Research Article

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Front vowels of Spanish: A challenge for Chinese speakers

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Abstract: This research proposes to define the timbre of front vowels [e] and [i] in the spontaneous speech of the Spanish interlanguage spoken by Chinese people and to determine the convergent and divergent features of Peninsular Spanish. Variables such as gender, level of Spanish proficiency and the (a)tonicity of the vowels will also be assessed to see the extent to which these factors influence the pronunciation of the learners. A corpus of 1,489 front vowels produced by 36 Chinese speakers and a corpus of 420 vowels produced by 79 Spanish speakers were used for this study. The mean F_1 and F_2 values were calculated for each vowel. According to the statistical analysis of spontaneous speech, the interlanguage and the target language are similar in that the sounds [i] and [e] are significantly different, the atonic and tonic [i] show no significant differences and the tonic [e] is more open than the atonic [e] in both genders. However, the interlanguage diverges more from the target language because the timbre of the front vowels is more dispersed, that of [i] is more closed and fronted and that of [e] is more open and fronted, in both males and females, tonic and atonic. Finally, the study reveals that the level of language proficiency and tonicity are factors that influence the acquisition of pronunciation.

Keywords: front vowels, acoustic analysis, L2 Spanish, spontaneous speech, Chinese speakers

1 Introduction

Since 2017, when Spanish was included as a subject on the Chinese University Entrance Exam curriculum (Ministry of Education, P.R.C. 2017, Ministry of Education, P.R.C. 2018), the number of Chinese students who chose to study Spanish has increased notably (Lu 2018, Vázquez Torronteras et al. 2020). This growing interest in learning Spanish can be explained by an increase in commercial transactions between Spanish-speaking countries and China.

In addition, in recent years, many Chinese people have moved to Spain as immigrants or university students interested in degrees and masters. These Chinese speakers often have ineffective communication with native Spanish speakers, which can lead to misunderstandings. In fact, maintaining a fluid conservation with Chinese speakers learning Spanish is not always an easy task. In this sense, one of the aspects that is typically lacking in Chinese students learning Spanish as a foreign language and which can hinder a fluid and effective communication is pronunciation.

Just over a decade ago, research began on the pronunciation of speakers of this interlanguage (Planas-Morales 2008, Cortés Moreno 2009, Lopez 2012, Poch and Igarreta 2014, Jiménez and Tang 2018, Igarreta 2019, Cao and Rius-Escudé 2019, Pérez García 2020) to be able to offer suitable didactic applications for

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Chinese learners of Spanish. However, all these studies are based on corpora of controlled speech, generally read, with a limited number of speakers, between three and six – except that of Poch and Igarreta (2014), with 37 speakers, and that of Cao and Rius-Escudé (2019) with 21, who have a basic or independent level of Spanish.

With respect to Spanish vowel sounds, these have also been investigated based on reading models (Quilis and Esgueva 1983, Martínez Celdrán 1995, Albalá et al. 2008). In terms of the advantages and disadvantages of research based on controlled or spontaneous speech, there are different criteria and opinions (Cantero 2015, Xu 2010). Either way, the existence of differences in the vocalism of the two types of speech has been demonstrated (DiCanio et al. 2015). The vowels emitted in a context of spontaneous speech are characterised by having a shorter duration (Correa 2017, Gil Fernández 2007), being more centralised (Harmegnies and Poch-Olivé 1992, Martín Butragueño 2011, Poch-Olivé et al. 2008, Willis 2005) and having a greater dispersion (Alfonso Lozano 2010, 2014, Pérez García 2018). Regarding semi-spontaneous speech, Iruela (1997) states that the vowels are articulated in a more relaxed and centralised way than in controlled speech and that they overlap more in the dispersion.

Considering this previous research, the present study proposes to define the timbre of front vowels [e] and [i] in the spontaneous speech of the Spanish interlanguage spoken by Chinese people and to determine the convergent and divergent features based on a comparison with those of Peninsular Spanish. In this comparison, the variables of gender, (a)tonicity of vowels, and the learners' level of Spanish proficiency, which has not been researched to date, will be considered to establish the extent to which these factors influence pronunciation.

This analysis will provide a better understanding of the phonetic characteristics of the vocalism of Chinese-speaking learners of Spanish at different stages of their interlanguage. The features obtained are part of their foreign accent and must be overcome to achieve a good proficiency in the target language. Therefore, the results of this study could be particularly useful for training Spanish teachers and elaborating didactic proposals for Spanish as a foreign language in China.

2 Literature review

The acquisition of a second language is a complex process due to the many factors that intervene. One of the most relevant is the transfer of the mother tongue (Corder 1983, Gil Fernández 2007, Odlin 1989, Smith and Kellerman 1986). Since the second half of the twentieth century, hypotheses and models of analysis have been proposed to try to describe the acquisition process of L2 and the factors that are involved. The first model is the *Contrastive Analysis Hypothesis*, elaborated by Lado (1957), which involves a comparative analysis of L1 and L2 that predicts the errors of L2 learners as a result of interlanguage transfer.

A decade later, the *Errors Analysis* model (Corder 1967) appeared, which includes the recognition that the errors of second language learners are not solely the result of transfer from the native language. The acquisition of L2 is seen as a creative process in which, based on the knowledge acquired in L1 and the contact maintained with L2, the learner evolves through various stages that make up successive grammars or interlanguages. In this creative process, the L2 learner, like the L1 learner, makes *errors*, meaning, deviations from the linguistic code of the language, which are highly systematic and informative and allow the stage of the interlanguage to be determined. Errors may be due to factors of a linguistic nature (interlingual transfer) or developmental errors caused by non-linguistic factors (intralingual transfer).

Based on the foundations established by Corder (1967), throughout the 1970s, the *Interlanguage Hypothesis* was developed. It was Selinker (1972) who coined the term interlanguage and made an important methodological contribution by considering not only the errors but also the non-errors to be relevant in the learning process of an L2. Interlanguage is a unique system, different from L1 and L2, that forms part of the process of acquisition of L2. Another concept introduced by Selinker (1972, 215) is fossilisation. This refers to the fact that adults reach a point when they stop developing L2 acquisition, mainly in terms of pronunciation, preventing them from reaching a level of proficiency similar to native speakers. Once

overcome, fossilisation remains a possibility and can even reappear in speakers with an acceptable communication level, despite believing it had been eliminated. Selinker called this phenomenon *backsliding* and postulates that it can occur when facing difficulties or situations of anxiety, excitement or extreme relaxation.

Even though different models have subsequently been developed, such as the *Creative Construction* (Dulay and Burt 1974a,b,c) approach, the *Markedness Differential Hypothesis* (Eckman 1977) or the *Speech Learning Model* (*SLM*) (Flege 1995, Flege and Bohn 2021), which is of note for its many followers, we have used that of Selinker (1972) because it provides a more suitable theoretical framework for the type of research we wish to carry out, based on the concepts of interlanguage and fossilisation.

In research dedicated to the acquisition of Spanish vocalism by Chinese speakers, the Contrastive Analysis Hypothesis model has frequently been used. In some studies, in which the two vowel systems, Spanish and Chinese, are analysed, the authors point out that both share the five vowels (Cortés Moreno 2014, Planas-Morales 2008, Wang 2003): [i], [e], [a], [o] and [u], although there is no consensus on how many make up the Chinese vowel system (Cortés Moreno 2009, Duanmu 2007, Jin 2007, Lin 2007, Tseng 1981, Wan and Jaeger 2003, Wu 1986, Yeh 2017, Zhou 1995). Most researchers opt for the seven-vowel inventory (Igarreta 2019). As expressed by Wang (2001), from a phonetic viewpoint, these five vowels of both languages have the same characteristics in their mode of articulation, their point of articulation and their soft palate and vocal cord movements. The Chinese vowel system also has two other phonemes: [y] – comparable to the French *u* in *une*, the German *ü* in *über* and the Danish *y* in *dyne* – and [ə] – comparable to the English *schwa* in the second syllable of *father* and to the neutral Catalan vowel in the second syllable of *pare* (Rius-Escudé 2020). Regarding the mode of articulation, in both the Spanish and Chinese systems, the difference between closed, mid and open, and front, central and back vowels is described. In addition, the Chinese system has the criterion of rounded [y], [o], [u] and unrounded [i], [e] [ə] vowels (Cortés Moreno 2009).

In terms of specific studies on the acquisition of Spanish sounds by Chinese speakers, some researchers, such as Ortí Mateu (1990), Planas-Morales (2008) and Cortés Moreno (2009), believe that learning the Spanish vowel system, with fewer units than their native language, poses no problems. Planas-Morales (2008, 501), however, points out that the difficulty in vocalism lies in the equivalences between spelling and sound and cites as an example the case of the spelling *e*, which in pinyin corresponds to four different sounds depending on their position: [ɤ]; [ə], in front of [n, ŋ]; [e] in front of [i]; [ɛ] after [i, y] and of the spelling *a*, which could be [a] or [ɛ]. She argues that, because of this phenomenon, Chinese learners tend to have a more open and back articulation of the Spanish [e].

Based on contrastive and error analyses of Spanish and Chinese, Lopez (2012) states that, compared to native speakers, all the tonic vowels of Spanish spoken by Chinese people [a], [e], [i], [o] and [u] are produced with a higher F_1, in other words, a larger mouth opening in the interlanguage, regardless of gender. Regarding F_2, the [i] presents greater tongue retraction in both sexes, as does the [e] in men. However, in women, the [e] is in a more fronted position, more similar to [ɛ].

In 2014, Poch and Igarreta, analysing the productions of a group of 37 first-year university Chinese speakers – unknown whether men or women – observed that vowel timbre is very unstable, although it is unknown if tonic or atonic, particularly those read by participants from Shanghai. The authors obtained results that showed more open vowel realisations than those produced by Spanish speakers; sometimes with [ə] pronounced instead of [a] or [e] and, in other cases, completely unexpected pronunciations.

Of note among the most recent studies that focus on the analysis of the vocalism of L2 Spanish by Chinese speakers, is the research carried out by Jiménez and Tang (2018), who, based on a read corpus by six women of each language, compare the vowel systems of Chinese and Spanish and of Spanish spoken by Chinese speakers. They note that Chinese learners do not have major difficulties in the acquisition of Spanish vocalism, although the L1 vowel system affects their performance in the interlanguage, in terms of presenting a more pronounced variability in F_1, a longer duration of vowel sounds and a greater degree of openness of mid vowels [e] and [o] and the low vowel [a]. In contrast to Poch and Igarreta (2014), Jiménez and Tang (2018) state that they did not observe the [ə] taking the place of the [e].

Igarreta (2019) bases her research on the analysis of vowels of a Spanish reading corpus by six Chinese-speaking women with an A2 level, the results of which are compared with those obtained from six native Spanish speakers. With regard to her results, F_1 and F_2 of [i] and [e] present a range of similar frequencies in both groups, although the realisations of native Spanish speakers are more homogeneous in terms of oral opening and tongue position. The differences between the groups are significant. In some cases, F_1 of [i] is close to the [e] and F_2 to [u], and the [e] is sometimes similar to [i] or [a].

Cao and Rius-Escudé (2019) present results on the timbre features of the vocalism of the Spanish interlanguage spoken by Chinese people, based on a corpus of semi-spontaneous speech with 21 speakers with an A2–B1 level of Spanish. According to their research, the mean values of the atonic and tonic vowels of Chinese learners show similarities and compared with read speech (Jiménez and Tang 2018); the vowels are articulated with a greater degree of openness in semi-spontaneous speech.

Finally, Pérez García's work (2020) is based on a read corpus and analyses F_1 of the stressed vowels of three Chinese women speaking Spanish with a B1–B2 level. He notes three values of F_1 for each vowel and maintains that this formant suffers greater internal variation the more open the vowel is and that the vowels of the interlanguage present the same degree of openness as in Spanish.

3 Corpus and methodology

This section presents the two corpora analysed: the first is of Chinese speakers speaking Spanish and the second of native speakers of Peninsular Spanish. The methodology used to obtain the acoustic data and the statistical processing of the results is also described.

3.1 Corpus

A study of spontaneous speech requires an analysis based on a large amount of data (Maekawa et al., 2000), for at least two reasons: interspeaker variables, such as age, gender, education, and intraspeaker variables, namely, the different speaking styles according to social and personal conditions (Labov 1972). For this reason, two very large corpora have been analysed in this research, one of the Chinese speakers who speak Spanish and the other of Peninsular Spanish speakers, which serves as a control group for comparison.

The corpus of Chinese learners of Spanish as a foreign language contains voice data of 36 Chinese speakers, 18 male and 18 female, who share the same age range, between 18 and 30 years old, and educational level (higher education). They come from 16 provinces and 13 different universities in China. All the Chinese-speaking participants have Mandarin as their everyday language, both in their university life and daily activities. It must be said that five also speak a dialect with their families in the home environment (3 Wu, 1 Cantonese and 1 Min).[1] The Chinese-speaking participants began studying Spanish as a foreign language when they started studying Spanish Philology at university.

To make an intergroup comparison according to the Chinese speakers' level of proficiency in Spanish, subjects were selected with different levels – basic, independent and proficient – according to CEFR (Consejo de Europa 2002), as follows:

a) Group A: This group consists of 25% of participants. They have a basic level of language proficiency, are aged between 18 and 20, and have been learning Spanish for between 9 and 12 months. The speakers in this group do not have a diploma to justify their language skills because they are first-year university students (January to June 2020).

1 These five dialect-speaking participants do not affect the research results because there are so few of them and their usual language, from a very early age, is Mandarin.

b) Group B: This group is made up of 44% of participants. They have an independent level (intermediate level), are aged between 20 and 27 and their language learning time varies from 2 to 5 years. The speakers in this group have obtained the DELE B or SIELE B diploma or Level 4 (EEE-4) (Bataller 2014, De la Fuente Cobas and Wei 2017, Zhou 2017).
c) Group C: This group includes 31% of participants who have a proficient level. Their ages range between 21 and 30 years, and they have been learning Spanish for between 4 and 12 years. The participants in this group have the DELE C or SIELE C diploma or Level 8 (EEE-8).

To obtain the sample for the spontaneous speech corpus, the Chinese speakers' voices were recorded. The recording activities are divided into two stages due to the COVID-19 pandemic.

In the first stage, over 180 min were recorded of seven speakers (six from group B and one from group C). The students had to have a group conversation about everyday topics and do role-plays, as well as give a presentation about their life, food preferences, hobbies, travelling, studying abroad, etc. The conversations took place at the Applied Phonetics Laboratory of the University of Barcelona (Mundet Campus). The recordings were made using the built-in microphone of an iPhone XS Max and automatically saved in M4A format. They were later converted into *wav* format to make them compatible with the Praat software.

In the second stage, telephone conversations were conducted between the subjects and the researcher instead of the role-play activity. The telephone dialogues were entirely voluntary. Although the informants were aware that they were participating in a study, they had no prior preparation or script, nor did they know the specific aims of the research. Therefore, the productions were completely spontaneous and the pronunciation was informal. The topics were diverse, including family, studies, university life, their plans, hobbies and other subjects. In this way, the voices of 29 participants (9 from group A, 10 from group B and 10 from group C) were recorded.

To improve the recording quality, participants were asked to find a relatively calm and quiet place, where they had to record their voice with their own device (a mobile phone or tablet). Once the recording was finished, each participant shared their audio file with the researcher. All of the participants then completed a questionnaire with their personal data and a consent form.

In total, from the two recording stages, 9 speakers were recorded from Group A (basic level), 16 from Group B (independent level) and 11 from Group C (proficient level, resulting in a very large corpus of spontaneous speech was obtained, with about 434 min of conversations). After an exhaustive selection of all the recorded utterances, a total of 754 utterances were obtained, from which a total of 1,489 vowel sounds, tonic and atonic were extracted. These were divided into:

a) 726 high front vowels [i] (52.3% tonic and 47.7% atonic), 52.6% spoken by men and 47.4% by women, classified into three groups, according to the level of Spanish of the participants: Group A, 25% (47% tonic and 53% atonic); Group B, 43% (57.2% tonic and 47.8% atonic) and Group C, 32% (50% tonic and 50% atonic).
b) 763 mid front vowels [e] (47.1% tonic and 52.9% atonic), 50.9% emitted by men and 49.1% by women, classified into three groups, according to the level of Spanish of the participants: Group A, 24.5% (46.6% tonic and 53.5% atonic); Group B, 45% (47% tonic and 53% atonic) and Group C, 30.5% (47.6% tonic and 52.4% atonic).

To be able to compare Spanish vowels spoken by Chinese speakers with those produced by Peninsular Spanish speakers, the Spanish corpus by Alfonso Lozano (2010) was used. This corpus is composed of two types of recordings. One was elaborated from 6 h of recordings from various television programmes in a spontaneous speaking situation (variety programmes, quiz shows, documentaries, etc.). The other consisted of recordings made at the Applied Phonetics Laboratory of the University of Barcelona (Mundet Campus) of conversations on any subject. There are a total of 79 participants in the Spanish corpus, 44 men (56%) and 35 women (44%), aged between 18 and 75, native speakers of Spanish, from different geographical origins. The corpus consists of 295 utterances from which 175 high front vowels [i] (54.8% tonic and 45.1% atonic), 52% spoken by men and 48% by women, and 245 mid front vowels [e] (46.1% tonic and 52.9% atonic), 46.5% spoken by men and 53.5% by women, have been extracted.

3.2 Methodology

Analysis of the front vowel sounds was carried out using Praat (Boersma and Weenink 1991–2018). The first two formants, F_1 and F_2, of all the vowel sounds in both corpora were analysed as these are the fundamental acoustic parameters of interest for defining the timbre of a vowel. The acoustic values were taken by calculating the mean value of the formant of each vowel, which is one of the most used measures in this type of research, although some authors use more points to analyse the trajectory of the vowels, above all for English (Chung 2020, Farrington et al. 2018, Renwick and Stanley 2020, Sarvasy et al. 2020).

All the acoustic values of the first two formants (F_1 and F_2) of front vowels [i] and [e] were statistically analysed using the SPSS program, version 26. To proceed with the analysis, first, each group of vowels [i] and [e] were separated according to whether they were produced by men or women. Each subgroup for each vowel was then divided according to whether they were tonic or atonic. For each set (e.g. tonic [i] produced by women), the mean and standard deviation were calculated.

To carry out the statistical analysis, first of all, the data were checked to ensure it fulfilled the assumptions of normality and homoscedasticity and to decide the corresponding tests. There are two alternatives for confirming the normality of data; if the number of samples is equal to or less than 50, the S–W (Shapiro–Wilk) test is selected; otherwise, K–S (Kolmogorov–Smirnov) is adopted. These two tests reveal if the sample contains a normal distribution.

Second, the homogeneity of the sample variances is verified with the Levene test. If the sample fulfils the two assumptions, normality and homogeneity, parametric tests are applied. In the opposite case, in which one of the two assumptions is not fulfilled or neither of the two is, non-parametric tests are carried out.

Where the two assumptions are met, the ANOVA test is applied if the number of samples is greater than two and Student's test is applied if there are two samples. It is worth pointing out that the results of the ANOVA test cannot verify the differences between samples; therefore, multiple post hoc comparisons were carried out, in this case, using the Scheffé test.

If the sample met the normality assumption but not the homogeneity assumption, either the Brown–Forsythe test (number of samples greater than two) or the Welch test (only two samples) was used. If the value of the critical level was less than 0.05, the post hoc test could be run, in the case for the Brown–Forsythe test, the Games–Howell test.

When one of the samples did not meet either of the two assumptions (normality and homogeneity), the Kruskal–Wallis H test (number of samples greater than two) or the Mann Witney U test (only two samples) was used. If the results of the Kruskal–Wallis H test revealed a significant difference between the groups, the post hoc test had to be run, in this case, the Games–Howell test. In all the tests described above, the level of significance was $p = 0.05$

4 Results

This section discusses the vowels [i] and [e] of the interlanguage and target language, describing their timbre characteristics, considering different variables and seeing to what extent the sounds of the interlanguage are similar or different to Spanish, once established that both vowels are significantly different ($p > 0.001$) in both variants.

4.1 High front vowel [i]

4.1.1 High front vowel [i] produced by Chinese speakers

Table 1 presents the mean values of the first two formants of the high front vowel [i] from the corpus of Chinese speakers, considering the variables of gender and vowel tonicity.

Table 1: Mean values of F_1 and F_2 of the tonic and atonic [i] of Spanish spoken by Chinese people

	Tonic				Atonic			
	F_1	SD	F_2	SD	F_1	SD	F_2	SD
Men	360	37.2	2,134	194.3	360	39.0	2,137	195.4
Women	428	61.9	2,594	210.5	425	56.3	2,592	232.6

There is no significant difference between the atonic and tonic [i] spoken by men in either F_1 (*t*-test: $p = 0.906$) or F_2 (Mann–Whitney: $p = 0.087$). Nor is the difference significant in the vowels of women in either F_1 (Mann–Whitney: $p = 0.725$) or F_2 (*t*-test: $p = 0.918$). Given that the statistical results show that the differences between atonic and tonic values are not significant, both these are presented together in Table 2.

4.1.2 High front vowel [i] produced by Spanish speakers

This section presents the mean values of the first two formants of the high front vowel [i] from the Spanish corpus, considering the variables of gender and vowel tonicity (Table 3).

The statistical results show that the differences between atonic and tonic vowels are not significant in either F_1 or F_2, either in men (F_1, *t*-test: $p = 0.206$; F_2, *t*-test: $p = 0.479$) or women (F_1, *t*-test: $p = 0.516$; F_2, Welch: $p = 0.804$). Accordingly, the atonic and tonic results are presented together in Table 4.

4.1.3 Comparison of the high front vowel of Chinese speakers and Peninsular Spanish speakers

As shown by the dispersion area in Figure 1 and Tables 2 and 4, the first finding is that the dispersion of the interlanguage vowel is somewhat greater than that of the target language. The difference between the two groups is significant in F_1 (Welch: $p = 0.02$). As for F_2, the vowel dispersion produced by Peninsular Spanish speakers is more central on the graph, although there are no significant statistical differences (Mann–Whitney: $p = 0.283$) between the two samples. Therefore, the interlanguage of male participants produces an [i] sound in a similar atonic and tonic position, which is different from the Spanish [i] sound as it is pronounced more closed and with a tendency to be more fronted, which is not significant.

Similarly, in the case of utterances by women, the interlanguage has a much greater dispersion than Spanish, as shown in Figure 2 and by the standard deviations in Tables 2 and 4.

Table 2: Mean values and standard deviation of F_1 and F_2 in the high front vowel [i] in Spanish spoken by Chinese people

	F_1	SD	F_2	SD
Men	360	38	2,135	194.6
Women	427	59.2	2,593	221.1

Table 3: Mean values of F_1 and F_2 in the tonic and atonic [i] of Peninsular Spanish

	Tonic				Atonic			
	F_1	SD	F_2	SD	F_1	SD	F_2	SD
Men	367	46.8	2,085	166.2	379	46.0	2,108	140.7
Women	450	57.9	2,335	176.2	442	56.1	2,327	130.3

Table 4: Mean values of F_1 and F_2 of both the tonic and atonic [i] of Peninsular Spanish

	F_1	SD	F_2	SD
Men	372	46.6	2,096	154.3
Women	446	56.9	2,332	157.3

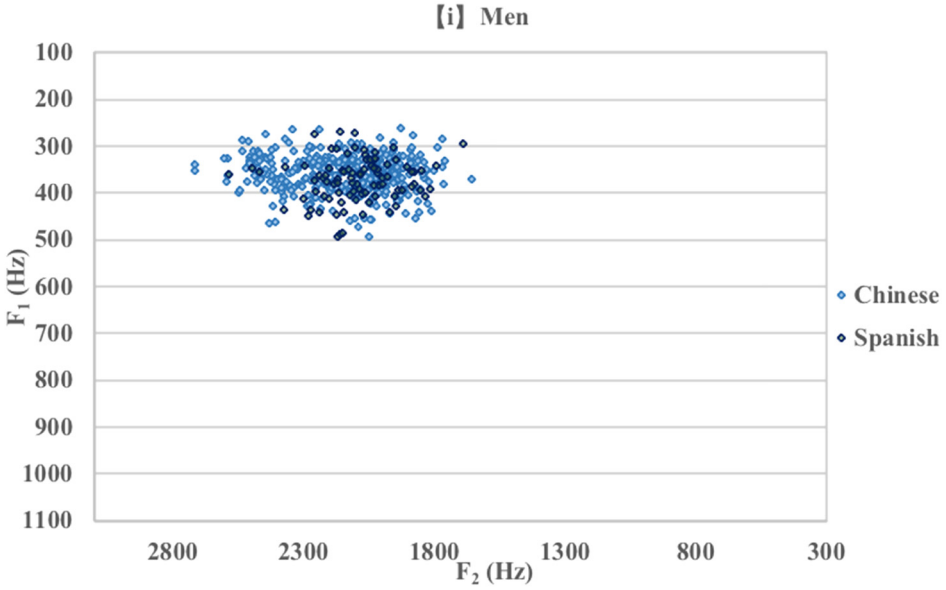

Figure 1: Dispersion of the vowel [i] of Spanish spoken by male participants from China and Spain.

The differences between the high front vowels produced by female Chinese and Spanish participants are significant in both formants (F_1, Mann–Whitney: $p = 0.003$; F_2, t-test: $p < 0.001$). This assertion is represented in Figure 2, where the vowel dispersion of [i] produced by Chinese participants is much larger than that of vowels produced by Spanish participants, particularly on the X-axis (1,900–3,200 Hz vs

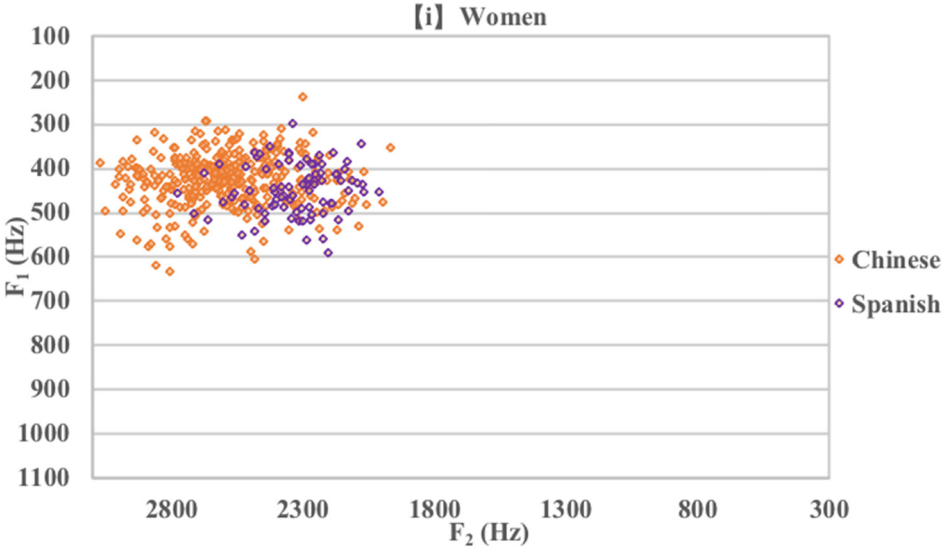

Figure 2: Dispersion of the vowel [i] of Spanish spoken by female participants from China and Spain.

Table 5: Mean F_1 and F_2 values of [i] of Spanish spoken by male Chinese participants according to their level of Spanish

	Group A		Group B		Group C	
	Hz	SD	Hz	SD	Hz	SD
F_1	364	33.3	368	38	336	32.5
F_2	2,153	182.1	2,082	156	2,247	239.7

2,000–2,800 Hz). Specifically, the dispersion of this vowel is displaced to a somewhat higher area and, particularly, to the left. This means that Chinese participants articulate the vowel [i] with a more closed mouth and a more fronted tongue position.

As explained above, the high front vowels [i] of the interlanguage and Spanish do not show significant (a)tonicity differences in either F_1 or F_2. What characterises the pronunciation of this sound in the interlanguage is that it is more diverse – the dispersion is greater – which is reflected in a clear tendency for the [i] to have a more closed vowel timbre and a more fronted tongue position compared to that of Spanish speakers, both men and women.

4.1.4 Comparison of groups with different levels of Spanish proficiency

This section presents the mean values of F_1 and F_2 and the standard deviation of the high front vowel [i] of Spanish spoken by male Chinese participants, classified by their level of language proficiency (basic, independent, proficient). According to the data presented in Table 5, Group C contains the most diverse values compared to the other groups: it has the lowest F_1 value (336 Hz) and the highest for F_2 (2,247 Hz).

Table 6 presents the mean F_1 and F_2 values of the high front vowel [i] of Spanish spoken by female Chinese participants. It shows that Group A has the highest F_1 (460 Hz) and F_2 (2,682 Hz) values, while Group C has the lowest F_1 value (400 Hz) and Group B has the lowest F_2 value (2,495 Hz).

The most remarkable feature according to the statistical results that can be observed in Figure 3 reveals that the differences between participants in Group C, proficient, and native Spanish speakers, of both genders, are significant in the productions of the high front vowel [i]: both in F_1 (*t*-test: $p < 0.001$, native v. C, for both genders) and in F_2 (Mann–Whitney: $p < 0.001$, native v. C, for men, and *t*-test: $p < 0.001$, native v. C, for women).

However, there are no significant differences between male Peninsular Spanish participants and Groups A and B of the Chinese speakers, either in F_1 (Games–Howell: $p = 0.523$, native v. A; $p = 0.901$, native v. B) or in F_2 (Games–Howell: $p = 0.093$, native v. A; $p = 0.923$, native v. B). This is also the case in F_1 of female participants (Games–Howell: $p = 0.461$, native v. A; $p = 0.495$, native v. B) but not in F_2 (Games–Howell: $p = 0.093$, native v. A; $p = 0.923$, native v. B).

Therefore, it is clear that the differences between the interlanguage speakers of Group C, with a proficient level, and native speakers, take the form of a more closed and fronted [i]. Also, there are significant differences in F_2 between women in Groups A and B and native speakers, which take the form of a more fronted vowel.

Table 6: Mean F_1 and F_2 values of [i] of Spanish spoken by female Chinese participants according to their level of Spanish

	Group A		Group B		Group C	
	Hz	SD	Hz	SD	Hz	SD
F_1	460	64.6	435	45.1	400	51.6
F_2	2,682	195.4	2,495	198.7	2,604	226.1

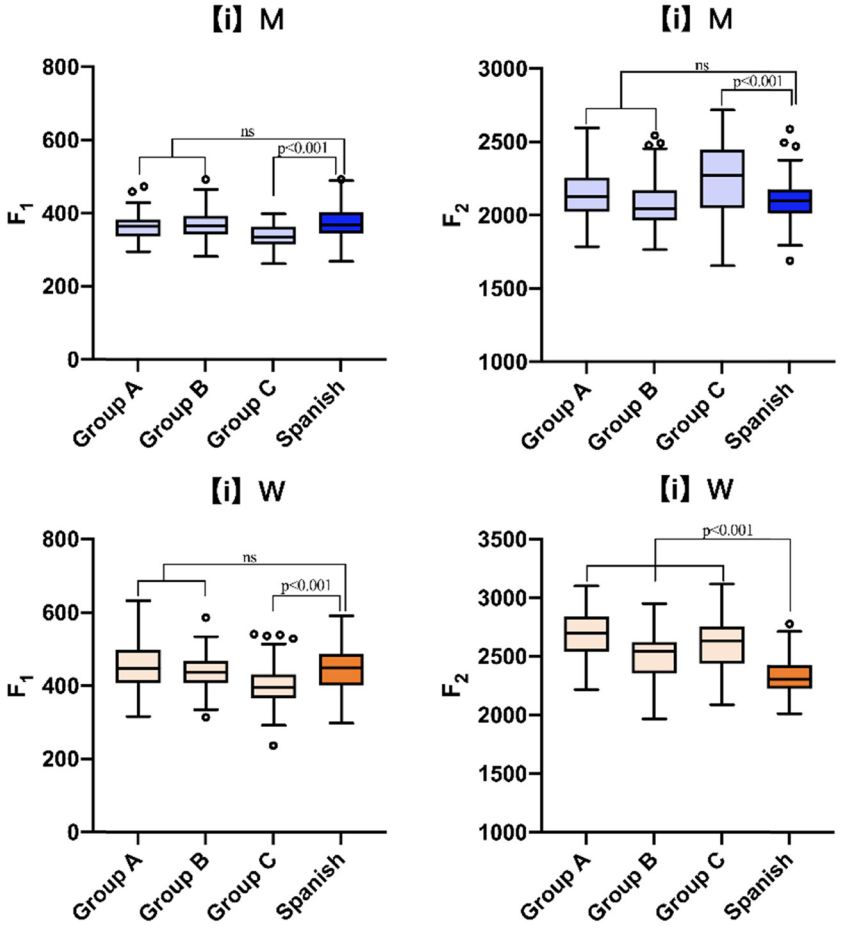

Figure 3: F_1 and F_2 values of the high front vowel [i] of the interlanguage and Peninsular Spanish speakers (top: men; bottom: women).

4.2 Mid front vowel [e]

4.2.1 Mid front vowel [e] produced by Chinese speakers

This section presents the mean values of the first two formants of the mid front vowel [e] of the interlanguage corpus, according to tonicity and gender (Table 7). The mean acoustic values in the tonic position are higher in F_1 and lower in F_2 than those in the atonic position, in both sexes.

The statistical results show that, in this case, there are significant differences between the tonic and atonic vowels produced by male Chinese speakers in F_1 (*t*-test: $p < 0.001$), but not in F_2 (Mann–Whitney: $p = 0.146$). As for productions of female Chinese speakers, there are no significant differences in F_1 (*t*-test: $p = 0.054$), but there are in F_2 (*t*-test: $p = 0.012$). In general, atonic vowels are characterised by being more

Table 7: Mean values of F_1 and F_2 of the tonic and atonic [e] of Spanish spoken by Chinese people

	Tonic				Atonic			
	F_1	SD	F_2	SD	F_1	SD	F_2	SD
Men	515	69.8	1,837	201.5	490	64.9	1,863	177.5
Women	609	99.8	2,073	219.8	590	95.2	2,129	211.0

Table 8: Mean values of F_1 and F_2 in the tonic and atonic [e] of Peninsular Spanish

	Tonic				Atonic			
	F_1	SD	F_2	SD	F_1	SD	F_2	SD
Men	506	41.7	1,771	125.9	483	48.0	1,760	111.3
Women	581	90.1	2,075	171.4	563	80.4	2,014	129.8

closed (significant in males and a tendency in females) and fronted (significant in females and a tendency in males) than tonic vowels, which are more open and central.

4.2.2 Mid front vowel [e] produced by Spanish speakers

Table 8 presents the mean values of the first two formants of the mid front vowel [e] from the corpus of Spanish speakers, considering the variables of gender and vowel tonicity. The mean values of the tonic vowel [e] are higher in F_1 and F_2 in both sexes than the atonic vowel.

The statistical results show that the differences between atonic and tonic vowels spoken by Spanish men are significant in F_1 (t-test: $p = 0.010$) but not in F_2 (t-test: $p = 0.623$). In female voices, there are no significant differences in F_1 (Mann–Whitney: $p = 0.222$) but there are in F_2 (Welch: $p = 0.026$). In general, the tendency is to produce atonic vowels more closed (significant in males and a tendency in females) and central (significant in females and a tendency in males) than tonic vowels. We can see, therefore, that the timbre features of the interlanguage's atonic [e] coincide with those of Spanish in the F_1, as they are more closed than the tonic. This is not, however, the case for F_2 because the atonic [e] of the interlanguage are more central, while those of Spanish are more fronted.

4.2.3 Comparison of the mid front vowel of Chinese speakers and Peninsular Spanish speakers

As shown by the dispersion area in Figure 4, both the vowels produced by Spanish men and Chinese men are displaced to a central position on the chart. The differences between the two groups are not significant in F_1, either tonic (Welch: $p = 0.210$) or atonic (Welch: $p = 0.415$) vowels, but they are significant in F_2 in tonic (Welch: $p = 0.004$) and atonic (Mann–Whitney: $p < 0.001$) vowels. As the dispersion shows the vowels produced by male Spanish participants are found in a more centralised and compact area on the graph. In contrast, the vowel [e] of Chinese learners presents a wide dispersion area, which implies diverse pronunciations. In this sense, Tables 7 and 8 show that standard deviations are more pronounced in the interlanguage than in Spanish. In general, the tonic and atonic [e] of the interlanguage are articulated with a more fronted position of the tongue and a certain tendency to be more open.

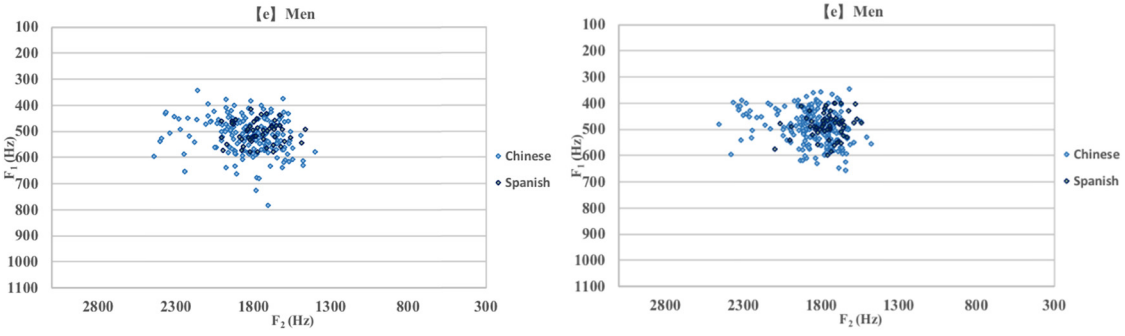

Figure 4: Dispersion of the vowel [e] of Spanish spoken by male participants from China and Spain (right: tonic; left: atonic).

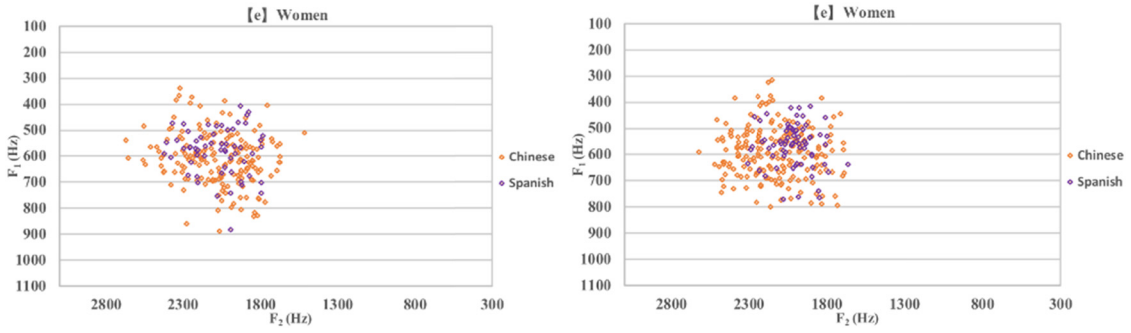

Figure 5: Dispersion of the vowel [e] of Spanish spoken by female participants from China and Spain (right: tonic; left: atonic).

As Figure 5 shows, the differences between female Chinese and Spanish speakers are significant in F_1, both in tonic vowels (Mann–Whitney: $p = 0.015$) and atonic vowels (t-test: $p = 0.038$). As for F_2, there are no significant differences in tonic vowels (t-test: $p = 0.931$) but there are significant differences in atonic vowels (Welch: $p < 0.001$) (Figure 5). Therefore, the female Chinese participants have a more open articulation of the tonic and atonic vowel [e] than female Spanish speakers and more fronted in atonic vowels. Just as in the case with male participants, in this case, the interlanguage productions are more diverse.

The tonic and atonic [e] of the interlanguage show significant differences in F_1 (t-test: $p < 0.001$, Chinese speakers; $p = 0.01$, Spanish speakers) in the case of men and in F_2 (t-test: $p = 0.012$, Chinese speakers; Welch: $p = 0.026$, Spanish speakers) in the case of women. Also, in this case, the dispersion is greater for the sounds of the interlanguage, in men and women, in atonic and tonic vowels, than in Spanish. In general, in the interlanguage, this greater dispersion tends to present higher frequency values in F_1 and F_2, which implies that [e] has a more open and fronted realisation than in Spanish speakers, both in men in tonic and atonic vowels and in the atonic vowels of women.

4.2.4 Comparison of groups with different levels of Spanish proficiency

The mean F_1 and F_2 values and the standard deviation of the mid front vowel [e] of Spanish spoken by male and female Chinese participants are presented in Tables 9 and 10, respectively.

Table 9: Mean F_1 and F_2 values of [e] of Spanish spoken by male Chinese participants according to their level of Spanish

	Tonic			Atonic		
	Group A	**Group B**	**Group C**	**Group A**	**Group B**	**Group C**
F_1	528	525	481	519	495	452
SD	84.3	57.8	68.7	61.6	61.7	57.9
F_2	1,818	1,798	1,945	1,799	1,840	1,968
SD	139.6	177.8	262.1	129.3	151.2	221.9

Table 10: Mean F_1 and F_2 values of [e] of Spanish spoken by female Chinese participants according to their level of Spanish

	Tonic			Atonic		
	Group A	**Group B**	**Group C**	**Group A**	**Group B**	**Group C**
F_1	636	636	567	653	593	536
SD	69.2	100	102.5	56.1	96.4	86.8
F_2	2,150	1,991	2,102	2,192	2,099	2,109
SD	221.7	214.4	200.6	232.6	195.3	200.3

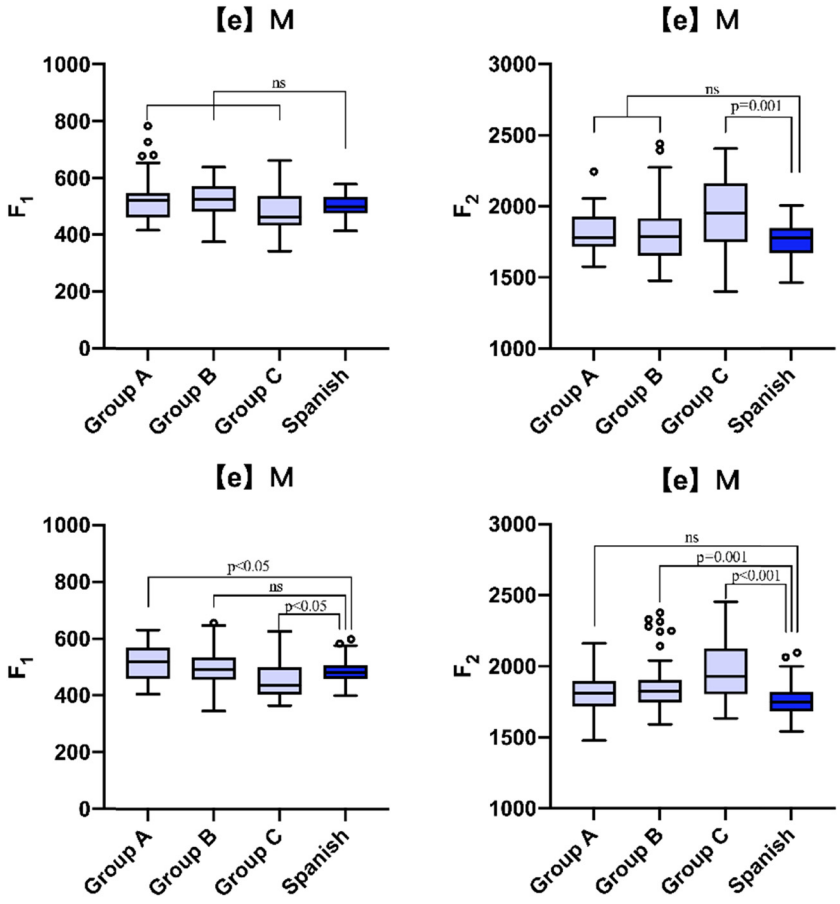

Figure 6: F_1 and F_2 values of the mid front vowel [e] of Spanish in the male voice of the interlanguage and Peninsular Spanish speakers (top: tonic; bottom: atonic).

The statistical results (Figure 6) reveal that regarding F_2, the tonic [e] variant of men only presents a significant difference between Group C and native speakers (Games–Howell: $p = 0.001$). Group C articulates the sound with a more fronted tongue position.

The atonic [e] variant produced by men presents more complex realisations. These atonic variants by Group C are more closed (Games–Howell: $p < 0.05$) and fronted (Games–Howell: $p < 0.001$) than those of native speakers; by Group B, more fronted (Games–Howell: $p = 0.001$); and by Group A, more open (Games–Howell: $p < 0.05$).

Regarding the acoustic results of the tonic mid front vowel [e] of the female voice, the statistical differences between Group C and Peninsular Spanish speakers are not significant, either in F_1 (Games–Howell: $p = 0.851$ in tonic; $p = 0.214$ in atonic) or in F_2 (Games–Howell: $p = 0.855$; Figure 7). In general, there are few differences between the various stages of the interlanguage and the language of native speakers. Only the basic (A) and independent (B) level groups present a more open vowel than native speakers.

Once again, for the atonic position, this time in the women's groups, the situation is more complex. Members of Group A present more open vowels and all three groups, A, B and C, show more fronted vowels compared to Spanish speakers.

5 Discussion

Some authors have regarded the fact that because Spanish has a smaller vowel system than Chinese, with five sounds with the same features as Chinese – which also has two additional sounds, [y] and [ə] – (Wang 2001), it does not cause Chinese learners many problems or lead to misunderstandings (Ortí Mateu 1990,

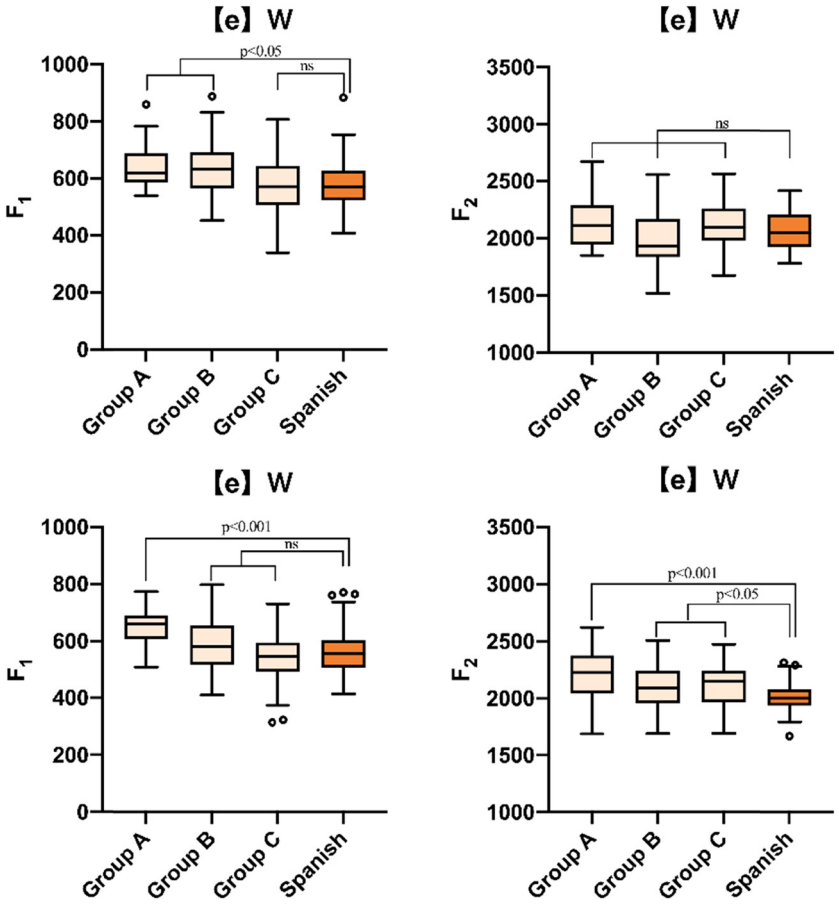

Figure 7: F_1 and F_2 values of the mid front vowel [e] of Spanish in the female voice of the interlanguage and Peninsular Spanish speakers (top: tonic; bottom: atonic).

Planas-Morales 2008, Cortés Moreno 2009). It is true that, in general, vocalism is not an insurmountable barrier when Chinese speakers communicate in Spanish. However, vowel timbre with a strong foreign accent, accompanied by a broken and faltering speech when pronouncing the words, does not favour effective communication with native speakers.

Basically, to explain this strong foreign accent, research has been carried out to date based on a limited number of female participants with an A2 or B1 level, in a corpus of read speech (Jiménez and Tang 2018, Igarreta 2019, Pérez García 2020). Considering this research and with a view to providing new and relevant information, the present study of the interlanguage's spontaneous speech – following the interlanguage notion of Selinker (1972) – was carried out, comparing it with the target language, using a large number of participants of both genders and analysing tonic and atonic [e] and [i].

In this study of spontaneous speech, the timbre values of tonic [i] and [e] are more open, centralised and dispersed on the formant chart, a trend that has been observed in other studies of languages, such as Catalan (Rius-Escudé 2016, 2020) and Spanish (Alfonso Lozano 2010, 2014, Harmegnies and Poch-Olivé 1992, Martín Butragueño 2011, Poch-Olivé et al. 2008, Willis 2005).

In general, researchers in previous studies have chosen to create corpora mainly with female voices (Jiménez and Tang 2018, Igarreta 2019, Pérez García 2020), except Lopez (2012), who includes results of both genders, and Poch and Igarreta (2014), for which the gender is unknown. For this study, participants of both sexes were chosen as this is one of the factors to be assessed to determine if there are differences in the learning of these sounds by students of different genders.

Regarding the timbre of interlanguage vowels, this study concurs with Igarreta (2019) regarding the dispersion of Spanish vowels, which he states to be more homogeneous than that of the interlanguage.

The results of this study confirm a greater dispersion in the timbre of the [i] and the [e] of the interlanguage and a more compact and delimited dispersion in the timbre of the Spanish sounds.

Lopez (2012) concludes that interlanguage vowels are more open and, specifically, that [i] presents a greater tongue retraction. In this sense, Igarreta (2019) concludes that F_1 of [i] is closer to [e], more open, and F_2 to [u]. However, Pérez García (2020) states that the vowels of the interlanguage have the same opening as in Spanish. In contrast to these results, the present research illustrates a clear tendency for the [i] to present a more closed vowel timbre and a more fronted position of the tongue in the interlanguage vowels, both in men and in women. In other words, the [i] on the formant chart of the interlanguage is found in a higher area and to the left and presents a greater dispersion than that of Spanish.

As for the [e], in Lopez (2012), it is in a more fronted position that is closer to [ɛ], in Poch and Igarreta (2014) to the [ə], in Igarreta (2019) it shows similarities with [a] and [i] and in Jiménez and Tang (2018) and Pérez García (2020), it is more open. In this study, higher frequency values were obtained in F_1 and F_2, which implies that [e] is realised with more openness, as Jiménez and Tang (2018) and Pérez García (2020) affirm, and fronted, as in Lopez (2012), than in Spanish speakers, both men, tonic and atonic, and atonic of women. In this case, results were obtained that were similar to previous studies that indicate that the realisations of the interlanguage have phonetic features that distance them from the target language: in general, the atonic and tonic [e] in men and women speaking the interlanguage are more open and fronted than Spanish.

If we compare the tonic and atonic [e] and the sound [i] of the interlanguage with the equivalent Spanish sounds on the formant chart, there is a tendency of an advanced tongue in these front vowels and of separation in terms of opening: the [i] is more closed and the tonic and atonic [e] are more open than in Spanish. The features of the three sounds are a general interlanguage characteristic – the participants are at different learning stages – and could be an issue of fossilisation, according to Selinker (1972). Either way, the results are also considered based on different learning levels, and we will see what types of trends can be found. It is worth mentioning that in all probability, this pronunciation does not cause misunderstandings but it does define characteristic features of the foreign accent that can be overcome to achieve more effective communication with native speakers.

The level of language proficiency of both genders is a factor that affects the [i], significantly among Group C learners who have a proficient level and who produce a more closed and fronted [i] compared to the target language. In contrast, basic and independent level learners, who would be expected to produce realisations of [i] less similar to the target language, produce them in a similar way.

A similar phenomenon occurs with the production of the sound [e] in the atonic position: proficient students (Group C) produce it more open and fronted and those of Group A (basic learners) only more open and those of Group B (independent learners) only more fronted. All these realisations that differ from the target language are reduced when it comes to the tonic variant of [e]. Only men in Group C produced the [e] more fronted and women in Groups A and B, more open.

All this seems to indicate that the tonic [i] and [e] are those acquired most easily, a phenomenon that can be explained by the transfer of their native language – these vowels exist and are tonic vowels – or perhaps because, as established by Cortés Moreno (2003), the perception of stress in Spanish does not pose a major problem for the learners, who perceive and produce tonicity more easily.

Another remarkable aspect of the results is the fact that Group C, proficient students, is the group that presents a pronunciation least similar to the target language, in particular, of the sound [i] and the atonic [e]. In terms of the sound [i], the phenomenon occurs as outlined by Iruela (1997, 75), who states that "there are studies that describe processes in which learners initially approach the phonic values of L2, but later, as they progress in their acquisition, move away from L2 rules towards the L1 or in another direction." In contrast, in the case of the atonic [e] sound, fossilisations occur from the beginning, which evolve during the different stages of learning and reappear at proficient level, creating a backslide phenomenon, as established by Selinker (1972).

Therefore, we can see that, in the case of the [i] sound, Selinker's approach should be expanded on, assuming that not only can fossilisations exist, which are believed to have been overcome and reappear at a later time – backsliding phenomenon – but also that, during the learning process, sounds can be unlearnt at a competent level although they were correctly pronounced at the beginning of the L2 learning. This is

because, as stated by Iruela (1997, 75) and shown in this research, progress is not linear and during learning, regressive processes can occur. In this regard, Leather (1999, 6) observed a backslide in a study on phonic acquisition of Chinese by English speakers and believed that this might be due to a restructuring process of the tonal categories when going from having a single interlocutor to several. The explanation for this backslide could explain the phenomenon that occurs in the [i] and the atonic [e]. Group A participants have learnt Spanish in China with a Chinese foreign language teacher. Those in Groups B and C, however, have broadened their horizons because they have spent more than 2 years in Spain, during which time the number of interlocutors has grown considerably and a restructuring process may have taken place.

In the case of the atonic and tonic [e] of the interlanguage, emitted by men and women, for which a greater difficulty in pronunciation has already been observed, seems to indicate that the factor that could influence the pronunciation of the vowel between the interlanguage and the target language is tonicity: according to the results, tonic vowels pronounced by male and female participants from the different levels – basic, independent and proficient – are similar to the target language, and the atonic vowels, less similar.

Finally, the gender variable was assessed to discover the differences between men and women in the acquisition of pronunciation. When the interlanguage vowels pronounced by both genders were compared with Spanish, the research established that they share the same features but with a different intensity. The interlanguage [i] is characterised by a clear tendency to present a more closed vowel timbre (significant in men, a clear tendency in women) and a more fronted tongue position (significant in women, a clear tendency in men) than that of Spanish speakers. The [e] is articulated more open and fronted than in Spanish speakers, in both men, tonic and atonic vowels, and women, atonic vowels. Only F_2 of the tonic variant in women presented no differences.

Regarding the relationship between language proficiency and gender, in the [i], men and women were equal: Group C participants (proficient) had a pronunciation that was much less similar to the target language. In the pronunciation of the atonic [e], the articulation of the vowels of most groups of different levels and both sexes was less similar to the target language, with some exceptions: there was no difference between female Group C participants and Spanish speakers in F_1 or between the men of Group A and Spanish speakers in F_2. And in the pronunciation of tonic [e], the articulation of the vowels of most groups of different levels, men and women, were very similar to the target language.

Furthermore, with regard to tonicity, the gender of the participant does not appear to be relevant. The [i] vowel and tonic [e] vowel are learnt more effectively and the atonic [e] with more difficulty, by both men and women.

6 Conclusions

This section presents the conclusions reached after carrying out this study on the front vowels [e] and [i] of the interlanguage of Spanish spoken by Chinese people in spontaneous speech.

Below, the similarities between the interlanguage and the target language are listed as follows:

- Although the sounds [i] and [e] have a wide dispersion and are more central than those of more formal corpora, as is typical of spontaneous speech, they are significantly different.
- There are no significant differences in the atonic and tonic [i] of men or women.
- The atonic and tonic [e] have different timbre characteristics: the tonic vowels are more open than the atonic vowels, in both genders.

Following, the timbre features of the interlanguage vowels [e] and [i] that diverge from the target language are described:

- Greater dispersion in the timbre of the [i] and [e] of the interlanguage and a more compact and delimited area in the timbre of the Spanish sounds.
- The [i] presents lower frequency values in F_1 of the interlanguage, implying a more closed vowel timbre, and higher values in F_2, indicating a more fronted tongue position, in both men and women. In other words, the [i] on the formant chart of the interlanguage is found in a higher area and to the left.

- The [e] presents higher frequency values in F_1 and F_2 of the interlanguage, implying that it is articulated more open (tendency in men but not significant) and fronted (except in women in tonic position) than those of Spanish.
- The level of proficiency of L2 is a factor that must be considered in the learning process but it is not always decisive. This study has verified that in the articulation of the [i] of the interlanguage and the tonic [e] by men, only learners with a proficient level present a sound least similar to the target language: the [i] more closed and fronted, the [e] more open and fronted. This could be due to the backsliding phenomenon of a phonetic restructuring caused by an increase in interlocutors.

In contrast, in the realisation of the atonic [e], in both genders and all the participants of the three levels of proficiency in Spanish – basic, independent and proficient – pronunciation is less similar to the target language. This appears to indicate that tonicity is a relevant factor that facilitates the learning of vowel pronunciation.

- (A)tonicity has been revealed as a possible factor that influences the acquisition of pronunciation: tonic vocalism is easier to learn than atonic vocalism.
- The gender of the participants, in general, is not an influencing factor because men and women have similar tendencies.

Throughout this research, it has been verified that there are differences in the vocalism of the interlanguage compared to the vocalism of Spanish with respect to the sounds [i] and [e]. Although these phonic features do not lead to serious misunderstandings, they can affect the effectiveness of communication between Chinese speakers of Spanish and native speakers due to an atypical pronunciation of vowels that characterises their foreign accent. A difficulty in realising tonic [i] and [e] vowels has also been observed, in proficient speakers – probably due to backsliding as well as difficulties for learners of all levels in pronouncing an atonic vowel sound. In this sense, the study confirms that the level of language proficiency and tonicity are factors to consider because they intervene in the acquisition of foreign languages.

In conclusion, the data obtained, which allows a better understanding of the acquisition process of Spanish by Chinese speakers of different levels and an understanding of the similarities and differences between the front vowels of Spanish L2 and L1, is an important basis for the preparation of pronunciation teaching activities adapted to the needs of learners. For this reason, this research should continue with the analysis of the rest of the interlanguage vowels and consider other factors to obtain a global vision of the interlanguage vocalism of these learners.

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