Third Language Grammatical Gender and Number Acquisition in a German-Like Artificial Language

Qualifying Paper 1

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Abstract

Previous work on the acquisition of German as a third language has suggested that beginner L3 learners with previous knowledge of Spanish as an L2 show an advantage over L1 Spanish learners in their ability to recognize grammatical gender errors in L3 German (Brown 2018; Brown 2020). However, Puig-Mayenco & Rothman (2019) note that there is a critical difference between low-proficiency and initial state learners. While these previous results demonstrate some difference between groups, it is unclear whether that difference resulted from initial transfer or later developmental difference. This experiment looks to further explore this question by examining true initial state L3 learners.

In order to better investigate learners' grammatical gender abilities at the true initial state of acquisition, as well as further analyze these learners' acquisition of L3 DP features as a whole, this study compares sequential Spanish/English (L1 English L2 Spanish and L1 Spanish L2 English) and Mandarin/English bilinguals (L1 English L2 Mandarin and L1 Mandarin L2 English) with no previous knowledge of German in their ability to acquire grammatical gender and number in an artificial Germanic L3.

Data collection was limited by unforeseen circumstances, but the results from the available data demonstrate trends that differ from this author's previous work. Results found no significant differences between any of the language background groups in ability to identify grammatical gender or number errors. It is possible that the lack of statistical significance in these findings was the result of the limited size of the participant pool, and that these later analysis may reveal significant differences when more data is available. However, as it stands these findings fall in line with several of the previously proposed partial transfer models of L3 acquisition. In particular, Slabakova's Scalpel Model (2017) stands out as able to predict not only these current findings, but also the L2 Spanish advantage that was found in the beginner (but non-initial-state) L3 German learners examined in this author's previous work.

Key Words: Third language acquisition, initial state, transfer, grammatical gender, grammatical number, artificial language, English, Spanish, German

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Contents

1 Introduction

Since early in the investigation of language acquisition, it has been observed that mistakes made by adult language learners are not random, but systematic (Adémian 1976, Corder 1967, Nemser 1971, Selinker 1972, and in many cases these errors can be attributed to the influence of the first or native language (L1) grammar (Hawkins & Chan 1997; Liceras et al. 1997; Smith & Tsimpli 1995). When this influence of a previously known language occurs at the very onset of second language (L2) acquisition, the phenomenon is often referred to as "transfer". The transfer of L1 grammatical features at the initial state of L2 learning is a topic that has been extensively discussed in the literature (e.g. Flynn 1981; White 2003).

In L2 acquisition research, the source of transfer for the initial state of the L2 is relatively straightforward: the L1 is the only potential source of linguistic knowledge from which the learner can transfer initial state grammatical features. If it were the case, however, that an L2 speaker or bilingual were to then acquire a third language (L3), then the process of initial state transfer will immediately become more complicated. The L3 initial state has two potential source languages from which it could be drawing linguistic information. The degree to which each language is able to transfer features to the L3 initial state is subject to a variety of potential variables which could potentially play a role. These factors include, but are not limited to, age of acquisition (of the L2 or the L3), order of acquisition, amount of classroom instruction, (psycho-)typological similarity, socio-cultural status of the language, language use in that speaker's community, and individual cognitive factors (Hammarberg, 2012).

This work looks to continue the work of Brown (2018, 2020), investigating the acquisition of L3 German by learners with language backgrounds of L1 English L2 Spanish and L1 Spanish L2 English, as well as a group of controls with L1 English L2 Mandarin or L1 Mandarin L2 English. Participant groups are compared in their ability to acquire grammatical gender and number in an artificial Germanic L3 in order to test the degree to which factors such as order of acquisition and typological similarity of previously known languages may influence transfer for speakers with these different language backgrounds. The remainder of the paper is structured as follows:

Section 2.1 outlines the previous proposals and models of L3 acquisition, Section 2.2 discusses previous work related to adult acquisition of grammatical gender and number, with section 2.2.3 going into further detail related to the use of artificial languages in this research. Section 2.3 provides a more detailed explanation of the research question and the predictions of various L3 acquisition models in regards to this work. Section 3 outlines the artificial language used and the experimental procedure. Results are reported in Section 4, and further analyzed in Sections 5 and 6.

2 Background

2.1 Models of L3 Acquisition

In an attempt to isolate key predictors of L3 initial state transfer out of the many potentially influencing variables, L3 researchers have proposed a variety of L3 acquisition models. Puig-Mayenco et al. (2018) have organized these models into two general categories: wholesale transfer or partial transfer models.

2.1.1 Wholesale Transfer Models

As their name suggests, wholesale transfer models predict that one language is selected in its entirety to serve as the exclusive source language at the initial stages of L3 acquisition. The non-selected language, meanwhile, is unable to contribute features to the L3 at the initial state, even if those features would be beneficial. However, the claims of individual wholesale transfer models differ in regards to which factors play a role in determining whether the L1 or the L2 serves as the source language.

One proposal that falls into the wholesale transfer camp is the idea that the process of L3 acquisition is similar to L2 acquisition in that the L1 is the sole contributor to the initial L3 grammar. This proposal, referred to as the L1 Transfer Hypothesis (L1T), is supported by the work of Hermas (2010, 2015) examining the acquisition of features including subject-verb inversion in declarative sentences, null expletive subjects, and restrictive relatives in L3 English by L1 Arabic L2 French bilinguals. Hermas found exclusive influence of L1 Arabic on the process of L3 English acquisition in his participants, despite the L2 status and stronger typological similarity of L2 French. While Hermas does not propose a model of L3 acquisition as a result of any of these findings, this paper will refer to the idea of a privileged status of the L1 as the source language for L3 acquisition as the L1 Transfer model (L1T). Other researchers who have found results supportive of L1T include Khodabandeh's (2013) analysis of L3 English adjectival word order in L1 Persian-L2 English compared L2 Persian speakers with an L1 of Azerbaijani, Armenian, or Gilaki learning L3 English. In terms of adjectival word order, Persian uses post-nominal adjectives while all other languages under consideration in this study, including the target L3 English, use pre-nominal adjectives. Results revealed exclusive transfer of the L1 word-order pattern for English learners with all language backgrounds.

Other researchers, meanwhile, have claimed the exact opposite of L1T: that the L2 holds a privileged role in initial state transfer. The L2 Status Factor Model (L2S), initially proposed by Bardel & Falk (Bardel & Falk 2007; Falk & Bardel 2010; Falk & Bardel 2011; Bardel & Falk 2012; Falk et al. 2015; Falk 2017; Bardel & Sánchez 2017; Falk & Lindqvist 2019) predicts that the similarities in acquisition experience, such as learning both the L2 and the L3 in adulthood, increased metalinguistic awareness of the L2 as a result of formal classroom instruction, and perception of the L2 and L3 as both being non-native or "foreign" languages, would result in the L2 becoming the exclusive contributor to the L3 initial state. Bardel & Falk base this claim on the neurolinguistic work of Paradis (1994), who suggests that the acquisition of additional languages beyond the L1 relies on fundamentally different neurological mechanisms than L1 acquisition. According to Paradis, L1 acquisition neurologically relies on two separate

brain mechanisms: procedural memory is responsible for the acquisition of implicit linguistic structure, including phonology, morphology, syntax, and the lexicon, while the declarative memory stores vocabulary as a set of word-meaning pairs. For L2 learners within Paradis' model, however, the procedural memory is no longer available for L2 informational storage. Instead, all L2 linguistic information is stored in the declarative memory. This difference in the brain mechanisms used to process and store linguistic structure information leads to key differences between the L1 and the L2, since the L1 linguistic structure was acquired implicitly and the L2 linguistic structure was acquired explicitly. Bardel & Falk (2012) speculate that L3 learning would show this same neurolinguistic difference vis-á-vis the L1 as the L2, and that this relation creates a strong bias for the speaker to either consciously or subconsciously choose the L2 as the source language at the initial state of L3. The L2 Status Factor model predicts that as a result of this choice, the initial L3 grammar is then created via a full transfer of the L2 grammar, regardless of whether the L2 features are beneficial, neutral, or inhibitory to L3 acquisition. L1 grammatical information meanwhile remains inaccessible for initial state transfer.

It should also be noted that in later work, Bardel & Sánchez (2017) noted that level of proficiency in both the L2 and the L3 can influence the degree to which L2 influence in L3 is found. This addition to the model was based on an analysis of L1 Spanish or Catalan, L2 German, L3 English students with different proficiency levels in both the L2 and the L3, where the L2 influence could be found in cases of low to intermediate proficiency in both the L2 and the L3. More advanced learners, however, were less likely to show L2 influence in the L3. The authors attribute these findings to these participants having a better understanding of the complex grammatical differences between the languages that comes with higher proficiency.

Additional support for L2S has been found by Jaensch (2010, 2012) in her analysis of the acquisition of various L3 German determiner phrase (DP) features such as adjectival inflection by L1 Japanese, L2 English and L1 Spanish L2 English learners, as well as in Berends et al.'s (2017) analysis of L3 Dutch quantitative pronoun constructions by sequential French/English and English French bilinguals.

It has also been proposed that a speaker's order of acquisition may not be the most critical factor in determining the source language for transfer in a wholesale transfer model. One alternative possibility is that the L3 learner transfers the previously known language that is perceived to be the most typologically similar to the new L3. The Typological Primacy Model (TPM: Rothman 2010; Rothman 2011; Rothman 2013; Rothman 2015) makes such a claim. According to TPM, the language faculty includes a device which Rothman calls the linguistic parser. Upon exposure to a new language, the linguistic parser is activated and begins gathering linguistic information about the new language and comparing it to the learner's previously known languages. The parser first evaluates lexical similarities between the L3 and all previously acquired L1s and L2s, followed by phonetic and phonological similarities, then functional morphological similarities, then syntactic similarities. According to Rothman, this process can be dependent either on actual typological similarities between languages or on perceived psychotypological similarity. Once the parser has determined which language is more (psycho)typologically similar to the L3, the entire grammar of the selected language is set as the starting point of the L3 grammar. Languages that were not selected are inaccessible to the L3.

Support for TPM has been found in an array of studies including investigations null subject acquisition (Rothman & Cabrelli Amaro, 2010), object clitic pronoun use (Montrul et al., 2011), differential object marking (Giancaspro et al. 2015), object drop (del Pilar García Mayo & Slabakova, 2015) and double object constructions (Agirre & del Pilar García-Mayo, 2017). However, it should be noted that the vast majority of studies found to support TPM have considered exclusively Indo-European languages, primarily Germanic and Romance. An analysis by Moghtadi (2016) examining the acquisition of L3 English by a group of L1 Azeri L2 Persian speakers, where both the L1 and the L2 are typologically distant from L3 English, found no significant correlation between learners' perception of similarity between the three languages and their L3 English grammar. Additionally, it should also be noted that many of the studies described in this section could potentially be supporting more than one of the proposed models. Examples can be found in the works of Rothman & Cabrelli Amaro (2010) and Berends et al. (2017), both of which fall in line with the predictions of both L2S and TPM.

A final, less prominent proposal in the L3 literature which should also be noted is the Language of the Community Proposal (LComm: Fallah et al. 2016). LComm suggests that rather than perceived similarity between the L3 and a previously known language leading to transfer, learners instead transfer the language that they are most reliant on in their everyday life. In other words, their primary language of communication serves as the source language for L3 transfer. This more recent proposal has had less support from researchers beyond the author, but emphasizes a factor that deserves additional consideration in future work.

2.1.2 Partial Transfer Models

Partial transfer models, meanwhile, predict that all previously known languages are available to the learner to some degree for the purposes of L3 transfer. The Cumulative Enhancement Model (CEM: Flynn, Foley & Vinnitskaya, 2004; Berkes & Flynn 2012 was the first model to make such a proposal, and holds that all previously known languages have the ability to potentially influence and enhance the development of subsequent language acquisition. When considering CEM, however, it is important to note that despite some summaries of CEM which have been made by other researchers (e.g. Rothman 2010; Rothman 2011; Slabakova 2017) CEM makes no direct claims regarding the transfer of unhelpful grammatical features, such as the case for Rothman & Cabrelli Amaro (2010), where the unhelpful feature of L2 Spanish null subject was found to transfer to L3 French.

It is on this topic of unhelpful or non-facilitative feature transfer where the Linguistic Proximity Model (LPM: Westergaard et al. 2017) looks to further develop the partial transfer ideas of CEM. Westergaard and her colleagues propose that language acquisition is cumulative, and that learners have access to all previously acquired linguistic knowledge, with no part of that previous linguistic competence being blocked at any stage of the acquisition process similar to the claims of CEM. They differ from CEM's claim in proposing that in addition to the facilitative transfer which occurs based on structural similarity, similar to TPM, non-facilitative influence, is also explicitly predicted as a result of learners incorrectly assuming that a linguistic property is shared between a previously acquired language, and the L3. This non-facilitative transfer may occur as a result of a mis-analysis of the L3 input, or the learner not having sufficient L3 input to make a more accurate assessment.

Structural similarity, however, may not be the only factor involved in partial transfer. In her Scalpel Model (SM) of L3 acquisition, Slabakova (2017) proposes a set of claims which are very similar to LPM in two key ways. First, both models claim that acquisition happens on a property-by-property basis, rather than wholesale transfer. Additionally, both models explicitly predict and attempt to explain non-facilitative transfer from previously known languages. However, Slabakova argues that in addition to the linguistic factors considered by LPM, cognitive and experiential factors can also influence the transfer of a particular feature. While Slabakova notes that her list of potential extra-linguistic influences is certainly not complete, she suggests processing complexity, misleading input, and construction frequency as three of the extra-linguistic variables which have been found to influence L3 acquisition success (Slabakova, 2017). It should be noted that the influence of certain factors such as order of acquisition and social context, which have previously been emphasized in certain wholesale transfer models (Bardel & Falk 2007; Fallah et al. 2016) could be accounted for in SM as extra-linguistic influences.

Examples of works which demonstrated both facilitative and non-facilitative transfer from both the L1 and L2 include Fallah et al. (2016) and Fallah & Jabbari (2018), which consider the acquisition of L3 English possessive constructions and attributives, respectively, by L1 Mazandarani L2 Persian speakers.

Table 1 below re-states all of the previously proposed models of L3 acquisition mentioned above.

Wholesale Transfer Models	**Partial Transfer Models**
L1 Transfer (L1T) Hermas, 2010	Cumulative Enhancement (CEM) Flynn et al, 2004
L2 Status (L2S) Bardel & Falk, 2007	Linguistic Proximity (LP) Westergaard et al, 2017
Typological Primacy (TPM) Rothman, 2010	Scalpel Model (SM) Slabakova, 2017
Language of Community (LComm) Fallah et al, 2016	

Table 1: Models of L3 Initial Transfer

2.1.3 Other Relevant Proposals

In addition to the L3 acquisition models listed above, all of which rely heavily on the specific language background of the L3 learner (i.e. what languages the speaker knows, what order they learned those languages in, and how similar to each other those languages are), Green (2017) emphasizes that much of the variation found between speakers in L3 research is likely the result of individual differences. More specifically, Green emphasizes that individuals will vary in their ability to activate relevant linguistic information for transfer while simultaneously suppressing the influence of unhelpful information. In other words, Green's proposal emphasizes the importance of individual extra-linguistic cognitive ability to suppress irrelevant information. Similar to the statement in section 2.1.1 regarding Fallah

et al.'s (2016) Language of Communication proposal, this work has had less direct follow-up experimental support in the literature. However, it proposes a factor that should be considered as a potential predictor of success in early L3 acquisition research.

Overall, this section has emphasized that current models of the L3 initial state are broad and often conflicting in their predictions for particular language triads. This work looks to contribute to this literature by continuing the work of Brown (2018, 2020) considering the acquisition of the L3 German determiner phrase (DP) features of grammatical gender and number.

2.2 Acquisition of Grammatical Gender and Number

2.2.1 Grammar of Nominal Gender and Number

Grammatical gender agreement is defined by Kramer (2015) as a system of sorting of nouns into two or more arbitrary classes, gender categories, or groups, which do not necessarily correlate with biological gender in any way. Grammatical gender is distinct from number and case marking within the DP, and can be expressed via morphological cues on the noun itself, as well as via agreement markers on other parts of the phrase including determiners and adjectives (Kramer, 2015).

Grammatical number agreement is another feature of the DP which is distinct from case, gender, or other DP grammatical features. In the case of the languages under consideration in this study, number agreement refers to the expression of count distinctions such as singular and plural on the noun itself, as well as agreement for that feature across other parts of the phrase such as determiners, adjectives, and verbs.

A summary of grammatical gender and number in each of the languages under consideration in this study is outlined below, with an emphasis on the aspects of these features which are relevant to the study at hand.

2.2.1.1 German

The German DP includes aspects of both gender and number morphology, both of which are heavily intertwined with case marking and definiteness in the phrase. The grammatical gender system of German includes masculine, feminine, and neuter gender categories, and the number system consists of a singular and plural.

Within the DP, gender and number agreement can occur on both determiners and adjectives. However, it is not the case that both features are always expressed on both the determiner and the adjective of a phrase at the same time. The only case in which gender is overtly expressed on both the determiner and the adjective of a German DP is when that phrase is used with an indefinite article and the noun is singular. Meanwhile, phrases containing plural nouns do not overtly express grammatical gender on determiners or adjectives, instead expressing only a number morpheme.

For the purposes of this study, the circumstances in which gender or number can be fully expressed on both the determiner and the adjective, which are noun phrases in the nominative case with an indefinite determiner, will be considered. Examples of the relevant German

phrases are provided in examples (1) through (6). More specifically, (1) provides an example of a DP with grammatical gender and number agreement on the determiner and adjective for a masculine, singular noun. (2) shows the same for a feminine, singular noun. (3) presents a DP with a neuter, singular noun. (4), (5), and (6) provide examples involving plural masculine, feminine, and neuter nouns, respectively. It should be noted that the masculine singular and neuter singular indefinite determiners in these cases are homophonous.

(1) Ein glücklich-er Mann
Det$_{[Masc/Sing]}$ happy$_{[Masc/Sing]}$ man$_{[Masc/Sing]}$
'A happy man' (Masculine, singular agreement)

(2) Ein-e glücklich-e Frau
Det$_{[Fem/Sing]}$ happy$_{[Fem/Sing]}$ woman$_{[Fem/Sing]}$
'A happy woman' (Feminine, singular agreement)

(3) Ein glücklich-es Mädchen
Det$_{[Neuter/Sing]}$ happy$_{[Neuter/Sing]}$ girl$_{[Neuter/Sing]}$
'A happy girl' (Neuter, singular agreement)

(4) Glücklich-en Männ-er
happy$_{[Pl]}$ man$_{[Pl]}$
'Happy men' (Plural agreement)

(5) Glücklich-en Frau-en
happy$_{[Pl]}$ woman$_{[Pl]}$
'Happy women' (Plural agreement)

(6) Glücklich-en Mädchen
happy$_{[Pl]}$ girl$_{[Pl]}$
'Happy girls' (Plural agreement)

2.2.1.2 Spanish

The Spanish DP also includes both gender and number morphology. However, Spanish differs from German in that both of these features are clearly expressed in all cases of determiners and adjectives in the phrase, with no dependency on case or definiteness. Additionally the Spanish grammatical gender system consists of only two options: masculine and feminine. Examples of the Spanish equivalents of the phrase structures outlined in examples (1)-(6) are provided in (7)-(10) below. It should be noted that one key syntactic difference in DP structure between Spanish and German is that the majority of adjectives in Spanish occur post-nominally, compared to the universally pre-nominal adjectives of German.

(7) Un hombre content-o
Det$_{[Masc/Sing]}$ man$_{[Masc/Sing]}$ happy$_{[Masc/Sing]}$
'A happy man' (Masculine, singular agreement)

(8) Un-a mujer content-a
Det$_{[Fem/Sing]}$ woman$_{[Fem/Sing]}$ happy$_{[Fem/Sing]}$
'A happy woman' (Feminine, singular agreement)

(9) Un-os hombre-s content-os
Det$_{[Masc/Pl]}$ man$_{[Masc/Pl]}$ happy$_{[Masc/Pl]}$
'Some happy men' (Masculine, plural agreement)

(10) Un-as mujer-es content-as
Det$_{[Fem/Pl]}$ woman$_{[Fem/Pl]}$ happy$_{[Fem/Pl]}$
'Some happy women' (Feminine, plural agreement)

2.2.1.3 English

While gender is relevant in English with respect to pronoun usage in English, grammatical gender in the nominal category system does not exist in English. Additionally, while English grammatical number can be expressed in some determiners such as demonstratives, when considering only the indefinite articles discussed in this experiment, grammatical number marking takes place using morphology only on the noun itself in English to mark plurality. This feature is not expressed in other parts of the DP such as the determiner or adjective. This is demonstrated in (11) and (12) below.

(11) A happy man
Det happy man$_{[Sing]}$

(12) Some happy men
Det happy man$_{[Pl]}$

2.2.1.4 Mandarin

Like English, Mandarin does not have any form of grammatical gender system. Meanwhile the grammatical number feature of Mandarin is not expressed using any type of morphological agreement system. Instead, number information can only be expressed in Mandarin using numerals (Tsang, 2016), as shown in examples (13) and (14).

(13) yi-ge gaoxing de nanren
One-CL[1] happy DE[2] man
'A happy man'

(14) yixie gaoxing de nanren
Some happy DE man
'Some happy men'

[1]CL = "Classifier"
[2]Pre-nominal modification marker (Huang, 2009)

2.2.2 L1 Grammatical Gender and Number Acquisition

Before discussing what is known about the process of German grammatical gender and number acquisition in adult learners, let us take a moment to discuss the research that has been done in regards to the process of grammatical gender and number morpho-syntactic acquisition in child L1 learners.

In terms of grammatical gender, researchers such as Clark (1986) and Soler (1984) have shown that children acquiring Spanish have acquired target-like grammatical gender abilities before the age of 2;7. Children acquiring German, meanwhile, acquire the gender system around the age of 3 years. However, these children have been shown to continue making gender errors with regard to neuter nouns until around the age of 4. This delay has been attributed to the complexity of the German grammatical system compared to those of Romance languages such as Spanish, including factors such as German's three gender categories and the intertwinement of gender with grammatical number and case (Mills 1986; Jansen 2009).

Acquisition of grammatical number morphology in L1, meanwhile, shows less variation between the languages discussed in this study. A variety of research has shown that children acquiring English (Wood et al., 2009), Spanish (Aguirre & Marrero, 2009), and German (Korecky-Kröll & Dressler, 2009) typically show limited and inconsistent use of plural morphology before the age of 2;0, followed by a dramatic increase in the use of plural morphology between the ages of 2;0 and 2;2.

Finally, in the case of both the acquisition of grammatical gender and number, research across several Romance and Germanic languages has found that children are first able to correctly apply the grammatical gender feature to determiners. Agreement between nominal features and adjectives tends to occur after the acquisition of agreement between those features and determiners (Blom et al. 2008; Nicoladis & Marchak 2011).

2.2.3 Gender and Number Acquisition in Adult Learners

In terms of adult acquisition of grammatical gender and number in an L2, researchers such as White et al. (2004) have found evidence that knowledge of grammatical gender and number in the L1 can aid in the acquisition of that feature in the L2. For grammatical gender more specifically, this phenomenon has been found to extend beyond acquisition of the two-way masculine/feminine system commonly found in Romance languages. While it has been found that the German gender system can be more difficult for adult learners to acquire than the gender system of Romance languages due to the convolution of gender with case and number agreement in the language (Eichler et al., 2012), research has shown that previous experience with a gendered language, whether it be Romance or Germanic, can provide an advantage in the acquisition of a second gendered language (Sabourin, 2001).

Meanwhile, research in the acquisition of L2 grammatical gender by learners with a non-gendered L1 has had more mixed findings. Speakers of a non-gendered language have been found to be capable of eventually acquiring the gender feature of nouns in Romance L2s, as well as of applying the acquired gender features of Romance language nouns to the larger DP including determiners and adjectives (Oliphant 1998; Granfeldt 2000; White et al. 2004). Despite these findings, mixed results related to performance differences on gender-related

tasks between near-native L2 speakers and native gendered language speakers have led to a debate in the literature as to the degree to which the gender system of L2 learners is truly native-like. However, for the purposes of this study, the question of interest is not whether the grammatical gender developed by these L2 learners is truly native-like, but rather to what degree that L2 gender system is transferable to serve as the initial state to L3. Given these findings that (a) L1 grammatical knowledge is transferable for use in the initial stage of L2 learning and (b) advanced L2 speakers with a non-gendered L1 are able to develop some sort of system of grammatical gender in their L2, the question remains as to the degree to which the grammatical gender systems of L1 vs. L2 are transferable at the initial stages of acquisition in an L3.

Jaensch (2012) was one of the first to approach this question of L3 grammatical gender transfer, comparing L3 German learners with L1 Spanish/L2 English or L1 Japanese/L2 English. Jaensch found that the L1 Spanish speakers, who had knowledge of grammatical gender from their L1, were less able to use phonological gender cues to correctly apply gender to novel nouns compared to the native Japanese speakers, who had no previous experience with grammatical gender. These results raise a variety of questions related to (1) whether factors such as order of acquisition or perceived typological dissimilarity inhibited the transfer of grammatical gender knowledge for these participants and (2) the degree to which speakers with knowledge of Spanish as an L2 might perform differently.

Brown (2018, 2020) looked to further investigate this phenomenon of L3 German grammatical gender acquisition by comparing sequential bilingual beginner L3 German learners with L1 English/L2 Spanish or L1 Spanish/L2 English in their ability to identify German grammatical gender errors in a grammaticality judgement task. She found that the speakers with L2 Spanish significantly outperformed the L1 Spanish speakers. Brown suggests that these results could serve as evidence in support of the L2 Status Factor model.

However, it was noted the beginner participants in Brown's previous work had all completed at least one full semester of German instruction before participating in the experiment. As a result, Brown's results may not have been an ideal representation of the true initial state of the language, but rather some early phase in the interlanguage development. The majority of the theories of L3 acquisition under consideration by Brown (2018, 2020) and outlined in Section 2.1 are concerned only with the structure of the L3 grammar at the very beginning of L3 acquisition, and do not address any later points in L3 development (Hammarberg, 2012).

Additionally, across all language background groups, Brown's participants demonstrated no evidence of interference from Spanish grammatical gender in cases of lexical items where the noun in question was masculine in one language and feminine in the other. If it actually was the case that L2 Spanish participants were transferring their Spanish gender knowledge to L3 German, then interference from mismatching gender assignments between the two languages would be expected in this group. L2S fails to account for these findings.

An alternative explanation for Brown's results could be that grammatical gender did not immediately transfer from the L2 for the L2 Spanish learners at the onset of L3 acquisition, as was predicted by both TPM as well as by several of the partial transfer models such as CEM and LPM. If this were the case, then the difference between L1 and L2 Spanish participants found in Brown's work could be that the L2 Spanish participants have more experience learning grammatical gender in a non-native, classroom context. So while both

groups may have had an initial state grammar with no grammatical gender, the L2 Spanish speakers were better equipped to learn gender in a foreign language context during one of the early (but not initial) stages of acquisition.

In short, Brown's previous findings suggest that there are fundamental differences in L3 German grammatical gender acquisition between L1 English L2 Spanish learners and L1 Spanish L2 English learners. However, the previous work does not clearly identify the source of those differences. This study looks to further investigate this question of the initial state and transfer of the nominal morpho-syntactic features of grammatical gender and number in sequential English/Spanish bilinguals' acquisition of a Germanic L3. This work outlines the results of a follow-up study which aimed to investigate the true initial state of an L3 learner's system, where participants have had no overt instruction regarding grammatical gender in the L3. In order to isolate the variables of interest in this research from other morpho-syntactic phenomena in the German DP, this work uses an artificial language as the L3.

2.2.4 Artificial Language Experiments in Grammatical Gender and Number

As outlined in Section 2.2.1.1, the expression of the grammatical features of gender and number in German is heavily intertwined with case and definiteness within the phrase. Since the complexity of the full German DP structure has been shown to add additional difficulty in gender and number acquisition for adult German learners (Eichler et al., 2012), this project chose to introduce sequential bilingual participants to an artificial language which includes gender and number, but does not include the distracting features of case and definiteness. There exists a precedent for the use of artificial languages in adult language acquisition research, especially in the case of grammatical gender and number research.

Examples of the use of an artificial language in research related to adult language acquisition include the work of Brooks et al. (1993), who used an artificial language experiment to demonstrate that L1 English learners are able to use phonological cues to aid them in gender category learning for new words, an outcome which is similar to the findings related to the L1 Japanese speakers in Jaensch's (2012) analysis of L3 German gender learning. Participants in Brooks et al.'s (1993) work demonstrated this use of phonological cues even when nouns were completely arbitrary and had no form of semantic grouping or categorization such as male/female or animate/inanimate.

In addition to this use of an artificial language in an investigation of phonological gender cues, however, L2 learners are also aided in grammatical gender learning by semantic cues. Research by Wonnacott, Brown & Nation (2017) found that learners were more able to correctly assign grammatical gender to new words in an artificial language when gender assignment related to some sort of semantic category system. Semantic categories found to aid in this process included biological gender, but also included other types of groupings such as categorizing animals into wild versus domesticated. Meanwhile, Culbertson, Gagliardi & Smith (2017) demonstrated that while child L2 learners have been found to use both phonological and semantic cues in their grammatical gender learning, their use of phonological cues to assign grammatical gender to unfamiliar words develops before their ability to use semantic cues.

Beyond the investigation of learners' ability to assign grammatical gender to new words,

researchers such as Siegelman & Arnon (2015) have also used artificial language experiments to demonstrate that exposing beginner learners of a new language to unsegmented speech input leads to those learners having better article-noun distinctions early in the L2 acquisition process.

These examples of L2 grammatical gender studies suggest that artificial language experiments can serve as a valuable tool to investigate the factors which may impact adult learners in their acquisition and cognition of L2 grammatical gender. However, while the research related to artificial language grammatical gender experiments in L2 is vast, this method of investigation has yet to be applied to the field of L3 grammatical gender learning. This experiment looks to fill that gap in the literature and investigate differences between sequential bilinguals with a gendered L1 versus a gendered L2 in their ability to acquire grammatical gender in an artificial language as an L3.

2.3 Current Experiment

The current study uses an artificial Germanic language to investigate the degree to which sequential bilinguals with four different language backgrounds are able to acquire and correctly apply the grammatical gender and number features of the language in both a forced-choice task and a production task. The questions under investigation are:

1. At the initial state of L3 acquisition, do learners have access to all previously acquired grammatical gender and number information for transfer to the L3?
2. If it is the case that a particular group of learners is unable to transfer their previous grammatical knowledge, do the patterns correlate with the predictions of any of the previously proposed models of L3 acquisition?

The language background groups targeted in this study and the predictions of various L3 acquisition models are outlined below.

2.3.1 Language Backgrounds

The four language background groups in this study are as follows: L1 English-L2 Spanish, L1 Spanish-L2 English, L1 English-L2 Mandarin, and L1 Mandarin-L2 English. The two groups of sequential Spanish-English bilinguals were selected due to a dual disparity, in (a) typological similarity to the target L3 and (b) occurrence of the grammatical gender feature: whereas English is typologically more similar to German, only Spanish has a grammatical gender system. By comparing L1 English/L2 Spanish and L1 Spanish/L2 English speakers in this task, the roles of typological similarity and order of acquisition in L3 transfer can be distinguished from one another. In terms of grammatical gender, the two groups of sequential Mandarin/English bilinguals serve as a control group in that they are sequential bilinguals who have the experience of learning an L2 in a formal classroom setting, but have no experience acquiring a language with grammatical gender.

For grammatical number acquisition, the roles of the two different language combinations are somewhat reversed. While the Spanish/English bilinguals will have experience using grammatical number marking to some degree in both of their previously known languages,

for the Mandarin/English bilinguals, only one of their languages (English) uses any type of morpho-syntactic number agreement marking. Therefore the role of order of acquisition could be relevant for the Mandarin/English bilingual participants' success in acquiring the L3 grammatical number feature.

2.3.2 Model Predictions

2.3.2.1 Grammatical Gender Predictions

In terms of model predictions for grammatical gender acquisition, all models make the same predictions in regards to grammatical gender transfer in the Mandarin/English bilinguals. Because these speakers have no previous grammatical gender knowledge which could transfer to the L3, any success that they have on the grammatical gender portion of this experiment would have to be the result of learning. It is for this reason that this group was selected to serve as a control group.

For the two groups of Spanish/English bilingual participants, the predictions for grammatical gender are as follows:

L1T predicts that participants transfer all and only their first language grammar to serve as the initial grammar for the L3, which means that only the participants who have L1 Spanish-L2 English would be able to transfer their Spanish grammatical gender knowledge to the initial stages of L3 German grammatical gender acquisition. For the L1 English-L2 Spanish learners meanwhile, this information would be blocked from transferring and these participants would be expected to perform at a level similar to the English/Mandarin control participants who do not have any background in grammatical gender.

L2S, meanwhile, makes the exact opposite prediction, stating that only participants with the L1 English-L2 Spanish background would have access to grammatical gender from Spanish while the L1 Spanish-L2 English participants would transfer their English knowledge, which does not include grammatical gender.

A third possible outcome follows from both TPM and LComm, which predicts that English will transfer as the initial source language grammar for all participants, regardless of order of acquisition.

For TPM, this prediction comes from the claim that the two primary linguistic features that influence the selection of a source language at the starting point of the L3 are cognates and phonological similarity. Since English is a Germanic language, the high level of shared cognates and phonology makes English much more likely to be selected as the starting language for L3 German in both the L1 English and the L1 Spanish groups. The assumption that English will be perceived to be more typologically similar to German than Spanish is based on a statement from Rothman, that English would be the source language in this particular language combination (Jaensch, 2012). According to TPM, therefore, despite understanding grammatical gender in Spanish, both L1 English and L1 Spanish beginner learners will start their L3 grammar without a grammatical gender feature due to their use of English grammar as the initial state of their L3 grammar. As a result, both groups of L3 German learners would be expected to perform at a level comparable to the English/Mandarin bilingual control group who have no previous experience with grammatical gender.

LComm meanwhile, would make the same predictions as TPM, but these predictions would be based on the premise that this experiment was conducted in a strongly English-speaking environment: an American university, where English is the most common language of the community.

Due to the high level of individual variation that is built-in to the design of the partial transfer models, less exact predictions can be made for each of the three partial transfer models outlined in this paper. However, it can be noted that all three of these models predict access to the grammatical information from all previously known languages, with no previously acquired grammatical knowledge being inaccessible to the L3 learner. While the partial transfer models predict that it is possible for some learners to not immediately transfer their grammatical gender knowledge from Spanish to their new L3, none of the partial transfer models predict that this lack of transfer will be exactly the same between all language backgrounds. Instead all of the partial transfer models predict that transfer of previously acquired grammatical gender knowledge is possible, at least for some of the participants in the Spanish/English bilingual participants, regardless of their order of acquisition. In this case, success in grammatical gender tasks in this study may vary within the two groups of Spanish/English bilingual learners. As a group, however, sets of Spanish/English bilingual learners would be expected to be more sucessful in grammatical gender and number acquisitoin than the Mandarin/English control groups.

An outline of the predictions of the L3 acquisition models outlined here is provided in Table 2.

L3 Model	L1 English L2 Spanish	L1 Spanish L2 English	L1 English L2 Mandarin	L1 Mandarin L2 English
Partial Transfer Models	Accessible	Accessible	N/A	N/A
L1T	**Inaccessible**	Accessible	N/A	N/A
L2S	Accessible	**Inaccessible**	N/A	N/A
TPM and LComm	**Inaccessible**	**Inaccessible**	N/A	N/A

Table 2: L3 transfer model predictions for grammatical gender, where N/A implies no previous grammatical experience that could be transferred

2.3.2.2 Grammatical Number Predictions

Unlike grammatical gender, morpho-syntactic grammatical number is present in English as well as Spanish for transfer to the L3. As a result the predictions of the aforementioned L3 acquisition models for grammatical number transfer are as follows:

L1T predicts that all language background groups except for the L1 Mandarin L2 English participants will have access to grammatical number from one of their previous languages. L2S meanwhile predicts that only the L1 English L2 Mandarin participants will find previous grammatical number knowledge inaccessible. TPM predicts that English will be selected as the source language for all language background groups, which would then transfer the grammatical number feature for all participants. Finally, all of the partial transfer models will propose access to previous grammatical number knowledge in all participant groups.

It should be noted that for grammatical number, TPM and the partial transfer models of L3 acquisition make the same predictions of accessibility to previous language knowledge. An

outline of the predictions of the various L3 acquisition models is outlined in Table 3.

L3 Model	L1 English L2 Spanish	L1 Spanish L2 English	L1 English L2 Mandarin	L1 Mandarin L2 English
Partial Transfer Models	Accessible	Accessible	Accessible	Accessible
L1T	Accessible	Accessible	Accessible	**Inaccessible**
L2S	Accessible	Accessible	**Inaccessible**	Accessible
TPM and LComm	Accessible	Accessible	Accessible	Accessible

Table 3: L3 transfer model predictions for grammatical number

3 Methods

3.1 Artificial Language

The artificial language used in this experiment, referred to in this paper as "Mini-German", was based loosely on the designs of Siegelman & Arnon (2015) and DeLuca, Alemán Bañón, Alonso, Puig-Mayenco, Miller, Soares, Slaats & Rothman (2019). Mini-German consisted of a total of 9 nouns (3 masculine, 3 feminine, 3 neuter), 5 adjectives which could be marked to agree with the gender and/or number features of the noun, 4 determiners (1 masculine/singular, 1 feminine/singular, 1 neuter/singular, and 1 plural), a carrier phrase, a set of three grammatical gender suffix morphemes that carried the "singular" number feature and attached to adjectives for gender-agreement with singular nouns, and a plural suffix which attached to nouns and adjectives. All nouns, adjectives, and the carrier phrase were actual German words from which any actual German gender or number morphology had been removed. All determiners, as well as the gender and number-marking morphology, were artificial, but designed to reflect German phonological rules. A complete list of the vocabulary and morphemes of Mini-German is provided in Appendix 1.

Sentences in Mini-German were in the format found in (15) below. Examples of a grammatical gender error on the determiner of the sentence (16), a grammatical gender error on the adjective (17), a grammatical number error on the determiner (18), and a number error on the adjective (19) are also provided. All sentences are spoken by a 23 year old male native German speaker from Switzerland, who has no auditory or speech impediments and was also proficient in English and French.

(15) Erblicken ern-e rot-e Gabel.
Behold $\text{Det}_{[\text{Fem/Sing}]}$ $\text{red}_{[\text{Fem/Sing}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a red fork' (Grammatically correct)

(16) *Erblicken ern-**et** rot-e Gabel.
Behold $\text{Det}_{[\textbf{Neu}/\text{Sing}]}$ $\text{red}_{[\text{Fem/Sing}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a red fork' (Incorrect gender marker on determiner)

(17) *Erblicken ern-e rot-**et** Gabel.
Behold $\text{Det}_{[\text{Fem/Sing}]}$ $\text{red}_{[\textbf{Masc}/\text{Sing}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a red fork' (Incorrect gender marker on adjective)

(18) *Erblicken ern-**in** rot-e Gabel.
Behold $\text{Det}_{[\textbf{Pl}]}$ $\text{red}_{[\text{Fem/Sing}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a red fork' (Incorrect number marker on determiner)

(19) *Erblicken ern-e rot-**in** Gabel.
Behold $\text{Det}_{[\text{Fem/Sing}]}$ $\text{red}_{[\textbf{Pl}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a red fork' (Incorrect number marker on adjective)

3.2 Procedure

Participants completed five component steps in the experiment: (1) a language background questionnaire, (2) a LexTALE vocabulary test in both their L1 and L2 (Lemhöfer & Broersma 2012; Izura et al. 2014; Chan & Chang 2018), (3) a training phase for the Mini-German task, (4) the main Mini-German assessment, which in itself had a forced-choice component and a production component, and (5) a flanker task to assess non-linguistic cognitive control.

The language background questionnaire and LexTALE tests were performed first using the Qualtrics 2019 survey tool. The order in which participants completed the LexTALE tests for their first and second language was randomized. Additionally, the ordering of questions within each LexTALE test itself was also randomized.

Following these tasks, participants completed the Mini-German tasks, which were created using the OpenSesame experimental design program (Mathôt et al., 2012). In the training session, participants were presented with a recording of a spoken sentence in Mini-German, as exemplified in (20), and were then asked to choose which of two pictures correctly represented the spoken phrase. After each response in the training section, participants were presented with a green "check" mark if they chose the correct picture, and a red "X" if they chose the incorrect picture. Participants were not given any explicit information in regards to the grammatical gender and number systems in Mini-German.

The first 18 sentences presented in the training phase did not contain an adjective, as demonstrated in (20), and only consisted of singular nouns. This was done in order to give participants time to familiarize themselves with the nouns in the lexicon before attempting to acquire adjectives and number markings.

(20) Erblicken ern-e Gabel.
Behold $\text{Det}_{[\text{Fem/Sing}]}$ $\text{fork}_{[\text{Fem/Sing}]}$
'Behold a fork' (Grammatically correct)

The remaining 27 sentences in the training section included the adjectives, also varied with respect to singularity/plurality. Over the course of the training section, participants were exposed to each of the nouns five times, and were exposed to each of the adjectives between five and six times.

Following the training task, participants began the main Mini-German experiment. This section consisted of two different tasks: a forced-choice task and a production task. In the forced-choice task, participants were shown a picture similar to those used in the training task, and were then presented with two spoken sentences. One of these sentences was a grammatically correct sentence which used the correct lexical items and grammatical gender and number markings to describe the picture. The other sentence consisted of either (a) a lexical error in either the adjective or the noun, or (b) a syntactic gender or number error occurring in either the determiner or adjective. Participants were asked to select the sentence, out of the two sentences presented to them, that best describes the picture. If participants failed to respond after 3000 milliseconds from the point when the second recording finished playing, the response was marked as "null" and OpenSesame proceeded to the next question in the series. Participants were given no feedback on the accuracy of their responses in any of the experimental tasks.

In the production task, participants were presented with an image similar to those used in the training and forced-choice tasks. Participants were then asked to describe the image in a way that was similar to the recordings in the forced-choice task. Participants were not given any time limitation on these tasks.

The ordering of the presentation of these two different tasks to the participant was as follows: the forced-choice task consisted of a total of 207 questions, which were divided into 10 sub-sections. After completing each sub-section of the forced-choice task, participants were presented with three questions of the production task, for a total of 30 spoken responses. This design of interweaving the listening and production tasks allows for the tracking of progress in both listening and production across time, as participants gain increased exposure to the artificial language.

After completing all Mini-German tasks, the final step of the experiment consisted of a brief Eriksen Flanker Task (Eriksen & Eriksen, 1974), which was used to assess participants' cognitive ability to suppress inappropriate responses in particular contexts.

3.3 Participants

A total of 19[3] participants have completed the study to date (15 female, 4 male: mean age = 20.88 years, age range = 18-28 years). The number of participants in each language group is outlined in Table 4 below. All participants had acquired their languages sequentially[4] and did not report having significant experience with any other languages that had a grammatical gender system. In order to assess participants' proficiency in their languages, as well as their status as sequential L2 learners, all participants completed a LexTALE vocabulary test in the L2 (Lemhöfer & Broersma 2012; Izura et al. 2014; Chan & Chang 2018) and a language background questionnaire conducted using Qualtrics (2019). All participants received a $10 Amazon gift card upon completion of the experiment.

Language Background	Number of Participants	Age of L2 Acquisition
L1 English L2 Spanish (E-S)	7	Mean = 6.8, Range = 4-14
L1 Spanish L2 English (S-E)	4	Mean = 7.0, Range = 5-11
L1 English L2 Mandarin (E-M)	4	Mean = 4.8, Range = 3-12
L1 Mandarin L2 English (M-E)	4	Mean = 8.5, Range = 7-10

Table 4: Participants in each language background group

[3]It was intended that participants would be matched across groups for L2 proficiency. However, given that data collection was interrupted by the COVID-19 pandemic, and will resume as soon as safely possible, participant numbers in each of the language background groups currently remain relatively small, and proficiency matching has not yet been conducted at this point

[4]L2 age of acquisition (AoA) varied widely in this participant pool, including several participants who reported being child L2 learners. Some analysis of the AoA variation in this data will be addressed in Section 4.2.1.3. However, this will be addressed in future research when a larger data pool is available.

4 Results

4.1 Data Scoring

4.1.1 Listening Task Scoring

Each participant was assigned two separate scores based on their responses to the different types of grammatical errors presented: a gender-error question score and a number-error question score. Each score is the sum of all cases where the participate chose the grammatically correct option of the two recordings presented. The maximum score for the grammatical gender questions was 68 and the maximum score on the grammatical number questions was 54. Accuracy on the lexical error control questions was also scored, with a maximum score of 81, and those results are outlined in Appendix 2.

4.1.2 Production Task Scoring

The spoken data was analyzed with regards to (1) participants' ability to consistently use the same gender or number markers across the determiner, adjective, and noun, and (2) participants' use of gender or number markers that correctly reflect the features of the image being described. It should be noted that while there is a potential for phonological interference in this secondary analysis related to coda-deletion in the [-et] ending of the neuter markers, where participants could regularly use the feminine [-e] morpheme on the determiners and adjective of neuter words. If this were the case, it would be unclear whether these utterances actually reflect grammatical gender errors, or are instead the result of coda deletion. No such cases of this issue were found in this data set, so this was not an issue for the data presented in this paper. Overall, for the purposes of this experiment, neither phonological errors that do not result in a grammatical gender or number error, nor lexical errors are considered in the production task scoring.

4.2 Analysis

4.2.1 Listening Task Analysis

Participant scores for the grammatical gender and grammatical number tasks were analysed separately, with grammatical gender errors being assessed in section Section 4.2.1.1, and grammatical number errors being assessed in Section 4.2.1.2. As was previously mentioned in section 4.1.1, participants' scores on the lexical error control questions were also analyzed, and are outlined in Appendix 2.

4.2.1.1 Grammatical Gender Error Identification Results

Participants' scores on the grammatical gender questions are outlined in Figure 1. Overall, participants across all groups performed relatively poorly, with the mean score across all language backgrounds being 38 correct questions out of 68. Figure 1 shows the L1 Mandarin L2 English participants having a seemingly overall larger range of scores, as well as a

lower average score, compared to the other three language groups. However, there were no statistically significant differences between group means as determined by one-way ANOVA ($F(3,14) = 0.56$, $p = .65$).

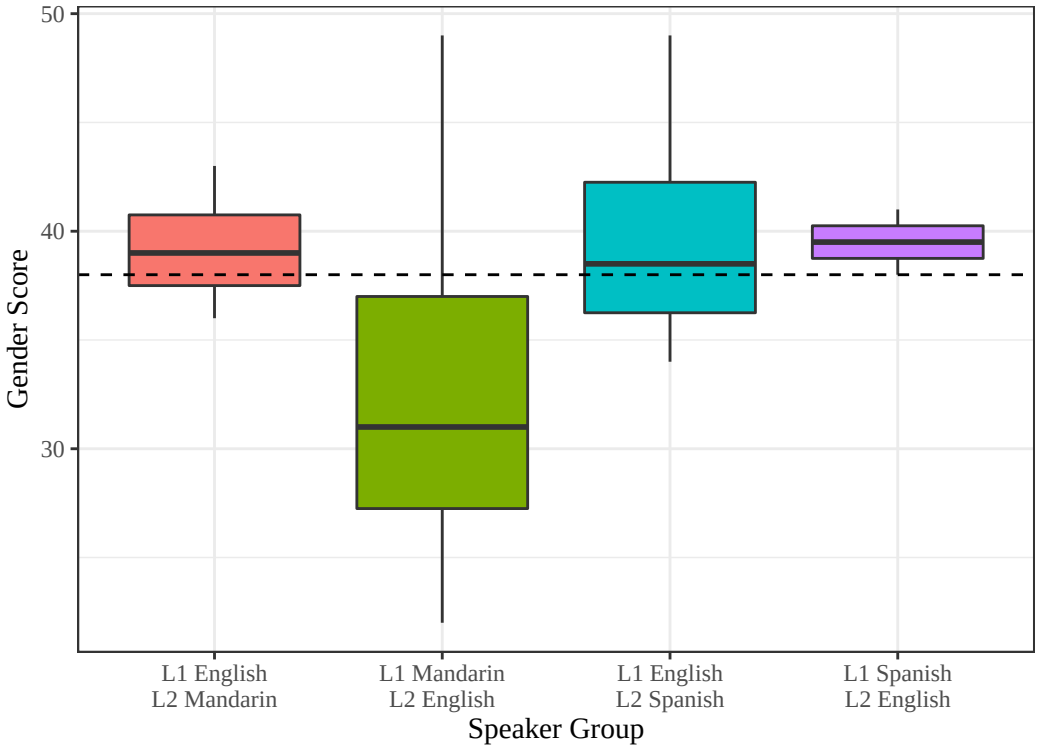

Figure 1: Total count of correct responses out of 68 grammatical gender questions by language background. The dotted line represents the overall average number of correct responses across all language background groups

4.2.1.2 Grammatical Number Error Identification Results

Participants' scores on the grammatical number questions are outlined in Figure 2. Similar to the grammatical gender results outlined above, participants across all groups generally performed relatively poorly, with the mean score across all language backgrounds being 30 correct questions out of 54. Also similar to the grammatical gender results, Figure 2 shows the L1 Mandarin L2 English participants appear to have a seemingly overall larger range of scores, as well as a lower average score, compared to the other three language groups. Once again, a one-way ANOVA ($F(3,14) = 1.02$, $p = .41$) found no statistically significant differences between group means. In other words, there was no significant difference between the grammatical number identification scores of any of the language background groups.

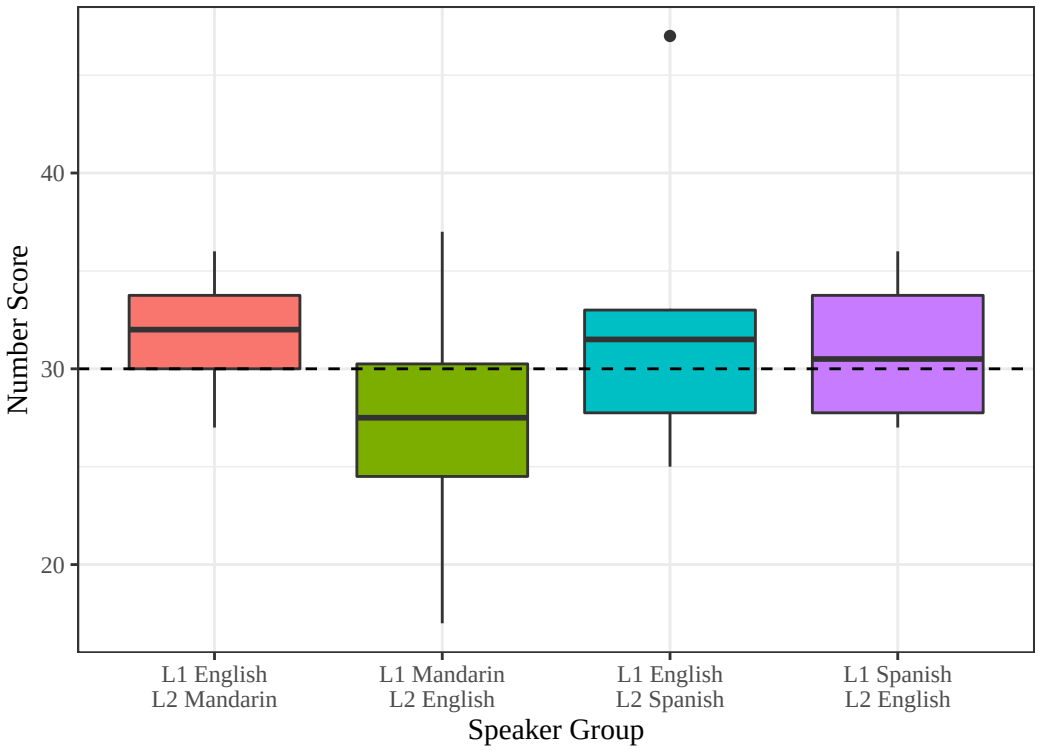

Figure 2: Total count of correct responses out of 54 grammatical number questions by language background. The dotted line represents the overall average number of correct responses across all language background groups

4.2.2 Production Task Analysis

Due to an unfortunate combination of technical errors, and circumstances beyond this researcher's control which limited additional data collection, of the 19 participants discussed in the listening task, only a subset of those participants' responses on the spoken task was able to be used (n=7 total, E-S= 1, S-E=2, E-M=2, M-E=2). This author intends to continue data collection on this task, but current results are as follows.

4.2.2.1 Production Task Coding and Assessment

Each of the 30 total production task questions was coded for grammatical correctness in terms of gender and number agreement in the determiner, adjective and noun. Lexical correctness was not considered in this analysis. On a first layer of scoring, the determiner, adjective, and noun of each sentence were each given a mark of "correct" if the participant produced the correct gender and number markers and a mark of "incorrect" if their production contained a grammatical error of any type. In each case of a noun, adjective, or determiner that was labeled as "incorrect", that error was further categorized into one of four types of errors:

1. not produced, referred to here as "absent"
2. incorrect grammatical gender assignment

3. incorrect grammatical number assignment
4. unintelligible

Small phonetic errors in production which did not affect the gender or number morphology were ignored. An example of one of these small phonetic errors is provided in (21a) along with a phonetically correct version in (21b).

(21) a. Erblicken ern-en schwarzin T**u**ssen
Behold Det$_{[Pl]}$ black$_{[Pl]}$ door$_{[Pl]}$
'Behold some black doors' (Grammatically correct, phonetic error in the noun)

b. Erblicken ern-en schwarzin T**a**ssen
Behold Det$_{[Pl]}$ black$_{[Pl]}$ door$_{[Pl]}$
'Behold some black doors' (Grammatically and phonetically correct)

In a secondary level of coding, all lexical items that were marked with an "incorrect" in the initial coding phase were additionally coded for the category of error that they produced. These error categories included (1) absence, (2) grammatical gender error, (3) grammatical number error, and (4) unintelligible. It was possible for a single utterance to contain both a grammatical number and a grammatical gender error in this level of analysis.

It should be noted that there were no cases in this data of lexical errors that switched two mini-German nouns with different grammatical genders. All lexical errors in this data set consisted of either (a) minor phonetic variation such as producing [d] instead of [t] in the noun "Tür" meaning "door", (b) seemingly unintentional code switching to English such as producing "Baggen" to describe the image of a bag, or (c) production of a completely invented word such as [huɛve] which does not have any phonologically similar word in the artificial language. In all three of these cases, spoken responses were coded in response to only the accuracy of the morphological gender and number cues, regardless of the accuracy of the lexical item itself.

4.2.2.2 Production Task Results

Due to the small number of participants and limiting size of the data collected at this time, statistical analysis has yet to be performed on this production task data. General trends for the data, however, are provided here. Figure 3 outlines the ratio of correct/incorrect utterances, and then further breaks down the incorrect utterances into the type of error that was produced (absent, gender, number, unknown). The graph shows that the two groups of speakers that had L1 English both overall produced more spoken errors than the two groups with L2 English. However, the L1 English L2 Spanish group also has the lowest incidence of grammatical gender errors of the four language background groups. The L1 Spanish L2 English participants, meanwhile had the lowest incidence of grammatical number errors of the three groups. These trends will be tested for statistical significance when more data becomes available.

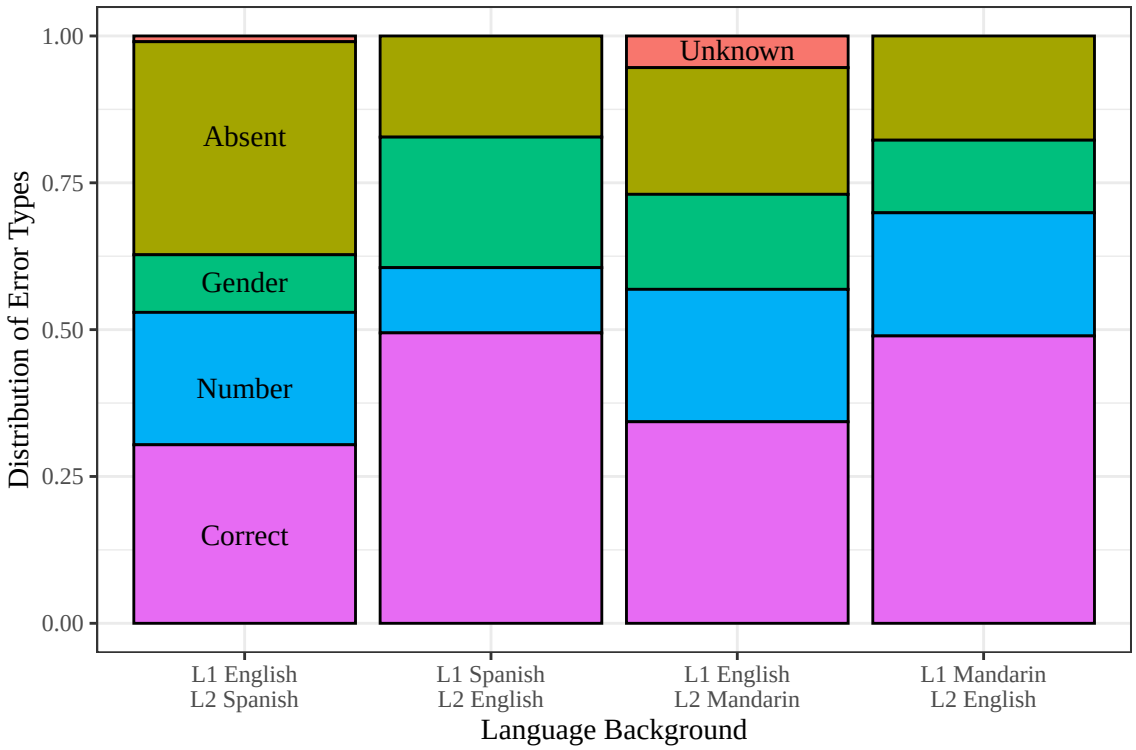

Figure 3: Distribution of spoken grammatical response accuracy and error types by language background

5 Discussion

In summary, this investigation of the initial state of L3 grammatical gender and number acquisition in sequential Spanish/English and Mandarin/English bilinguals found the following results:

(1) Overall, all participants performed relatively poorly at identifying grammatical gender errors in the listening task. These results differ from those found in this author's previous work (Brown 2018, 2020). More specifically, neither the L1 English L2 Spanish nor the L1 Spanish L2 English participants were found to be significantly more successful at the grammatical gender questions compared to the L1 English L2 Mandarin and L1 Mandarin L2 English controls.

(2) The grammatical number analysis found that no one particular language background was significantly more successful. It is unclear at this time whether these findings reflect participants being "successful" or "unsuccessful" per se in their grammatical number abilities. However, no one participant group was found to have a significant advantage compared to the others.

Additional data collection will be necessary for both a proper statistical analysis of the spoken data results, as well as further investigation into whether the lack of significance found in the listening grammatical gender data was the result of a true lack of a difference, or instead simply a result of the small participant pool. However, the findings that have been reported here have important implications for the current models of L3 acquisition. The predictions of each of the L3 acquisition models previously outlined in Tables 2 and 3, have been restated here as Tables 5 and 6, where bold text reflects agreement between the predictions of a given model and the findings of this study.

L3 Model	L1 English L2 Spanish	L1 Spanish L2 English	L1 English L2 Mandarin	L1 Mandarin L2 English
Partial Transfer Models	**Accessible**	**Accessible**	N/A	N/A
L1T	Inaccessible	Accessible	N/A	N/A
L2S	Accessible	Inaccessible	N/A	N/A
TPM and LComm	**Inaccessible**	**Inaccessible**	N/A	N/A

Table 5: L3 transfer model predictions for grammatical gender

L3 Model	L1 English L2 Spanish	L1 Spanish L2 English	L1 English L2 Mandarin	L1 Mandarin L2 English
Partial Transfer Models	**Accessible**	**Accessible**	**Accessible**	**Accessible**
L1T	Accessible	Accessible	Accessible	Inaccessible
L2S	Accessible	Accessible	Inaccessible	Accessible
TPM and LComm	**Accessible**	**Accessible**	**Accessible**	**Accessible**

Table 6: L3 transfer model predictions for grammatical number

Taken together, the two sets of findings for the grammatical gender and number data fit most closely with the predictions of both TPM/LComm and the Partial Transfer Models. It should be noted that the findings outlined in Table 5 may seem contradictory in that TPM/LComm and the Partial Transfer Models are both reported as having predictions that are in-line with

the reported results of this study. However, it is important to note that in the case of all three Partial Transfer Models discussed in Section 2.1.2, the predictions are that participants will have *access* to all previously known linguistic information, but not necessarily that every relevant feature will immediately transfer at the onset of L3 acquisition. As a result, the predictions of the Partial Transfer Models cannot be dismissed based on this data alone.

As previously noted, TPM (Rothman, 2010) predicts that at the onset of L3 acquisition, all participants will immediately transfer the entire grammar of the previously known language which is typologically more similar to the L3. In this case, the more typologically similar language for all participants would be English, which has a grammatical number system, but no grammatical gender system. As a result, TPM predicts that participants in all four language background groups should perform similarly in terms of transferring their grammatical number knowledge from English, but not transferring any grammatical gender knowledge. In terms of grammatical gender, the results of this study fall in line with TPM's predictions in that the two groups of participants with previous experience with grammatical gender in Spanish did not show an advantage in the grammatical gender questions compared to the participants with no previous grammatical gender knowledge. The implications of the grammatical number data for TPM, however, are less straightforward. This data falls in line with TPM's predictions in that no one particular language background group was found to have an advantage over any other group. However, overall success on the grammatical number task remained relatively low across all language background groups, and it remains unclear whether these low scores can truly been interpreted as evidence of grammatical number transfer. In other words, these results are in line with the predictions of TPM in terms of the uniformity across language background groups, but remain unclear in terms of participants' successful transfer of the previously acquired feature of grammatical number.

In terms of the partial transfer models, meanwhile, all three of the previously mentioned partial transfer models predict the possibility of, but do not guarantee, the transfer of all previously known linguistic information at the onset of L3 acquisition, and throughout the L3 acquisition process. Given that the results of this study remain unclear as to whether participants successfully transferred their previously acquired grammatical number knowledge, the broader claims of the partial transfer models align more closely with the results of this study as it stands.

That being said, teasing apart the key distinctions between the predictions of the three previously discussed partial transfer models in relation to this work is difficult. In particular, the key difference between the claims of CEM (Flynn et al. 2004, Berkes & Flynn 2012) and LPM (Westergaard et al., 2017) is that LPM explicitly accounts for the transfer of non-facilitative linguistic features to the L3, while CEM makes no direct claims about the transfer of non-facilitative linguistic features. However, given that non-facilitative features were not examined in this study, and both of these models predict the successful transfer of relevant previously known linguistic features, the predictions of both of these models fall in line with the aforementioned results.

The Scalpel Model (Slabakova, 2017), meanwhile, makes the same overall predictions in terms of transfer, but differs from CEM and LPM in that it predicts variation between participants due to a variety of cognitive and experiential differences. According to the model, factors such as metalinguistic awareness and educational experience do not necessarily need to influence the very onset of acquisition, but can still play a role at later points in acquisition, which

could potentially account for not only the findings in this study, but also the L2 Spanish advantage found in this author's previous work Brown (2018, 2020).

It should be noted, however, that the Scalpel Model's claims in regards to what extra-linguistic factors may or may not play a role in the facilitation of transfer are concerningly broad and vague. As a result, the model lacks any true predictive power. Slabakova herself notes in her work that the only potential result that might straightforwardly disprove the Scalpel Model would be one that finds exclusively wholesale transfer across a wide variety of linguistic structures (Slabakova, 2017). Slabakova also notes that the details of what extra-linguistic factors may be influencing L3 transfer have yet to be determined at the time of her proposal. Should additional data further support the findings of this study, then additional research will be needed in regards to what extra-linguistic factors may have an influence in L3 DP feature transfer.

Overall, the findings presented here will require additional data in order for more concrete claims to be made, but preliminary results suggest support for TPM, as well as partial transfer models of L3 acquisition, and the Scalpel Model in particular.

6 Conclusion

This work looks to follow up on the results of Brown (2018, 2020) by examining the way that sequential Spanish/English and Mandarin/English bilinguals acquire the grammatical features of gender and number in an artificial L3. Results found no difference between language groups in their identification of grammatical gender or number errors. These findings fall in line with several of the previously proposed models of L3 acquisition. In particular, Slabakova's Scalpel Model (2017) stands out as being able to account not only for the lack of significant difference between the four language background groups examined in this study, but also for the L2 Spanish advantage in L3 German grammatical gender acquisition found in Brown's previous work. However, this model remains extremely vague in its ability to actually predict outcomes for a particular L3 acquisition situation.

In addition to continuing to collect data in this experiment, further research on this topic could investigate the following:

1. The degree to which these findings can be replicated with different language combinations, especially combinations which include more typologically distant languages, such as the acquisition of the nominal category systems of Bantu languages
2. The role of additional potentially influential factors not considered in this study such as the participants' language dominance
3. Whether similar results are found with respect to other features of L3 DP structure, such as case and definiteness

These different factors may provide valuable information related to the process of DP acquisition and structure in adult L3 learners.

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Appendix 1: Mini-German Lexicon

Word	**Meaning**	**Part of Speech**	**Gender**	**Number**
Erblicken	Behold	Carrier Phrase	N/A	N/A
Ern	Indefinite Article	Indefinite Article	Masculine	Singular
Erne	Indefinite Article	Indefinite Article	Feminine	Singular
Ernet	Indefinite Article	Indefinite Article	Neuter	Singular
Ernen	Indefinite Article	Indefinite Article	N/A	Plural
Beutel	Bag	Noun	Masculine	Singular[5]
Schlüssel	Key	Noun	Masculine	Singular
Stift	Pen	Noun	Masculine	Singular
Tasse	Cup	Noun	Feminine	Singular
Gabel	Fork	Noun	Feminine	Singular
Tür	Door	Noun	Feminine	Singular
Hemd	Shirt	Noun	Neuter	Singular
Buch	Book	Noun	Neuter	Singular
Haus	House	Noun	Neuter	Singular
Weiß	White	Adjective	N/A	N/A
Schwarz	Black	Adjective	N/A	N/A
Rot	Red	Adjective	N/A	N/A
Tupfen	Polka-Dotted	Adjective	N/A	N/A
Gestreift	Striped	Adjective	N/A	N/A
-in	N/A	Nominal & Adjectival Suffix	N/A	Plural
[NO SUFFIX]	N/A	Adjectival Suffix	Masculine	Singular
-e	N/A	Adjectival Suffix	Feminine	Singular
-et	N/A	Adjectival Suffix	Neuter	Singular

[5] All Mini-German nouns were singular in their root forms, and were made plural by the addition of the plural suffix

Appendix 2: Lexical Error Identification Results

As outlined in Figure 4, participants across all language background groups performed relatively well in terms of identifying the correct Mini-German lexical items. The mean score across all participant groups was 70 out of 85 total lexical questions. A one-way ANOVA ($F(3,14) = 1.39$, $p = .28$) found no significant difference between the lexical error identification scores of any language background groups.

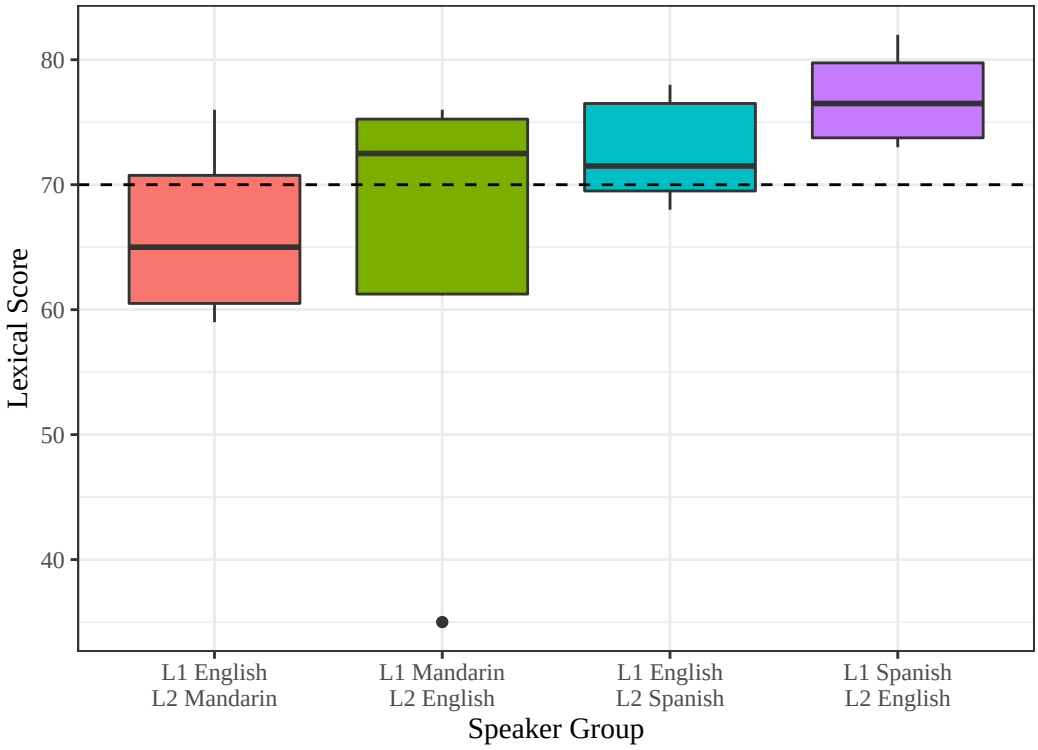

Figure 4: Total count of correct responses out of 85 lexical questions by language background. The dotted line represents the overall average number of correct responses across all language background groups