The role of lexico-syntactic features in noun phrase production and comprehension: insights from Spanish and Chinese in unilingual and bilingual contexts

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Chapter 1

General Introduction

1.1 Background

Over half of the world's population speaks more than one language, making bilingualism[1] a widespread phenomenon rather than an exception (Grosjean, 1982). This prevalence naturally raises one important question in the field of bilingualism (e.g., Desmet & Duyck, 2007), i.e., how do bilingual speakers manage two distinct languages in their minds? To answer this question, accumulating research has first established that bilinguals undoubtedly differ from monolinguals in certain ways, such as vocabulary size and verbal skills (e.g., Bialystok et al., 2010; Bialystok & Luk, 2012), as well as cognitive patterns and lexical retrieval (e.g., response time and accuracy in picture-naming tasks, word production, and comprehension, see Bialystok et al., 2008; Gollan et al., 2005; Costa & Santesteban, 2004; Hernandez et al., 2000; Gollan et al., 2007; Roberts et al., 2002). From a psycholinguistic perspective, most theories of bilingual lexical access propose that both lexicons in a bilingual's mind are activated in parallel (e.g., Costa et al., 1999a; De Bot, 1992; De Bot & Schreuder, 1993; Dijkstra & Van Heuven, 1998; Green, 1986; Roelofs, 1998). According to these theories, bilinguals undergo a more complex and multi-staged process than monolinguals when producing a word: first, to-be-produced lexical items are activated simultaneously in both used and non-used languages; then, an external production rule determines the target language; third, the highest activated target lexical item in the chosen language is ultimately produced while suppressing those of the non-used languages.

A widely held view is that bilingualism often arises not from deliberate personal choice, but from circumstances such as birthplace, migration background, or the language patterns prevalent within an individual's community (Bialystok et al., 2012). This is especially evident among early Spanish−Chinese bilinguals living in a young but stable immigrant community in Barcelona, Spain, where consistent heritage language use and rich

[1] In this thesis, *bilingualism* is used as a cover term to refer broadly to individuals who speak two or more languages.

language contact often create a context of frequent use of two languages. This thesis thus focuses on this bilingual population, not only because their language practices offer rich opportunities to study bilingual language processing, but also because they remain notably understudied in existing research. Specifically, we defined ***early Spanish–Chinese bilinguals*** as individuals who acquired Chinese as a heritage language (HL), that is, as their home language learned in a Chinese-speaking household environment, and Spanish through formal educational settings in Spain. Moreover, we included two baseline comparison groups, Mandarin Chinese speakers and Spanish speakers, to establish language-specific patterns and provide essential reference points for identifying strategies or deviations unique to bilinguals. Rather than labeling these participants as monolinguals, we defined them more precisely: ***Mandarin Chinese speakers*** are individuals born and raised in monolingual Chinese-speaking environments in China, and ***Spanish speakers*** are those born and raised in Spanish-speaking countries. This approach acknowledges that even individuals raised in predominantly single-language environments may possess some knowledge of other languages. Notably, these two groups were included only in the unilingual[2] investigations in this thesis.

The central languages of interest in this thesis are Spanish and Mandarin Chinese (hereafter, "Chinese" refers to Mandarin Chinese), as these two languages differ markedly in their typological and grammatical systems, providing a compelling case for exploring bilingual language processing. Specifically, they contrast not only in typology, with Spanish being a fusional language with rich inflectional morphology, while Chinese is isolating with minimal morphology, but also in key lexico-syntactic

[2] In this thesis, *unilingual* refers to the use of only one language by bilingual speakers, typically in a task or interaction conducted in a single language. It describes the language mode, not the speaker type. In contrast, *monolingual* refers to individuals who primarily use one language in their daily lives or to tasks involving exclusively monolingual participants. This distinction ensures that the term *unilingual* is reserved for describing the single-language use of bilinguals, while monolingual pertains to both speaker identity and task composition.

features. In this thesis, ***lexico-syntactic features*** are broadly defined as properties of a word that reflect both its lexical characteristics (such as meaning or category, e.g., noun, verb) and its syntactic role or behavior within a sentence (such as agreement). These features help determine how words combine to form phrases and sentences, and how they interact with grammatical rules. Examples of lexico-syntactic features include grammatical gender, classifier systems, and adjective placements (see detailed descriptions in Section 1.2). In Spanish, grammatical gender is an inherent feature of nouns, requiring determiners and adjectives to agree with nouns in gender (Roca, 1989; Harris, 1991). For example, la_{FEM} $mesa_{FEM}$ "the table", where the feminine determiner *la* agrees in gender with the feminine noun *mesa*. In contrast, Chinese lacks grammatical gender but instead employs a classifier system, where classifiers are obligatorily placed after numerals or demonstratives but before nouns (Li & Thompson, 1981). The selection of classifiers largely depends on the semantic properties of nouns they modify, such as animacy, shape, size, function, and consistency (Li & Thompson, 1981; Myers & Tsay, 2000). For instance, *一棵树*, /yi1ke1shu4/ [one + classifier-ke1 + tree], "one tree", both the classifier *棵* /ke1/ and the noun *树* /shu4/ "tree" refer to plants (Guo, 2002). Another point of contrast lies in the adjective placements: Spanish typically places adjectives after nouns (e.g., *guante amarillo*, [glove yellow], "yellow glove"), whereas Chinese adjectives generally precede nouns (e.g., *黄色的手套*, [yellow glove], "yellow glove"). These structural differences provide a rich context for examining how bilingual speakers navigate the lexico-syntactic features across their languages during production and comprehension.

Taken together, these lexico-syntactic contrasts between Spanish and Chinese create "conflict sites" for bilingual speakers (Poplack & Meechan, 1998), where the grammatical rules of the two languages differ. To understand how bilinguals mentally navigate such lexico-syntactic differences across languages, it is essential to first examine how these features function in each language individually. Unlike the adjective placements, which exist

in both languages but are realized differently, grammatical gender and classifiers are language-specific lexico-syntactic features that exist in Spanish and Chinese, respectively, but serve comparable grammatical functions. Among these, grammatical gender stands out as one of the most extensively studied lexico-syntactic features, particularly in monolingual language production, as evidenced by the well-documented ***gender congruency effect*** (e.g., Bürki et al., 2016; Heim et al., 2009; La Heij et al., 1998; Schiller, 2013; Schiller & Caramazza, 2003; Schiller & Costa, 2006; Schriefers & Teruel, 2000; Starreveld & La Heij, 2004). The gender congruency effect refers to a more efficient and accurate processing of gender-congruent nouns (i.e., nouns and determiners or adjectives agree in gender) compared to gender-incongruent nouns (i.e., nouns and determiners or adjectives disagree in gender, see Wang & Schiller, 2019; Sá Leite et al., 2022 and Bürki et al., 2023 for overviews).

According to the influential Levelt, Roelofs, and Meyer (LRM) speech production model (Levelt et al., 1999), there are three main stages to produce a word. First, the to-be-produced word is conceptualised. Then, the concept is lexicalised, which activates and encodes the grammatical properties (e.g, grammatical gender, classifiers, number, etc.) and phonological and phonetic form of the word. Finally, the to-be-produced word is articulated. This production process is mostly examined in a picture-naming task using the picture-word interference (PWI) paradigm (Rosinski et al., 1975), where speakers are asked to name a target picture while ignoring a simultaneously presented distractor word. In this context, the gender nodes for both the target and the distractor are activated. When the target and distractor mismatch in gender (i.e., gender-incongruent condition), the gender feature of the distractor word competes with that of the target picture, resulting in a longer time to name the picture. Conversely, when the target and the distractor have an agreement in gender (gender-congruent condition), they activate the same gender node, where no competition occurs and results in shorter naming latencies. This difference in processing, reflected by faster naming latencies in the gender-congruent condition, is referred to as the gender congruency effect. This

effect has been extensively documented in Germanic languages (see Wang & Schiller, 2019; Sá Leite et al., 2022 and Bürki et al., 2023 for an overview), while controversial results have been observed in Romance languages, where this effect has been reported to either exist, be absent, or even reverse, especially in Spanish NP production (see Section 1.2.1 for detailed descriptions). This motivates the present thesis to first investigate whether Spanish speakers show a gender congruency effect in Spanish NP production. Establishing this baseline is essential for understanding how grammatical gender is processed in unilingual contexts, which in turn provides a foundation for examining how bilingual speakers process grammatical gender in bilingual speech contexts.

Another comparable lexico-syntactic feature is the numeral classifier system in Chinese, which has received much less investigation, especially regarding its processing in bilingual speech production. Like grammatical gender, classifiers are processed through the same stages of word production proposed in the LRM model (Levelt et al., 1999), from conceptualisation to lexical encoding of grammatical properties and finally to articulation (see Wang & Schiller, in press and Qian, in press for overviews). In monolingual speech production, a phenomenon known as the ***classifier congruency effect*** has been consistently documented using the PWI paradigm (e.g., Wang et al., 2006; Huang & Schiller, 2021). This effect shows that speakers name pictures faster when the distractor and target picture match regarding their classifiers (classifier-congruent condition) than when there is a mismatch (classifier-incongruent condition). Specifically, studies using the PWI-based picture-naming task have demonstrated that Chinese speakers produce classifier-NPs more quickly under classifier-congruent conditions than under classifier-incongruent conditions, as the classifier of the distractor competes with that of the target under classifier-incongruent conditions, leading to longer naming latencies (e.g., Wang et al., 2006; Huang & Schiller, 2021). While this effect has been well-documented among monolingual Chinese speakers, it is still unclear whether bilingual speakers exhibit a similar classifier congruency effect when processing classifiers in unilingual Chinese. Addressing this gap, the pres-

ent thesis also aims to investigate how Spanish−Chinese bilinguals process classifiers in such unilingual contexts.

Before we delve into how bilinguals manage grammatical gender, classifiers, and adjective placements across their two languages, it is first essential to clarify what we mean by ***bilingual*** in this thesis. Following Grosjean (1992, p. 51), bilinguals are defined as "…those people who need and use two (or more) languages in their everyday lives." In previous research, bilingual speakers are often suggested to activate both their languages in parallel during speech production and comprehension (e.g., De Bot, 1992; De Bot & Schreuder, 1993; Dijkstra & Van Heuven, 1998; Green, 1986), making it unlikely for one language to be fully "switched off", even when in single-language contexts (Desmet & Duyck, 2007). As a result of such parallel activation, bilingual speakers do not simply manage two separate linguistic systems in isolation; rather, they often alternate between them and integrate elements from both languages within a single conversation, a phenomenon known as code-switching (CS) (Poplack, 1980; Deuchar, 2012). Interestingly, it has also been observed that bilinguals actively make choices about when, where, and with whom to use one language or to mix the two in code-switching (Parafita Couto et al., 2023). Thus, studying code-switched speech often offers a unique window to our understanding of language, as it can reveal patterns that might remain hidden when examining a single language (Parafita Couto et al., 2023). In this way, combining the investigation of code-switched speech with an analysis of how bilinguals process and manage lexico-syntactic features across their two languages provides a more comprehensive perspective than studies limited to monolingual speakers or contexts. This thesis therefore shifts the focus away from monolingual contexts, aiming to use bilingualism instead as a gateway into the mechanisms underlying these lexico-syntactic features, both in unilingual and bilingual language modes. In doing so, it allows us to observe not only how these features are processed in a single-language mode but also how they interact across two languages, thereby offering insights into a relatively comprehensive understanding of bilingual language processing.

Building on this aim, this thesis then extends the investigation by examining how grammatical gender, classifiers, and adjective placement are managed and processed in code-switched speech. It is widely accepted that code-switching does not involve a random mixture of two languages but follows specific rules (e.g., Poplack, 1980; Deuchar, 2012; Bullock & Toribio, 2009). Accordingly, previous studies have first explored how grammatical gender is processed and assigned in code-switched speech, particularly in mixed NPs involving gender-marked determiners with non-gender-marked nouns (cf. Bellamy & Parafita Couto, 2022). Specific to language combinations involving Spanish (e.g., Spanish–English), previous studies have identified three main strategies for gender assignment (cf. Bellamy & Parafita Couto, 2022; also see Section 1.2.1 for detailed descriptions). This includes assigning gender based on either translation equivalents or morpho-phonological properties of nouns, or by defaulting to masculine, which serves as the default gender in Spanish (see Bellamy & Parafita Couto, 2022 for an overview). By contrast, to date, no studies have systematically examined how classifiers are assigned in code-switched speech. Given the similar noun-based nature of both grammatical gender and classifier systems, it is plausible that comparable assignment strategies apply to classifiers. Thus, we propose that classifiers may be assigned using translation equivalents, morpho-phonological cues, or defaulting to the general classifier *ge*, which is used as default in Chinese (Myers & Tsay, 2000, see detailed descriptions in Section 1.2.2). In doing so, this thesis systematically investigates how grammatical gender and classifiers are assigned and processed in mixed NPs, thereby shedding light on the strategies Spanish–Chinese bilinguals employ when navigating these two lexico-syntactic features across their two languages.

Additionally, adjective placement, as a unique "conflict site", emerges in bilingual contexts where the conflict depends on whether adjectives come before or after nouns in the language involved. This issue has been extensively explored in several studies using different methodologies across language combinations (e.g., Balam & Parafita Couto, 2019; Stadthagen-González et al., 2019; Parafita Couto & Gullberg, 2019; Pablos

et al., 2019; Vanden Wyngaerd, 2017; Parafita Couto et al., 2015; Parafita Couto et al., 2017; Vaughan-Evans et al., 2020; Van Osch et al., 2023; also see overview in Appendix 6.A in Chapter 6). These studies examined such adjective placement conflicts based on predictions of two theoretical frameworks, including the Matrix Language Frame (MLF; Myers-Scotton, 1993, 2002) and the Minimalist Program (MP)-based approaches (Cantone & MacSwan, 2009). These models capture different aspects of syntactic constraints and differ in predictions: the MLF (Myers-Scotton, 1993, 2002) proposes that code-switched sentences involve a matrix language (ML) that provides the morphosyntactic frame and an embedded language (EL) that supplies lexical items, and thus predicts that the word order of ML determines adjective positions. In contrast, MP-based approaches (Cantone & MacSwan, 2009) argue that code-switching should be governed by the same grammatical principles as monolingual syntax, and thus grammatical features are determined by the properties of individual lexical items. Thus, regarding adjective placement in code-switching, Cantone and MacSwan (2009) follow Cinque's (1994, 1999) proposal that adjectives are universally placed before nouns (see Section 1.2.3 for detailed descriptions). Based on this, they reach the descriptive generalization that adjective placement should be determined by the language of the adjective itself. Notably, although these two models capture different aspects of adjective-noun patterns and differ in assumptions, their predictions sometimes converge or diverge, i.e., adjective positions may align with both models, with only one, or with neither.

To date, previous studies have examined predictions of these two models and yielded inconclusive results regarding fully explaining grammatical patterns in adjective placement in code-switched speech (see Section 1.2.3 for detailed descriptions). Specifically, while some studies, such as those on English−Welsh (e.g., Parafita Couto et al., 2015), Spanish−English (e.g., Balam & Parafita Couto, 2019), Papiamento−Dutch (e.g., Parafita Couto & Gullberg, 2019), and Spanish−Dutch/Papiamento−Dutch (e.g, Van Osch et al., 2023), found evidence supporting predictions of both models, others like French−Dutch (e.g., Vanden Wyngaerd, 2017), Welsh−English (e.g., Parafita Couto et al., 2017; Vaughan-Evans et al., 2020),

Spanish−English (e.g., Stadthagen-González et al., 2019), and Papiamento−Dutch (e.g., Pablos et al., 2019) suggested that adjective-noun patterns could be explained by either the MLF or MP, or neither of them (see Appendix 6.A in Chapter 6). Although these findings are inconclusive, the preference for noun insertion has been consistently observed in previous studies (e.g., Parafita Couto et al., 2015; Vanden Wyngaerd, 2017; Van Osch et al., 2023). This thesis therefore seeks to build on these findings by systematically examining how Spanish−Chinese bilinguals process syntactic constraints proposed by these two models in placing adjectives within mixed adjective-noun nominal constructions. In doing so, it aims to deepen our understanding of bilingual syntactic integration while also exploring whether these bilingual speakers exhibit a preference for noun insertion as part of their integration strategy.

Taken together, the combined investigation of grammatical gender, classifiers, and adjective placement is crucial for a comprehensive understanding of bilingual language processing. These three lexico-syntactic features represent distinct but parallel grammatical systems that vary significantly across Spanish and Chinese. Grammatical gender is exclusive to Spanish, while classifiers are unique to Chinese; however, both function as noun-based lexico-syntactic features that require selection based on the morpho-phonological or semantic properties of the noun. Despite their language-specific nature, they offer a valuable basis for examining how bilinguals manage comparable grammatical functions across different linguistic systems. For instance, analyzing bilinguals' processing of grammatical gender in unilingual Spanish and classifiers in unilingual Chinese enables us to investigate whether similar strategies are employed across these structurally distinct systems. Moreover, exploring these features in bilingual Spanish−Chinese contexts sheds light on the extent to which shared processing mechanisms underlie cross-linguistic integration. However, given that grammatical gender and classifiers are language-specific lexico-syntactic features that exist independently in each language, they cannot directly inform us about how the two linguistic systems are integrated or interact in the bilingual mind. In contrast, adjectives are present in

both Spanish and Chinese but differ in their syntactic placement. This shared yet structurally divergent feature provides a unique opportunity to examine how bilinguals resolve syntactic conflicts when both languages encode the same lexico-syntactic feature differently across their languages. While Spanish adjectives encode grammatical gender, which is absent in Chinese adjectives, we focus here on the shared feature, namely the linear order of adjectives and nouns, rather than the language-specific feature of grammatical gender. Moreover, since grammatical gender does not affect the placement of adjectives, it is not considered in our discussion of adjective placements. As such, adjective placement complements the study of grammatical gender and classifiers by enabling us to explore an aspect that is not fully captured by language-specific features alone. Collectively, the examination of grammatical gender, classifiers, and adjective placement offers a more holistic understanding of how lexico-syntactic features are processed and integrated in bilingual speech.

The overarching aim of this dissertation is to uncover how grammatical constraints, task types/demands, and underlying cognitive processing mechanisms guide bilinguals' production and comprehension of lexico-syntactic features across languages, in both unilingual and bilingual contexts. This is accomplished through four core areas of exploration: first, we examine the gender congruency effect in unilingual Spanish NP production using data from Spanish speakers and establish a baseline for how grammatical gender is processed in unilingual contexts. Second, we explore the classifier congruency effect in unilingual Chinese NP production, drawing on data from both Mandarin Chinese speakers and early Spanish−Chinese bilinguals. This comparison helps determine whether bilinguals process classifiers in a way similar to Mandarin Chinese speakers and provides a basis for understanding how bilinguals employ classifiers in unilingual Chinese. Together, these first two investigations provide initial insights into how comparable lexico-syntactic features across languages are processed and produced in unilingual contexts. Third, we analyze the strategies bilinguals use to assign grammatical gender and classifiers in mixed NPs through multi-task approaches, aiming to understand how bilinguals navigate and assign lexico-syntactic features in

bilingual contexts, particularly during code-switching. Fourth, we investigate how bilinguals resolve syntactic conflicts that arise from the different word order preferences of adjectives in Spanish and Chinese, aiming to understand how bilinguals integrate their two language in bilingual contexts.

The remainder of this section is structured to provide a detailed description of these lexico-syntactic features in both unilingual and bilingual contexts. First, section 1.2 offers an overview of key lexico-syntactic features across languages in both unilingual and bilingual contexts. Specifically, subsection 1.2.1 reviews grammatical gender, with a focus on Spanish in particular. Subsection 1.2.2 introduces the classifier system, especially as realized in Mandarin Chinese. Subsection 1.2.3 discusses adjective placement patterns in Spanish and Chinese. Together, these sections lay the groundwork for investigating how bilingual speakers manage, process, and produce these features in both unilingual and bilingual contexts. Furthermore, section 1.3 introduces the importance of open science and bilingualism as discovery science in scientific research. Finally, section 1.4 lists the main examination of each chapter in the thesis.

1.2 Overview of lexico-syntactic features across languages in unilingual and bilingual contexts

To establish a solid foundation for understanding how the lexico-syntactic features are processed and produced in both unilingual and bilingual contexts, this section begins with a broad overview of the main properties of lexico-syntactic features across languages. We then narrow our focus to two languages of interest, Spanish and Chinese, by introducing the core characteristics of their respective lexico-syntactic systems and how these features are processed and produced in both unilingual and bilingual contexts.

1.2.1 Grammatical gender: an overview of Indo-European languages with a focus on Spanish

In many languages, morphosyntactic classification systems are employed to classify their nominal lexicon, with two of the most widespread features being grammatical gender in Indo-European languages and lexico-syntactic numeral classifiers in East Asian languages (Seifart, 2010; Aikhenvald, 2000; Parafita Couto et al., in press). In Indo-European languages, i.e., those that still have a gender system, grammatical gender is considered a lexico-syntactic feature to classify nouns and plays an integral role in computing agreement within the NPs (Corbett, 1991; Schriefers & Jescheniak, 1999). In gender-marking languages, human and animate nouns are primarily assigned grammatical gender categories that are related to biological sex (e.g., *maestro* "male teacher"; *maestra* "female teacher"). Likewise, inanimate nouns, which refer to non-living objects, are also marked exclusively for grammatical gender, although this marking is not deducible from the noun's meaning (e.g., the noun *mesa* "table" is feminine; *abrigo* "coat" is masculine; Corbett, 2013). In other words, the distinction of grammatical gender to inanimate nouns has no conceptual basis and is therefore considered relatively arbitrary and invariable, as each noun is assigned to only one gender form (e.g., feminine or masculine in Spanish; Corbett, 1991). Moreover, nouns denoting the same referent may receive different grammatical gender assignment across languages (Corbett, 1991), as nouns often receive distinct gender classifications depending on the language. For instance, the word *car* is masculine in Spanish (*el*$_{MASC}$ *coche*$_{MASC}$) but feminine in French (*la*$_{FEM}$ *voiture*$_{FEM}$) and neuter in German (*das*$_{NEU}$ *Auto*$_{NEU}$). Despite this cross-linguistic variability, gender is fundamentally a system of agreement classes, with agreement serving as its defining characteristic (Hockett, 1958; Corbett, 1991).

In gender-marking languages, grammatical gender is an inherent property of nouns, typically manifested through agreement with associated words such as determiners and adjectives, which must align with the

gender of the noun they modify (Hockett, 1958; Corbett, 1991;). According to the LRM speech production model (Levelt et al., 1999), grammatical gender assignment generally occurs at the lexical and syntactic levels. At the lexical level, the grammatical gender of a noun is activated and retrieved as part of its syntactic feature, with each noun assigned to one specific gender category (e.g., masculine or feminine in Spanish). When multiple lexical candidates are activated during speech planning, their gender features are encoded and compete for selection at the lemma level within the mental lexicon. At the syntactic level, gender agreement is established between the noun and other elements within NPs, such as determiners and adjectives, with these elements reflecting gender agreement with the head noun. Accordingly, gender agreement between nouns and their accompanying determiners or adjectives within NPs is easily observed in many Indo-European languages, such as Romance languages (e.g., Spanish, Italian, French) and Germanic languages (e.g., German, Dutch, see Wang & Schiller, 2019 and Sá Leite et al., 2022 for overviews).

A well-established phenomenon that illustrates the role of gender agreement in NP processing is the ***gender congruency effect***, which reveals how the gender agreement between nouns and their modifiers (i.e., nouns and modifiers agree or disagree in gender) significantly affects the speed and accuracy of NP production (see Wang & Schiller, 2019; Sá Leite et al., 2022; and Bürki et al., 2023 for an overview). Previous studies have used the PWI paradigm (Rosinski et al., 1975) to explore the gender congruency effect, where participants name the target picture while ignoring the simultaneously presented distractor word. Studies have consistently found faster naming latencies when distractors and target nouns were gender-congruent (i.e., both share the same grammatical gender) compared to gender-incongruent pairings (i.e., nouns and distractors have distinct grammatical genders) in NP production in Germanic languages, such as German (e.g., Bürki et al., 2016; Heim et al., 2009; Schiller, 2013; Schiller & Caramazza, 2003; Schiller & Costa, 2006; Schriefers & Teruel, 2000) and Dutch (e.g., La Heij et al., 1998; Schiller, 2013; Schiller & Caramazza, 2003, 2006; Starreveld & La Heij, 2004).

In contrast to the consistent gender congruency effects in Germanic languages, findings from Romance languages, particularly Spanish, have been more conflicting and less conclusive. For instance, Spanish, one of the primary languages of investigation in this thesis, employs a binary gender system in which all nouns possess an inherent grammatical gender, either masculine or feminine (Roca, 1989; Harris, 1991). This gender distinction is often predictable due to the relatively transparent morpho-phonological structure of nouns in Spanish, i.e., *-o* are predominantly masculine, *-a* are often feminine, and *-e* can be either gender (Roca, 1989; Harris, 1991). Within Spanish NPs, determiners and adjectives do not carry inherent gender themselves, but instead exhibit agreement by aligning with the gender of the noun they modify (e.g., *la manzana roja* [the$_{FEM}$ apple$_{FEM}$ red$_{FEM}$] "the red apple", Hopp, 2016). As such, gender agreement is relatively transparent and easily observed in Spanish NPs. Despite this structural transparency, empirical findings on the gender congruency effect in Spanish remain inconsistent and contradictory. For instance, Paolieri et al. (2010) reported a reversed gender congruency effect in Spanish bare noun production, while other studies found no such effect, as in Finocchiaro et al. (2011) and O'Rourke (2007) (see detailed descriptions in Chapter 2 of this thesis). Further inconsistencies arise in Spanish NP production, where Von Grebmer zu Wolfsthurn et al. (2021) observed a cross-language gender congruency effect among German second language (L2) learners of Spanish, whereas Costa et al. (1999b) reported no such effect in native Spanish speakers. This variability highlights the need for a more nuanced understanding of how grammatical gender is processed and produced in Spanish NP production, thereby motivating the current investigation into unilingual Spanish NP production by Spanish speakers in Chapter 2.

However, how is grammatical gender processed in bilingual contexts, particularly in situations where code-switching frequently occurs? In previous research on code-switching, it has been found that bilinguals tend to frequently code-switch between gender-marked determiners and gender-marked or non-gender-marked nouns within mixed NPs in

naturalistic data (e.g., Parafita Couto & Gullberg, 2019; Deuchar, 2005, 2006). This raises great interest in how grammatical gender is assigned for nouns, especially for non-gender-marked nouns, within mixed NPs. By investigating this phenomenon, three main gender assignment strategies have been identified and well-documented using different methodologies across language combinations (e.g., Spanish–English, Spanish–Basque, Purepecha–Spanish, see overview in Appendix 3.A of Chapter 3). This includes the default strategy, the translation equivalent strategy, and the shape-based strategy (see Bellamy & Parafita Couto, 2022 for an overview).

The first well-documented strategy is the default strategy, which refers to a tendency to default one gender to most inserted nouns from the other language, irrespective of their translation equivalents, semantic properties, or morpho-phonological features (cf. Bellamy & Parafita Couto, 2022). For example, Spanish–English bilinguals in Miami, Florida, default Spanish masculine gender to a transparent feminine human-referent English noun and produce *un renaissance woman* "the$_{\text{MASC}}$ renaissance woman", rather than *una renaissance woman* "the$_{\text{FEM}}$ renaissance woman" (Valdés Kroff, 2016). The second strategy is the translation equivalent strategy, also known as analogical criterion (Liceras et al., 2008) or analogical gender (Montes-Alcalá & Lapidus Shin, 2011), in which speakers tend to assign gender to most other-language inserted nouns based on the gender of their translation equivalents in the matrix or recipient language in mixed NPs (cf. Bellamy & Parafita Couto, 2022). For instance, Spanish-English bilinguals associate the English word *deer* with its masculine Spanish translation equivalent *venado*$_{\textit{MASC}}$, producing a mixed NP such as *el deer* "the$_{\text{MASC}}$ deer" (Jake et al., 2002). The third is the shape-based strategy, which also refers to "phonological gender criterion" (Poplack et al.,1982) or "phonological strategy" (Munarriz-Ibarrola et al., 2022). This strategy has primarily been observed among bilinguals with alphabetic languages that share similar morpho-phonological properties (cf. Bellamy & Parafita Couto, 2022). In such cases, bilinguals tend to rely on the phonological or morpho-phonological cues of nouns from the donor language when assigning gender in the recipient language (cf. Bellamy & Parafita Couto,

2022). For instance, Basque–Spanish bilinguals produce *la liburua* "the$_{FEM}$ book" where they associate the Basque definite marker *-a* with the Spanish feminine marker *-a*, although Basque does not feature a gender system (Parafita Couto et al., 2016).

In the previous studies, these three strategies have been consistently documented in various language combinations (see Bellamy & Parafita Couto, 2022), some of which involve a pairing where one language has grammatical gender while the other does not (e.g., Spanish–English in Balam et al., 2021 and Liceras et al., 2008; Spanish–Basque in Parafita Couto et al., 2016; or Spanish–Purepecha in Bellamy et al., 2018; also see Bellamy & Parafita Couto, 2022 for an overview), and other combinations involve languages in which one or both have two or more gender categories (e.g., Spanish–German in González-Vilbazo, 2005). Building on this background, we have already gained a broader understanding of how bilinguals employ strategies to assign grammatical gender in different language combinations in code-switching contexts. Despite this progress, some language pairs remain understudied. One such language pair is Spanish–Chinese, which, to date, has received little attention and remains largely unexplored, making it a valuable case for examining how the presence or absence of grammatical gender across bilinguals' languages shapes gender assignment strategies. As such, we aim to examine how Spanish–Chinese bilinguals assign Spanish grammatical gender to Chinese nouns in Spanish–Chinese mixed NPs, and, accordingly, to determine which gender assignment strategies they would employ in Chapter 3.

1.2.2 Classifiers: an overview of East Asian languages with a focus on Chinese

Unlike Indo-European languages, which often feature grammatical gender systems, most East Asian languages do not categorize nouns based on grammatical gender; instead, they use lexico-syntactic numeral classifier systems (Aikhenvald, 2000; Parafita Couto et al., in press). These classifier systems in most East Asian languages typically comprise extensive sets of

classifiers, often ranging from dozens to hundreds, many of which overlap in form or meaning with open-class nouns (see Seifart, 2010; Bisang, in press; Parafita Couto et al., in press). In such systems, the numeral classifier functions to categorize count nouns into distinct semantic groups, with each group corresponding to a specific classifier (Gil, 2005). These classifiers are obligatorily used in numeral constructions, where they appear adjacent to numerals, but not necessarily to the nouns (Greenberg, 1972). However, the position of classifiers is often not consistent across East Asian languages. For example, in Chinese, classifiers typically precede the noun, as in 一只鸟, /yi1zhi1niao3/ [one + classifier-zhi1+ bird], "one bird", which follows the grammatically acceptable structure of [numeral + classifier + noun]. In contrast, Japanese and Korean allow classifiers to appear either before or after the noun (see Qian, in press for an overview). For example, in Japanese, both 三羽の鳥, /san wa no tori/ [three + classifier-wa + genitive case marker + bird], "three birds", where the classifier precedes the noun, and 鳥三羽, /tori san wa/ [bird + three + classifier-wa], "three birds", where the classifier follows the noun, are grammatically acceptable (see Qian, in press for an overview). Importantly, the selection of classifiers largely depends on the semantic properties of nouns, in which classifiers largely align with the semantic properties of the noun they modify (Seifart, 2010).

Chinese serves as a primary example of the numeral classifier language, in which a numeral classifier system is used for categorizing nouns. In Chinese NPs, classifiers are obligatorily positioned between numerals or demonstratives and nouns (i.e., demonstrative/numeral + classifier + noun, Li & Thompson, 1981). The selection of classifiers within Chinese NPs largely relies on semantic properties of nouns, such as animacy, shape, size, function, and consistency, though this transparency does not apply uniformly to all nouns (Li & Thompson, 1981; Myers & Tsay, 2000). For example, in the phrase 一把勺子, /yi1ba3shao2zi0/ [one + classifier-ba3 + spoon], "one spoon", both the classifier 把 /ba3/ and the noun 勺子 /shao2zi0/ "spoon" refer to things that typically have a handle (Guo,

2002). This relative transparency of classifier choice has raised considerable interest in research on classifier processing, particularly in how speakers access and retrieve classifiers during speech production.

Following the LRM speech production model (Levelt et al., 1999), previous research suggested that numeral classifiers, as a lexico-syntactic feature, undergo a selection process that is similar to that of grammatical gender in gender-marking languages (e.g., Wang et al., 2019; also see Wang & Schiller, in press and Qian, in press for an overview). One phenomenon that supports this parallel is an analogous effect observed in Chinese, i.e., the ***classifier congruency effect***, which reflects how congruent or incongruent classifier-noun pairings influence the speed and accuracy of Chinese NP production. Specifically, previous studies using the PWI paradigm found that Mandarin Chinese speakers tend to produce classifier-NPs more quickly and accurately when the classifier is congruent with the noun, as opposed to when there is incongruency in NP production (e.g., Wang et al., 2006; Huang & Schiller, 2021) but not in bare noun production (e.g., Wang et al., 2006; Wang et al., 2019). While the classifier congruency effect has been documented in Chinese speakers, little is known about how bilingual speakers, particularly those whose other language does not employ a classifier system, process and retrieve classifiers during speech production. To address this gap, Chapter 4 of this thesis investigates the classifier congruency effect in the Chinese NP production of early Spanish−Chinese bilinguals, offering insights into how lexico-syntactic features are processed in bilinguals' minds.

In addition to exploring the phenomenon of classifiers in unilingual Chinese contexts, this bilingual population also provides a special opportunity to examine how classifiers are processed and assigned within mixed NPs during code-switching. However, to date, limited studies have specifically investigated this aspect among Spanish−Chinese bilinguals. Given that both grammatical gender and classifier function as noun-based categorization systems, and that Section 1.2.1 and Chapter 3 of this thesis have already discussed gender assignment strategies across bilingual communities and within the Spanish−Chinese bilingual group, it is thus

equally important to examine how classifier assignment unfolds in code-switched contexts. This investigation helps build a more complete picture of how bilingual speakers navigate parallel lexico-syntactic features across their two languages. To set the stage for this investigation, we thus draw on the strategies of gender assignment in Section 1.2.1 to hypothesize analogous strategies for classifier assignment within mixed NPs in Chapter 5.

First, we propose a comparable default strategy for classifier assignment in mixed NPs. Comparable to Spanish, which features a default masculine gender, Chinese also possesses the general classifier *ge* (个 /ge4/) that is often used as a default choice for most Chinese nouns by Mandarin Chinese speakers in Mainland China, particularly with nouns lacking specific categories or involving unfamiliar concepts (see Myers & Tsay, 2000 and Erbaugh, 2006). By analogy, this suggests the plausibility of a potential default strategy that applies to classifier assignment in mixed NPs, in which the general classifier *ge* would be the default for most other-language inserted nouns. Thus, we posited a default strategy for classifier assignment in mixed NPs. Second, according to the rationale of the translation equivalent strategy in gender assignment, we also hypothesize a comparable translation equivalent strategy for classifier assignment in mixed NPs. By employing such a strategy, bilingual speakers might draw on the classifier typically associated with the Chinese translation equivalents of other-language inserted nouns.

However, unlike the first two strategies described above, we do not expect the shape-based strategy to appear for classifier assignment in Spanish–Chinese bilingual contexts. This is largely due to the typological and orthographic differences between the two languages. Specifically, this strategy has been predominantly observed in bilinguals with two alphabetic languages, where phonological or morpho-phonological cues, such as phonological or morphological endings of nouns, can serve as reliable gender cues across languages (cf. Bellamy & Parafita Couto, 2022). In contrast, Chinese is a logographic language that lacks both inflectional

morphology and transparent phonological endings in typology, orthography, and morpho-phonological form. Moreover, classifier assignment in Chinese is not typically driven by the phonological or morphological shape of the noun; instead, it largely relies on the semantic properties of nouns. Furthermore, Spanish lacks a classifier system. Therefore, the shape-based strategy is unlikely to be used for classifier assignment in Spanish–Chinese bilingual contexts. Together, by analogically proposing two classifier assignment strategies, we aim to examine how bilinguals process the assignment of Chinese classifiers in Chinese–Spanish code-switched NPs in Chapter 5.

To sum up, adopting this dual perspective by examining both grammatical gender and classifier in unilingual and bilingual contexts is particularly valuable, as it sheds light on how early Spanish–Chinese bilinguals navigate two distinct but systematic mechanisms in mixed NPs involving different lexico-syntactic features. Studying both features provides us with a broader understanding of how bilinguals manage typologically different grammatical systems and whether they rely on similar or distinct cognitive processes when processing these diverse lexico-syntactic features.

1.2.3 Adjective placement in Spanish and Chinese

We have established how grammatical gender and classifier systems, language-specific features, are featured and processed in Spanish and Chinese, respectively. It is also crucial to turn to another key aspect of lexico-syntactic features: adjective placement, a shared feature that is present in both languages but differs in its position. Specifically, Spanish predominantly employs a postnominal adjective order, placing the adjective after the noun in most nominal constructions (Terker, 1985). For example, *flor roja*, [flower red], "red flower". This surface postnominal order in Spanish (i.e., Romance language) is generally explained by overt noun movement across the adjective, triggered by a strong EPP (Extended Projection Principle) feature in the agreement phrase (AgrP), as described by Cinque (1994, 1999) within the universal base structure. In this account,

adjectives are base-generated prenominally, but the noun raises past them to satisfy language-specific syntactic requirements, resulting in the surface postnominal order typical of Spanish. Cantone and MacSwan (2009) further propose that, in code-switched speech, the adjective placement should be determined by the language of the adjective itself. Moreover, considering such features of adjectives in code-switched speech, in which the adjective placement is determined by the lexical item (i.e., the adjective itself, proposed by the MP model) while at the same time shaped by language-specific syntactic rules (e.g., to check strong agreement features before pronunciation), we thus treated adjective placement, particularly adjective-noun word order, as a lexico-syntactic feature in this thesis. Nevertheless, it is important to note that the following paragraphs also address alternative explanations for adjective positioning offered by the MLF model (Myers-Scotton, 1993, 2002).

Unlike Spanish, Chinese employs two common adjective-noun structures, adjective *de* noun (A *de* N) and adjective plus noun (A N), with the adjective consistently preceding the noun in both structures (Li & Thompson, 1981; Paul, 2010). The "A N" form typically categorizes the noun as a subtype (e.g., *黄豆*, /huang2dou4/ [yellow bean], "soybean"), while the "A *de* N" structure uses *de* (i.e., *的* /de0/) as a linker to specify or clarify features of the noun (e.g., *红色的花*, /hong2se4de0hua1/ [red flower], "red flower") (Li & Thompson, 1981; Paul, 2010). In general, the "A *de* N" structure is the more frequent pattern for adjectival modification than the "A N" structure in Chinese (Li & Thompson, 1981), and it is therefore the primary focus of this thesis.

In recent years, adjective placement in code-switched speech has been well-studied and discussed in several studies (e.g., Cantone and MacSwan, 2009; Myers-Scotton, 1993, 2002; Balam & Parafita Couto, 2019; Stadthagen-González et al., 2019; Parafita Couto & Gullberg, 2019; Pablos et al., 2019; Vanden Wyngaerd, 2017; Parafita Couto et al., 2015; Parafita Couto et al., 2017; Vaughan-Evans et al., 2020; Van Osch et al., 2023), particularly because it provides an informative lens into how bilingual

speakers manage structures that exist in both languages but are governed by distinct syntactic rules. Such structures represent what Poplack and Meechan (1998) term "conflict site", where the grammatical rules of two languages differ. Adjective placement thus provides an ideal case for investigating how bilinguals manage lexico-syntactic integration across Spanish and Chinese.

Two influential theoretical frameworks, the Matrix Language Frame (MLF, Myers-Scotton, 1993, 2002) and the Minimalist Program (MP)-based approaches (MacSwan, 1999), have been proposed to account for the adjective placement conflict in bilingual speech. Specifically, the MLF (Myers-Scotton, 1993, 2002) suggests that in code-switching, one language, the ML, provides the morphosyntactic structure, while the other language, the embedded language (EL), contributes the lexical items. As such, in adjective-noun code-switched phrases, the MLF (Myers-Scotton, 1993, 2002) predicts that the adjective placement should follow the word order of the ML. On the other hand, the MP-based approaches (Cantone & MacSwan, 2009) suggest that the grammatical features in code-switched phrases should be determined by the lexical items themselves. Moreover, following Cinque's (1994, 1999, 2005) universal base structure, Cantone and MacSwan (2009) reach the generalized description that the adjective placement is determined by the language of the adjectives. It is important to note that although these two models focus on different aspects and have distinct assumptions, their predictions about adjective placement can overlap or differ. For example, some sentences can be explained by both models (MLF+/MP+), some only by one of them (e.g., MLF+/MP− or MLF−/MP+), and others by neither (MLF−/MP−).

While the predictions of these models have been extensively examined across various language combinations, such as Spanish−English (e.g., Balam & Parafita Couto, 2019; Stadthagen-González et al., 2019), Papiamento−Dutch (e.g., Parafita Couto & Gullberg, 2019; Pablos et al., 2019), French−Dutch (e.g., Vanden Wyngaerd, 2017), Welsh−English (e.g., Parafita Couto et al., 2015; Parafita Couto et al., 2017; Vaughan-Evans et al., 2020), and Spanish−Dutch/Papiamento−Dutch (e.g., Van Osch et al.,

2023), no definitive consensus has yet been reached in fully explaining grammatical patterns in adjective-noun code-switching. This lack of conclusive findings underscores the importance of further research with understudied language combinations to deepen our understanding of adjective-noun code-switched patterns. The Spanish−Chinese language combination is especially underexplored in this context, which could provide an ideal opportunity to address this gap and offer new insights into how bilinguals resolve syntactic conflicts involving adjective-noun order. Accordingly, Chapter 6 of this thesis aims not only to examine how bilinguals process grammatical constraints proposed by these models when placing adjectives in mixed adjective-noun constructions, but also to uncover novel aspects of code-switching behavior in this distinctive linguistic context.

1.3 Open science and bilingualism as discovery science

Beyond the core linguistic and psycholinguistic issues discussed so far, it is also important to situate this thesis within broader scientific practices. In particular, we turn to the emerging phenomenon of ***Open Science***, which has become increasingly influential in shaping contemporary scientific practices (Vicente-Saez & Martinez-Fuentes, 2018). Specifically, Open Science provides a framework for greater transparency, accessibility, shareability, and collaboration within the scientific community. Those goals are supported through practices, such as open data, open code, open access, open peer review, and pre-registration (Vicente-Saez & Martinez-Fuentes, 2018). The absence of such practices has been considered a major factor that caused the ***replication crisis*** in linguistics, particularly in experimentally oriented fields (Sönning & Werner, 2021; Ioannidis, 2005). For instance, a lack of transparency in methodology and data analysis, and the unavailability of original data and materials, have made it difficult to verify published results and to reproduce scholarly work (Sönning & Werner, 2021). To address these challenges, recent research has encoura-

ged measures such as full transparency of data analysis and full accessibility of materials and code (Paquot & Callies, 2020), and the pre-registration of data collection and analysis plans (Chambers, 2013). This thesis aims to continuously contribute to these Open Science efforts in several ways. First, we ensure full transparency in our experimental designs, procedures, and in reporting participants' linguistic backgrounds in all main chapters. Second, we have made all experimental materials, data analyses, and statistical code for all chapters openly available and easily accessible through the Open Science Framework (OSF, Foster & Deardorff, 2017). Finally, we provide a detailed rationale for our statistical analytical choices and describe every step of our data analysis procedures thoroughly. By doing so, all data for each chapter in this thesis are transparent, accessible, and readily replicable.

Apart from concerns about Open Science, there has been growing attention on the replication crisis in bilingualism research, particularly regarding the reproducibility and replicability of published findings (Navarro-Torres et al., 2021). Previous research has pointed out that factors such as statistical power and sample size (e.g., Brysbaert, 2021), sampling and methodological noise (e.g., García-Pentón et al., 2016a, 2016b), and publication bias (Bialystok et al., 2015) undoubtedly affect how reproducible and interpretable bilingualism research is. However, it is the prescribed solutions to these factors, such as employing large samples (e.g., Brysbaert, 2021) or enforcing strict methodological uniformity (i.e., employing exactly the same methodologies as those used in the studies being replicated, García-Pentón et al., 2016a, 2016b), that have the strongest influence on shaping the current replication challenges in bilingualism research (Navarro-Torres et al., 2021). These prescribed solutions can be overly simplistic and fail to reflect the true nature of science as a process of discovery, one that involves exploration, adaptation, interpretation, and evolution, thereby easily misleading the direction of replication research (Navarro-Torres et al., 2021). The remedy for this issue is the generation of ***variety*** by applying diverse ideas, methods, and scientific practices, as it could help identify reliable signals (e.g., appr-

opriate characterization, research practices, and research tools) from inconsistent observations to ensure incremental improvement in science (Navarro-Torres et al., 2021). This is evident, for example, in the study on grammatical gender assignment strategies in mixed NPs (i.e., Chapter 3 of this thesis), where findings and interpretations regarding the strategies employed by bilinguals have varied across studies, different methods, bilingual populations, social networks, and community characteristics (see Chapter 3 for detailed descriptions). In such cases, simply following rigid prescriptions, such as repeating a single study's methodologies or expanding the sample size, cannot guarantee meaningful and successful replication. Instead, identifying convergent patterns across diverse studies and maintaining *variety*, such as exploring new hypotheses, employing multi-method approaches, and interpreting findings within the complex variables of bilingual contexts based on rich characterizations of data, is key to reaching reliable, replicable conclusions (i.e., reliable signals).

To sum up, bilingualism is complex, and we are still far from fully defining the limits and conditions of previous findings (Navarro-Torres et al., 2021). For replication efforts on bilingualism to be truly meaningful, it is essential to situate them within the broader view of science as an ongoing process of discovery, where incremental insights and methodological diversity are essential in advancing research on bilingualism. In line with these principles, the present thesis continues this effort by combining rich participant characterizations, accessible and transparent materials, multi-method approaches, and incremental understanding to support more reliable and replicable research on Spanish−Chinese bilingual language processing. Central to this endeavor is the systematic use of a multi-task approach, employing diverse methodologies as a response to the complexity of bilingualism in the context of this thesis. It reflects an effort to extract reliable signals from inconsistent observations by capturing a relatively broad and comprehensive range of variables relevant to bilingual language processing. This approach underpins the bilingual investigation carried out in this thesis.

1.4 The current thesis

Taken together, the questions outlined above bring us back to the central question: how do bilingual speakers manage two distinct languages in their minds? Despite considerable research, several critical issues still remain to be addressed in order to answer this question: first, we aim to determine whether grammatical gender is competitively selected during Spanish NP production and further identify whether this competitive selection is reflected in the grammatical gender effect; second, we explore how Spanish grammatical gender is processed and assigned to Chinese nouns in mixed Spanish−Chinese NPs by Spanish−Chinese bilinguals and determine which gender assignment strategies are employed; third, we investigate whether classifiers are activated and competitively selected during Chinese NP production by both Mandarin Chinese speakers and Spanish−Chinese bilinguals and whether such selection processes manifest as a classifier congruency effect; fourth, we examine how classifiers are processed and assigned to Spanish nouns in mixed Chinese−Spanish NPs by Spanish−Chinese bilinguals and identify the corresponding classifier assignment strategies they used in mixed NPs; fifth, we explore how Spanish−Chinese bilinguals resolve syntactic conflicts in adjective placement across their two languages in mixed adjective-noun constructions, aiming to not only examine how grammatical constraints influence bilinguals' processing of adjective placements but also uncover insights into code-switching behaviors in this unique linguistic context. Overall, our core research questions center on a unifying theme: how are lexico-syntactic features, namely grammatical gender, classifiers, and adjective placement, processed and produced in bilingual and/or unilingual contexts across Spanish and Chinese?

In **Chapter 2** of this thesis, we first explore the effects of grammatical gender on Spanish NP production by Spanish speakers. Specifically, we examine the *gender congruency effect* on Spanish determiner-NP production by measuring Spanish speakers' naming latencies. Previous studies exploring the presence of the gender congruency effect in Spanish

language production obtained controversial results, in which this effect was reported as either existing (e.g., Von Grebmer zu Wolfsthurn et al., 2021) or non-existent (e.g, Costa et al., 1999b; Finocchiaro et al., 2011; O'Rourke's, 2007), or even a reverse effect was observed (e.g., Paolieri et al., 2010). To tackle this critical issue, we employ a PWI paradigm to address the following questions: first, whether the selection process of grammatical gender is competitive in Spanish; second, if the process is competitive, whether this competition of grammatical gender surfaces as a variation in naming latencies is reflected by the gender congruency effect in Spanish. In this, we seek to characterize how Spanish speakers process grammatical gender in unilingual Spanish determiner-NP production. This study is important, as establishing the gender congruency effect in Spanish is not just a "baseline" but a critical behavioral evidence for challenging existing inconsistencies in Romance language literature. Additionally, this study offers valuable insights into how Spanish speakers process grammatical gender in Spanish NP production within unilingual Spanish contexts, laying a foundational understanding for investigating lexico-syntactic features not only in bilingual contexts but also in typologically different languages that share comparable lexico-syntactic features (e.g., classifier in Chinese).

In **Chapter 3**, we shift the focus from unilingual to bilingual contexts to investigate how grammatical gender is processed in mixed determiner-NPs by bilingual speakers. Yet, little research has explored the processing and assignment of grammatical gender in bilingual contexts involving Spanish and Chinese. Therefore, we employ a multi-task approach to test how early Spanish−Chinese bilinguals process and assign Spanish grammatical gender to Chinese nouns in mixed Spanish−Chinese NPs. In other words, we examine which grammatical gender categories (e.g., masculine or feminine) bilinguals tend to assign to Chinese nouns through their choice of Spanish determiners. Next, we identify the corresponding gender assignment strategies that bilingual speakers prefer when selecting grammatical gender in mixed NPs. The critical contribution of this study lies in being the first to examine how grammatical gender is assigned in

mixed Spanish–Chinese NPs by Spanish–Chinese bilinguals. It documents that Spanish–Chinese bilinguals do not rigidly adhere to one linguistic rule or strategy, but instead flexibly adapt their language processing and production based on task demands and sociolinguistic context. As such, this study adds a crucial piece to the broader picture of how grammatical gender, as one of the lexico-syntactic features, is processed in bilingual contexts.

In **Chapter 4**, we turn our attention to the effects of classifiers in Chinese, a comparable lexico-syntactic feature that exists in a typologically different language from Spanish. Previous research on Chinese NP production is scarce, particularly regarding the role of Chinese classifiers in both Mandarin Chinese speakers and early Spanish–Chinese bilinguals with electrophysiological measures. Therefore, we investigate how Chinese classifiers are processed during Chinese NP production in overt picture-naming tasks by both early Spanish–Chinese bilinguals and Mandarin Chinese speakers. Specifically, we examine whether the *classifier congruency effect* occurs in Chinese NP production in both groups. To do so, we measure naming latencies and probe electrophysiological correlates, with particular focus on the modulation of the N400-like component elicited by classifier violations, during the production of Chinese NPs in four manipulated conditions. This study contributes to crucial behavioral and neurocognitive evidence for the robustness of the classifier congruency effect in bilingual language production, advancing our understanding of how bilinguals process classifiers in ways that closely resemble the patterns observed in monolingual Chinese speakers in previous studies. This finding is important to the thesis because it extends the investigation of lexico-syntactic processing beyond grammatical gender, showing that bilinguals also demonstrate sensitivity to classifier-NPs in production and underscoring the parallel cognitive processing mechanism in both gender and classifier systems. As such, this study provides a more complete picture of how bilinguals manage different lexico-syntactic systems across their two languages.

In **Chapter 5**, we extend the investigation by examining how bilingual speakers assign classifiers during the processing and production of code-switched classifier-NPs. Building on the fundamental understanding of classifier processing in Chinese NP production within unilingual contexts established in Chapter 4, this chapter expands the research to bilingual contexts to examine how bilinguals assign classifiers when processing and producing mixed Chinese–Spanish NPs. To do so, we employ a multi-task experimental design parallel to that used in Chapter 3 to determine which classifier assignment strategies bilinguals will use in mixed NPs. This approach allows us to examine whether bilinguals apply similar strategies when assigning these distinct lexico-syntactic features in mixed NPs within bilingual contexts. This study contributes to the first demonstration that bilinguals flexibly employ default and translation equivalent strategies for classifier assignment based on task demands and sociolinguistic context. It reveals parallel patterns with gender assignment strategies observed in the same bilingual community in Chapter 3, highlighting bilingual flexibility and adaptability in navigating multiple linguistic systems. Additionally, this particular study completed a piece of the puzzle to this thesis in understanding how lexico-syntactic features are processed within NPs across unilingual and bilingual contexts.

In **Chapter 6**, we present a study on adjective-noun order in mixed Spanish–Chinese nominal constructions, conducted with the same group of early Spanish–Chinese bilingual speakers examined in Chapter 5. Building on the previous four chapters, which provided a relatively comprehensive understanding of how grammatical gender and classifiers are processed in unilingual and bilingual contexts, we shift our focus to adjective placement. This is because grammatical gender and classifiers are language-specific features unique to Spanish and Chinese, respectively, and thus offer limited insight into how the two systems interact. In contrast, adjective placement represents a shared structure with contrasting word orders, which allows us to explore how bilinguals navigate structural differences between their languages. Thus, we examine how early Spanish–Chinese bilinguals resolve the conflict of adjective place-

ment in mixed Spanish–Chinese nominal constructions. Specifically, we probe how syntactic constraints, proposed by two theoretical models (i.e., the MLF model and MP-based approaches), shape adjective-noun patterns in these code-switched constructions. Moreover, we examine whether noun insertion, which is favored by bilinguals in other communities, is similarly preferred by Spanish–Chinese bilinguals. This study is conducted in both unilingual and bilingual contexts to provide a comprehensive understanding of whether bilinguals process adjective-noun constructions in similar ways across language contexts. This allows us to further explore how bilinguals navigate linguistic interaction in two languages with divergent grammatical systems. This study addresses syntactic differences with an underexplored bilingual population and language pair, contributing to the growing body of research on adjective placement in bilingual speech. Importantly, this study offers the final analytical piece in understanding how lexico-syntactic features are processed and integrated across Spanish and Chinese in both unilingual and bilingual contexts, completing the broader investigation undertaken in this thesis.

Chapter 7 provides an integrated discussion of the research findings from each chapter, emphasizing their theoretical implications. Furthermore, we identify potential limitations of the different studies and outline directions for future research to provide a more comprehensive understanding of how lexico-syntactic features are processed in both unilingual and bilingual contexts.