Grammatical gender processing in L2 speakers of Spanish

The role of cognate status and gender transparency

Lauren Halberstadt,[1] Jorge R. Valdés Kroff[2] and Paola E. Dussias[1]
[1]The Pennsylvania State University | [2]University of Florida

Recent findings indicate that native speakers (L1) use grammatical gender marking on articles to facilitate the processing of upcoming nouns (e.g., Lew-Williams & Fernald, 2007; Dussias, Valdés Kroff, Guzzardo Tamargo, & Gerfen, 2013). Conversely, adult second language (L2) learners for whom grammatical gender is absent in their first language appear to need near-native proficiency to behave like native speakers (Dussias et al., 2013; Hopp, 2013). The question addressed here is whether sensitivity to grammatical gender in L2 learners of Spanish is modulated by the cognate status of nouns due to their heightened parallel orthographic, phonological, morpho-syntactic and semantic activation. Additionally, the role of transparent and non-transparent word-final gender marking cues was examined because past studies have shown that native speakers of Spanish are sensitive to differences in gender transparency (Caffarra, Janssen, & Barber, 2014). Participants were English learners of Spanish and Spanish monolingual speakers. Data were collected using the visual world paradigm. Participants saw 2-picture visual scenes in which objects either matched in gender (same-gender trials) or mismatched (different-gender trials). Targets were embedded in the preamble *Encuentra el/la* ___ 'Find the ___'. The monolingual group displayed an anticipatory effect on different gender trials, replicating past studies that show that native speakers use grammatical gender information encoded in prenominal modifiers predictively. The learners were able to use gender information on the articles to facilitate processing, but only when the nouns had gender endings that were transparent. Cognate status did not confer an advantage during grammatical gender processing.

Keywords: second language, grammatical gender, L2 processing, cognates, transparency, morphosyntax

https://doi.org/10.1075/jsls.17023.hal
Journal of Second Language Studies 1:1 (2018), pp. 5–30. issn 2542-3835 | e-issn 2542-3843

One benchmark of achieving high proficiency in a second language is the mastery of grammatical gender. Grammatical gender assigns nouns to classes and marks the surrounding words for agreement (Corbett, 1991; Hockett, 1958); as a result, knowledge of a noun's gender is essential for proper phrase construction (Arnon & Ramscar, 2012). Whereas native speakers seldom make mistakes in grammatical gender use (Pérez-Pereira, 1991), proficient second language (L2) speakers have shown variable success (e.g., Griebling McCowen & Alvord, 2006; Lew-Williams & Fernald, 2010; Montrul & Potowski, 2007). The evidence on what it takes for L2 learners to achieve native-like proficiency using grammatical gender is mixed. The presence of grammatical gender in the L1 (e.g., Dussias, Valdés Kroff, Guzzardo Tamargo, & Gerfen, 2013; Sabourin, Stowe, & de Haan 2006; Sabourin & Stowe 2008), years of immersion in the L2 context (e.g., Gillon Dowens, Vergara, Barber, & Carreiras, 2009), and near-native like proficiency in the L2 (e.g., Dussias et al. 2013; Hopp, 2013; White, Valenzuela, Kozlowska-McGregor, & Leung 2004), all contribute to positive outcomes, but not uniquely. In the work presented here, we take direction from two recent findings – one demonstrating that speed of lexical access affects grammatical gender processing (Hopp, 2013), and another one suggesting that weaker associations between L2 nouns and gender nodes in the L2 can lead to less efficient use of gender cues during processing (Grüter, Lew-Williams, & Fernald, 2012) – to examine how cognate status and grammatical gender transparency, which are two variables associated to words themselves, impact grammatical gender processing in the L2.

Research investigating native language processing has revealed a central role for speed of lexical access during language comprehension. We know that higher frequency words promote faster lexical processing (Forster & Chamber, 1973; Gordon, 1983; Schilling, Rayner, & Chumbley, 1998; Ziegler, Perry, & Coltheart, 2003), and results derived from word naming and lexical decision tasks, as well as eye-tracking methods, have consistently shown a correlation between frequency and faster processing (Gordon, 1983; Schilling et al., 1998). We also know that real words are processed faster than non-words (Forster & Chamber, 1973), and that words with regular sound-spelling correspondence show faster lexical processing (Ziegler et al., 2003). These findings, along with research demonstrating that at least some features of the language processing architecture, including syntactic and morpho-syntactic processing, are uniform across levels of linguistic processing (Jurafsky, 1996; MacDonald, 1993; MacDonald, Pearlmutter, & Seidenberg, 1994; MacDonald, 2013) lead to the hypothesis that speed of lexical access should affect some aspects of grammatical processing in a second language. This is precisely the conclusion reached in Hopp (2013). L1 English-L2 German participants were shown four-picture displays on a computer screen and were asked to describe the objects on the screen using a definite article and a noun. This

tested the participants' ability to accurately produce correct grammatical gender agreement. The same four-picture displays were then used to test real-time spoken word recognition. Participants heard sentences that included the target noun and its definite article, while their eye movements and fixations were recorded. The displays varied according to whether the target noun was accompanied by same-gender competitors ('same' trials) or different-gender competitors ('different' trials). If participants are able to use gender information marked on prenominal determiners, then they should exhibit earlier and greater fixations to different trial targets. As might be expected, participants who could accurately demonstrate grammatical gender assignment and agreement in production could also use gender information predictively in the processing of upcoming nouns in determiner + noun phrases. What was more interesting about the study, however, was that speed of lexical access significantly correlated with predictive syntactic agreement of gender. Speed of lexical access was measured by testing how quickly participants used numeric cues (singular/plural) in real time. For both the native German speaking control group and the L2 learners, mean reaction times in the lexical cue condition were significantly correlated with the size of the predictive gender effect. Hopp (2013) concluded that less automatic levels of lexical access can lead to lower levels of grammatical gender use in predictive, real-time processing. In contrast, faster processing at the word level enables speakers to access grammatical information associated with that word (i.e. grammatical gender) and, in turn, to use it predictively.

The Hopp (2013) study found that only near-native L2 speakers (participants who scored > 20 on a standardized written language test, p. 42) were able to exploit grammatical gender predictively. One open question is whether there are other means by which speeding up lexical processing can give L2 speakers fast access to grammatical gender. Cognates could have the properties that may allow speakers to do precisely this. Cognates are words that are phonetically, semantically, and orthographically similar across languages. There is robust evidence indicating that cognates have a special status in the bilingual mental lexicon because they are words that are shared between the bilingual's two languages. A finding that is often reported in the bilingual literature is that cognate words are processed more quickly than non-cognate words, leading to a "cognate facilitation" effect. The effect is most often reported in the bilingual's less dominant language (typically the L2), although studies have also demonstrated cognate facilitation effects in the bilingual's dominant language (e.g., Van Hell & Dijkstra, 2002). The cognate facilitation effect has most often been reported in studies involving visual lexical decision tasks and in word production studies. In the visual domain, cognate facilitation effects are the strongest when cognate words are presented in isolation (De Groot & Nas, 1991; Sánchez-Casas, García Albea, & Davis, 1992; Van Hell

& Dijkstra, 2002). Although a number of studies have also reported a cognate advantage when cognate words are embedded in sentences, the effect tends to be smaller (e.g., Libben & Titone, 2009; Schwartz & Kroll, 2006; Van Assche, Duyck, Hartsuiker, & Diependaele, 2009). In production, bilingual studies have demonstrated that cognates are named faster than non-cognates in both word naming (e.g., Schwartz, Kroll, & Diaz, 2007) and picture naming tasks (Costa, Caramazza, & Sebastián-Gallés, 2000), and that during reading tasks, cognates are read faster than non-cognates (Sherkina-Leiber, 2004; Hoshino & Kroll, 2008). If the cognate facilitation effect extends to spoken language processing, one might predict that it should be easier to access grammatical gender information during online processing for cognate words relative to non-cognate words, under the assumption that cognates speed up lexical access. Investigating this prediction is one goal of the work presented here.

Recent studies have also suggested that the strength of the lexical representation of L2 words and gender nodes in the L2 is another important variable (e.g., Grüter, Lew-Williams, & Fernald, 2012; Lew-Williams and Fernald; 2010). The idea is that differences in learning paths between adult L2 learners and children may impact the acquisition of lexical and syntactic knowledge, which in turn could modulate how grammatical gender information is accessed and processed in real time. In support of this, Grüter et al. (2012) showed that advanced and near-native L2 speakers of Spanish did not have difficulties with grammatical gender agreement operations in a sentence-picture matching task and an elicited production task, but performed significantly below the native bar when assigning grammatical gender to nouns. Importantly for our purpose, errors occurred more frequently among irregularly-marked nouns than among nouns with so-called 'transparent' endings. The authors drew two significant conclusions from their findings. First, the asymmetry observed in L2 speakers concerning the production of errors in gender assignment vis-à-vis gender agreement, suggests that the reported difficulty with grammatical gender by adult L2 speakers lies primarily in the representation of lexical items rather than in the syntactic processes that govern grammatical gender agreement. Second, weaker strength of associations in the mental lexicon between nouns and their gender nodes can lead to errors of gender assignment during language production as well as to less effective use of gender cues during online processing.

The results reported in Grüter et al. (2012) hint to the idea that nouns with clear cues to gender membership class might be processed more efficiently than nouns without such cues. In Spanish, one cue to grammatical gender comes in the form of word-final gender markings. Spanish has a two-way gender category distinction – feminine and masculine – and gender assignment is predominately morpho-phonologically based. 'Transparently-marked' nouns exhibit a high cor-

respondence between their noun endings and their grammatical gender category. For example, the word *casa* 'house' ends in *-a* and is assigned feminine gender, while *libro* 'book' ends in *-o* and is assigned masculine gender. Noun endings that do not demonstrate a high degree of correspondence with grammatical gender categories are often referred to as non-transparent (or opaque). Spanish words that end in *-e* or in consonants still have grammatical gender, but do not offer a phonological cue as to their gender assignment. For example, *leche* 'milk' ends in *-e* and is feminine, while *coche* 'car' also ends in *-e*, but is masculine.

Recent findings suggest that native speakers are sensitive to differences between transparently-marked and non-transparently-marked gender on nouns. Imaging studies, for example, provide results showing that native Spanish speakers making decisions about the gender of nouns require deeper and more effortful processing to retrieve lexical and syntactic information for non-transparent nouns than for transparent nouns (Hernandez, Kotz, Hofmann, Valentin, Daprettom & Bookheimer, 2004). Other research has shown that effects of gender agreement errors in both transparent and non-transparent nouns can be seen during the early stages of language comprehension. Caffarra, Janssen, and Barber (2014) analyzed event-related potentials (ERPs) to examine gender agreement processing in Spanish article-noun pairs. In one manipulation, participants were asked to decide whether transparent and non-transparent nouns agreed in grammatical gender with the preceding article. Behaviorally, higher accuracy rates were observed for transparent nouns relative to opaque nouns. The ERP results showed greater negative amplitudes for transparent nouns in the 'disagreement' condition (when there was a mismatch between the article and the noun) compared to opaque nouns, and this was evident both at the 350–500 ms and at the 500–750 ms time windows. If transparent nouns are more easily integrated into the grammatical gender system than non-transparent nouns, one might expect that transparently-marked nouns should confer processing advantages relative to non-transparent nouns. The second goal of the work presented here is to test this hypothesis.

In summary, over two experiments that use the visual world technique (e.g., Allopenna, Magnuson, & Tanenhaus, 1998; Altmann, 2011; Cooper, 1974), the present study considers two questions on grammatical gender processing in L2 speakers. First, we ask whether adult proficient speakers of L2 Spanish who are native speakers of an L1 without grammatical gender, use grammatical gender encoded in definite articles to predict an upcoming target noun. We further investigate whether cognates provide facilitated lexical access and therefore greater ability to use grammatical gender predictively (Experiment 1). Experiment 2 tests whether the transparency of gender marking on Spanish nouns plays a role in gender processing. Three research questions guided the investigation:

1. Do proficient L1 English-L2 Spanish speakers use the grammatical gender information encoded in Spanish definite articles *el* and *la* to facilitate the processing of upcoming nouns?
2. Are L1 English-L2 Spanish speakers more successful at using grammatical gender marked on articles as a predictive cue to anticipate upcoming nouns when those nouns are cognates?
3. Are L1 English-L2 Spanish more likely to use grammatical gender marked on articles as a predictive cue to anticipate upcoming transparent nouns?

Experiment 1: Processing the grammatical gender of cognates

In Experiment 1, two-picture visual scenes in which pictured objects matched or did not match in grammatical gender were displayed on a computer screen, while at the same time a sentence was played over speakers. Adult English-Spanish bilinguals and monolingual Spanish speakers were asked to listen to the sentence and to click on the object named in the sentence as soon as the name was identified. Although English does not instantiate grammatical gender assignment and agreement, past research suggests that at near-native levels of L2 proficiency, speakers of languages without grammatical gender can successfully use the grammatical gender marked on prenominal modifiers to anticipate an upcoming noun (Dussias et al., 2013: Hopp, 2013). The anticipatory gender effect is further predicted to be modulated by speed of lexical access. Thus, cognate status of the noun may modulate the gender anticipatory effect such that the gender effect may emerge or be stronger for cognate words than for non-cognate words. Spanish-monolingual participants are expected to use gender marking on articles to anticipate upcoming nouns in contexts in which two-pictured objects belong to different gender classes (Dahan, Swingley, Tanenhaus, & Magnuson, 2000; Lew-Williams & Fernald, 2007). This group, however, should not be sensitive to modulations of the cognate status of words.

Method

Participants

Twenty-three Spanish monolingual participants (12 female) were recruited from a Spanish university. All participants reported being functionally monolingual, with no experience studying any other languages. Eighteen adult L1 English learners of Spanish (9 female) recruited from advanced undergraduate Spanish courses at a large North American university, and who had advanced-low proficiency in Span-

ish, also participated in the study. As a measure of proficiency in Spanish, the participants completed a subsection of a standardized Spanish grammar test, the *Diploma de Español como Lengua Extranjera* (Diploma of Spanish as a Foreign Language, DELE). The test is administered by the Ministry of Education, Culture, and Sport of Spain (http://diplomas.cervantes.es/en) for L2 Spanish speakers. The shortened version of the Superior Level C2 – the highest level of accreditation – consisting of a cloze test (20 questions), a vocabulary test (10 questions), and a grammar test (20 questions), was administered to participants. All questions were multiple choice. The learners of Spanish scored significantly lower ($M = 32$, SD = 7.0) than the monolingual group ($M = 42$, SD = 4.7) on the DELE ($t(28.409) = 5.504$, $p < 0.001$).

Additionally, participants were administered a picture naming task that included the pictured objects from Experiment 1 and Experiment 2 ($N = 107$), alongside filler items ($N = 101$) Participants were asked to name the images, and accuracy of responses to the items used in the eye-tracking experiments was tabulated. This was done to ensure that the participants were familiar with the names of the objects in the eye-tracking experiments.[1] Results showed no significant difference between the monolingual ($M = 82\%$ correct, SD = 3.8%) and bilingual groups ($M = 78\%$ correct, SD = 9.5%) on accuracy ($t(29.148) = 0.758$, $p = 0.45$). While the results of the DELE showed that the proficiency level of the bilingual participants was lower than that of the monolingual group, the results of the picture naming task demonstrated that the bilingual group did not have any difficulty completing the picture naming task.

Materials and design

Eighty images were selected, half with feminine gender and half with masculine gender (the corresponding words can be found in Appendix A). Within each gender class, the noun objects were further split between cognate and non-cognate target nouns. All words had transparent gender marking and were controlled for lexical frequency. Words were matched in pairs based on frequency (e.g., a high frequency word was presented alongside another high frequency word, and a low frequency word was presented with a word of similar frequency). As discussed earlier, cognates have a distinct processing advantage over non-cognates in the bilingual lexicon. Consequently, cognates were paired with other cognates, and non-cognates were paired together. Items presented throughout the experiment were paired together taking into account the word onset (i.e. no two items had the same initial syllable) and the complexity of the image that the word represented. For example, a picture featuring a highly imageable, concrete, and familiar

1. Latency data was not collected during the picture naming task

object was paired with an image of equal imageability, concreteness, and familiarity. EsPal (Duchon, Perea, Sebastián-Galles, Martí, & Carreiras, 2013) was used to obtain imageability, concreteness, and familiarity ratings for the pictures used.

Each participant saw 40 pairs of images in which one image was the target noun named in the auditorily-presented sentence and the other image was a distractor. Images were counterbalanced across participants for target image versus distractor image. The 40 image pair trials were randomized. In order to assess naming agreement of the pictures, prior to administering the picture naming task described in the *Participant* section, the pictures used in the experiment were normed by ten individuals who did not participate in the experiment. Only pictures in which there was 100% naming agreement were selected. Given that readers of left-to-right languages show a bias to view the left side of the screen before viewing the right side, the presentation side of target items was counterbalanced such that each target appeared on the left and on the right side of the screen.

The conditions for the pairs are illustrated in Table 1. There were two 'same' conditions – where the gender assigned to the items was not informative because both nouns had the same grammatical gender (Conditions 1 and 2) – and two 'different' conditions, where the gender assigned to the items was informative because each noun had different grammatical gender (Conditions 3 and 4). Of these, half of the conditions contained non-cognate pairs (Conditions 1 and 3) and the other half contained cognate pairs (Conditions 2 and 4).

Table 1. Experiment 2 same and different gender conditions

Condition	Gender	Cognate status	Target example	Distractor example
1	Same	Noncognate	*cereza* FEM 'cherry'	*mochila* FEM 'backpack"
2	Same	Cognate	*cono* MASC 'cone'	*micrófono* MASC 'microphone'
3	Different	Noncognate	*mesa* FEM 'table'	*libro* MASC 'book
4	Different	Cognate	*aluminio* MASC 'aluminum'	*guitarra* FEM 'guitar'

During the experiment, participants heard a sentence (*Encuentra el/la* _____/'Find the$_{MASC}$/the$_{FEM}$ _____') that instructed them to find a picture on a computer screen. Target sentences were split into two parts (the preamble '*Encuentra el/la*' and the noun), and each was recorded separately to prevent effects of co-articulation, which have been shown to impact eye movements (Dahan, Magnuson, Tanenhaus & Hogan, 2001). The sentences were recorded 3–5 times at a comfortable speaking rate by a female native speaker of Peninsular Spanish who was a trained linguist. Recordings were done in a sound-attenuated chamber with a Shure SM57 microphone on a Marantz Solid State Recorder

PMD670 at a sampling rate of 44.1 kHz. The sentences were produced using standard intonation (i.e., no narrow focus or other emphasis was produced on the target noun). A trained lab phonologist then selected one of the samples for subsequent use as the final experimental item and hand-edited each acoustic wave in order to produce a uniform duration of 147 ms ± 3 ms for the determiner (*el* or *la*) preceding the critical Spanish noun in each sentence. The determiner duration was selected by averaging the duration of the determiners produced by the speaker in the selected experimental sentence recording. This allowed for a natural-sounding set of experimental sentences, while at the same time tightly controlling for the duration of the determiner, which carried the first crucial auditory information containing Spanish grammatical gender.

Procedure

After providing their consent, participants completed the picture naming task, followed by the eye-tracking experiment. Participants' eye movements were recorded using an Eyelink 1000 eye tracker manufactured by SR Research. Viewing was binocular, and eye movements were recorded from the right eye only. Stimuli were presented on a color 17-in. ViewSonic 17PS monitor. Participants were seated 70 cm from the monitor, and rested their chins on a chin rest. To begin the experiment, participants completed a 9-point calibration, and the experiment proceeded if the average error was below 0.5 degrees. Subsequently, participants were asked to look at a fixation point at the center of the monitor; this action initiated the trial. Two images were displayed on the computer screen for 500ms before a Spanish sentence was played through the speakers. The images remained on the screen for the duration of the trial. Participants were instructed to quickly click on the image mentioned in the sentence. After the selection, the display disappeared. Eye movements were time-locked to the speech signal as participants continued with the task. Each participant completed 6 practice trials and 40 experimental trials. After completing the eye-tracking experiment, participants completed the DELE grammar test.

Results

We were interested in both the overall looks to target items and the time course of how looks to the target item change; thus, we analyzed the data along two dimensions. First, we conducted a Gender Matching (same gender, different gender) x Form (cognate, non-cognate) repeated-measures ANOVA on the overall difference of looks to the target item minus the distractor item (target advantage) within the time window of 250 ms to 500 ms post-article onset. We identified this time window based on the overall time course graphs demonstrated in Figures 1–2. In order to determine when looks to the target item were significantly

favored over the distractor item, we also employed a time course analysis (following Hopp, 2013 and Valdés Kroff, Dussias, Gerfen, Perrotti, & Bajo, 2017). In the time course analysis, paired t-tests were conducted on the target advantage measure in 50ms time regions from article onset to 900ms. Our main interest was identifying the first time-window in which participants show significantly greater looks to the target items and which sustain these significantly greater looks to the target for the remainder of the time course. Research has shown that native Spanish speakers and proficient English-Spanish bilinguals (see Dussias et al., 2013) can use grammatical gender information in spoken word cues to facilitate processing, so the different gender trials, where the gender of the article is informative in target noun identification, should result in significant looks to the target in earlier time regions than the same gender trials. The minimum latency to plan and launch a saccade has been estimated to be approximately 200 ms (e.g., Saslow, 1967). Thus, approximately 200 ms after target onset is the earliest point at which one expects to see fixations driven by acoustic information from the target word. Visually, we plotted the time-course of proportion of fixations towards target items, following Lew-Williams and Fernald (2007, 2010). Figures 1 and 2 plot the time course of the difference in the proportion of looks to the target item minus the distractor item. Additionally, we plot as a visual aid the first time-window in which there are significantly greater and sustained looks to the target item for each condition.

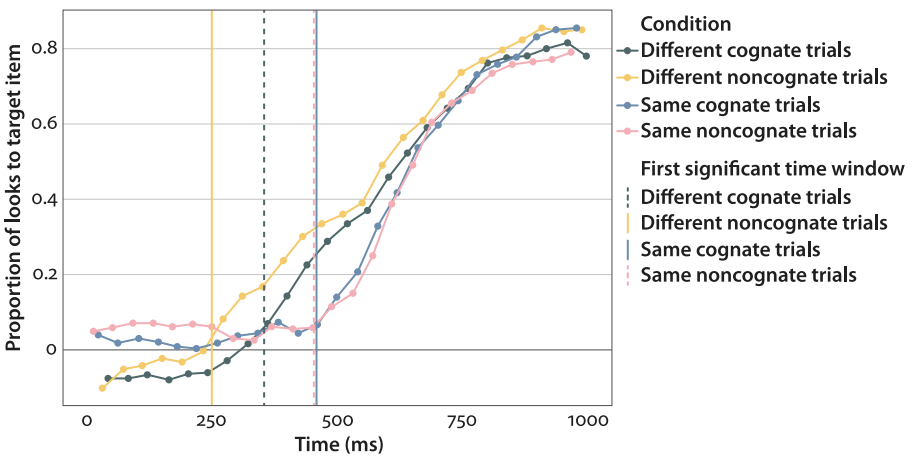

Figure 1. Monolingual group – Proportion of fixations to target items over time for same gender and different gender, noncognate and cognate trials

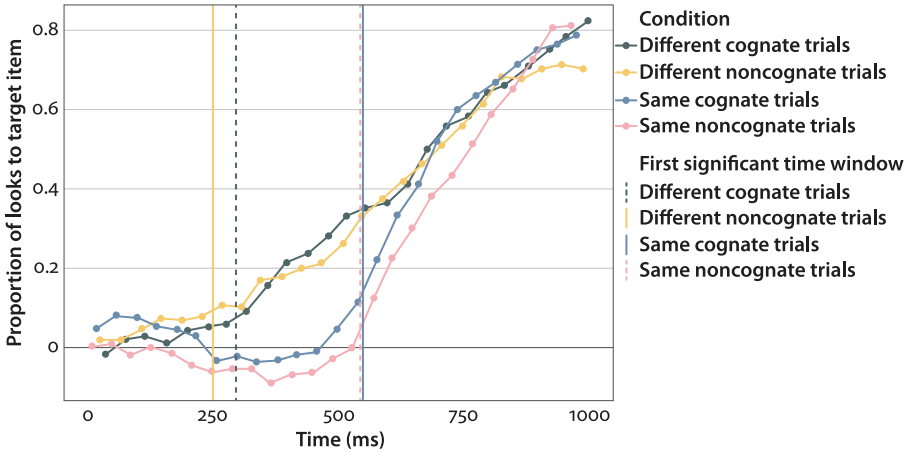

Figure 2. Bilingual group – Proportion of fixations to target items over time for same gender and different gender, noncognate and cognate trials

Monolingual Spanish speakers

Repeated-measures ANOVA

The model revealed a main effect for Gender Matching ($F(1, 22) = 7.822$, $p = 0.011$, $\eta_p{}^2 = 0.056$) and no main effect for Form ($F(1, 22) = 1.385$, $p = 0.252$, $\eta_p{}^2 = 0.014$) or interaction between the two factors ($F(1, 22) = 1.213$, $p = 0.283$, $\eta_p{}^2 = 0.014$). Within the time window of 250 ms and 500 ms post-article onset, different gender trials had an overall higher target advantage ($M = 0.109$, SD = 0.383) than same gender trials ($M = 0.096$, SD = 0.374).

Time course analysis

For same-gender trials, participants showed continued significant looks to the target beginning at the 450ms region for the non-cognate items ($t(114) = 2.401$, $p = 0.017$) and at the 450ms time region for cognate items ($t(114) = 2.978$, $p = 0.004$). When the gender information on the article was informative (i.e., in different gender trials), participants showed continued significant looks to the target beginning at the 250ms time region for non-cognate items ($t(114) = 2.710$, $p = 0.008$) and at the 350ms time region for cognate items ($t(114) = 2.673$, $p = 0.009$). This suggests that Spanish monolinguals use the gender information encoded in the article to facilitate the processing of the upcoming noun in different gender trials, regardless of the cognate status of the noun.

While this group is clearly using the gender on the article in informative contexts to facilitate processing, they appear to be slower with the cognate nouns

(significance at 350ms window) than with non-cognate nouns (significance at 250ms window). We take up this issue in the discussion.

English-Spanish speakers

Repeated-measures ANOVA

As was the case for Spanish monolinguals, the English-Spanish bilinguals exhibited a main effect for Gender Matching (F1,17 = 13.185, $p = 0.002$, $\eta_p{}^2 = 0.148$); there was neither a main effect for Form ($F(1,17) = 0.222$, $p = 0.644$, $\eta_p{}^2 = 0.001$) nor an interaction between the two factors ($F(1,17) = 0.044$, $p = 0.836$, $\eta_p{}^2 < 0.001$). As before, the bilinguals exhibited a greater and positive target advantage for different gender trials ($M = 0.089$, SD = 0.393) compared to same gender trials ($M = 0.022$, SD = 0.392).

Time course analysis

In the same-gender trials, the bilingual group showed continued significant looks to the target beginning at the 550ms region for non-cognates ($t(89) = 3.158$, $p = 0.002$) and at the 550ms time region for cognates ($t(89) = 4.270$, $p < 0.001$). In different-gender trials, the bilingual participants demonstrate a similar behavior to the native speakers and showed continued significant looks to the target beginning at the 250ms time region for non-cognate items ($t(89) = 2.039$, $p = 0.044$) and at the 300ms time region for cognate items ($t(89) = 2.226$, $p = 0.029$). In this experiment, the bilingual group responded to the trials with a similar time course as the monolingual group. The bilinguals were able to successfully use the gender information on the article to reliably facilitate the processing of the upcoming noun, whether that noun was a cognate or non-cognate.

The findings in Experiment 1 replicate previous work indicating that monolingual Spanish speakers use grammatical gender information on prenominal modifiers to facilitate the processing of the upcoming noun (Lew-Williams & Fernald, 2007; Dussias et al., 2013). Further, bilingual speakers were able to perform like monolingual speakers when processing determiner phrases with informative gender marking on articles. Unexpectedly, the bilinguals made no distinction between cognate and non-cognate items and processed both types of words with equal speed and success.

Experiment 2: Processing transparently marked grammatical gender

Results from the first experiment confirm that monolingual and L2 speakers of Spanish use grammatical gender embedded in the definite article to facilitate processing of following nouns, and that cognate status did not modulate the effect. Because a large body of literature suggests that cognate words should facilitate processing in bilinguals (see Sherkina-Leiber, 2004; Costa et al., 2000; Hoshino and Kroll, 2008), the lack of an advantage for cognates relative to non-cognates was unexpected. In Experiment 2, we examine whether transparent gender marking on the noun provides a processing advantage.

Method

Participants

A new group of sixteen English-Spanish bilinguals (7 females) and the same monolingual participants who completed Experiment 1, were recruited for Experiment 2. The participants completed the DELE and the picture naming tasks described in Experiment 1. DELE scores for the monolingual group ($M = 42$, $SD = 4.7$) were significantly higher than the scores for the bilingual group ($M = 28$, $SD = 5.7$; $t(26.064) = 8.293$, $p < 0.001$). Importantly, however, the bilinguals in Experiment 2 did not differ significantly from the monolingual group in the picture naming task (Bilinguals: $M = 76\%$ correct, $SD = 9.3\%$; Monolinguals: $M = 82\%$ correct, $SD = 3.8\%$; $t(19.73) = 1.793$, $p = 0.09$), and were closely matched to the bilingual group in Experiment 1 both in the DELE ($t(30.984) = 1.836$, $p = 0.08$) and the picture naming task ($t(26.715) = 1.061$, $p = 0.298$).

Materials and design

Ninety-six nouns representing highly familiar picturable objects, half with feminine gender and half with masculine, were selected (the words can be found in Appendix B). Half of the nouns had transparent gender (i.e., words ending in *-a* for feminine and *-o* for masculine) and the other half were non-transparent (words ended in *-e* or a consonant). All words were non-cognates and were controlled for lexical frequency. As in Experiment 1, words were matched in pairs based on frequency: a high frequency word was presented with another high frequency word, and a low frequency word was presented alongside a word of similar frequency. Items presented throughout the experiment were paired together, taking into account the word onset and the complexity of the image that the word represented, following the same procedure described in Experiment 1. Each participant saw 48 pairs of images in which one image was the target noun named

in the auditorily-presented sentence and the other image was a distractor. Images were counterbalanced across participants for target image versus distractor image. The pictures used in this experiment were previously normed for naming agreement in the same way as Experiment 1. The 48 image pair trials were randomized, and the presentation side of target items was counterbalanced such that each target appeared on the left and on the right side of the screen.

There were two 'same' conditions where both images shared the same grammatical gender (conditions 1 and 2) and two 'different' conditions where the gender assigned to the items was informative because the nouns had different grammatical gender (conditions 3 and 4). Of these, half the conditions used nouns marked with non-transparent gender (conditions 1 and 3) and the other half contained pairs with transparent gender (conditions 2 and 4). A sample item is given in Table 2:

Table 2. Experiment 2 same and different gender conditions

Condition	Gender	Transparency	Target example	Distractor example
1	Same	Nontransparent	*peine* MASC 'comb'	*lápiz* MASC 'pencil"
2	Same	Transparent	*cocina* FEM 'kitchen'	*iglesia* FEM 'church'
3	Different	Nontransparent	*leche* FEM 'milk'	*árbol* MASC 'tree'
4	Different	Transparent	*loro* MASC 'parrot'	*langosta* FEM 'lobster'

The carrier phrase used to introduce the nouns was the same employed in Experiment 1 (*Encuentra el/la* _____/ Find the _____); recordings of the nouns were created using the same equipment, speaker, and procedure described in Experiment 1.

Procedure

The procedure was the same as described in Experiment 1. Each participant completed 6 practice trials and 48 experimental trials.

Results

The same analysis described in Experiment 1 was used to analyze the data in Experiment 2. A 2 x 2 repeated-measures ANOVA was conducted with the within-subjects factors of Gender Matching (different gender, same gender) and Form (transparent, non-transparent). Additionally, time course analyses that included paired t-tests in 50ms time windows were conducted to determine the time course with which participants exhibited looks to the target items.

Monolingual Spanish speakers

Repeated-measures ANOVA

For the time window of 250 ms to 500 ms post-article onset, the repeated-measures ANOVA revealed a main effect of Gender Matching ($F(1, 22) = 10.784$, $p = 0.003$, $\eta_p^2 = 0.156$) and no main effect of Form ($F(1, 22) = 1.668$, $p = 0.21$, $\eta_p^2 = 0.011$) or the interaction between the two factors ($F(1, 22) = 0.109$, $p = 0.744$, $\eta_p^2 < 0.001$). As in the first experiment, monolinguals demonstrated overall greater and positive target advantages in different gender trials ($M = 0.188$, SD = 0.043) compared to same gender trials ($M = -0.012$, SD = 0.025).

Time course analysis

For same gender trials, participants showed continued significant looks to the target beginning at the 500ms region for the non-transparent items ($t(114) = 2.557$, $p = 0.012$) and at the 450ms time region for transparent items ($t(114) = 2.129$, $p = 0.035$). In contrast, for different gender trials – in which the target and distractor had different grammatical gender and the article in the auditory cue was informative – participants showed continued significant looks to the target beginning at the 200ms time region for non-transparent items ($t(114) = 2.320$, $p = 0.0221$) and at the 250ms time region for transparent items ($t(114) = 2.198$, $p = 0.0299$). Spanish monolinguals used the gender marked on the article to facilitate the processing of the upcoming noun when the speech cue was informative in different gender trials, regardless of the transparency status of grammatical gender marking on the noun.

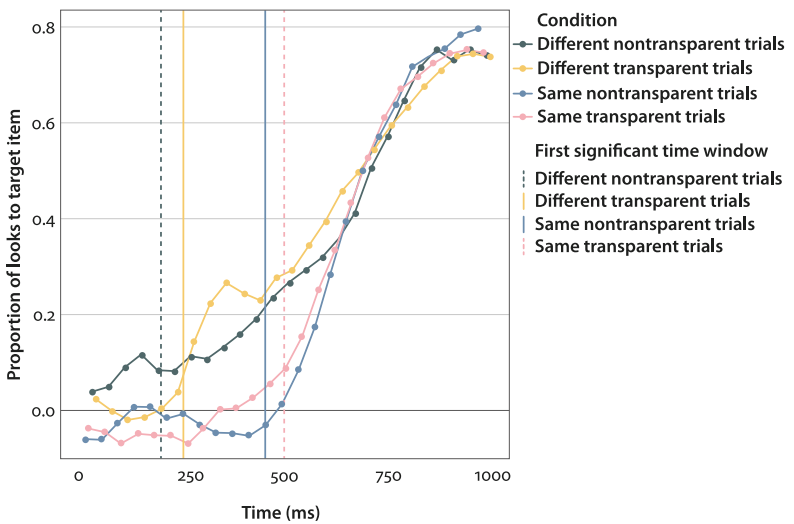

Figure 3. Monolingual group – Proportion of fixations to target items over time for same gender and different gender, nontransparent and transparent trials.

English-Spanish speakers

Repeated-measures ANOVA

In contrast to the monolingual speakers and to the bilinguals' performance in Experiment 1, the repeated-measures ANOVA revealed a significant interaction between Gender Matching and Form ($F(1,14) = 10.027$, $p = 0.007$, $\eta_p{}^2 = 0.137$) and no main effects (Gender Matching, $F(1,14) = 1.154$, $p = 0.301$, $\eta_p{}^2 = 0.015$; Form, $F(1,14) = 0.125$, $p = 0.729$, $\eta_p{}^2 = 0.003$). To further investigate this interaction, we conducted pairwise comparisons using Tukey's HSD. The target advantage measure was significantly different for the contrast between different and same gender transparent trials (mean difference = 0.172, $z = 3.935$, $p < 0.001$). However, there was no significant difference in overall target advantage measure between same and different gender non-transparent trials (mean difference = 0.091, $z = 1.446$, $p = 0.432$).

Time course analysis

Turning to the bilingual group's performance in same gender trials, participants showed continued significant looks to the target beginning at the 600ms region for the non-transparent items ($t(74) = 5.915$, $p < 0.001$) and at the 550ms time region for transparent items ($t(74) = 3.671$, $p < 0.001$). For the bilingual group in different gender trials, participants did not show continued significant looks to the target until the 550ms time region for non-transparent items ($t(74) = 2.438$, $p = 0.017$), the same as their performance on same gender trials. Conversely, participants were able to make continued, significant looks at the target beginning at the 300ms time region for transparent items ($t(74) = 2.229$, $p = 0.0288$).

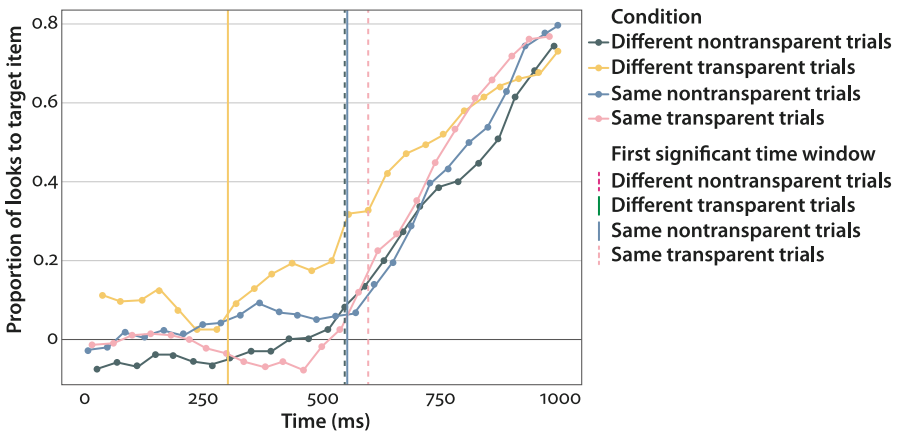

Figure 4. Bilingual group – Proportion of fixations to target items over time for same gender and different gender, nontransparent and transparent trials

In sum, the monolingual speakers were able to use grammatical gender information encoded in the article to facilitate the processing of nouns in informative contexts. The bilingual group showed a similar time course for grammatical gender processing, but only when the target item had transparent gender. Like the monolingual group, the bilingual group showed looks to the target in later time regions in same-gender trials. Unlike the monolingual group, the bilingual group could not successfully use the information encoded on the article to facilitate processing in non-transparent gender trials. However, with transparent gender nouns, the bilingual speakers were able to fixate on the target items at an early time region, much like the monolingual speakers.

Discussion

In this study, two variables were examined, the cognate status of words and the transparency of word-final gender markings, to ask whether nonnative speakers of Spanish can use grammatical gender information encoded in prenominal modifiers to facilitate processing of ensuing nouns. The monolingual Spanish speakers showed an anticipatory effect on different gender trials, demonstrating that they were able to use grammatical gender information present in articles predictively. This finding was consistent across the two experiments. One unexpected result was that monolinguals took longer to process cognate words than non-cognate words. If the processing advantage reported for cognates is a result of the cross-language activation between the bilinguals' two languages, monolinguals should show neither an advantage nor a disadvantage when processing cognate words. One possible explanation for the unexpected result is that the cognates used in Experiment 1 differed from the non-cognates with respect to lexical properties. To examine this possibility, we conducted a post-hoc analysis to determine whether word length differences between cognates and non-cognates could account for the unexpected findings. The analysis showed that cognate words were significantly longer in number of syllables than the non-cognates ($t(39) = 20.95$, $p < 0.001$). Perhaps processing the entire auditory stimuli took longer for the cognates, accounting for the difference between cognate and non-cognate items. This point remains a limitation of the present study.

Results for the L1 English-L2 Spanish learners suggest that they were able to use gender information to facilitate processing, but only when the nouns had gender endings that were transparent. Cognate status did not confer an advantage during grammatical gender processing. Why might this be? One reason could be that the phonological overlap of the cognates in the two languages was not sufficient to confer a processing advantage when participants heard the words in

the spoken instructions, even though the presence of the pictures representing the cognate words might have activated shared orthography in the two languages. Some indirect support for this comes from a study by Schwartz et al. (2007), who found that the time to name cognates in each of the bilinguals' two languages was affected by the phonological similarity of the cognate's translation in the other language. When cognate words had similar phonology in the two languages ('piano' in Spanish and English), naming latencies were faster than when the cross-language phonology was distinct ('base' is pronounced /beɪs/ in English and /base/ in Spanish). When the same words were presented to a group of monolingual English speakers, none of these differences emerged. This demonstrates that the facilitatory effects associated with cognate words between the bilingual's two languages can be reduced when there is not a consistent mapping across all codes.

The lack of interactivity between the bilingual's two languages concerning grammatical gender in cognate words provides some support for the view that grammatical gender information is language-specific in bilinguals, a theoretical stance that finds some support in past literature. For example, Kousta, Vinson, and Vigliocco (2008) found that monolingual Italian speakers produced more gender-preserving semantic substitution errors (saying "eye" instead of "ear") than monolingual English speakers. Critically, Italian-English bilinguals demonstrated language-specific grammatical-gender behaviors, suggesting that some aspects of the representation of words in the bilingual lexicon, such as grammatical gender, are intra-linguistic and, hence, not referential (Paradis, 1997). Similarly, in a series of experiments involving naming pictures in the L2 whose corresponding translations in the L1 had same or different grammatical gender, Costa, Kovacic, Franck, and Caramazza (2003) found that the gender value of the words in the non-response language did not affect processing in the response language (but see Bordag & Pechmann, 2007; Kaushanskaya & Smith, 2016; Lemhöfer, Spalek, & Schriefers, 2008; Paolieri et al., 2010). Although our study was not designed to adjudicate between competing proposals about the interactivity of grammatical gender information in a bilingual's two languages, our results – although rather tentative at this point – are congenial with the view that automatic activation of L2 grammatical gender information is not instantiated during the processing of cognate words. One aspect that makes this theoretical interpretation of our results tentative, however, is that both the cognate and non-cognate words used in Experiment 1 carried transparent gender markings, and we know from the results of Experiment 2 that gender transparency is linked to facilitation. Hence, it could be that the presence of transparent gender in the stimuli blurred the contribution of cognate status.

The finding that transparent gender facilitated processing in L2 learners is predicted by models that propose the presence of multiple routes for accessing

grammatical gender. In one such model, Gollan and Frost (2001) propose two routes to grammatical gender. The first route – known as the form-based route – is said to derive gender from the availability of cues to gender marking at the level of the word form. Transparent noun-ending markings such as *-a* and *-o* in Spanish would be one example of this. The second mechanism is a lexical-based route in which grammatical gender is a lexical feature abstractly represented in the mental lexicon. There is some recent ERP evidence by Caffarra and colleagues (e.g., Cafarra et al., 2014) suggesting that information derived from strong correlations between the gender of a noun and its form (as would be the case with transparent gender nouns) is activated as early as 350ms after stimulus onset. It is quite possible, then, that the early activation of gender information through the form route in nouns with transparent gender, coupled with converging gender class information that becomes activated through the lexical route, impacted early access to gender information, allowing participants to use the grammatical gender information in the articles to facilitate noun processing.

The finding that transparent gender facilitated processing is consistent with proposals that transparent nouns are more easily integrated into the grammatical gender system than non-transparent nouns (Hopp, 2017). We discussed earlier that Spanish has a gender marking system that is phonologically (and orthographically) highly transparent, and that the vast majority of Spanish nouns end either in "-a" (for feminine) or "-o" (for masculine). The results from Experiment 2 indicate that this feature of lexical gender in Spanish has an additive effect, allowing L2 speakers of Spanish to anticipate which noun from the visual scene will be mentioned, by taking direction from the gender marking in the preceding article. One interesting feature of our results is that this was possible despite the fact that the L1 of the bilingual speakers did not support between-language gender correspondences. Past studies have reported that lexical incongruency in grammatical gender assignment between the L1 and the L2 interfere with predictive processing in a second language (e.g., Morales, Paolieri, Dussias, Valdés Kroff, & Gerfen, 2015). Given this, one might have expected that the native English speakers would not have been able to employ gender information in Spanish articles predictively because their L1 does not instantiate this particular type of predictive processing. However, research investigating other types of lexically-encoded information (e.g., *verb bias* or the likelihood that a verb immediately preceding noun phrase is followed by a particular type of complement) has shown that even when the L1 does not encourage the use of lexically-encoded information to anticipate upcoming material, if proficiency in the L2 is high enough, L2 speakers perform similarly to native speakers of the target language (e.g., Lee, Lu, & Garnsey, 2013). In our study, the native English speakers were advanced speakers in their L2, Spanish, which allowed them to optimally combine gender information

in Spanish articles and Spanish nouns, in spite of the fact that English lacks grammatical gender. Whether the same result would be obtained in lower proficiency L2 speakers could clarify if it is the lack of grammatical gender features in English that facilitate learning in the L2, or whether proficiency is the critical variable.

In summary, this study provides insight into the gender processing abilities in L2 speakers of Spanish. First, like native speakers, proficient L1 English-L2 Spanish speakers demonstrated that they could use gender information encoded in the definite article to facilitate the processing of upcoming nouns. Second, both cognates and non-cognates were processed with similar ease when word-final gender marking was transparent. Finally, L2 speakers show predictive gender processing, but only when nouns carried transparent gender. The findings contribute to the better understanding of gender processing in L2 speakers whose L1 does not instantiate grammatical gender.

Acknowledgments

This research was supported in part by NSF Grant BCS-1535124, NSF Grant OISE-1545900, NIH Grant HD082796, and NIH Grant HDO71758 to Paola Dussias. Lauren Halberstadt was supported with funding from NSF OISE-0968369, and Jorge Valdés Kroff was supported by a Rothman Faculty Summer Fellowship through the Center for Humanities and the Public Sphere at the University of Florida.

References

Allopenna, P. D., Magnuson, J. S., & Tanenhaus, M. K. (1998). Tracking the time course of spoken word recognition using eye movements: Evidence for continuous mapping models. *Journal of Memory and Language*, 38, 419–439. https://doi.org/10.1006/jmla.1997.2558

Altmann, G. T. M. (2011). Language can mediate eye movement control within 100 milliseconds, regardless of whether there is anything to move the eyes to. *Acta Psychologica*, 137, 190–200. https://doi.org/10.1016/j.actpsy.2010.09.009

Arnon, I., & Ramscar, M. (2012). Granularity and the acquisition of grammatical gender: How order-of-acquisition affects what gets learned. *Cognition*, 122, 292–305. https://doi.org/10.1016/j.cognition.2011.10.009

Bordag, D., & Pechmann, T. (2007). Factors influencing L2 gender processing. *Bilingualism: Language and Cognition*, 10, 299–314. https://doi.org/10.1017/S1366728907003082

Caffarra, S., Janssen, N., & Barber, H. A. (2014). Two sides of gender: ERP evidence for the presence of two routes during gender agreement processing. *Neuropsychologia*, 63, 124–134. https://doi.org/10.1016/j.neuropsychologia.2014.08.016

Cooper, R. M. (1974). The control of eye fixation by the meaning of spoken language: A new methodology for the real-time investigation of speech perception, memory, and language processing. *Cognitive Psychology*, 6, 84–107. https://doi.org/10.1016/0010-0285(74)90005-X

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

Costa, A., Caramazza, A., & Sebastian-Galles, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1283–1296.

Costa, A., Kovacic, D., Frank, J., & Caramazza, A. (2003). On the autonomy of the grammatical gender systems of the two languages of a bilingual. *Bilingualism: Language and Cognition*, 6, 181–200. https://doi.org/10.1017/S1366728903001123

Dahan, D., Swingley, D., Tanenhaus, M. K., & Magnuson, J. S. (2000). Linguistic gender and spoken-word recognition in French. *Journal of Memory and Language*, 42, 465–480. https://doi.org/10.1006/jmla.1999.2688

De Groot, A. M. B. & Nas, G. L. J. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language*, 30(1), 90–123. https://doi.org/10.1016/0749-596X(91)90012-9

Duchon, A., Perea, M., Sebastián-Galles, N., Martí, A., & Carreiras, M. (2013). EsPal: One-stop shopping for Spanish Word properties. *Behavior Research Methods*, 45, 1246–1258. https://doi.org/10.3758/s1342801303261

Dussias, P. E., Valdés Kroff, J. R., Guzzardo Tamargo, R. E., & Gerfen, C. (2013). When gender and looking go hand in hand. *Studies in Second Language Acquisition*, 35, 353–387. https://doi.org/10.1017/S0272263112000915

Forster, K. I., & Chambers, S. M. (1973). Lexical access in naming time. *Journal of Verbal Learning and Verbal Behavior*, 12, 627–635. https://doi.org/10.1016/S0022-5371(73)80042-8

Gillon Dowens, M., Vergara, M., Barber, H. A., & Carreiras, M. (2009). Morphosyntactic processing in late second-language learners. *Journal of Cognitive Neuroscience*, 22, 1870–1887. https://doi.org/10.1162/jocn.2009.21304

Gollan, T. H. & Frost, R. (2001). Two routes to grammatical gender: Evidence from Hebrew. *Journal of Psycholinguistic Research*, 30(6), 627–651. https://doi.org/10.1023/A:1014235223566

Gordon, B. (1983). Lexical access and lexical decision: Mechanisms of frequency sensitivity. *Journal of Verbal Learning and Verbal Behavior*, 22, 24–44. https://doi.org/10.1016/S0022-5371(83)80004-8

Griebling McCowen, L., & Alvord, S. M. (2006). Mi mamá es bonito: Acquisition of Spanish gender by native English speakers. In C. A. Klee & T. L. Face (Eds.), *Selected Proceedings of the 7th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages* (pp. 161–169). Somerville, MA: Cascadilla Proceedings Project.

Grüter, T., Lew-Williams, C., & Fernald, A. (2012). Grammatical gender in L2: A production or a real-time processing problem. *Second Language Research*, 28, 191–215. https://doi.org/10.1177/0267658312437990

Hernandez, A. E., Kotz, S. A., Hofmann, J., Valentin, V. V., Dapretto, M., & Bookheimer, S. Y. (2004). The neural correlates of grammatical gender decisions in Spanish. *NeuroReport*, 15, 863–866. https://doi.org/10.1097/00001756-200404090-00026

Hockett, C. F. (1958). *A course in modern linguistics*. New York, NY: Macmillan.

Hopp, H. (2013). Grammatical gender in adult L2 acquisition: Relations between lexical and syntactic variability. *Second Language Research*, 29, 33–56. https://doi.org/10.1177/0267658312461803

Hopp, H. (2017). Cross-linguistic lexical and syntactic co-activation in L2 sentence processing. *Linguistic Approaches to Bilingualism*, 7(1), 96–130.

Hoshino, N., & Kroll, J. F. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition*, 106, 501–511. https://doi.org/10.1016/j.cognition.2007.02.001

Kaushanskaya, M., & Smith, S. (2016). Do grammatical-gender distinctions learned in the second language influence native-language lexical processing? *International Journal of Bilingualism*, 20, 30–39. https://doi.org/10.1177/1367006915576830

Kousta, S. T., Vinson, D. P., Vigliocco, G. (2008). Investigating linguistic relativity through bilingualism: The case of grammatical gender. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34, 843–858

Lee, E., Lu, D., & Garnsey, S. (2013). L1 word order and sensitivity to verb bias in L2 processing. *Bilingualism: Language and Cognition*, 16, 761–775. https://doi.org/10.1017/S1366728912000776

Lemhöfer, K., Spalek, K., & Schriefers, H. (2008). Cross-language effects of grammatical gender in bilingual word recognition and production. *Journal of Memory and Language*, 59, 312–330. https://doi.org/10.1016/j.jml.2008.06.005

Libben, M. R. & Titone, D. A. (2009). Bilingual lexical access in context: Evidence from eye movements during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35(2), 381–390.

Lew-Williams, C., & Fernald, A. (2007). Young children learning Spanish make rapid use of grammatical gender in spoken word recognition. *Psychological Science*, 18, 193–198. https://doi.org/10.1111/j.1467-9280.2007.01871.x

Lew-Williams, C., & Fernald, A. (2010). Real-time processing of gender marked articles by native and non-native Spanish speakers. *Journal of Memory and Language*, 63, 447–464. https://doi.org/10.1016/j.jml.2010.07.003

MacDonald, M. C. (1993). The interaction of lexical and syntactic ambiguity. *Journal of Memory and Language*, 32, 692–715. https://doi.org/10.1006/jmla.1993.1035

MacDonald, M. C. (2013). How language production shapes language form and comprehension. *Frontiers in Psychology*, 4, 1–16. https://doi.org/10.3389/fpsyg.2013.00226

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. *Psychological Review*, 101(4), 676–703. https://doi.org/10.1037/0033-295X.101.4.676

Montrul, S., & Potowski, K. (2007). Command of gender agreement in school-age Spanish-English bilingual children. *International Journal of Bilingualism*, 11, 301–328. https://doi.org/10.1177/13670069070110030301

Morales, L., Paolieri, D., Dussias, P. E., Valdés Kroff, J. R., Gerfen, C., & Bajo, M. T. (2015). The gender congruency effect during bilingual spoken-word recognition. *Bilingualism: Language and Cognition*, 19, 294–310. https://doi.org/10.1017/S1366728915000176

Paolieri, D., Cubelli, R., Macizo, P., Bajo, T., Lotto, L., & Job, R. (2010). Grammatical gender processing in Italian and Spanish bilinguals. *The Quarterly Journal of Experimental Psychology*, 63, 1631–1645. https://doi.org/10.1080/17470210903511210

Paradis, M. (1997). The cognitive neuropsychology of bilingualism. In A. M. B. de Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 331–354). Mahwah, NJ: Lawrence Erlbaum Associates.

Pérez-Pereira, M. (1991). The acquisition of gender: What Spanish children tell us. *Child Language*, 18, 571–590. https://doi.org/10.1017/S0305000900011259

Sabourin, L., Stowe, L. A., & de Haan, G. J. (2006). Transfer effect in learning a second language grammatical gender system. *Second Language Research*, 22, 1–29. https://doi.org/10.1191/0267658306sr2590a

Sabourin, L., & Stowe, L. A. (2008). Second language processing: When are first and second languages processed similarly? *Second Language Research*, 24, 397–430. https://doi.org/10.1177/0267658308090186

Sanchez-Casas, R. M., Davis, C. W., & Garcia-Albea, J. E. (1992). Bilingual lexical processing: Exploring the cognate/non-cognate distinction. *European Journal of Cognitive Psychology*, 4(4), 293–310. https://doi.org/10.1080/09541449208406189

Saslow, M. G. (1967). Latency for Saccadic Eye Movement. *Journal of the Optical Society of America*, 57, 1030–1033. https://doi.org/10.1364/JOSA.57.001030

Schilling, H. E. H., Rayner, K., & Chumbley, J. I. (1998). Comparing naming, lexical decision, and eye fixation times: Word frequency effects and individual differences. *Memory & Cognition*, 26, 1270–1281. https://doi.org/10.3758/BF03201199

Schwartz, A. I. & Kroll, J. F. (2006). Bilingual lexical activation in sentence context. *Journal of Memory and Language*, 55(2), 197–212. https://doi.org/10.1016/j.jml.2006.03.004

Schwartz, A. I., Kroll, J. F., & Diaz, M. (2007). Reading words in Spanish and English: Mapping orthography to phonology in two languages. *Language and Cognitive Processes*, 22(1), 106–129.

Sherkina-Leiber, M. (2004). The cognate facilitation effect in bilingual speech processing: The case of Russian-English bilingualism. *Cahiers linguistiques d'Ottawa*, 32, 108–121.

Valdés Kroff, J. R., Dussias, P. E., Gerfen, C., Perrotti, L., & Bajo, M. T. (2017). Experience with code-switching modulates the use of grammatical gender during sentence processing. *Linguistic Approaches to Bilingualism*, 7, 163–198. https://doi.org/10.1075/lab.15010.val

Van Assche, E., Duyck, W., Hartsuiker, R. J., & Diependaele, K. (2009). Does bilingualism change native-language reading? Cognate effects in a sentence context. *Psychological Science*, 20(8), 923–927. https://doi.org/10.1111/j.1467-9280.2009.02389.x

Van Hell, J. G. & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin & Review*, 9, 780–789. https://doi.org/10.3758/BF03196335

White, L., Valenzuela, E., Kozlowska-McGregor, M., & Leung, Y. I. (2004). Gender and number agreement in nonnative Spanish. *Applied Psycholinguistics*, 25, 105–133. https://doi.org/10.1017/S0142716404001067

Ziegler, J. C., Perry, C., & Coltheart, M. (2003). Speed of lexical and nonlexical processing in French: The case of the regularity effect. *Psychonomic Bulleting & Review*, 10, 947–953. https://doi.org/10.3758/BF03196556

Appendix A. Experiment 1 materials

acuario
aeropuerto
aguja
alfombra
almohada
aluminio
ambulancia
anillo
atomo
banana
barba
basura
bata
bicicleta
blusa
bolsa
bomba
bota
brazo
búfalo
burro
caballo
cabaña
cadena
calculadora
calendario
cama
cámara
camello
campana
canguro
carpintero
carta
castillo
cebra
cepillo
cerdo
cerveza
chaqueta
cigarrillo
circo
cocina
cocodrilo
cola
computadora
cono
cortina
cuaderno
cuadro
cucaracha
cuchillo
cuna
diccionario
dinamita
dinosaurio
disco
domino
edificio
ensalada
escritorio
espejo
estadio
estéreo
estomago
fruta
fuego
gato
globo
gorila
guitarra
hamaca
helado
helicóptero
hipopótamo
hoja
hueso
huevo
iglesia
insecto
jirafa
ladrillo
lago
lampara
langosta
lata
libro
llave
luna
mantequilla
manzana
mariposa
medalla
microfono
microscopio
mono
monstruo
montaña
motocicleta
ojo
oso
pájaro
palmera
paloma
panda
panuelo
pasta
patata
pavo
pera
periodico
perla
perro
piano
pierna
pinguino
pipa
pirata
pizza
planta queso
rosa
regalo
rueda
semáforo
servilleta
sombrero
tarántula
tarjeta
taza
teléfono
telescopio
templo
toalla
toro
tortuga
trompeta
tumba
una
vaca
vela
vestido
vino
zanahoria
zapato

Appendix B. Experiment 2 materials

aceite	cuadro	leche	ratón
aguja	cuchillo	lengua	red
ajo	cuna	limón	regalo
árbol	dedo	llave	reloj
avión	diamante	loro	rueda
bandeja	espejo	luz	sal
barba	faro	maquillaje	sartén
barril	flor	miel	semáforo
basura	fogata	mono	señal
bolsa	frente	nariz	sol
botón	galleta	nido	tarjeta
burro	gato	nieve	taza
cadena	gente	nube	teclado
café	hoja	nuez	televisión
calabaza	hueso	pájaro	tenedor
calle	iglesia	pañuelo	tetera
cangrejo	impresora	papel	tigre
cárcel	jabón	pato	tiza
carne	jamón	pavo	toro
cerveza	jardín	peine	torre
cinturón	jaula	periódico	vaca
ciudad	ladrillo	pie	vela
cocina	langosta	piel	vestido
corazón	lápiz	pirámide	zanahoria
cruz	lata	puente	
cuaderno	lazo	queso	

Address for correspondence

Lauren Halberstadt
The Pennsylvania State University
407 Boucke Building
University Park, PA 16802
USA

lyp5028@psu.edu

Co-author information

Jorge R. Valdés Kroff
University of Florida
Department of Spanish and Portuguese Studies
jvaldeskroff@ufl.edu

Paola E. Dussias
The Pennsylvania State University
Department of Spanish, Italian, and Portuguese
pdussias@psu.edu