of sex in Spanish, a two-gender language. The participants performed a lexical decision task and a gender decision task in the auditory modality, including words referencing inanimate entities associated with males or females. The sex stereotype could be congruent (falda [skirt], feminine) or incongruent (corbata [tie], feminine) with the grammatical gender. If the transfer from grammatical gender to conceptual information related to sex is settled, we should observed faster access for the congruent words compared with the incongruent ones both in the gender decision task and in the lexical decision task. The results showed a facilitation while processing congruent vs. incongruent words where attention to gender was mandatory during the adapted gender decision task. However, there was a lack of transference during the lexical decision task that might have been caused by the absence of direct conceptual activation by the time the decision was made. Additionally, we found that grammatical gender and sex-related information are closely connected, such as the indexical information about the sex of the speaker primes the activation of information related to sex at the conceptual (sex stereotype) and also at the lexical level (grammatical gender). Altogether, the results indicate that gender congruency effect is magnified by direct gender activation.

1. Introduction

The lexical access in Romance languages seems to involve the automatic activation of the grammatical gender (Casado et al., 2018; Cubelli et al., 2005; De Martino et al., 2011; Paolieri et al., 2010; Paolieri et al., 2011). Interestingly, some evidence has established that grammatical gender activation influences the ease of lexical access during word processing. In a previous study (Casado et al., 2018), we showed that lexical access was facilitated when the activation of grammatical gender was promoted by congruent semantic primes. In particular, we showed that processing words presented by speakers whose biological sex matched the grammatical gender (e.g., female voice—feminine gender) was faster than when the words were presented by speakers whose biological sex mismatched the grammatical gender (male voice—feminine gender) (see also Vitevitch et al., 2013). This finding indicates that, despite the arbitrary grammatical gender assignment

(Comrie, 1999; Corbett, 1991; Harris, 1991), it is associated with conceptual information related to sex, which ultimately influences the lexical access of gendered words.

In the present research, we were interested in exploring to what extent grammatical gender is associated with conceptual information related to sex, and how this relationship can influence the access of gendered words. Previous research has already attempted to explore whether there is transference from grammatical gender to conceptual information related to sex, with conflicting results (see a recent review by Samuel et al., 2019). While there is evidence favoring the transference in Spanish when using inanimate targets (Boroditsky et al., 2003; Flaherty, 2001; Forbes et al., 2008; Konishi, 1993, 1994; Martinez & Shatz, 1996; Sera et al., 1994), the results might have been biased by some factors. For instance, the fact that Spanish is a two-gender language (masculine, feminine) may have favored a stronger link between biological sex and grammatical gender because of the greater repetition

* Corresponding author.
E-mail address: alba.casado@uj.edu.pl (A. Casado).

and a stronger correlation between sex and gender in human animates' words (Bender et al., 2018; Sera et al., 1994; Sera et al., 2002[1]; Vigliocco et al., 2005[2]). Also, as criticized by previous research (Bender et al., 2011, 2018; Ramos & Roberson, 2011), it is important to acknowledge that some of the tasks used in previous studies made explicit reference to sex dimensions (i.e., sex assignment or voice assignment task to inanimate objects) favoring the strategic use of gender information to endorse the task at hand. That is, the idea that the connotative meanings associated with female/male is automatically activated when processing grammatical gendered nouns of inanimate referents should be taken cautiously. In the present study, we intended to explore under what circumstances there is a transference from grammatical gender to conceptual information related to sex in Spanish.

In the Spanish language system, most of the words referring to animate entities with biological sex have a congruent grammatical gender assignment (Harris, 1991). That is, words referring to females are feminine (e.g., hermana [sister]), and words referring to males are masculine (e.g., hermano [brother]). In these cases, it is impossible to distinguish whether the activation of the conceptual information related to sex is influenced by the grammatical gender assignment, always congruent. However, biological sex is not the only kind of semantic information related to the sex distinction. Consider the following statements: girls like to play with dolls; boys like to play football. What the two sentences have in common is that each of them reveals an overgeneralized assumption based on the sex distinction. The overgeneralized assumptions related to the behavior toward or preference for objects by males and females are known as sex stereotypes. These beliefs are dependent on the culture and are developed and strengthened based on the speakers' experience with the world (Beller et al., 2015; Bender et al., 2016, 2018; Nicoladis & Foursha-Stevenson, 2012; Segel & Boroditsky, 2011). Contrary to the denotative meaning, stereotypical information varies from community to community, and even from speaker to speaker inside each community (Allan, 2007). However, despite being part of the connotative meaning, stereotypes are frequently stable within speakers (Koenig and Eagly, 2014). In that sense, when accessing the conceptual representation of words associated with sex stereotypes, the stereotypical information is activated in the very early stages of processing (Oakhill et al., 2005; Wang et al., 2017). Interestingly, the associated sex stereotype does not always match the grammatical gender in nouns making reference to inanimate entities. That is, the relationship between the associated sex stereotype and the grammatical gender assignment is arbitrary; therefore, we can find congruent or incongruent cases. An example of a congruent case is the Spanish word falda (skirt), which is grammatically feminine and associated with females. As an instance of an incongruent example, there is the word corbata (tie), also grammatically feminine but associated with males. This dissociation between the associated sex stereotype and the grammatical gender has allowed us to examine whether the automatic activation of grammatical gender is able to prime the activation of conceptual information related to sex, that is, sex stereotypes.

A previous study (Bender et al., 2016) intended to study the interaction between grammatical gender and the conceptual information related to sex by using allegorical associations. Some inanimate entities —mostly referencing abstract concepts— are associated with males or females, such as frequently these concepts portrayed as sexed human beings. For instance "freedom" or "spring" are commonly portrayed as a

women. In the study, they compared the processing of German congruent allegories —for which the grammatical gender corresponded with the associated biological sex (e.g., Freiheit [FEM], freedom) — with the processing of incongruent allegories —for which the grammatical gender did not correspond with the associated biological sex (e.g., Frühling [MAS], spring) using implicit and explicit tasks. The implicit task consisted on a modification of the Simon Task (Extrinsic Affective task), and the explicit task was a voice assignment task. The results showed a gender congruency effect, that is, more efficient processing of the congruent allegories compared with incongruent allegories. The gender congruency effect was stronger in the explicit task than in the implicit task. These results were particularly consistent in the accuracy analysis. Nonetheless, when including in the accuracy analysis the strength of the allegorical associations and the grammatical gender as factors, the gender congruency effect found in the implicit task vanished. The authors concluded that the observed gender congruency effect was not driven by the linguistic feature of grammatical gender, but by the association of the biological sex with the concept. Notwithstanding, we have to acknowledge a critical difference between the previous study (Bender et al., 2016) and the present study. Bender et al. (2016) selected a special type of words —the allegories—that make reference to abstract concepts (e.g., freedom), in contrast, with our study, in which the words associated a sex stereotype, makes reference to concrete entities (e.g., skirt). As concrete and abstract words are represented differently in memory (e.g., Barber et al., 2013) and abstract words may have fewer semantic features than concrete words (e.g., De Groot, 1989; Plaut & Shallice, 1993), it is reasonable to predict that concreteness might modulate the processing of grammatical gender activation, if we consider that grammatical gender and semantic information interact. Moreover, recently, a reduced effect of grammatical gender with abstract words in comparison with concrete words has been found in bilinguals (see Paolieri et al., 2019).

1.1. Current study

The aim of the current study was to explore under what circumstances the automatic activation of grammatical gender influences the activation of conceptual information related to sex in Spanish. For this purpose, we used sex-stereotypical words, which have been used previously to explore congruency and incongruence with lexical and syntactic categories (e.g., Molinaro et al., 2016; Wang et al., 2017). In particular, we selected nouns with congruent (falda [skirt]), incongruent (corbata [tie]), and without stereotype (mesa [table]) relationships between the grammatical gender and the associated sex stereotype.

In order to explore whether grammatical gender influences the activation of conceptual information related to sex in an incidental way, we decided to use a lexical decision task. During the task, the participants had to decide whether the presented stimuli were real words or pseudowords. Despite the fact that accessing the semantic information was not mandatory to perform the task, previous research showed that, indeed, it is accessed (see Haro et al., 2017). That is, we considered that, in this task, the salience of gender information was low, as no direct attention to the grammatical gender or to the conceptual information related to sex was required. Moreover, in order to explore whether grammatical gender influences the activation of conceptual information related to sex when the salience of gender information was high, we decided to use a modification of the gender decision task. During the task, the participants had to decide whether the presented stimuli (we presented nouns and verbs) had a grammatical gender, and if so, whether the gender was masculine or feminine. Thus, paying attention to the grammatical gender feature may have enhanced the reinforcing of the transference from the grammatical gender to the semantic information related to sex (Bender et al., 2011, 2018; Samuel et al., 2019).

Based on the assumption that the transference from grammatical gender to conceptual information related to sex occurs automatically,

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[1] They proposed that, in Spanish in particular, there is a semantic basis when assigning the grammatical gender to inanimate entities that makes this language more prone to gender biases.

[2] In their explanation of the sex and gender hypothesis, Vigliocco et al. (2005) proposed that the effects of grammatical gender in conceptual information should be greater for languages with two genders due to the more prevalent association between the gender of nouns referring to humans and the sex of referents than for languages with more than two genders.

through a bidirectional connections between the lexical and the conceptual level (i.e., Levelt et al., 1999) we made the following prediction for both the lexical decision task and the gender decision task: the grammatical gender will prime the activation of the sex stereotype, such that we will observe faster lexical access when there is a match between the grammatical gender and the sex stereotype (i.e., congruent: falda [skirt], feminine) and slower lexical access when there is a mismatch (i.e., incongruent: corbata [tie]). However, if the transference only occurs when useful for the task, we should only observe the priming from the grammatical gender to the sex stereotype during the gender decision task. Additionally, we expected this effect to depend on the sex of the speaker. In particular, in the lexical decision and the gender decision tasks, based on previous studies using similar paradigms (Casado et al., 2018; Vitevitch et al., 2013), we expected greater priming when the sex of the speaker matched the grammatical gender, such as when lexical access is boosted when there is a match between the sex of the speaker and the grammatical gender (e.g., falda [skirt], feminine presented with female voice) compared with when there is a mismatch (e.g., falda [skirt], feminine presented with male voice).

2. Lexical decision task

2.1. Methods

2.1.1. Participants

The experiment involved 36 native Spanish speakers (18 females; mean age = 22.78; SD = 4.71) from the University of Granada who took part in exchange for either course credits or money (€5). The participants had no hearing impairments, uncorrected visual impairments, or language or neurological impairments.

2.1.2. Materials

To select words related to a sex stereotype, 60 participants (30 men, 30 women) following the same selection criteria as the study participants (university students; mean age = 21.4; SD = 2.49) completed a pretest questionnaire in which they evaluated the grade in which 124 nouns were sex stereotyped on a Likert-type scale from 1 to 7 (How do you perceive these nouns? 1 = very feminine, 2 = feminine, 3 = slightly feminine, 4 = neutral, 5 = slightly masculine, 6 = masculine, and 7 = very masculine). The nouns that scored the highest on either extreme (masculine or feminine stereotypes) were selected for the study. The stereotypical scores were transformed into a scale from 1 to 3 in which 1 = highly stereotypical and 3 = lowly stereotypical regardless of the

category (masculine or feminine) (see Table 1 for the characteristics of the nouns used in the study). Following the design of previous studies (Casado et al., 2018; Vitevitch et al., 2013), we chose 48 transparent, gendered nouns making reference to inanimate entities (masculine nouns ending in -o and feminine nouns ending in -a). We also controlled for other variables, such as frequency of use, number of phonemes, phonological neighbors, imageability, and concreteness of grammatical and stereotypical gender, using scores from the EsPal database (Duchon et al., 2013; see Table 1 for the characteristics of nouns used in the study). We selected 48 words as targets. Half of the nouns were stereotypically associated with females, and the other half stereotypically associated with males. Half of the stereotypical nouns associated with females were grammatically feminine, and the other half were masculine. Similarly, half of the stereotypical nouns associated with males were grammatically feminine, and the other half were masculine. For the sake of control, we selected 24 additional stereotypically neutral nouns, half of which were grammatically masculine and the other half grammatically feminine. We decided to include words with lack of stereotypes to ensure that participants did not pay direct attention to the stereotypical information (see Appendix A for the complete list of the stimuli). As fillers, we used 72 pseudo-words created from the nouns using Wuggy software (Keuleers & Brysbaert, 2010), maintaining the Spanish syllabicity structure and the numbers of letters.

To create the auditory stimuli, all the words were recorded with both male and female voices. The speakers were dizygotic twin siblings with very similar dialectic voices due to their origin and family environment. The words were recorded in mono (26 bits, 44,100 Hz). The mean fundamental frequency (F0) of the male voice was 124.52 Hz, and that of the female voice was 189.58 Hz. The words were recorded with a neutral emotional tone, and environmental sounds were filtered. The sound recording was time framed to control the word duration for each word spoken by the two speakers. The participants did not report any difference related to the quality of the recording by the different speakers.

Two versions of the same experiment were created. In each version, half of the target words were presented with the female voice (36) and the other half with the male voice (36). Half of the words recorded with the female voice had feminine grammatical gender (18), and the other half had masculine grammatical gender (18). Similarly, half of the words recorded with the male voice had feminine grammatical gender (18), and the other half had masculine grammatical gender (18). One-third of the words recorded with the female and the male voices were stereotypically associated with females (12), one-third were stereotypically

Table 1.
Characteristics of the stimuli used in the study. The numbers correspond to the average, and in brakets we present the stardard deviation. At the right there is the comparison of Grammatical gender (Feminine vs. Masculine) in Frequency of use (log), Number of phonemes, Phonological neighbors, Imeageability, Concretness, and Stereotype score . At the right, we present the comparison of Stereotypical gender (Feminine vs. Masculine). At the botton, we present the comparison between the Sex of the Speaker (Female vs. Male) in the duration of the sound file (ms).

	Grammatical gender		Stereotypical gender		
	Feminine	Masculine	Feminine	Masculine	
Frequency log t(46) = 0.75; p = .45	0.75 (0.51)	0.64 (0.51)	0.57 (0.48)	0.83 (0.52)	Frequency log t(46) = −1.78; p = .08
Number of phonemes t(46) = −0.81; p = .42	5.96 (1.39)	6.33 (1.78)	6.12 (1.57)	6.17 (1.66)	Number of phonemes t(46) = −0.09; p = .92
Phonological neighbors t(46) = −0.29; p = .76	14.42 (14.49)	15.79 (17.52)	13.50 (13.48)	16.71 (18.18)	Phonological neighbors t(46) = −0.69; p = .49
Imageability t(18) = 0.27; p = .78	5.98 (0.41)	5.92 (0.49)	6.04 (0.46)	5.90 (0.42)	Imageability t(18) = 0.69; p = .49
Concreteness t(22) = 0.37; p = .71	5.66 (0.75)	5.54 (0.77)	5.53 (0.75)	5.66 (0.76)	Concreteness t(22) = 0.75; p = .66
Stereotype Score t(43) = −1.58; p = .12	2.31 (0.75)	2.65 (0.67)	2.33 (0.75)	2.64 (0.68)	Stereotype score t(43) = −1.45; p = .15
	Sex of the speaker				
	Female	Male			
Sound file duration (ms) t(94) = −0.11; p = .91	650 (103)	652 (101)			

associated with males (12), and one-third were not associated with a stereotype (12).

2.1.3. Procedure

The stimuli were presented on a laptop computer using *E*-Prime version 2.0 (Psychology Software Tools, Pittsburgh, PA, USA). The participants listened to the words via headphones. They were told to listen carefully to each word and press a different key depending on whether the stimulus was a word or a pseudo-word. All trials had the same structure: each trial began with a warning signal (a sound-bit composed of a pure tone of 500 ms), and then there was a wait interval of 250 ms followed by the stimulus presentation. The stimuli were presented aurally via headphones, and the participants were given 2000 ms to respond. To avoid the fatigue effect and give the participants a short rest period, the experiment was divided into two blocks of 72 trials (36 experimental stimuli and 36 fillers). The presentation of the blocks was randomized, and presentation of the trials within each block was as well. The experimental session lasted approximately 15 min.

2.1.4. Data analysis

We measured the response time from the end of the sound file corresponding to each word. Prior to the statistical analysis, we filtered the response time data, including only the correct trials (accuracy = 0). In addition, we filtered the response time score 2.5 SD higher or lower than the average per participant. The analysis was performed using analysis of variation (ANOVA) implemented in the "afex" package (version 0.22–1; Singmann et al., 2015) in R. As a dependent variable, we included the scaled response times (RTs). As factors, we included grammatical gender (gramgen: masculine, feminine), sex stereotype (sexstereo: associated to males, associated to females), and sex of the speaker (sexspeak: male voice, female voice), and the interactions among the factors. Pairwise comparisons were implemented with a least squares means (lsmeans) package (Lenth & Lenth, 2018).

2.2. Results

The analysis revealed a significant interaction between the grammatical gender and the sex of the speaker, $F(1, 34) = 4.86$, $p = .03$ (see Fig. 1). The pairwise comparison showed that the feminine words were processed faster when presented with female voice (M = 249 ms), compared with when presented with male voice (M = 291 ms), t(64.9)
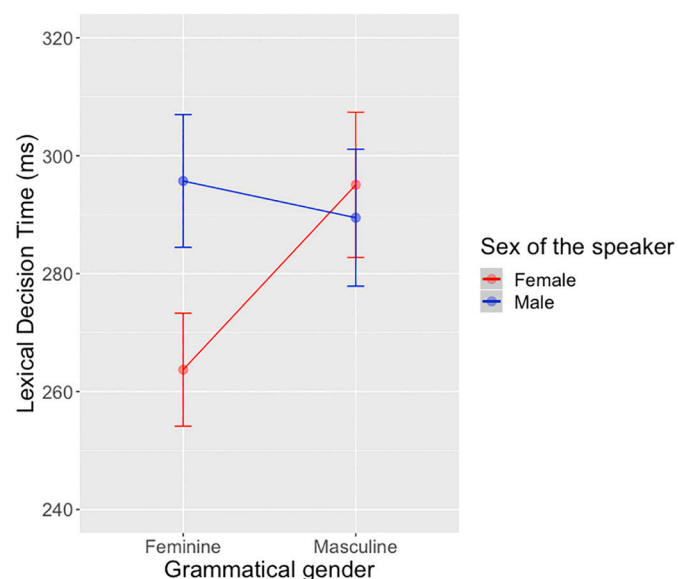

Fig. 1. Interaction between the grammatical gender and the sex of the speaker in the Lexical Decision Task. The lines represent the standard error.

$= -2.28$, $p = .02$; no significant differences appeared for the masculine words (mean female voice = 263 ms; mean male voice = 276 ms), t (64.9) = 1.16, $p = .23$ (see Table 2). Unexpectedly, interaction between the grammatical gender and the sex stereotype was not significant, F(1, 34) = 3.81 $p > .05$.

2.3. Discussion

In the our study, we explored whether the automatic activation of grammatical gender influences the activation of conceptual information related to sex in an incidental way. We hypothesized that grammatical gender primes the activation of sex stereotypes, facilitating lexical access when congruent (e.g., falda [skirt]) and hindering lexical access when incongruent (e.g., corbata [tie]). Contrary to our prediction, we did not observe any modulation in the activation of the associated sex stereotype. We could take these results as confirming the lack of transfer from the grammatical gender to the conceptual information related to sex when not beneficial for the task at hand. However, it may be the case that, during the presented tasks, the conceptual information triggered by the noun was not accessed by the time the lexical decision was made. According to the interactive view of Roelofs (2005) described in the language production model WEAVER ++ (Levelt et al., 1999), the processing of spoken words starts with the decodification of the word form. The word form triggers lemma activation, where the lexical and syntactic information is included. Once the lemma is accessed, the bidirectional flow between the lemma and the conceptual information starts, allowing feedback to flow from the lexical nodes to the conceptual-semantic representations and vice versa. According to this model, the decision about the lexicality of the stimulus can commence just after accessing the lemma, prior to starting the flow of the conceptual information. In that sense, even though the conceptual information may eventually be activated during the lexical decision task, as reflected in previous experiments (Haro et al., 2017), it is not likely to occur before 300 ms, the time the participants took to make the lexical decision. Actually, this seems to be in line with the neurocognitive model of language comprehension proposed by Friederici (2002). In her model of auditory comprehension, the primary acoustic analysis is performed around 0–100 ms, where the phonemes are extracted, and the phonological word form is identified. After that, word category information is accessed around 150–200 ms, which is the information needed to perform the lexical decision task. In the next step, from 300 to 500 ms, the lexical-semantic and morpho-syntactic information is accessed. Finally, around 500–1000 ms, the integration occurs, where there is a reanalysis of elements when incompatible with the activated information. Therefore, it seems that we cannot observe any modulation in the activation of sex stereotypes in the response times of the lexical decision task because the semantic level is not completely accessed by the time the decision is made. That is, we expected the grammatical gender information at the lexical level to prime the activation of sex stereotypical information at the conceptual level. However, due to the limitation of our design, we cannot confirm or refute that grammatical gender influences the activation of stereotypical information related to sex when not directly useful for the task at hand.

Nonetheless, the data from our experiment replicate the previous findings regarding the sex of the speaker. That is, we found evidence supporting the premise that the sex of the speaker acts as a semantic prime boosting the grammatical gender activation during lexical access, such as the words presented by speakers whose biological sex matched the grammatical gender (e.g., female voice— feminine gender) were processed faster compared with cases where they were mismatched (e. g., male voice— feminine gender) (Casado et al., 2018; Vitevitch et al., 2013). Interestingly, the facilitation of the lexical activation triggered by the sex of the speaker only occurred when the feminine words were produced by a female speaker, in contrast to when the feminine words were produced by a male speaker. That is, no differences were found for masculine words regarding the sex of the speaker. It is important to note

Table 2
ANOVA lexical decision task.

	Sum Sq	Df	Error SS	den DF	F value	p value
(Intercept)	0.00007	1	78.164	34	0.0000	0.99553
gramgen	0.58382	1	8.889	34	2.2332	0.14430
sexstereo	0.02937	1	10.114	34	0.0987	0.75527
sexspeak	0.17602	1	7.463	34	0.8020	0.37681
gramgen*sexstereo	1.18751	1	10.589	34	3.8129	0.05913
gramgen*sexspeak	1.66497	1	11.642	34	4.8626	0.03431 *
sexstereo*sexspeak	0.65937	1	8.561	34	2.6188	0.11484
gramgen*sexstereo*sexspeak	0.00301	1	8.173	34	0.0125	0.91159

that, in Spanish, only one gender is marked, the feminine (Harris, 1991). Similarly, as in other Romance languages (e.g., French, Italian), the masculine form represents the generic or default gender. Accordingly, the lack of influence of the sex of the speaker for the masculine words may be due to the generic status of the masculine gender (Harris, 1991). That is, while the feminine gender is very sensible to congruency with the sex of the speaker due to the gender mark, the generic-masculine gender is more flexible to congruency with the sex of the speaker due to the lack of gender mark.

All in all, despite replicating the influence of the sex of the speaker on the activation of the grammatical gender with our design, we are not able to shed light on the central matter of our concern: the incidental role of the grammatical gender during the activation of sex-related conceptual information.

3. Adapted gender decision task

3.1. Methods

3.1.1. Participants

The experiment involved 36 native Spanish speakers (18 females and 18 males; mean age = 20.31; SD = 2.99) from the University of Granada, who took part in exchange for either course credits or money (€5). The participants did not have auditory impairments, or language or neurological impairments. None of the selected participants participated in the lexical decision task.

3.1.2. Materials

This experiment employed the same targets as in the previous lexical decision task. For the filler trials, we used verbs that had no gender distinction (Corbett, 1991). We decided to include the verbs so the participants would not focus on the word's ending to perform the task. In Spanish, regular verbs of the first conjugation end in -o in the first singular person of the present indicative and end in -a in the third singular person. To avoid ambiguity, we excluded words that could be both nouns and verbs (e.g., el camino/yo camino = The way/I walk).

3.1.3. Procedure

The stimuli were presented on a laptop computer using *E*-Prime version 2.0 (Psychology Software Tools, Pittsburgh, PA, USA). The participants listened to the words via headphones. They were asked to listen carefully to each word and then select the grammatical gender by pressing key 1 for grammatically masculine words, key 2 for grammatically feminine words, and key 3 for verbs. Each trial began with a sound-bit of 500 ms in duration, followed by a wait interval of 250 ms. The stimuli were presented aurally via headphones. The participant was given 2000 ms to answer. To avoid the fatigue effect and give the participants a short rest period, the experiment was divided into three blocks of 32 trials. The presentation of both the trials and the blocks was randomized in each condition. The experimental session lasted approximately 15 min. During the practice, we presented example words associated with the male sex stereotype, with the female sex stereotype, and with lack of the sex stereotype so the participants would know what kind of words to expect. Intentionally, we never mentioned

to the participants the involvement of the sex stereotype, but we gave them feedback about the performance so it was clear to them that they had to focus on the grammatical gender only.

3.1.4. Data analysis

We measured the RT from the end of each word. Prior to the statistical analysis, we filtered the RT data, including only the correct trials (accuracy = 0). In addition, we filtered the response time score 2.5 SD higher or lower than the total mean per participant. The analysis was performed using ANOVA implemented in the "afex" package (version 0.22–1; Singmann et al., 2015) in R. As the dependent variable, we included the scaled RTs. As factors, we included the grammatical gender (gramgen: masculine, feminine), sex stereotype (sexstereo: associated with males, associated with females), and sex of the speaker (sexspeak: male voice, female voice), and the interactions among them. Pairwise comparisons were implemented with the "lsmeans" package (Lenth & Lenth, 2018).

3.2. Results

The analysis revealed a significant main effect of grammatical gender, $F(1, 35) = 39.61$, $p < .0001$. The feminine words (M = 399 ms) were processed faster than the masculine words (M = 424 ms). In addition, there was an interaction between the grammatical gender and the sex stereotype. The feminine words were processed faster when associated with a female sex stereotype (M = 380 ms) compared with when associated with a male sex stereotype (M = 417 ms), $t(66.8) = -3.93$, $p = .0002$. Similarly, the masculine words were processed faster when associated with a male sex stereotype (M = 421 ms) compared
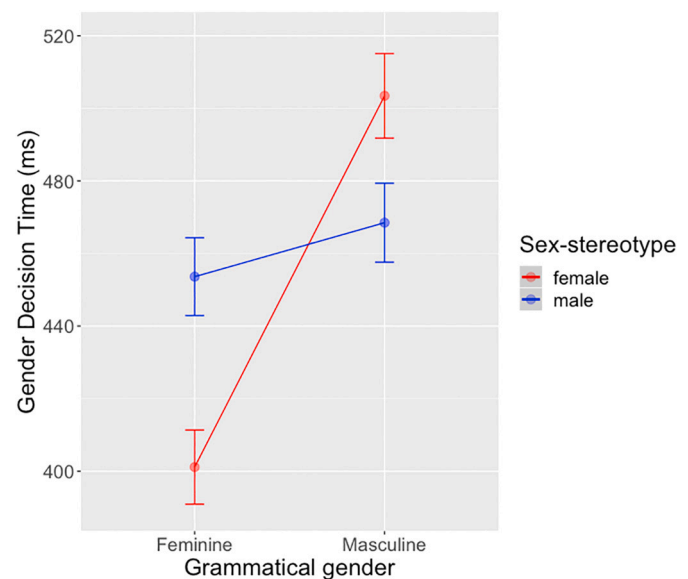

Fig. 2. Interaction between the grammatical gender and the *sex*-stereotype in the adapted Gender Decision Task. The lines represent the standard error.

with a female sex stereotype (M = 427 ms), t(66.8) = 2.55, p = .01 (see Fig. 2). Furthermore, there was an interaction between the sex of the speaker and the sex stereotype, F(1, 35) = 6.38, p < .01. The words associated with the female sex stereotype were processed faster when presented with the female voice (M = 392 ms) than when presented with the male voice (M = 415 ms), t(60.7) = −2.04, p = .04. Similarly, the words associated with the male sex stereotype were processed faster when presented with the male voice (M = 411 ms) compared with when presented with the female voice (M = 427 ms), t(60.7) = 2.17, p = .03 (see Fig. 3 and Table 3).

In order to account for the possible bias related to the transparent gender ending mark, we performed further analysis in which we included only the filler verbs. We created a linear model in which we included the sex of the speaker (male or female voice), the endings (−o, −a), and the interaction as factors. The results showed that there was not a main effect of the sex of the speaker (t = 0.402), not a main effect of the ending (t = 1.841), nor an interaction between the two (t = 0.174).

3.3. Discussion

This second task was designed to explore whether the transference from gender to the conceptual information related to sex occurs when it could be useful for the task; that is, whether making an active use of grammatical gender information influences access to conceptual information related to sex. We hypothesized that the activation of the grammatical gender will prime the activation of the associated stereotype. In line with our prediction, we found that the gender decision was facilitated when the grammatical gender matched the sex stereotype (e. g., falda [skirt]), and it was hindered when there was a mismatch (e.g., corbata [tie]). This shows that, during this task, the grammatical gender primed the activation of conceptual information related to sex despite the grammatical gender assignment being arbitrary. The main implication of this finding is that, in line with previous studies (Boroditsky et al., 2003; Flaherty, 2001; Forbes et al., 2008; Konishi, 1993, 1994; Martinez & Shatz, 1996; Sera et al., 1994), we showed that there is transference from grammatical gender to conceptual information related to sex, even when processing words making reference to inanimate entities. Remarkably, the transference from grammatical gender to conceptual information related to sex occurred when strategically useful for the task at hand, that is, during the adapted gender decision task. This finding alines with previous studies that claimed that the congruency gender

Fig. 3. Interaction between the sex-stereotype and the sex of the speaker in the adapted Gender Decision Task. The lines represent the standard error.

effect might have been triggered by using the gender in a strategic manner such as when it is helpful to complete the task at hand (Bender et al., 2011, 2018; Ramos & Roberson, 2011). Given these results, we cannot confirm that grammatical gender influences the conceptualization of nouns making reference to inanimate entities, but we can suggest that gender and sex-related information are certainly connected and that this heuristic connection is activated when beneficial for the task at hand.

Furthermore, we predicted finding a stronger priming of the grammatical gender toward the activation of the sex stereotype when the sex of the speaker matches the grammatical gender (e.g., falda [skirt], feminine presented with the female voice) compared with when there is a mismatch (e.g., falda [skirt], feminine presented with the male voice). However, instead of the expected three-way interaction (sex of the speaker, grammatical gender, and sex stereotype), we found that the sex of the speaker directly modulated the activation of the sex stereotype. In particular, we observed a facilitation when the sex of the speaker matched the sex stereotype associated with the word compared with when there was a mismatch, independent of the grammatical gender. This indicates that the indexical information about the sex of the speaker serves as a semantic prime (Bender et al., 2011), such as it pre-activates the conceptual representation of sex.

In addition, we also found a main effect of the grammatical gender: the feminine words were processed faster than the masculine words. As we discussed before, the feminine is the marked gender in Spanish (Harris, 1991). Therefore, words with a marked gender (feminine) will be easily classified in terms of grammatical gender compared with words with a generic gender (masculine).

Moreover, the use of transparent phonological cues might have favored a more direct strategic use of grammatical gender information, favoring overgeneralization of the gender cues (Bates et al., 1995; Vigliocco et al., 2005). As control, we performed further analysis including only the verbs (ending in –o and –a). The results revealed no interaction between the word ending and the sex of the speaker, showing that the sex of the speaker was not strategically facilitating the processing of the last phoneme in verbs. Notwithstanding, at present, we cannot rule out the possibility that the transparent word ending might have biased the processing of nouns.

4. General discussion

In our study, we wanted to explore under what circumstances the automatic activation of grammatical gender modulates the activation of conceptual information related to sex. Previous research has shown contradictory results. While some studies pointed to the transfer from grammatical gender to conceptual information related to sex in Spanish (Boroditsky et al., 2003; Flaherty, 2001; Forbes et al., 2008; Konishi, 1993, 1994; Martinez & Shatz, 1996; Sera et al., 1994), others suggested that the results might be biased by the specificity of the language system (two-gender language) (Bender et al., 2018; Samuel et al., 2019; Sera et al., 1994, 2002; Vigliocco et al., 2005) and affected by the explicit requirements of the tasks previously used, which possibly trigger the use of grammatical gender information in a strategic manner (Bender et al., 2011, 2018; Ramos & Roberson, 2011). In order to shed some light on the topic, we selected nouns making reference to inanimate entities in Spanish, stereotypically associated with males and females (i.e., falda [skirt], associated with females) for which the grammatical gender was either congruent (e.g., falda [skirt], feminine), incongruent (e.g., corbata [tie], feminine), or without stereotype (e.g., mesa [table], feminine). We believe that these words are particularly informative not only because of the possible dissociation between the associated stereotype and the grammatical gender, but also because they make reference to concrete objects. A previous study also chose words making reference to inanimate entities associated with males and females in which the grammatical gender could be dissociated from the associated sex stereotype (Bender et al., 2016). Remarkably, while the words selected in
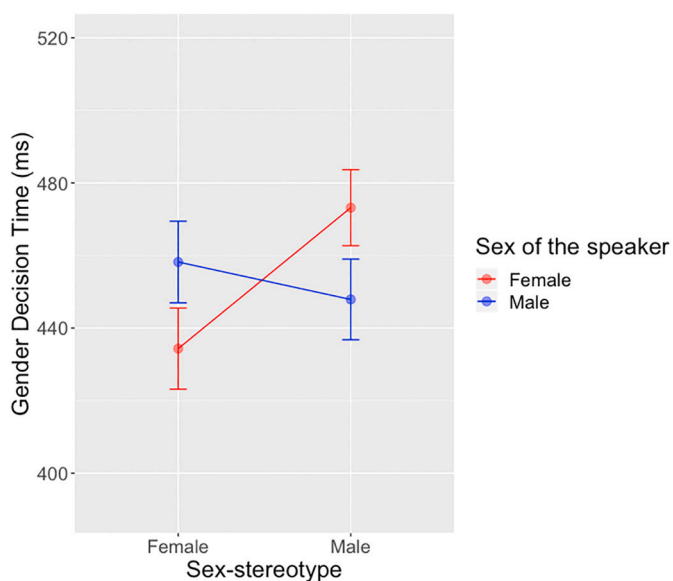
Table 3
ANOVA gender decision task.

	Sum Sq	Df	Error SS	den DF	F value	p value
(Intercept)	0.1421	1	67.940	35	0.0732	0.788301
gramgen	6.8195	1	6.025	35	39.6124	0.00001 ***
sexstereo	0.1760	1	5.105	35	1.2070	0.279429
sexspeak	0.0014	1	4.083	35	0.0123	0.912273
gramgen*sexstereo	3.9218	1	7.971	35	17.2198	0.00021 ***
gramgen*sexspeak	0.6976	1	6.791	35	3.5952	0.066225
sexstereo*sexspeak	1.7017	1	9.338	35	6.3780	0.016236 *
gramgen*sexstereo*sexspeak	0.3878	1	6.128	35	2.2148	0.145652

Bender et al.'s study referenced abstract concepts, in the current study we selected words referencing concrete concepts. This difference is crucial such as abstract words, compared with concrete words, have less semantic features (e.g., de Groot, 1989; Plaut & Shallice, 1993) and therefore they are represented differently in memory (e.g., Barber et al., 2013). Given that we consider that grammatical gender and semantic information are connected bidirectionally, the number of semantic features might modulate the interaction between the lexical and the conceptual level. In fact, a previous study already showed that the gender congruency effect is reduced with abstract words compared with concrete words in bilinguals (Paolieri et al., 2019). Consequently, despite it is possible to dissociate between the associated and the grammatical gender in both Bender et al. study (2016) and in our study, the gender congruency effect should be slightly stronger for concrete than abstract words. We studied the processing of these nouns in two different tasks: a lexical decision task, where the processing of the grammatical gender could have been considered unnecessary, and a gender decision task, where the processing of grammatical gender was mandatory. If the transfer from grammatical gender to conceptual information related to sex was settled, and therefore occurred by default, we should have observed faster access for the congruent words compared with the incongruent ones both in the gender decision task and in the lexical decision task. However, if the transfer from grammatical gender to sex conceptual information depended on the demands on the task, we should have observed the faster access to the congruent words compared with the incongruent ones uniquely in the gender decision task, where the use of gender information favored the activation of conceptual features associated with males and females.

The results revealed an interaction between the grammatical gender and the associated sex stereotype in the gender decision task, that is, the congruent words were processed faster than the incongruent words. However, this pattern of results was not reproduced in the lexical decision task. There, the congruency between the grammatical gender and the associated sex stereotype did not influence the speed of lexical access when attention to the grammatical feature was not relevant for the task. These results aline with the pattern of results in Bender et al. (2016) using allegories. In particular, we found similarly as Bender et al. a gendered congruency effect between the grammatical gender and the associated sex-stereotype with an explicit task (in their case a voice assignment task). However, Bender et al. (2016), also found the gender congruency effect with an implicit task (the extrinsic affective task) —although weaker compared with the explicit task (uniquely apparent in the accuracy analysis) — that we do not reproduce in our study. This lack of effect could be taken as proof favoring the hypothesis that the transfer from gender to sex-related conceptual information is not settled, and the link between the dimensions is activated in an heuristic manner when advantageous for the task. However, it is also possible that the semantic level was not accessed by the time the lexical decision was made. Despite previous research showing that conceptual information is activated during the lexical decision task (Haro et al., 2017), our obtained RTs were around 300 ms, that is, earlier than what the neuro-cognitive model of language comprehension (Friederici, 2002) predicted for activating the conceptual-semantic representation (300–500 ms). Therefore, we cannot rule out the possibility that the lack

of transfer from the gender to the sex-related information is due to the absence of the complete activation of the conceptual information.

Fortunately, the second variable we explored, the sex of the speaker, proved to be useful for clarifying whether the conceptual level was activated during the lexical decision task or not. Previous research showed that the sex of the speaker acts as a semantic prime influencing the lexical access of gendered words (Casado et al., 2018; Vitevitch et al., 2013). This indicates that grammatical gender is associated with semantic information related to sex, despite the fact that the grammatical gender assignment for inanimate entities is arbitrary (Comrie, 1999; Corbett, 1991; Harris, 1991). In view of the findings of previous studies, we expected the sex of the speaker to prime the activation of the grammatical gender when the biological sex of the speaker matched the grammatical gender, thus influencing the speed of lexical access such as faster processing is expected when this is congruent (e.g., female voice – feminine gender) compared with incongruent (e.g., male voice – masculine gender) in the task. Following our predictions, we found faster lexical access when there was congruency between the sex of the speaker and the grammatical gender of the word compared with when incongruent in the lexical decision task. Interestingly, we found a different pattern of responses in the gender decision task: the sex of the speaker modulated the activation of the associated stereotype instead of the activation of the grammatical gender. Although it may seem contradictory to find a different pattern of responses between the lexical decision and the gender decision task regarding the role of the sex of the speaker, actually, it concurs with the idea that the sex of the speaker works as a semantic prime. That being the case, the sex of the speaker will pre-activate the available information related to sex. In contrast with previous studies (with the exception of Bender et al., 2016), where the separation between grammatical gender and conceptual information related to sex was not possible (the explored items were words making reference to animate entities with congruent gender assignment, i.e., hermano [brother] masculine) or words making reference to inanimate entities without an associated stereotype, i.e., mesa [table] feminine), here we could separate the grammatical gender (information related to sex at the lexical level) from the sex stereotype (information related to sex at the conceptual level). If we assume that the conceptual level was not activated during the time the lexical decision time was taken, we can expect the grammatical gender to be the only available information related to sex and, consequently, primed by the sex of the speaker. In the case of the gender decision task, two kinds of information related to sex would be activated: the grammatical gender and the sex stereotype. If the sex of the speaker works as a semantic prime, it is reasonable to expect it to pre-activate the conceptual information related to sex (i.e., the sex stereotype) rather than the grammatical information.

Accordingly, we assume that, in the lexical decision task, the influence of the sex of the speaker on the grammatical gender activation commences at the conceptual level, where the connotation related to sex is activated by the indexical information about the sex of the speaker. Thus, the conceptual information related to sex triggered by the sex of the speaker, in a top-down manner, acts like a semantic prime modulating the grammatical gender activation at the lexical level (Brunellière & Soto-faraco, 2015). In the gender decision task, the sex of the speaker triggers the activation of conceptual information related to sex, which

directly primes the activation of the sex stereotype at the conceptual level, possibly reducing the top-down influence at the lexical level. Therefore, the sex of the speaker primes information related to sex, which includes grammatical gender.

Finally, it is important to consider that our study has some limitations. The more important one is that we uniquely tested Spanish, a two-gender language. This issue has been discussed before by other authors because most of the studies reporting an influence of grammatical gender on the conceptualization of inanimate entities were produced in two-gender language systems (for a review, see Samuel et al., 2019). This bias might have been caused by the dichotomy in the Spanish gender system between male— masculine and female— feminine. That is, the stronger repetition and correlation between sex and gender in words making reference to animate entities may have enhanced the priming of sex-related information during gender processing (Bender et al., 2018; Sera et al., 1994, 2002; Vilgiocco et al., 2005). Therefore, the results, although interesting, should be considered cautiously, as they may not be generalizable to other formal gender language systems, such as languages with two gender categories indirectly related to sex (animated and neuter as in Dutch), or with three gender categories (masculine, feminine, and neuter as in German). Another limitation of our study is the inclusion of only nouns with gender-marked endings (in Spanish -o for masculine and -a feminine). Although we showed that the use of transparent phonological cues did not seem to favor a more direct strategic use of grammatical gender information, in future research, it would be insightful to use opaque marked endings. Additionally, in future research, it would be valuable to add a final questionnaire to see whether the participants were aware of the manipulation to determine if the awareness might have triggered the strategic use of gender.

In summary, we intended to explore under what circumstances we could observe a transference from grammatical gender to the conceptual representation of sex in Spanish, a two-gender language. When our participants were explicitly required to use gender in the adapted gender decision task, we observed a faster processing of words with a congruent relationship between the grammatical gender and the sex-related stereotype (falda [skirt], feminine) compared with incongruent words (corbata [tie], feminine). However, we could not replicate the same findings in the lexical decision task, where the use of gender was not mandatory. We would argue that the lack of transference during the lexical decision task was most likely caused by the absence of direct/strong conceptual activation by the time the decision was made. Therefore, with the present design, we could not rule out the possibility that the transference that we found during the gender decision task was not established by default, but caused by a strategic use of gender and facilitated by the two-gender language. However, the results of both lexical decision and gender decision tasks suggested that grammatical gender and sex-related information are closely connected, that is, the indexical information about the sex of the speaker primes the activation of information related to sex at the conceptual (sex stereotype, gender decision) and also at the lexical level (grammatical gender, lexical decision).

CRediT authorship contribution statement

Alba Casado: Term, Conceptualization, Software, Formal analysis, Writing – original draft & editing, Visualization; **Alfonso Palma**: Term, Conceptualization; **Daniela Paolieri**: Conceptualization, Resources, Writing – reviewing & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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Appendix A

Feminine stereotype - Feminine grammatical gender	Masculine stereotype - Feminine grammatical gender	Neuter stereotype - Feminine grammatical gender
braga - panties	armadura - armour	acera - sidewalk
coleta - ponytail	barba - beard	bombilla - light bulb
compresa - sanitary towel	caza - hunting	cama - bed
diadema - hairband	corbata - tie	carpeta - folder
faja - girdle	escopeta - shotgun	chimenea - fireplace
falda - skirt	espada - sword	ducha - shower
horquilla - hairpin	gorra - cap	estantería - bookshelf
melena - long hair	pajarita - bow tie	lámpara - lamp
moda - fashion	pelota - ball	mesa - table
muñeca - doll	perilla - goatee	puerta - door
pamela - pamela hat	rodillera - kneepad	silla - chair
rosa - rose	sotana - cassock	ventana - window
Feminine stereotype - Masculine grammatical gender	**Masculine stereotype - Masculine grammatical gender**	**Neuter stereotype - Masculine grammatical gender**
bolso - hand bang	arado - plough	arbusto - bush
cepillo - brush	astillero - shipyard	bolígrafo - pen
coletero - scrunchie	barco - ship	cuadro - painting
cosmético - cosmetic	bolo - skittle	despacho - office
decorado - theatre set	boxeo - boxing	disco - disc

(*continued*)

fregadero - sink	calzoncillo - underpants	lavabo - sink
ganchillo - crochet	escudo - shield	libro - book
lazo - bow	puñetazo - punch	mechero - lighter
liguero - suspender belt	puro - cigar	periódico - newspaper
moño - bun	remo - oar	plato - plate
plumero - feather duster	serrucho - hand saw	suelo - floor
vestido - dress	tejado - roof	teléfono - phone

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