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Gender Assignment in Spanish-German Bilinguals: The Gender System and Background Factors

La asignación de género en bilingües español-alemán: El sistema de género y factores de contexto

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Abstract

This paper investigates the development of gender assignment and the role of background factors on gender assignment in Spanish-German bilinguals. While Spanish offers a transparent gender system with little difficulties for children, the German gender system is opaque with few reliable rules. This study investigated 33 simultaneous bilinguals between 5;0 and 8;11 living in Spain and Germany. Results show that Spanish gender seems to undergo an earlier acquisition than German gender. Lexical skills play a bigger role in Spanish gender acquisition than in German and gender accuracy in both languages is differently

affected by factors such as age, balanced bilingualism, country of residence, language proficiency or cognitive variables. This indicates that an opaque system takes more time to be acquired. Also, the idea of a general linguistic capacity is proposed, and further theories derived from the results discussed.

Keywords: gender assignment, Spanish, German, bilingualism, transparent, opaque

Resumen

Este trabajo investiga el desarrollo de la asignación de género y el papel de los factores contextuales en la asignación de género en bilingües español-alemán. Mientras que el español ofrece un sistema de género transparente con pocas dificultades para los niños, el sistema de género alemán es opaco con pocas reglas fiables. Este estudio investigó 33 bilingües simultáneos de entre 5;0 y 8;11 años que viven en España y Alemania. Los resultados muestran que el género español parece tener una adquisición más rápida que el alemán. Las habilidades léxicas desempeñan un papel más importante en la adquisición del género en español que en alemán y la precisión del género en ambos idiomas se ve afectada de forma diferente por factores como la edad, el bilingüismo balanceado, el país de residencia, la competencia lingüística o las variables cognitivas. Esto indica que un sistema opaco tarda más tiempo en adquirirse. Asimismo, se propone la idea de una capacidad lingüística general y se discuten otras teorías derivadas de los resultados.

Palabras clave: asignación de género, español, alemán, bilingüismo, transparente, opaco

1. Introduction

Although bilingual children may show balanced abilities in both languages (Rodina & Westergaard, 2017), they are not two monolinguals in one. Bilingual language development is influenced by the specific combination of languages acquired (e.g., Cummins,

1979; Kaltsa et al., 2019), leading to differences in developmental patterns compared to monolinguals. This complexity hinders generalizations as different language combinations may not behave similarly. Thus, they need investigation to identify potential general patterns.

To establish these patterns, influencing factors of bilingual language development must be examined. While factors such as age of onset (Chondrogianni & Marinis, 2011), frequency of exposure, language use, and quality of input are generally stable in monolinguals (Daskalaki et al., 2020; Schmidtke, 2016), their variability shapes bilinguals' language development uniquely as their effect on each language differs. Therefore, variables known to influence language acquisition, such as age (of acquisition), may not impact bilinguals the same way they affect monolinguals due to interaction effects. For instance, many families use the one language – one parent – approach (OPOL). In this approach, each parent uses their own native language to speak to the child (Palviainen & Boyd, 2013). However, research has shown that fathers and mothers differ in their communication and interaction with the child, causing unique reactions and interference with the child´s development (e.g. Feldman, 2015; Leech et al., 2013; Tamis-LeMonda et al, 2004). Additionally, young children rely heavily on the input from family members, educators and close friends, as they mainly interact with them (Blewitt et al., 2018). Bilingual children, therefore, might receive a certain type of input only in a certain language, which could alter their acquisitional process.

Given the unique challenges bilingualism entails, gender assignment (GA) provides an interesting area to study its effects on language acquisition. Research, among other questions, seeks to answer if it is acquired by lexical learning (e.g. Hohlfeld, 2006; Roelofs, 1992) or through rule-based learning (e.g. Unsworth, 2013) and has identified key factors influencing it, including aspects related to language exposure (frequency), such as both parents' language profile, country of residence (CoR) or richness of language experience (e.g. Janssen, 2014; Kaltsa et al., 2019; Rodina & Westergaard, 2017). Linguistic abilities like reading abilities, grammatical gender, general

linguistic abilities or balanced bilingualism influence gender assignment, as well as personal factors like socioeconomic background or age (e.g., Balam et al., 2021; Duff et al., 2015). However, their exact effects are still under discussion as discrepancies have risen, sometimes even for monolinguals. For instance, German monolinguals have been shown to assign gender with an accuracy over 90% - a threshold often used to declare completed acquisition (Motsch & Rietz, 2019) – at 3 to 4 years (e.g. Ruberg, 2013) or significantly later, at 7 or 8 years (Ulrich, 2017). For Spanish, however, no such discussion exists, as children are normally found to perform over the 90% threshold before the age of six (e.g. Perona Jara, 2016).
Another example of a still discussed variable is exposure, which has sometimes been identified as essential (e.g., Arnaus Gil & Jiménez Gaspar, 2022; de Houwer, 2007). However, in other investigations its influence was limited (e.g., Kaltsa et al., 2019). Similarly, the impact of age (e.g., Rodina & Westergaard, 2017) and school environment (e.g., Balam et al., 2021; Gathercole & Thomas, 2009) has also yielded inconsistent results.

In addition to these factors, the influence of cognitive variables, such as auditory attention, phonological awareness, and inhibitory control, is also discussed. Some studies report an advantage for bilinguals over monolinguals in improved linguistic performance (e.g., Aguilar-Mediavilla et al., 2019; Crivello et al., 2016; Müller et al., 1997), but not consistently (e.g., Poarch & Krott, 2019; Ware et al., 2020). Inconsistent results for some factors influencing gender assignment indicate the need to further investigate their role in bilingual language acquisition.

Another factor is the transparency of gender systems, analysed for monolinguals (Rodina & Westergaard, 2013) and bilinguals (e.g. Kupisch et al., 2002). It is a grammatical feature that plays an important part, e.g., in morphosyntax and refers to the fact of how predictable a certain grammatical property – in this case, gender – is based on the morphophonological shape of a word. A (gender) system can therefore be classified as "transparent" (e.g. Russian) if the morphophonological shape of a word does not lead to ambiguity and clarifies the grammatical gender reliably. An "opaque" gender system

(e.g. Norwegian), on the other hand, does not always allow connecting the shape of a word to its gender (Rodina & Westergaard, 2017). This makes it harder to acquire and therefore, in investigations, a special interest has been put on bilinguals acquiring a transparent and an opaque gender system, e.g. to examine the possibility of cross-linguistic influence or to compare the speed of acquisition (e.g., Fhlannchadha & Hickey, 2017 for English-Irish; Kupisch et al., 2002 for Russian-German; Unsworth et al., 2014 for Greek-Dutch). This paper extends this approach to the almost unexplored combination of the Spanish (transparent) and German (opaque) gender systems, distinguishing between a mainly rule-based, reliable system (Spanish) and an unreliable one, based on tendencies and regularities (German). Two previous papers examined gender assignment in this language combination: Kuchenbrandt (2008) compared three monolinguals to three Spanish-German speaking children aged 2-4, at a stage where gender is supposed to be phonologically lead (Mariscal, 2009). Both groups showed similar abilities and higher accuracy rates in Spanish than in German. In the second paper, Eichler et al. (2012) investigated two Spanish-German bilinguals and two German monolinguals, aged 1;5 to 4 years. Their findings aligned with Kuchenbrandt (2008), showing German gender was more difficult to acquire than Spanish. They also analysed balanced bilingualism, defined as similar abilities in both languages and established through MLU, and its effect on gender assignment. Children with unbalanced bilingualism sometimes showed higher gender accuracy than those with balanced bilingualism, possibly due to a reduced vocabulary size dominated by high-frequency words.

Studies investigating gender assignment in language development for opaque and transparent gender systems cover various language combinations, including Spanish-English (Balam et al., 2021), French-Swedish (Granfeldt, 2018), Greek-Albanian/Greek-English (Kaltsa et al. 2017), Greek-German/Greek-English (Kaltsa et al. 2019), German-Russian (Kupisch et al., 2022), and Russian-Norwegian (Rodina & Westergaard, 2013, 2017). Despite limitations on generalization, results align with findings by Eichler et al. (2012) and Kuchenbrandt (2008) for Spanish-German bilinguals: Little or no

difference with monolinguals, neuter being most problematic, bilinguals defaulting to masculine, development of gender systems boosted if both acquired languages contain grammatical gender, and transparent language learned more easily and accurately than opaque language (e.g., Granfeldt, 2018; Kupisch et al., 2022).

1.1. Gender in Spanish

Spanish uses a two-gender-system with a masculine and a feminine gender. Gender is marked in singular and plural through articles, though some consider it a morphological feature marked by suffixes on nouns (e.g., Calvo, 1979). The default gender is masculine. It is used in contexts of mixed natural gender, such as groups of males and females (Beatty-Martínez & Dussias, 2019). However, feminine gender is typically easier to detect as its form is more regular. Feminine words normally end in *-a*, making them easily recognizable. It is their most common ending, even though there are other options such as *-e* [*la frente* (forehead), *la superficie* (surface)], *-l* [*la sal* (salt)] or *-d* [*la bondad* (kindness)] (Beatty-Martínez & Dussias, 2019). Corresponding definite articles are *la* (sg.) and *las* (pl.) and the indefinite ones, *una* (sg.) and *unas* (pl.). However, there are exceptions to this rule: Words beginning with a stressed *-a*, e.g., *agua* (water) or *harpa* (harp), use the masculine article for phonological reasons (Beatty-Martínez & Dussias, 2019). However, their gender remains feminine, as can be seen when adding adjectives as in (1):

(1) El agua bendita
The.masc water holy – femin
"The holy water"

Using a masculine adjective would result in an incorrect phrase (2):

(2) * El agua bendito
The.masc water holy – masc.
"The holy water"

As another exception, words ending in *-ema*, e.g., *problema* (problem), or *sistema* (system), default to the masculine due to their nature as Greek loanwords, which are masculine in their majority (De la Cruz Cabanillas et al., 2007).

On the other hand, masculine nouns show greater inconsistency as the feminine ones which tend to end in *-a*. Though they often end in *-o*, other endings such as *-e* or consonants like *-n* or *-l* are also very common (Beatty -Martínez & Dussias, 2019; Harris, 1991). Their articles are *el* (sg.) y *los* (pl.) and *uno* (sg.) y *unos* (pl.). Exceptions are words like *la mano* (hand) or *el mapa* (map) which maintain the original Latin gender.

1.2. Gender in German

Unlike Spanish, German uses a three-gender-system comprising masculine, feminine and neuter. Gender is marked not only on articles, but also on adjectives, determiners, and pronouns (Szagun et al., 2007), adding to the complexity of the system. Besides number, also marked on Spanish articles, German marks case on articles, increasing the derivational forms present in the paradigm. Additionally, forms are usually ambiguous and phonologically similar (Table 1), making distinguishing them challenging, especially for children.

Table 1. *Definite/indefinite article paradigm for German.*

	male	**female**	**neuter**	**plural**
Nominative	der/ein	die/eine	das/ein	die/-
Genitive	des/eines	der/einer	des/eines	der/-
Dative	dem/einem	der/einer	dem/einem	den*/-
Accusative	den/einen	die/eine	das/ein	die/-

In the plural, all three genders use the same forms as gender is not marked in plural. In all but one case (* in Table 1) – the dative – this form corresponds to the feminine singular article forms. There are no plural forms for indefinite articles.

Challenges are created not only by the amount and similarity of existing articles, but also by gender assignment itself. German, unlike Spanish, lacks gender assignment rules. However, the system is not arbitrary (Eichler et al., 2012) but comprises natural gender rules and regularities of semantic, morphological, or phonological nature. For a detailed discussion, consult Duden (1995) or Köpcke and Zubin (1984).

These regularities mostly enclose small groups of nouns and relate to probabilities or tendencies of gender assignment, e.g., weather phenomena falling from the sky (rain, fog) use masculine or words ending in *-e* use feminine. Semantic rules typically apply to small groups of words, but more consistently. Phonological rules target larger groups with lower accuracy. However, some morphological regularities are consistently met: Certain suffixes indicate specific genders, e.g., *-heit*, *-keit* or *-ung* for feminine, *-en* or *-er* for masculine, and *-chen* and *-lein* for neuter (Szagun et al., 2007).

1.3. The present study

This study investigates how the nature of a gender system – transparent or opaque – and certain background variables regarding input, cognitive ability and child specific variables affect gender acquisition in Spanish-German bilinguals. For this reason, the study addresses the following research questions:

1. Are there quantitative differences in the gender acquisition of a transparent and an opaque gender system?
2. Are there differences in the importance of lexical skills for gender assignment accuracy in Spanish and in German?
3. Which of the background variables or which combination of them can best predict gender assignment accuracy in both languages?

To answer these questions, a group of Spanish-German

bilingual children aged 5;0 to 8;11 was studied, residing either in Spain or in Germany, with one parent speaking the minority language with the child.

This investigation expands on existing literature about Spanish-German bilinguals by offering a different methodological view on older bilinguals. This provides new insights about the performance of this bilingual group at a more developed stage than those analysed previously. The chosen language combination highlights differences between transparent and opaque gender systems. German's opaque system with increased complexity due to more articles and case marking is expected to pose a greater challenge, delaying acquisition and leading to lower accuracy rates compared to Spanish. Because Spanish relies more on rules for gender assignment, a stronger relationship between lexical skills for Spanish than German is expected.

Each background variable is expected to influence gender assignment. Child-specific variables include:

1. Age
2. Balanced bilingualism (BB)
3. The mother's dominant language (DL-M) and the father's dominant language (DL-F)
4. Receptive vocabulary in Spanish (PPVT-S) and in German (PPVT-G)

Input variables include:

1. Frequency of exposure in Spanish (Ex-S) and German (Ex-G)
2. Language use in Spanish (Use-S) and German (Use-G)
3. Country of residence (CoR)

Exposure and language use are presumed to be highly significant predictors but are related to CoR. It determines the majority language, to which exposure is easier as more speakers are available. Nevertheless, minority language speakers can create communities in which members primarily use the minority language.

The cognitive factors studied in this paper include:

1. Inhibitory control (IN)
2. Auditory attention (AA)
3. Phonological awareness (PA)

Inhibitory control is expected to play a key role in gender assignment accuracy due to bilinguals' constant need to inhibit one language (e.g., Jia, 2022; Linck et al, 2008). While inhibitory control may not directly influence gender assignment, it affects the ability to maintain a language in a required context and may indirectly modulate language use frequency. Increased auditory attention and phonological awareness should improve children's ability to capture small differences in articles presented orally.

2. Method

2.1. Participants

The participants in this study were 33 simultaneous bilingual Spanish-German children, aged 5;0 to 8;11 years ($\mu = 6.67$, $SD = 1.18$). 19 were boys and 14 girls, 11 born and living in Spain and 22 in Germany. Country of birth and residence was the same for each case. Bilingualism resulted from having at least one parent speaking the minority language with the child at home. Simultaneous bilingualism was established as all children grew up with both languages present since birth. Children attended kindergarten (18) or primary school (15). In 23 cases, the educational institution was bilingual German - Spanish; in 10 cases, only the residential language – German (7) or Spanish (3) – was spoken. All children were typically developing with no history of speech and/or language disorder. Almost all households (32) had two parents, with at least one having a University degree. All households and educational institutions used a one parent/educator – one language system (Palviainen & Boyd, 2013). In no households was the minority language spoken by both parents. If the child had siblings (31), they showed a preferred language when talking to them, mostly the majority language (23).

Children in Spain were recruited by their paediatrician (4),

educational institution (6) or other participants (1) and tested at homes (7) or educational institutions (4). Children in Germany were recruited by their educational institution (15) or other participants (7) and tested at homes (9) or educational institutions (13).

2.2. Materials and procedure

For this study, two subtests measuring morphosyntactic development from the standardized battery Clinical Evaluation of Language Fundamentals (CELF-5) (Wiig et al., 2013) were used, as it has an adaptation for German and Spanish: "Formulated Sentences" (FS) and "Recalling Sentences" (RS). In FS, the child is given a picture and a clue (one or two words) and asked to formulate a sentence about the picture including the target. In RS, the child is presented with sentences of varying length and difficulty and asked to recall them immediately after oral presentation by the examiner. In both languages, FS asks children for twenty-four sentences. Three clues are nouns without indication of gender. Sentence length varied between children. The production of nouns and GA differed between subjects, but not between languages ($Z = .7$, $p = .506$, $r = .1$) with a range of 3-74 ($\mu = 35.79$, $SD = 19.07$) gender + noun combinations for German and 4-75 for Spanish ($\mu = 36.14$, $SD = 16.69$). In RS, both languages offer twenty-six sentences for recall which include sixty-eight opportunities for GA in German and sixty-seven for Spanish. Total production differed between subjects, but the difference between languages, ranging from 8-67 ($\mu = 38.46$, $SD = 15.61$) for German and 14-67 for Spanish ($\mu = 38.61$, $SD = 15.98$), was not significant ($Z = -1.4$, $p = .162$, $r = -.3$).

All children were tested in individual sessions by two examiners, a native speaker of Spanish or German. The order of language in test sessions varied between children with at least 5 days interval between sessions. To calculate GA accuracy, responses including any type of article were counted. The total number of articles was registered, then the total of GA errors was established. For Spanish, an error included assigning a male article to a female noun and vice versa. For German,

analysis was more complex as articles include information about case assignment. Only gender errors were counted; erroneous case marking with correct gender was counted as correct. For ambiguous cases (e.g., "der" being the nominative for masculine nouns or the dative for feminine nouns), if the sentence could not resolve the ambiguity, the article was counted as correct. The same applied to "die" for feminine singular nouns and plural nouns. As plural is unmarked for gender in German, plural forms were not included. If the sentence could not clarify the intended use, the article was counted as correct.

The CELF-5 determined BB. Children were considered balanced if scores in both languages for the Core Language Score (subtests "Sentence Comprehension", "Word Structure", FS and RS) were similar. A procedure similar to Kaltsa et al. (2017) was applied. As standardized scores for five-year-olds are unavailable in the German CELF version, raw scores were used. These were summed for the four subtests and converted to z-scores. German scores were subtracted from Spanish scores. A result between -0.5 and +0.5 indicated balanced bilingualism. Sixteen cases were balanced. Of seventeen unbalanced children, seven were dominant in Spanish and ten in German.

Cognitive variables data (auditory attention, inhibitory control, phonological awareness) was collected using NEPSY-II subtests (Korkman et al., 1998). For auditory attention, children listened to a 2-minute recording of random words. They touched a red circle when hearing "red". In a second run, more rules were added: touch red for "green", green for "red", blue for "blue", and no action for "black".

The inhibitory control task had two parts using circles/triangles and arrows as stimuli, each with three sections of changing rules. Children named objects/directions, then opposites, and finally opposites for black objects/arrows but correct ones for white ones.

For phonological awareness, children identified pictures corresponding to presented word parts (syllable/sound). Those over six performed syllable and sound switching exercises with orally presented words. Mistakes were counted in all tasks.

The variable receptive vocabulary was measured with the Peabody Picture Vocabulary Test (PPVT), currently in its third version

for German (Dunn et al., 2015a) and its forth for Spanish (Dunn et al., 2015b). The PPVT was administered in individual sessions by a native speaker, with sessions separated by at least 5 days. Children were presented with four pictures and given a word, then had to point to the corresponding picture. Some children older than 5 years named the picture number instead. Words were grouped in sets of 12, with the test ending when more than 8 mistakes were made within a set. The starting set corresponded to the child's age or earlier if needed. The raw score was calculated by subtracting the total mistakes from the number of the last word in the highest set reached, which could be converted into t-scores and IQ-scores (for German) or enneatypes and IQ-scores (for Spanish).

Background variables were collected using the Q-BEx questionnaire (De Cat et al., 2022), administered online to parents in their preferred language. The questionnaire includes questions about language acquisition, exposure, use, and preferred language for each child, family members, and caregivers. Data for age, mother's and father's language dominance, current use, and current exposure were extracted from the Q-BEx. Age refers to the child's biological age at the time of questionnaire administration. Parents were asked about their dominant language, with some being bilingual but speaking only their dominant language with their child. Current use and exposure percentages were calculated by the Q-BEx.

The Ethics Committee for Investigation in Humans of the University of Valencia, Spain approved this procedure, and parents signed informed consent forms.

3. Results

To answer research questions 1 and 3, simple (1) and multiple (3) binary logistic regression using Generalized Estimating Equations (GEE) were performed, as they handle within-subject correlation robustly (Shults et al., 2009). This is ideal for analysing bilingual children's abilities in both languages. GEE also provide valid population inferences (Shults et al., 2009), key for this exploratory study. For research question 2, a Pearson product-moment correlation

was performed.

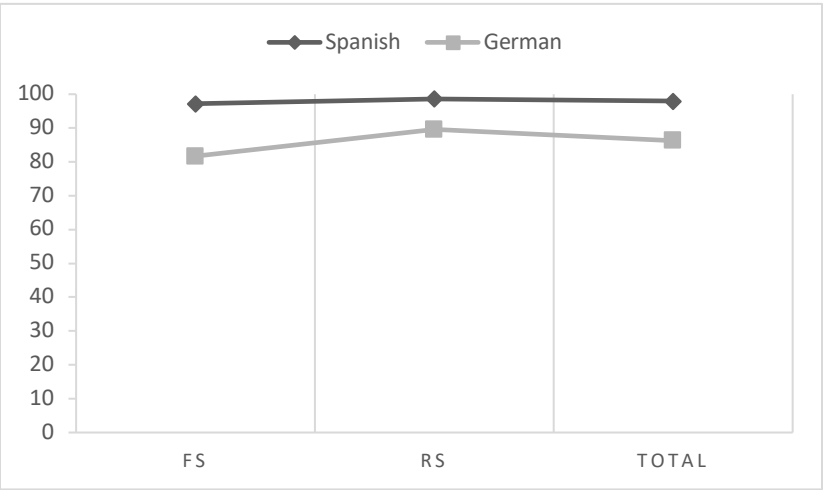
Accuracy in gender assignment

For overall accuracy, including results from FS and RS, 2134 Spanish articles were registered, with 2089 correct (97.9%) and 45 incorrect ones. For German, children produced 2314 articles, with 1998 correct (86.3%) and 316 incorrect ones.

In FS, children produced 1026 Spanish articles, 997 correct (97.2%) and 29 incorrect ones, and in German, 1072 articles, 876 correct (81.7%) and 196 incorrect ones.

In RS, Spanish articles totalled 1108 with 1092 correct (98.6%) and 16 incorrect ones, while German articles totalled 1252, with 1122 correct (89.6%) and 130 incorrect ones. Accuracy rates for all three modalities are shown in Figure 1.

Fig. 1. *Accuracy rates for gender assignment in Spanish and German for total, FS and RS scores.*



To confirm statistical significance of higher Spanish accuracy

rates, binary logistic regressions using GEE were calculated for FS, RS, and total accuracy (Table 2). Children's answers were the binary response variable, with language as the predictor variable. The GEE models used an independent correlation structure to account for repeated language measures.

Table 2. *Simple binary logistic regression using GEE models for total, FS and RS scores.*

Model	OR Spanish	OR German	95% CI	Wald	p
FS	1	0.13	0.05 0.35	16.80	<.001
RS	1	0.13	0.06 0.29	24.67	<.001
Total	1	0.14	0.06 0.34	18.78	<.001

Model outcomes are similar for all three modalities, indicating statistical significance ($p < .001$) in all cases. Likelihood of correct answer was reduced by 86% (total) or 87% (FS and RS) for German compared to Spanish, sustaining the lower percentage found for accuracy scores. This demonstrates children's difficulty in mastering the opaque gender system. Additionally, simple binary logistic regression using GEE tested performance differences between FS and RS. For both languages, children performed significantly better in RS than FS (Table 3).

Table 3. *Simple binary logistic regression using GEE models for task performance differences for Spanish and German.*

	Spanish				German			
Task	**OR**	**95% CI**	**Wald**	**p**	**OR**	**95% CI**	**Wald**	**p**
FS	1	-	-	-	1.	-	-	-
RS	1.98	1.22 – 3.23	7.61	.006	1.93	1.45 – 3.57	20.44	.001

3.1. The role of lexical skills in gender assignment

After establishing significant differences between GA accuracy in Spanish and German, a Pearson product-moment correlation was performed to investigate the relationship between lexical skills and GA in the two gender systems. German, unlike Spanish, has an opaque gender assigning system. Thus, in Spanish, lexical knowledge for GA should be more important than in German. The correlation of lexical skills – measured through receptive vocabulary skills – and target-like gender marking should be stronger for Spanish than German. The Pearson product-moment correlation coefficient was computed, and significant positive correlations were found for both languages. For German, the coefficient was $r(33) = .41$, $p = .017$ and for Spanish, $r(33) = .69$, $p = .001$. Therefore, German shows a moderate correlation for lexical knowledge and GA, while Spanish manifests a strong one. Additionally, for Spanish, 48% of the variability in GA ($R^2 = .48$) can be explained through vocabulary scores, compared to the lower 17% ($R^2 = .17$) for German. Thus, the correlation for Spanish, with its more transparent gender system, is stronger than for German, with its opaque gender system.

This pattern holds when examining the relationship for both tasks separately. For Spanish, both correlated individually with lexical skills [FS: $r(33) = .52$, $p = .002$, $R^2 = .27$; RS: $r(33) = .78$, $p < .001$, $R^2 = .61$]. However, RS correlated more strongly and explained more variance

than FS. For German, only RS showed a significant correlation with lexical skills [FS: $r(33) = .32$, $p = .07$, $R^2 = .10$; RS: $r(33) = .42$, $p < .01$, $R^2 = .18$].

3.2. Predictor variables

After observing quantitative differences in GA between both languages and a higher importance of lexical skills for the transparent language, it is important to assess how predictor variables collectively predict GA. This was done through binary logistic regression models using GEE: To establish which variables to include in the multiple regression model, simple binary logistic regression models for both languages were calculated to identify significant ($p < .05$) and relevant ($p < .1$) variables to be fitted in a multiple binary logistic regression model using GEE (Table 4). The thresholds were selected considering the exploratory nature of this investigation and the complexity of bilingual GA. Including variables up to $p < .1$ allows capturing trends possibly reflecting underlying effects that could be disguised by small sample size.

Table 4. *Simple binary logistic regression model outcomes using GEE for Spanish and German predictor variables.*

	Spanish				**German**			
Predictors	**OR**	**95% CI**	**Wald**	**p**	**OR**	**95% CI**	**Wald**	**p**
CoR	S: 1				S: 1			
	G: 1.09	0.18 6.62	0.01	.952	G: 1.13	0.57 2.23	0.12	.729
Age			11.13	**.011**			2.34	.504
	5: 1				5: 1			
	6: 4.53	0.89 23.1	3.30	**.069**	6: 0.58	0.27 1.27	0.58	.173
	7: 6.31	1.26 31.5	5.03	**.025**	7: 0.71	0.31 1.66	0.71	.430
	8: 20.8	3.42 126.8	10.85	**.001**	8: 1.01	0.46 2.19	0.99	.985
BB	No: 1				No: 1			
	Yes: 3.95	1.02 15.3	3.94	**.047**	Yes: 2.70	1.39 5.27	8.50	**.004**
DL-F	S: 1				S: 1			
	G: 0.33	0.08 1.31	2.49	.114	G: 1.32	0.68 2.59	0.67	.412
DL-M	S: 1				S: 1			
	G: 0.28	0.08 1.02	3.74	**.053**	G: 1.34	0.65 2.79	0.62	.430
PPVT - S	1.08	1.05 1.11	23.86	**< .001**	1	0.99 1.02	0.18	.673
PPVT – G	1.07	1.02 1.13	6.47	**.011**	1.02	0.99 1.05	3.32	**.069**
AA	1.39	1.10 1.75	7.85	**.005**	0.99	0.90 1.10	0.01	.932
IN	1.12	1.01 1.25	4.90	**.027**	1.06	0.98 1.14	2.08	.149
PA	1.17	1.05 1.29	8.98	**.003**	1.06	0.97 1.15	1.50	.220
Ex-S/-G	1.08	1.01 1.16	4.83	**.028**	1.01	0.97 1.01	1.58	.295
Use-S/-G	1.09	1.03 1.16	9.43	**.002**	1.01	0.99 1.03	2.30	.129

For Spanish, most variables in the simple regression model were significant or relevant with only CoR and DL-F not reaching either level. Surprisingly, German showed a different picture. Besides BB and receptive vocabulary in German, all variables stayed above both thresholds, showing no significant or relevant relationship with GA.

In conclusion, significant or relevant predictors of GA for both

languages included age, BB, DL-M, receptive vocabulary in both languages, auditory attention, inhibitory control, phonological awareness and exposure and use of Spanish. These variables were entered into the multiple regression model. However, use of Spanish was dropped due to correlation issues. Additionally, CoR, exposure to German and DL-F were added to ensure potential interactions with significant predictors were not overlooked (Table 5).

Table 5. *Multiple binary logistic regression outcomes using GEE for both languages.*

	Spanish				**German**			
Predictors	**OR**	**95% CI**	**Wald**	**p**	**OR**	**95% CI**	**Wald**	**p**
CoR	S: 1				S: 1			
	G: 0.10	0.02 0.55	7.12	**.008**	G: 0.52	0.22 1.22	2.26	.133
Age			7.92	**.048**			8.19	**.042**
	5: 1				5: 1			
	6: 5.38	1.01 28.5	3.91	**.048**	6: 0.44	0.22 0.86	5.72	**.017**
	7: 0.14	0.02 1.18	3.28	.070	7: 0.71	0.04 1.29	1.28	.258
	8: 0.61	0.04 8.95	0.13	.715	8: 0.34	0.06 1.95	1.47	.226
BB	No: 1				No: 1			
	Yes: 0.31	0.03 3.13	1.00	.317	Yes: 5.93	2.36 14.9	14.3	**< .001**
DL-F	S: 1				S: 1			
	G: 0.11	0.02 0.62	6.34	**.012**	G: 2.62	0.96 7.19	3.50	.061
DL-M	S: 1				S: 1			
	G: 0.01	0.00 0.31	7.25	**.007**	G: 2.25	1.01 5.00	3.91	**.048**
PPVT - S	1.05	0.95 1.17	1.04	.307	0.98	0.96 1.01	2.41	.121
PPVT – G	0.99	0.93 1.07	0.02	.888	1.04	1.01 1.07	5.28	**.022**
AA	1.53	1.30 1.80	26.3	**.001**	0.95	0.84 1.08	0.56	.456
IN	1.15	0.91 1.45	1.36	.244	1.13	0.99 1.29	3.45	.063
PA	1.11	0.91 1.36	1.13	.289	0.92	0.81 1.03	1.99	.158
Ex - S	1.01	0.98 1.04	0.38	.537	1.02	0.98 1.07	1.10	.294
Ex - G	1.06	1.02 1.11	7.27	**.007**	0.99	0.97 1.03	0.02	.888

In both languages, surprisingly few predictors were significant.

For Spanish, CoR, age, both parents' dominant language, auditory attention, and exposure to German became significant ($p < .05$). Older children residing in Spain with at least one parent speaking Spanish as dominant language, better auditory attention, and higher exposure to German assigned gender correctly with higher probability.

For German, age, BB, DL-M, and receptive vocabulary in German became significant. Older, balanced bilinguals with German as the mother's dominant language and better German vocabulary skills assigned gender correctly with higher probability.

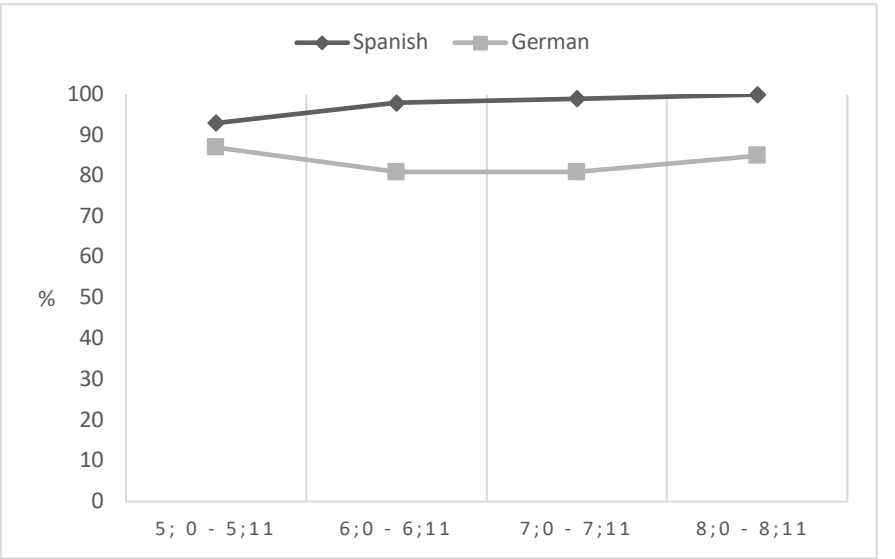
Additionally, some CIs exhibited wide ranges, indicating important variability. For instance, six-year-olds in Spanish had a 1.01 – 28.5 CI and balanced bilinguals in German, a CI of 2.36 – 14.9. Other examples were eight-year-olds in Spanish, and father's dominant language German for German GA. This could be due to the complexity and multiple factors in bilingual GA.

When looking at both languages simultaneously, only age and DL-M emerged as significant predictors for GA in both languages. All other variables showed different effects for Spanish than for German. Interaction models confirmed this pattern. Five predictors showed a significant difference in effect on both languages: age ($p = .007$), receptive vocabulary in Spanish (PPVT-S) ($p = .001$), auditory attention (AA) ($p = .004$) and use of and exposure to Spanish ($p = .010$, $p = .002$, respectively). These results are supported by the regression models, as age was significant in the simple model for Spanish, but only in the multiple model for German. PPVT-S influenced Spanish in the simple model but had no effect on German. Auditory attention, exposure, and use of Spanish were only significant for Spanish, never for German.

3.2. The effect of age in gender assignment

As age was one of only two significant predictors for both languages, a closer look at how children behaved according to biological age was taken and their average accuracy scores separated in age groups (Figure 2) calculated.

Fig. 2. *Accuracy rates for gender assignment in Spanish and German according to age groups.*



As shown in the figure (Figure 2) and Table 5, for Spanish - matching significance levels in the multiple regression model - gender accuracy improved significantly from five to six years old. Afterwards, increases became insignificant, likely due to high accuracy rates. For German, five-year-olds assigned gender more accurately than older children. As in Spanish, the German model shows a significant difference only between ages five and six. Unlike Spanish's increasing accuracy, German accuracy rates were significantly lower for six than for five-year-olds. No older group outperformed the five-year-olds in gender accuracy, despite accuracy increasing again at age seven.

4. Discussion

All predictions regarding the first research question were borne out. A significant difference in the accuracy for gender assignment in

Spanish and German was found. Opaque gender systems seem to take longer to acquire, aligning with e.g. Rodina and Westergaard (2017) or Eichler et al. (2012) for German-Spanish bilinguals. They found almost no difficulties in transparent GA, with less accuracy in opaque systems. However, the exact characteristics of opaque systems causing this delay are yet to be determined, even though higher variability of articles and case marking may contribute. This is because early article acquisition is mostly phonologically led (Kuchenbrandt, 2008), with children acquiring article + noun chunks before understanding their morphosyntactic role (e.g., Mariscal, 2009). Due to the higher paradigm complexity, children are exposed to more chunk varieties in German than Spanish. Higher variability leads then to less frequency, whose effect on gender has often been acknowledged, e.g. decreasing acquisition speed (e.g. Janssen, 2014) or learning reliability (e.g. Szagun et al., 2007). Future research should therefore explore early phonological abilities in bilinguals.

Therefore, using criteria from Motsch and Rietz (2019), who consider a grammatical feature acquired at 90% accuracy or above, German GA does not seem acquired by bilinguals aged 5;0-8;11. These findings differ from German monolinguals performing over 90% at age 3 or 4 (e.g., Ruberg, 2013). However, contradictions exist, as Ulrich (2017) found children reach 90% accuracy around age 7 or 8. She also argued that the 90%-accuracy rule might not be the best acquisition criterion, a thought addressed later in this discussion.

Yet, differences between mono- and bilinguals in gender accuracy may only occur in early stages and be mainly phonological, disappearing when morphosyntactic features emerge (Kuchenbrandt, 2008). This study's data suggest otherwise, as children above five, when understanding of morphosyntax is present, are below data found for monolinguals (e.g., Ulrich, 2017). Accuracy was highest for five-year-olds, dropping significantly for six-year-olds and growing steadily thereafter, though the differences for children older than six were not significant, possibly due to the small sample size. Eichler et al. (2012) offer an explanation: younger children have less vocabulary with more frequent words and therefore handle fewer, better-known words to higher accuracy. Then, they expand to less frequent words at

six, lowering accuracy before it increases again with age as language proficiency does. The start of formal education at six in both countries also expands vocabulary (e.g., Duff et al., 2015), potentially contributing to the observed drop.

However, for Spanish, performance is above the 90%-threshold. Significant differences were only found for five and six-year-olds. The lack of significance for older groups could be due to the small sample size. However, this doesn't seem to be the case as accuracy rates appear close to ceiling performance from age six, suggesting gender is acquired by this age. From then, children make only small gains aligning with monolingual data (e.g., Perona Jara, 2016), for what gender could count as an early acquired feature of Spanish. However, quantitative differences at earlier ages cannot be ruled out, though Kuchenbrandt (2008) found no differences in GA for Spanish-German mono- and bilinguals aged 2-4 but investigated few children. Rodina & Westergaard (2013), studying Norwegian-English found no differences in four 1;9-3;0-year mono-and bilinguals. This confirms the need for future investigation with younger bilinguals.

The data also corroborate higher importance of lexical skills in Spanish GA compared to German, validating the second prediction. This could be because Spanish GA is more rule-based than German. Therefore, in the Romance language, better vocabulary knowledge would lead to better rule derivation and increased gender accuracy. As almost each word Spanish children learn follows pre-established patterns, their acquisition reinforces the rule, increasing its availability. This seems true for the children in this study. Conversely, German gender acquisition is not rule-based, or at least not to the degree Spanish is.

Additionally, German has a three-gender system, meaning that GA cannot be done by discarding as in Spanish. Increasing difficulty even more, only natural gender cues and unreliable regularities exist, applicable to restricted word groups. These can have a limited effect, such as in French (Granfeldt, 2018) whose gender system shares similarities with German as it is opaque, with straightforward semantic but unreliable morphological gender rules.

In German, knowing more vocabulary can only lead to a small

increment in gender accuracy as acquiring the phonological label for a concept does not necessarily include information about its gender. This is why Ulrich (2017) questions the feasibility of the 90%-rule for German, as it implies a rule-like nature for GA, which does not seem to be the case. Ulrich (2017) suggests that for German judging assignment reliability could be more appropriate.

Additionally, differences in the importance of lexical skills were found for task type and language. While in Spanish both tasks correlated with lexical skills, in German only RS did. This could be due to RS showing higher correlations with lexical skills and significantly higher accuracy rates than FS. Structural differences between tasks could also be the reason. RS relies on lexical retrieval, demands higher lexical variety, and requires more precise production, yet offers a model before requiring production. FS provides a more open setting but allows for constant repetition of high-frequency words. As both tasks place different demands on children, GA accuracy could vary depending on the task. Therefore, performance expectations should be adjusted accordingly, expecting better outcomes for RS due to the model. This is especially important as morphosyntactic assessments usually propose closed contexts with words from a wide range of frequencies. Considering the results from this paper, it can be expected that children perform worse on these formats than in FS or RS.

Results from the regressions showed significant predictors for GA. Only age and mother's dominant language reached significance in both languages. These findings contradict previous research. Rodina and Westergaard (2017) found an age-related influence only for opaque languages. In their study, Norwegian GA was predicted only by age, while Russian showed no such relationship and was only predicted by cumulative exposure.

However, in congruence with the Norwegian-Russian results, the interaction effect showed that age affected Spanish and German differently. It is therefore possible that it impacts the acquisition of all transparent and opaque languages, with the nature of its impact distinct for each language type. While Spanish gender demonstrated constant growth, German gender accuracy peaked at age five, almost

reaching the same levels again at age eight.

A possible reason for the contradiction with previous literature might be that in Rodina and Westergaard's investigation, children had already reached ceiling performance and were thus too old to show age effects in GA in the transparent language. Gender in transparent languages may be early acquired and reach ceiling effects at very young ages, with delayed ceiling effects for opaque languages. For instance, Unsworth (2013) reported no ceiling effects in Dutch, with an opaque gender system, until 17 years of age. Hence, investigating younger children in transparent languages more deeply is essential.

Other factors contributed solely to GA in one language. BB and receptive vocabulary in German were predictors for GA only in German, contributing uniquely to gender acquisition in the opaque language. Spanish showed an exclusive relationship with CoR, father's dominant language, auditory attention and exposure to German.

Firstly, auditory attention being significant for Spanish, but not for German, may be due to the differing structure of gender systems. Spanish relies heavily on phonological clues (*-a* and *-o*, mainly) for gender identification. Therefore, children don't depend on memory to retrieve noun gender, as paying attention to word structure is typically enough. For German, there's no need to rely on auditory attention for GA, as few reliable phonological clues are available. Consequently, the idea of gender acquisition as lexical learning through memorization has been proposed (e.g., Roelofs, 1992). Children would learn gender similar to how they acquire vocabulary, a theory that seems to receive support by the results in this investigation.

In contrast to auditory attention, inhibitory control and phonological awareness were not significant predictors. As children's abilities fell within the normal range, this suggests they do not significantly interfere with GA but may serve as a foundation. Altered cognitive abilities could negatively influence GA, potentially lowering accuracy rates. Further investigation with children with developmental language disorders could shed light on the relationship between both aspects.

The role of factors such as auditory attention would also explain why receptive vocabulary was only a significant predictor of German

GA, but not for Spanish. While the results suggested a strong correlation between Spanish GA and lexical skills, in the multiple model, other factors like auditory attention were more influential. This implies a strong link between both variables that weakens under the effect of others as children may rely more on their auditory attention than vocabulary abilities to assign gender.

For German, as children cannot use other clues for correct GA, more extensive vocabulary knowledge provides better outcomes as children may memorize the correct gender when including the word in their lexicon. Children would learn chunks of article+word holistically. However, they might not store the information about gender with the word itself but link the word to a certain gender node (Hohlfeld, 2006). It would be interesting to include assessment of memory aspects to see if they influence German GA or Spanish GA, e.g., in children with low auditory attention abilities.

For Spanish, it is generally enough to memorize only the word, without its morphological information. In vocabulary learning, it is crucial to differentiate between the semantic knowledge of concept labels and the morphological knowledge of gender connected to it. The transparent, rule-based nature of Spanish correlates more with semantic knowledge, while the opaque German gender system depends on the morphological part attached to it. In German, children's GA accuracy could benefit from explicit instruction focusing on new vocabulary and introducing the corresponding gender, providing strategies for gender acquisition that they could generalize to other settings.

Studies show higher vocabulary leads to more efficient neural processing of language (e.g., Müller et al., 1997). Bilingual children with good vocabulary might master higher demands better, enhancing performance in opaque GA but less essential for transparent Spanish gender, which can be learnt without those abilities due to its simplicity.

Structural differences between gender systems may induce the role BB plays specifically in German. BB occurs when children learn both languages to similar, age-expected proficiency and unbalanced bilingualism is expected to slow language acquisition and increase

errors (Eichler et al., 2012). Factors contributing to BB are yet to be determined, but cortical differences, early exposure, equal frequency between languages, and higher maternal education are under discussion (e.g., Arnaus Gil & Jiménez Gaspar, 2022; Hoff et al., 2021). Its presence might be an indicator for the existence of a general linguistic ability.

This ability is included in the linguistic interdependence theory (Cummins, 1979) as Common Underlying Proficiency (CUP) where cross-linguistic psycholinguistic abilities would create a predisposition to language learning. Balanced bilinguals would have higher CUP than unbalanced bilinguals, enabling correct language acquisition under less adequate circumstances. While this ability might not affect transparent gender systems like Spanish, it may advantage German acquisition due to its complexity, leading to better accuracy rates. This seems to contradict Eichler et al. (2012), who reported better GA performance for unbalanced bilinguals in some instances. However, their acquisition process was slower, reducing vocabulary significantly and giving those children more control over fewer words. This investigation could not replicate these findings, possibly due to age differences as Eichler et al. (2012) studied children up to age five. Older unbalanced children may have acquired so many words that they can no longer memorize gender to the accuracy rates balanced bilinguals achieve.

This supposition is strengthened because five-year-olds showed better performance than older children. Up to age five, acquisition speed and expressive vocabulary range might be key performance predictors. As linguistic and cognitive abilities develop, they might lose influence, while the importance of a balanced language system increases.

It is unsurprising that input-related factors, such as CoR, the parents' dominant language or exposure rates became significant. Numerous investigations have identified such measures as important for gender acquisition (e.g., Unsworth et al., 2014). However, their exact influence is still under discussion, as only some studies found that exposure influenced GA (e.g., De Houwer, 2007; Gathercole & Thomas, 2009). For instance, general morphological features were

reported to be influenced only by length of exposure to a language, while vocabulary performance was additionally predicted by age of onset and mother's language proficiency (Chondrogianni & Marinis, 2011).

Some studies reported cross-linguistic ability transfers between languages. Kaltsa et al. (2019) or Unsworth et al. (2014) discovered this phenomenon in their participants but only if both languages contained grammatical gender, which is the case in the language combination under investigation. However, surprising was that exposure to German influenced Spanish GA positively. For Spanish-German bilinguals, improved performance for German through knowledge of Spanish had been described (Kuchenbrandt, 2008). Participants in this study behaved oppositely as exposure to German improved Spanish GA, showcasing an influence of the opaque system over the transparent system. This might be caused by increased metalinguistic awareness of grammatical gender through exposure to German. Also, Spanish gender might be easier to use in contrast to German, in which case the contrast between both systems would boost performance in Spanish.

Like exposure rate, unexpectedly, CoR influenced only Spanish with children residing in Spain performing better on Spanish GA. Surprising is that German GA was not affected by the country children resided in. Living in Germany must not provide conditions conducive to acquire necessary abilities for GA, e.g., lexical learning for which participants' age might be the cause. Young children typically do not engage much with people outside their family, friends and educational context. Their interactions with society are limited and may mostly comprise small chunks of sentences overheard outside (Blewitt et al., 2018). Such limited exposure could not be enough to impact the acquisition of an opaque gender system meaningfully but do so for a transparent one.

However, CoR and parental language use at home impact GA. Some studies found children with both parents speaking the minority language performed better than those exposed to only one parent using it. This implies accuracy rates could be lower for children exposed to both minority and majority languages at home. This seems

unlikely for Spanish, with accuracy rates above 93% for all age groups, but cannot be ruled out for German where rates are lower. Further research should clarify the effect of CoR, considering parental language use at home.

Parental language was a significant factor for GA in this study. Both parents' dominant language influenced Spanish outcomes, while only the mother's language affected German. This suggests a more critical role of maternal language, at least for opaque languages. Theories propose a distinct bond between mothers and offspring compared to fathers. Maternal influence may focus on calming effects and communication, while fathers offer challenging activities encouraging exploration (Tamis-LeMonda et al., 2004). These differences provide infants with varied experiences. Neuroanatomical evidence shows different brain activation patterns in infants interacting with mothers and fathers (Feldman, 2015). In linguistic outcomes, although paternal influence is acknowledged, maternal impact has been reported as more significant (e.g., Leech et al., 2013), particularly in vocabulary, distinctively linked to GA in both transparent and opaque languages in this paper.

Due to this disparity, the challenges of an opaque gender system may require aspects of input fathers do not provide to the same extent as mothers. Another, by this study uncovered, possibility is that fathers in Germany might not have spent as much time with their children as fathers in Spain.

Lastly, in the simple binary logistic regressions and interaction model, factors like BB, receptive vocabulary, use of and exposure to Spanish, inhibitory control and phonological awareness reached significance, though their influence decreased below it in the multiple model. Their contribution to GA might therefore be less important than other predictors but should not be excluded from further research on gender assignment, as they could play a more important role under different circumstances.

Consequently, bilingual GA proves to be a complex mechanism influenced by multiple factors. For this reason, for professionals in educational or therapeutic settings, knowledge of it is necessary to adequately adjust to children's needs.

There are limitations to this study. The small sample size necessitates further investigations to reinforce the findings and can affect model outcomes, such as significance levels. Bilinguals are not a homogenous group, with many variables creating high variability in language development, especially considering the interaction of their two languages. Some variables have been included here, but others could be investigated further. For instance, while families provided information on the educational institution, its influence was not further investigated. This would be of interest in the future, as it seems logical that it should affect language development, though this has not always been found (e.g., Balam et al., 2021). Considering the exploratory nature of this investigation and limited previous evidence, GA in Spanish-German bilinguals would benefit from future research including different methodology and heterogeneous participants to expand knowledge and allow generalization of findings.

5. Conclusion

This study investigated gender acquisition in Spanish-German bilinguals, comparing a transparent (Spanish) and an opaque (German) gender system. As expected, accuracy was diminished in the opaque language. Lexical knowledge played a lesser role for the opaque than the transparent system. Several predictors were identified for gender acquisition. Age and mother's dominant language emerged as the only predictors for both languages. However, CoR, mother's dominant language, auditory attention, exposure to German, BB and receptive vocabulary in German influenced at least one language significantly. Factors such as receptive vocabulary or use and exposure to Spanish only demonstrated significance in simple models. It is proposed that gender acquisition relies on lexical learning in German. The findings contribute to research on gender acquisition and bilingual language development. They also impact professionals in education and language therapy, such as reducing accuracy expectations and adapting gender teaching in opaque languages.

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