Research on early grammatical gender processing: what do we know about Spanish-speaking children?*

Abstract: Over the past several decades, there has been an increase of psycholinguistic research on how grammatical gender information is processed in brains of both monolingual and bilingual speakers. Research on grammatical gender processing with Spanish-speaking adults have shown that transparent grammatical gender marking facilitates noun recognition, whereas opaque word-ending has the opposite effect. This paper provides a review of recent research on how Spanish-speaking toddlers process grammatical gender and make use of it in object recognition process. It is reported that Spanish children are sensitive to so called distributional co-occurrences of gender, i.e., gender information containing in the determiners and adjectives.

Keywords: language acquisition; language processing; grammatical gender acquisition; gender cues; Spanish

La investigación sobre el procesamiento temprano del género gramatical: ¿qué sabemos sobre los niños hispanohablantes?

Resumen: En las últimas décadas ha habido un incremento de investigaciones psicolingüísticas centradas en el procesamiento del género gramatical en los celebros de hablantes monolingües y bilingües. Los estudios con adultos nativos de español han demostrado que la marcación transparente del género gramatical facilita el reconocimiento

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de sustantivos, mientras que las terminaciones opacas tienen el efecto contrario. El presente artículo pretende proponer una revisión de estudios recientes que han investigado cómo los niños hispanohablantes procesan el género gramatical y lo utilizan en el reconocimiento de los objetos. Según los resultados, los niños hispanohablantes muestran sensibilidad a lo que se le llama "co-ocurrencias distribucionales de género", es decir, la información sobre el género gramatical que se contiene en los determinantes y artículos.

Palabras clave: adquisición del lenguaje; procesamiento del lenguaje; adquisición de género gramatical; claves del género; español

1. INTRODUCTION

In many languages of the world, all nouns are grouped into gender categories (Corbett, 1991). Languages are said to have grammatical gender if there is an agreement between the nouns and other associated words (Corbett, 1991; Aronoff & Fudeman, 2005). The agreement affects determiners (articles and adjectives), as shown in examples (1a) and (1b) from Portuguese, or past verbal forms, as exemplified in (2a) and (2b) from Russian[1].

1. a. *um-Ø* *gat-o* *pret-o.*
   a-INDEF-M cat-M black-M
   'a black he-cat'

   b. *um-a* *gat-a* *pret-a.*
   a-INDEF-F cat-F black-F
   'a black she-cat'

[1]The following abbreviations are used in the glosses: Ø: consonant ending, indef.: indefinite, pastimp: past imperfective, M: masculine, F: feminine.

2. a.

мальчик	лежал	и	смотрел
mal'čik	*ležal-Ø*	*i*	*smotrel- Ø*
boy	lie-PASTIMP-M	and	watch-PASTIMP-M

‘a boy was lying and watching’

b.

девочка	лежал-а	и	смотрел-а.
devočka	*ležal-a*	*i*	*smotrel-a*
girl	lie-PASTIMP-F	and	watch-PASTIMP-F

‘a girl was lying and watching’

According to the World Atlas of Language Structures (WALS) (Corbett, 2013a), although grammatical gender is a common characteristic of a number of Indo-European languages, it is absent in others. The number of languages presented in WALS is 257, approximately a half of them do not have gender system. 20% of them present double-way gender system, approximately 10% have three genders or 5 gender classes, and only 5% have four genders systems. Gender systems vary crosslinguistically as well. Some of them are sex-based, i.e., biological sex distinction is the base for gender assignment, whereas others are based on the animacy feature (Corbett, 2013b).

On this basis, toddlers acquiring a gendered language (e.g., Spanish) have to extract information from the input in order to find out how to assign grammatical gender to all the nouns they learn. This, in turn, is essential to be able to establish an agreement between nouns and other parts of the sentence and subsequently convey correctly any message.

In this paper, we will primarily focus on reviewing research on early grammatical gender processing in Spanish-speaking children. In the following section 1.1, we present an overview of grammatical gender system in Spanish, as well as what cues help native speakers to predict grammatical gender and to assign it to new words. Section 2 briefly describes gender processing studies in Spanish-speaking adults. In Section 3, we review studies on early gender processing in Spanish-speaking toddlers, as well as provide evidence from

longitudinal and empirical studies. Finally, in Section 4, conclusion remarks are made, and future research directions are proposed.

1.1. On grammatical gender in Spanish

Spanish belongs to the group of languages with two-ways gender system. All Spanish nouns are either masculine or feminine (Harris, 1991). Animate nouns (those that denote people and animals) are classified on the basis of the referent' biological sex. Therefore, nouns like *tío/tía* 'uncle/aunt' or *gato/gata* 'cat-M/F' would belong to masculine or feminine groups as their referents are either males or females. As for inanimate nouns, although classification is reported to be arbitrary, morphophonological characteristics of the nouns help to indicate their gender.

Generally, inanimate nouns ending in –o (e.g., *verano* 'summer-M') are masculine, whereas those ending in –a (e.g., *ventana* 'window-F) are feminine (Harris, 1991). These nouns are considered to be phonologically marked or transparent. Nouns that end in a consonant or –e or other vowels are called opaque, as they may either be masculine (e.g., *puente* 'brigde-M', *sillón* 'arm-chair-M) or feminine (e.g., *fuente* 'fountain-F', *razón* 'reason-F'). Apart from opaque nouns, there are quite a lot of exceptions in "masculine-o / feminine-a" rule, for example, the noun *mano* 'hand', although being feminine, ends in –o. Some studies also explored the frequencies of specific endings and the associated gender. For instance, Bull (1965) concluded that nouns ending in *–l, -r, -n* and *–s* would be masculine in 96% of cases, whereas those ending in *–d, -ción, -sis* or *–it* is would be feminine in 98%. So, although phonological regularities are useful to determine grammatical gender of a noun, they are not 100% reliable (Arias-Trejo, Falcón & Alva, 2013).

Gender requires agreement between a noun and its determiners. In Spanish, both indefinite and definite articles precede the noun whereas the adjectives normally follow it. Thus, nouns preceded by the definite article "*la*" or by the indefinite article "*una*" are feminine, whereas nouns preceded by the definite article "*el*" or by the indefinite article "*un*" are masculine. As previously suggested by Arias-Trejo *et al.* (2013), for feminine nouns the combination of gender-marked determiner "*la*" or "*una*" and ending –a would act as an accelerator to access the grammatical gender information. Apart from that, for opaque nouns such as *balón* 'ball', the preceding article in some cases can be the only gender information available: *el balón* 'the-M ball'. However, extracting gender information only from the determiner can also cause some agreement mistakes. When the beginning of a Spanish feminine noun is a stressed /a/, definite determiner "*la*" and determiners ending in –a (*una* 'a-F', *alguna* 'some-F', *ninguna* 'none-F') have to be changed to masculine form in order to avoid pronouncing double /a/. A study by Eddington and Hualde (2008) reported that native speakers are sometimes confused by this variation and make mistakes in preceding prenominal modifiers, for instance, *mucho hambre* 'much-M hunger-F' instead of *mucha hambre* 'much-F hunger-F'.

To conclude, in Spanish there are three possible indicators that help to extract gender information: i) syntactic, coming from the gender agreement between a noun and its determiner, ii) phonological, embedded in the ending of a noun, iii) semantic, revealed from the referent's biological sex (Pérez-Pereira, 1991). As previously suggested, grammatical gender cannot be reliably retrieved from a single source of information. Sometimes no cues help to extract gender at all, for instance, *dos árboles verdes* 'two green trees' is masculine noun phrase, whereas *dos calles grandes* 'two big streets' is a feminine one. Then possibly, as also reported in previous studies, gender information is more easily retrieved and

processed when several cues are available (Pérez-Pereira, 1991, Arias-Trejo *et al*., 2013). As Grüter, Lew-Williams and Fernald (2012: 193) suggest, "the only consistent and fully reliable cue to noun's gender class is distributional, consisting of its co-occurrence relations with transparently gender-marked modifiers, such as determiners and (attributive and predicative) adjectives".

2. GENDER PROCESSING STUDIES IN ADULTS

Grammatical gender processing has recently received quite a lot of attention from psycholinguistic research. Generally, the discussion is centred around the issue of how the linguistic system determines the gender of a noun. One group of researchers (Levelt, Roelofs & Meyer, 1999; Miozzo & Caramazza, 1997) claim that gender information is retrieved via lexical route. According to this view, native speakers store nouns associated with a gender in their mental lexicon. Thus, when a speaker needs to access gender information, e.g., in sentence comprehension, gender is extracted via lexical activation. Nonetheless, as seen in Section 1.1., Spanish gender has a strong correlation with formal features of the nouns. Due to this reason, some authors argue that the cognitive system takes advantage of this source of information (Caffarra & Barber, 2015). This idea is in line with Gollan and Frost's hypothesis (2001). According to this view, apart from lexical route of gender retrieval, there is a second route, based on the formal features of the words. Thus, the gender of two Spanish words, e.g., *ventana* 'window-F' and *sartén* 'frying pan-F', can be extracted in two different ways. In case of *ventana* 'window-F', a gender-marked ending is available, so the system can either extract gender accessing lexical information (lexical route) or it can take advantage of the

feminine ending *-a* (form-based route). However, in case of *sartén* only lexical route of gender retrieval is available.

EEG studies with Spanish speakers found evidence for two routes to gender (Caffarra, Janssen & Barber, 2014; Caffarra & Barber 2015). Caffarra *et al.* (2014) investigated gender agreement processing using a grammaticality judgement task. In this study, the authors used Spanish article-noun pairs which either agreed or did not agree in gender, e.g., *el queso* 'the-M cheese-M' or *la queso* 'the.F cheese-M' in transparent condition and *el reloj* 'the-M watch-M' or *la reloj* 'the.F watch-M' for opaque condition. The results revealed that transparent and opaque nouns are processed differently, as different ERP signals emerged. They have also found a higher accuracy for transparent nouns than for opaque ones, which leads to the conclusion that the gender transparency facilitates nouns recognition. Similar results were obtained in a study with Portuguese-speaking adults. It is claimed that gender violations are more easily detected between a transparent noun and a determiner rather than between an opaque noun and its determiner (Alencar de Resende, Mota & Seuren, 2018). As previous studies were conducted on isolated word or word pair, Caffarra and Barber (2015) went even further and tested the system's sensitivity to gender formal cues in sentence comprehension. The findings suggest that the system can detect formal cues to gender at early stage, thus, as authors claim, this is probably a part of the word recognition process. Both outcomes are in line with behavioural studies conducted with Italian speakers (Bates, Devescovi, Pizzamiglio, D'amico & Hernández, 1995; Bates, Devescovi, Hernández & Pizzamiglio, 1996; Caffarra, Siyanova-Chanturia, Perciarelli, Vespignani & Cacciari, 2015).

In conclusion, studies mentioned above have provided evidence that native speakers of Spanish are sensitive to gender information embedded in the formal features of nouns,

specifically, -o/-a endings. The results also report that transparent and opaque nouns are processed differently supporting the theory of two routes of gender processing.

3. EARLY GENDER PROCESSING STUDIES

Generally, research on gender acquisition has questioned whether children begin assigning gender using grammar (morphosyntactic cues) or do they pay attention to extralinguistic information (biological sex). Evidence from longitudinal and experimental studies focused on gender acquisition reports that gender is acquired early, at approximately 3-4 years of age (Hernández-Pina, 1984; López-Ornat, Fernández, Gallo & Mariscal, 1994; Pérez-Pereira, 1991). In fact, biological sex distinction between males and females (e.g., *niño / niña* 'boy / girl') appears before the second birthday (Hernández-Pina, 1984). Psycholinguistic research provides convincing evidence that Spanish-speaking children make use of morphosyntactic cues to assign gender to novel nouns. Interestingly, semantic cue does not seem to be used as a potential source of gender information by children (Pérez-Pereira, 1991).

In the previous section we have mentioned some studies on gender processing in adults. However, how do children access and retrieve gender information? From previous research with French and Dutch learners, it is known that children who acquire French (25-month-old) were able to retrieve gender information from the determiners in an object recognition task (Van Heugten & Shi, 2009). Essentially, children identify the object more efficiently when presented with two objects of different gender. However, in a similar task, Dutch learners did not recognise target nouns more efficiently (Van Heugten & Johnson, 2011). These results, as stated by Arias-Trejo *et al.* (2013), may be explained by the transparency of the system: in Dutch there are two determiners (common and neuter) for

three genders (masculine, feminine and neuter), whereas in French there are two determiners for two genders. Considering Spanish has a transparent gender system, a prediction to be made is that children would be able to retrieve gender and use this information in object recognition task.

Research focused on early gender processing by Spanish-speaking children is not numerous. To our knowledge, up to date, three studies have been carried out and published. Lew-Williams and Fernald (2007) conducted a research with 34-42-month-old Spanish toddlers. Children were tested in an eye-tracking procedure. They were presented with pair of pictures of either the same (*la pelota* 'the-F ball-F', *la galleta* 'the-F cookie-F) or different grammatical gender (*la pelota* 'the-F ball-F', *el zapato* 'the-M shoe-M') (see Figure 1). At the same time, children heard an audio stimulus that made reference to one of these pictures, for example, *encuentra la galleta* 'find the cookie'.

FIGURE 1. Examples of visual stimuli used in Lew-Williams and Fernald's experiment (2007). Two upper objects are same-gender items, whereas lower objects are different-gender items

Figure 2 shows the time course of finding the target-object for adults and toddlers. These results suggest that, although children were less fast and less accurate than adults, both

groups of the participants responded faster on different-gender trials than on same-gender trials. Specifically, 2-3-year-old Spanish learners can identify familiar nouns 90 ms faster (after the task onset) when a determiner gives them a cue about grammatical gender of the referent.

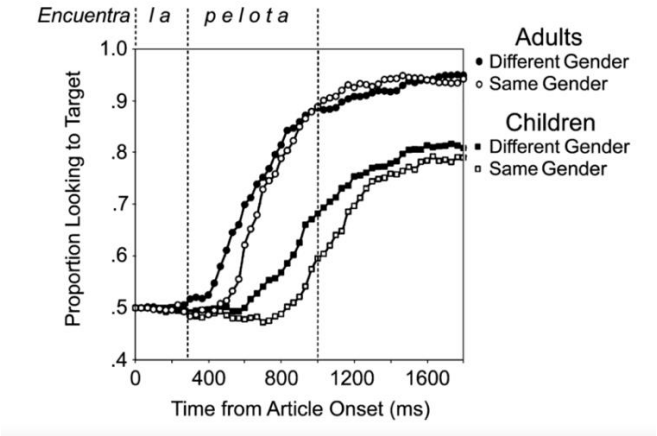

FIGURE 2. The time course of children's and adults' looking to same-gender or different gender items in Lew-Williams & Fernald (2007)

From a critical perspective, this research has two mayor shortcomings. The authors did not use opaque nouns in their experiment. Hence, it remains unknown whether children are able to process gender of these words. As a result, this study does not provide any evidence on the facilitation effect of transparent nouns, as was reported for adults (Caffarra, Janssen & Barber, 2014). The second limitations of this study is that only familiar words were used, so we cannot know how children extract gender information of previously unknown nouns.

The pilot study by Lew-Williams and Fernald (2007) was then extended by Arias-Trejo *et al.* (2013). Specifically, they tested children on whether they would be able to use determiners with non-transparent words, so in their research opaque nouns, such as *pie* 'foot', *llave* 'key', *calcetín* 'sock', were included. Participants of this study were grouped according

to their age: 24-month-olds, 30-month-olds, and 36-month-olds. In two experiment, children were presented pairs of familiar objects (a target and a distractor) and heard a feminine or masculine definite or indefinite article. For example, as shown in Figure 3, children saw an apple (*manzana*-F) and a banana (*plátano*-M) and heard "*Mira*" (200 ms after the onset of the visual stimuli), and either *la* or *el* (between 2000 ms and 4000 ms). Finally, from 2000 ms to 4000 ms children heard the target label (e.g., *manzana*).

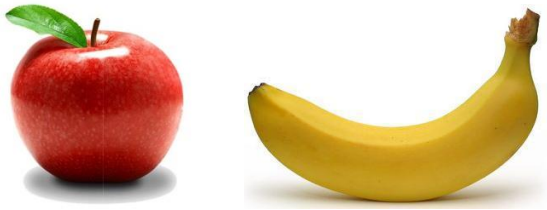

FIGURE 3. Examples of visual stimuli used in Arias-Trejo *et al.* (2013)

The results from both experiments show that toddlers were able to use definite and indefinite articles to find the target object. Interestingly, 24-month-olds used indefinite articles *un* and *una* but not definite *el* and *la*, whereas older toddlers (30 and 36-month-olds) were able to use both types of articles to correctly infer a target. This result suggests that the ability to use indefinite articles emerges earlier than the use of definite articles. The novelty of this work, as previously said, consisted in the fact that researchers included irregular nouns in their experiment. To conclude, this study shows children are sensitive to article-noun consistency. In the beginning, they seem to rely on morphophonological regularities (24-month-olds) but later (approximately at 3 years) toddlers are able to take advantage of syntactic information when the ending of a noun is not available.

The results of this study, particularly the fact that younger toddlers (24-month-olds) were not able to use the definite articles *el* and *la*, may be questioned in light of existing

longitudinal evidence. Hernández-Pina (1984) suggested that, although the indefinite articles are much more frequent in child speech, the definite articles are the first to be acquired. So, future research is needed to prove this point.

Arias-Trejo and Alva (2012) have also revealed that Spanish-speaking toddlers, apart from using gender information embedded in the articles, benefit from the morphological consistency of the adjectives. They tested 30-month-olds via intermodal preferential looking procedure. As Figure 4 shows, two unfamiliar objects were used in the experiment: a diabolo and a fire hydrant. There were eight variants of each imagine: red, yellow, broken, pretty, small, blue, green and big. The first five variants were used during the training, whereas the other three were used during the test. As for the auditory stimuli, the authors used a novel masculine noun *pileco* and a novel feminine noun *betusa.* During the training, toddlers saw eight trials in which both objects (the hydrant and the diabolo) were presented individually, each time, the characteristic of the object changed. For example, for the yellow hydrant toddlers heard "*Mira es amarillo*" 'look, it is yellow' and next time "*Mira es bonito*" 'look, it is pretty'. After training, children were presented two objects simultaneously and heard in a random order "*mira, una betusa*" 'look, a-F betusa' and "*mira, un pileco*" 'look, a-M pileco'.

One half of the toddlers were trained as follows: masculine adjectives for the hydrant and feminine adjectives with the diabolo. Other half of the children were trained with the opposite pattern: masculine adjectives for the diabolo and feminine adjective for the hydrant. Trials lasted 5,000 ms, as shown in Figure 4. The test trials were divided into two phases: a prenaming and postnaming phase. The first phase served to measure a baseline imagine preference, whereas the postnaming served to confirm that toddlers associate a novel noun with the correct object.

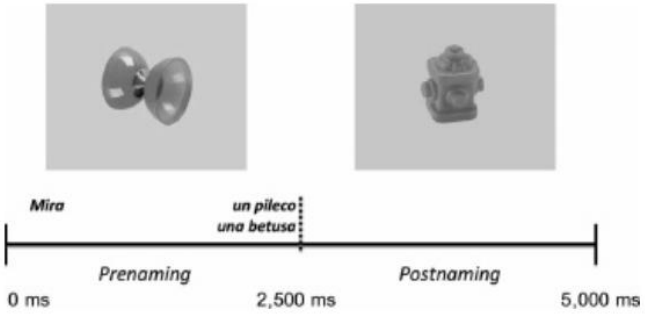

FIGURE 4. Example of test trial used in Arias-Trejo & Alva (2012)

The results of this study revealed that Spanish 30-month-old toddlers were able to identify the appropriate target referent in the test, on the basis of –o/-a pattern established during the training phase for familiar adjectives. Specifically, when children heard adjectives ending in –a, as *amarilla, roja, rota,* they exhibited preference for the target object which was called *betusa.* Whereas the preference to associate the nonce-word *pileco* was observed for the item previously described with masculine adjectives as *amarillo, rojo, roto.* This study has provided evidence that 30-month-old Spanish toddlers can already make use of grammatical gender information stored in adjectives. Another important point researchers make is that children are very sensitive to adult speech. In Spanish, it is very common to replace referent name by a gendered pronoun (e.g., *pásamela* 'pass it.F to me' to refer to a ball (*pelota*)) or to describe an object instead of naming it (e.g., *la blanca* 'the white.F one'). So, as Arias-Trejo and Alva (2012: 6) claim, children are very frequently exposed to sentences like "mira, está rota" 'look, it is broken.F'. Thus, the data provided by this experiment showed that children can bootstrap meanings from the morphological cues provided by adjective. The outcomes of this research, however, need to be replicated with younger Spanish-speaking toddlers in order to see whether there is similar effect on them as

well. In a recent study conducted by Smolík and Bláhová (2018), Czech 21-24-month-old toddlers were tested in a similar paradigm. Czech is a language with rich morphology and no obligatory articles preceding a noun, so the authors used adjectives in the experiment. The results suggest that some children were able to extract gender information from the bound morphemes available in adjective. This leads to the conclusion that even at the two-word combination stage children already have knowledge on basic properties of their native language.

4. Conclusion and future directions

The current paper aimed to review studies focused on early gender processing in Spanish-speaking toddlers. Research with native speakers of Spanish has shown that adults are sensitive to gender cues, specifically the ending of the nouns, which help them to identify gender violations in noun-article agreement (Caffarra *et al.*, 2014) and process gender information within sentence comprehension (Caffarra & Barber, 2015).

Regarding early gender processing, studies with Spanish-speaking toddlers report that children are able to use both articles and adjectives to predict the upcoming nouns in a sentence (Lew-Williams & Fernald, 2007, Arias-Trejo *et al.*, 2013, Arias-Trejo & Alva-Canto, 2012). Moreover, gender regularities seem to help children to learn new nouns through adjectives (Arias-Trejo & Alva-Canto, 2012). Yet, future research is needed to explore other aspects of grammatical gender processing. For example, whether children can learn new words based on article-noun distributional co-occurrences. Another point of interest is when exactly children begin to process transparent and opaque nouns differently,

as reported for adults, or when do they become sensitive to the transparency and opaqueness of the nouns' endings.

Another possible research line is to explore how young children process double gender nouns, such as *astranauta* 'austanaut' or *cantante* 'singer'. This nouns are frequently used in so-called "masculine generic" form. In a recent study by Gygax (2019), French children (3-5-year-old) were tested whether they were affected by masculine generic forms. In an experimental task, children were presented two pairs of pictures (one pair of two boys, another pair of one boy and one girl) and were asked to look at, for example, "nurses". The authors then monitored where the gaze was directed. The results suggest that 3-5-year-old French children have already established masculine generic form for those nouns that are stereotypically associated with males' professions, as children tended to gaze more at boy-boy pair of pictures. When a profession was stereotypically associated with females, children showed gaze preference towards boy-girl pair. Since both French and Spanish are Romance languages, we can predict a similar effect on children.

In sum, the present article reviewed research on early gender processing by Spanish-speaking children. Processing studies are highly relevant for language acquisition research, as they enable to explore comprehension before production is available.

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