

*Bilingual Spanish (Germany) at age 3;0*

- Manuel: a. ¿Ves aquí las jirafas?  
 'Do you see the giraffes here?'  
 b. ¿Ves aquí que hacemos?  
 'Do you see here what (we) are doing?'  
 Simon: a. ¿Mamá, me buscas el pegamento?  
 'Mom, do you find the glue for me?'  
 b. ¿Puedo subir al tren?  
 'May I enter the train?'

*Bilingual German (Spain) at age 3;0:*

- Inés: a. Und grüne auch?  
 'And the green ones too?'  
 b. Da rein machen?  
 'Put it there?'  
 Nardo: a. Das ist ein Ritter?  
 'Is this a knight?'  
 b. Kann ich aufstehen gleich?  
 'Can I stand up soon?'

*Bilingual Spanish (Spain) at age 3;0*

- Inés: a. ¿Se pueden comer?  
 'Can we eat them?'  
 b. ¿Te gusta mi silla?  
 'Do you like my chair?'  
 Nardo: a. ¿Has visto?  
 'Have you seen?'  
 b. ¿Están aquí?  
 'Are they here?'

## Perception of German vowels by bilingual Portuguese-German returnees

### A case of phonological attrition?

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This study investigates the perception of German vowels by a group of eight Portuguese adolescents and young adults who were raised bilingually in Germany and returned to Portugal in early childhood (between the ages of 5 and 10 years). All the participants reported that they never use German in Portugal and that they are unable to formulate accurate sentences in that language. Our aim was to test whether their perceptual ability to discriminate German sounds had undergone attrition or remained invulnerable to the lack of language use. Unlike German vowels, Portuguese vowels are not distinctive in duration and the Portuguese inventory does not contain the rounded vowels /y/ and /y:/ or the lax vowels /ɪ/ and /ɪ/. Thus, we tested the participants' perceptual ability to discriminate vowels in terms of (i) duration, in the contrast /a-a:/; (ii) quality+duration, in the contrasts /ɪ-i:/ and /ɔ-u:/; and (iii) quality in the contrasts /i-y/, /o-y/, /i-i:/ and /u-y:/ by means of a categorical discrimination test. The results reveal that the returnees were able to make vowel duration and quality perceptual distinctions in the attrited language. This indicates that their ability to discriminate German sounds seems to remain stable.

**Keywords:** attrition, returnees, perception, German phonology

### 1. Introduction

The diversity of studies on language attrition published in the last thirty years reveals how complex and multi-faceted the phenomenon of language loss is. The difficulties in describing language attrition already start with its definition. In its most common characterization, the process of language attrition is defined as the non-pathological decrease in a language that had been previously acquired by an individual due to changes in language input (Köpke & Schmid 2004).

However, this vast definition allows different interpretations of the decline process. In its most severe manifestation, it can be understood as a total loss of the ability to speak or even to recognize a language that an individual acquired in childhood. Those cases of language attrition are described in studies on international adoptees, who lose contact with their first language (L1) at a very young age (e.g. Pallier, Dehaene, Poline, Le Bihan, Argenti, Dupoux & Mehler 2003; Ventureyra, Pallier & Yoo 2004). On the other hand, slight changes in the use of the L1 by adults who immerse in a dominant second language (L2) setting are also characterized as language attrition.

The high variability in the degree of language loss comes along with the complexity in characterizing the nature of the decline process. Despite the increasing number of attrition studies, it remains an unresolved question whether the changes in the bilingual's language proficiency are the consequence of a definite modification of his mental grammar or only the effect of processing difficulties, an issue primarily discussed by Sharwood Smith (1983, 1989) under the competence/performance dichotomy. Moreover, it is not clear if a lost language is really erased from the speaker's mind (like Pallier and colleagues defend) or strongly inhibited (as theorized in Paradis' 1997, 2004 Activation Threshold Hypothesis).

A further complex question in language attrition research is the selectivity of the language loss process. Investigations carried out in the last three decades have shown that certain areas of linguistic knowledge are more susceptible to attrition than others (Seliger 1989, 1996). While the lexicon and inflectional morphology appear to be the most affected domains, syntax reveals to be more vulnerable, although recent research, testing the *interface hypothesis*, has shown that phenomena set at the interface between syntax and other cognitive systems, such as lexical-semantics or discourse pragmatics (Sorace 2000; Gürel 2004; Montrul 2004; Tsimpli, Sorace, Heycock & Filiaci 2004) "are more vulnerable to attrition than purely syntactic aspects" (Sorace 2004: 143).

Phonology is the least explored domain in language attrition research. Due to the diversity of methods and foci of investigation (i.e., speech perception or production), it is almost impossible to draw any consistent conclusion about the vulnerability of the phonetic/phonological domain. Concerning production, Major (1992) reports the occurrence of phonological L1 attrition in native English speakers who were long-term residents in Brazil. In their study of Spanish-Italian bilingual speakers, Colantoni and Gurlekian (2004) show the influence of Italian on Spanish intonational patterns. Major and Baptista's (2009) study on the detection of global foreign accent by long-term Brazilian immigrants living in the United States demonstrates some loss of sensitivity to rate the degree of

foreign accent in their native language. As regards perceptual attrition, Cancila, Celata & Giannini (2005) investigate the perceptual ability of Luchese immigrants in the United States, reporting L1 attrition in the perception of Italian geminate consonants. Focusing on adoptees, the studies conducted by Pallier et al. (2003), Ventureyra et al. (2004), and Hyltenstam, Bylund, Abrahamsson and Park (2009) address the interdependence of L1 attrition and L2 acquisition in speakers who experienced an apparent total loss of their L1 during childhood. The first two studies investigated attrition in adoptees of Korean origin living in France. The age of adoption ranged from 3 to 9 years; their length of residence was approximately 20 years. Pallier et al. (2003) used fMRI behavioural tests in Korean involving sentence identification, translation and speech segment tasks, while Ventureyra et al. (2004) investigated the participants' ability to discriminate among Korean VOT categories. Neither study found any difference between the adoptees and the French control group, claiming that these speakers lost their L1 completely. Hyltenstam et al. (2009) report different findings. They analyzed L1 remnants in Korean adoptees living in Sweden. The study consisted of two tests of Korean proficiency: a grammaticality judgment test and a VOT perception test. The results showed that on the grammaticality judgment test the adoptees did not perform better than the Swedish native group, but in the perception test there was a high rate of variation within the adoptees group: Some participants performed like Swedish natives, while others scored like Korean natives. All in all, the findings suggest that the remnants of the adoptees' L1 consist primarily of lower level features of Korean phonology and phonetics rather than of more complex, higher-order grammatical features.

A further important variable in language attrition is the age factor. Despite the methodological differences in language attrition research, researchers agree without dispute that the attrition process is much more severe in childhood than among adult speakers. The rate of attrition described in studies that deal with language attrition in childhood (e.g. Olshtain 1986; Cohen 1989; Kaufman & Aronoff 1991; Turian & Altenberg 1991; Kuhberg 1992; Tomiyama 2000; Kaufman 2001; Hansen & Shewell 2002; Nicoladis & Grabis 2002; Pallier et al. 2003; Ventureyra et al. 2004; Hyltenstam et al. 2009) contrasts visibly with the data presented in studies investigating adults, which suggests that there might be an age limit after which attrition effects are not significant. Bylund (2009) reviewed a great number of studies exploring age effects in attrition and concluded that there might be a change in attrition susceptibility at around age 12.

## 2. The present study

Studies investigating perception and production of second/foreign language (L2) sounds by adults reveal that these learners are characterized as having a “perceptual foreign accent” (Strange 1995: 22), which is the perceptual equivalent of the concept of foreign accent. This means that the speaker relies on L1 acoustic parameters to perceive L2 sounds. To better understand this process, Flege (1995) proposes the Speech Learning Model (SLM), which hypothesizes that the full establishment of phonetic categories for L1 will impede subsequent L2 category formation because L1 phonology causes L2 learners to filter perceptual acoustic differences. This obstacle to the formation of new categories is due to the cognitive mechanism of equivalence classification. Flege (1987) states that this mechanism, which is helpful for L1 learning because it allows children to identify sounds produced in different contexts or by different speakers as pertaining to the same category, might hinder L2 speakers’ formation of categories for ‘similar’ sounds, since the more subtle the perceived phonetic dissimilarity between an L2 and an L1 sound, the more difficult it will be for phonetic differences between these two sounds to be discerned. On the other hand, Flege (1987) considers an L2 sound which does not resemble any L1 sound to be “new” and easier to be perceived and produced.

Thus, taking the SLM and the concepts of ‘similar’ and ‘new’ into account, this study contributes to the discussion about the nature of language attrition in childhood by addressing the question whether bilingual speakers who lose contact with one of their languages during childhood lose their perceptual sensitivity to sounds of the attrited language. In other words, this study aims at investigating how a group of German-Portuguese bilinguals who lost contact with German perceive German vowels which have duration and spectral quality features different from those of Portuguese. Even though the participants acquired German and Portuguese in childhood, it is interesting to investigate whether the lack of contact with German results in difficulties to perceive specific acoustic characteristics of the lost language.

The study was carried out in northern Portugal and focuses on participants who were born in Germany as second generation migrants, but moved to Portugal, their parents’ country of origin, during childhood. By investigating returnees, we focus on individuals who acquired their L2 (German) in a native-like way, but later left the L2 language environment. In a strict sense, these informants are not returnees, since they were born in the host country and started living in Portugal only after the age of (at least) seven years. However, this study is part of a larger research project on second-generation migrants with heterogeneous migration

backgrounds, who were all labeled ‘returnees’.<sup>1</sup> The database collected in the context of this larger research project on Portuguese-German bilingualism includes recordings of 60 bilingual returnees. One part of the recording was a sociolinguistic interview where participants were asked to talk about themselves, about their individual experiences during migration and after return and about aspects like language choice, identity and attitudes towards bilingualism. The interviews revealed substantial changes in the language use that characterizes the majority of the informants.

The return to Portugal comes along with a drastic change in language dominance, whereby the – until now – dominant language (German) is almost completely excluded from daily communication and is only receptively present in their lives (for example through TV and music). In the interviews some returnees expressed sorrow about the loss of contact with German, while others were indifferent to it. Thus, the emotional investment undoubtedly varies from speaker to speaker.

In previous research conducted within the FCT-project on Second-Generation Returnees, Flores (2010) investigated a group of 32 informants, focusing on their German syntactic competence. In her study, the main criterion to separate the participants into subgroups was the age of input loss. One subgroup of participants lost German input during early childhood (between ages 7 and 10 years) while the returnees of the other group were 11 years or older when they left Germany. Analyzing verb placement in main and embedded clauses, the author concluded that the speakers who lost L2 input earlier than age 11 show significantly more syntactic deficits than the other speakers. Early returnees frequently fail to produce verb-second and verb-final structures. Despite the vulnerability of the syntactic feature under investigation, it is suggested that the observed attrition effects were the result of insufficient L2 activation rather than the expression of undergoing competence loss.

Taking Flores’ study as a starting point, the present work changes the focus from syntax to phonology by addressing the question of whether the premature interruption of L2 input influences the speakers’ ability to perceive the sounds of the disused language. For this purpose we restricted the group of informants of the FCT-project to the participants who came to Portugal at a very young age and who claimed not to be able to speak German any longer. In their cases, the initial sociolinguistic interviews were conducted in Portuguese.

Studies on bilingual sound acquisition (Werker, Gilbert, Humpfrey & Tees 1981; Burns, Werker & McVie 2003; Bosch & Sebastián-Gallés 2003; Brasileiro

1. We would like to thank FCT, the Portuguese Council for Research, which supported the project (grant POCH/LIN/59780/2004).

2009) have shown that, despite some temporary periods of delay in early phases of development, bilingual children equal their monolingual counterparts in acquiring the ability to discriminate native sounds, differentiating the systems of the two languages, as also largely assumed for syntax (Meisel 2001). Thus, we assume that second generation children, who have contact with the sounds of the two languages of environment from very early on, develop native perceptual abilities in their two languages. The question is how this ability develops after the break of input from one language in pre-puberty.

Our interest is to further investigate how the Portuguese returnees perceive German vowels which differ from Portuguese vowels in terms of duration and quality. The following section describes the two vowel systems and presents our objectives and hypotheses.

### 3. The vowel systems

In European Portuguese (EP), there are three unrounded front vowels (/i, e, ε/), three rounded back vowels (/u, o, ɔ/), and two central vowels (/e, a/), totaling eight oral vowels in stressed position (Barroso 1999; Mateus, Falé & Freitas 2005). On the other hand, the German vowel system has five unrounded front vowels (/i:, i, e, ε, e: /), four rounded front vowels (/y:, y, ø, œ /), two unrounded back vowels (/a, a: /), and four rounded back vowels (/u:, u, o, o: /), totaling 15 oral vowels in stressed position (Wiese 1996: 11, 20). Differently from German, Portuguese vowels are not distinctive in duration and its inventory contains neither rounded front vowels nor the lax vowels /ɪ/ or /ʊ/. According to Wiese (1996: 11, 20), the vowels of the German pairs /i:/-/ɪ/, and /u:/-/ʊ/ are very similar in quality, differing mainly in duration and tongue root retraction (lax/tense vowels). Thus, our aim was to test the returnees' perceptual ability to discriminate vowels in terms of (i) duration only, in the contrast /a-a:/; (ii) duration+quality, in the contrasts /i-i:/ and /o-u:/; and (iii) quality only, in the particular contrasts /i-y/, /o-y/, /i-y: /, and /u-y: /. The choice of /y/ and /y:/ was to test whether roundedness, a feature not present in Portuguese front vowels, would be a more salient feature than vowel height, tenseness or duration.

Considering the differences between the Portuguese and German vowel inventories, we formulated the following hypotheses:

A. as regards vowel duration and duration+quality, the returnees and the control group formed by German listeners will be able to discriminate between the similar German vowels /a-a:/, /i-i:/ and /o-u:/, but the native Portuguese speakers of another control group will consider them equivalent due to their

L1 categories established for the vowels /a/, /i/ and /u/ and the lack of duration contrast in the Portuguese inventory;

B. as regards vowel quality, the three listener groups (returnees and the two control groups) will be able to discriminate between the pairs /i-y/, /o-y/, /i-y:/, and /u-y: /. Because there is no rounded front vowel in the Portuguese inventory, roundedness will be considered a feature more salient than tenseness or height of /ɪ/ and /ʊ/; thus, the native Portuguese and the returnees will have less difficulty to discriminate between the new rounded front vowels and the similar (/ɪ, ʊ/) or identical (/i:, u:/) vowels.

## 4. Method

### 4.1 Participants

A group of eight second-generation emigrants (Ret), six women and two men, aged from 13 to 22 years (mean = 17.1 years, standard deviation (SD) = 3.3 years), raised bilingually in Germany, participated in this study. All of them were born in the host country and can be classified as early successive bilinguals. The bilinguals moved to the Minho region (north of Portugal) and have lived there since they returned to Portugal. The process of language acquisition was very similar for all participants. Portuguese was the family language, i.e., the language dominantly used at home, classified as L1. However, the contact with German, which we classify as L2, was also present from very early on. In the case of Participant 6, the mother, who was herself a bilingual speaker of German and Portuguese, spoke German to her children since birth. The other participants had older siblings and cousins who used German as the preferred language. In the course of their development the amount of input from both languages changed considerably. The German input increased and German became the most used language, while the L1 was restricted to conversations at home. All participants attended kindergarten during childhood and five of them also attended primary school in Germany. When they were asked about their fluency in German before returning to Portugal, all participants said that German was their dominant language. By this time, Portuguese, their heritage language, was the weaker language, a fact that caused some integration difficulties in the Portuguese school system when they arrived in Portugal.

Regarding the age at return, all participants came to Portugal by the age of 11 years, i.e., the age which is found to be the critical limit in language maintenance. By the time the data was collected, all participants had been living in Portugal for more than 5 years. The length of residence ranged from 5;01 years to 15;06 years

(mean 10;0 years, SD = [3;10] years). In the literature on language attrition we can find different proposals for the establishment of the minimal baseline after which attrition effects may appear. For adults many authors delineate a minimal length of 10 years in the new linguistic environment (e.g., Gürel 2004). Studies on pre-puberty attrition, however, have shown that the effects of attrition appear much earlier when the attriter is a child. The children investigated by Kaufman & Aronoff (1991), Kuhberg (1992) and Tomiyama (2000), for instance, demonstrate significant changes in their linguistic competence less than two years after the change of the dominant linguistic environment. In view of that, we assume that a minimal length of residence of 5 years is sufficient for the potential emergence of attrition effects in our group of returnees.

With respect to the amount of contact with German after moving to Portugal, in all cases the frequency of L2 input decreased drastically. Their contact with German was restricted to some passive input through TV and sporadic phone talks with family/playmates still living in the emigration country. It is important to mention that German is not taught as a foreign language in Portuguese primary schools; thus, any sort of academic input was no longer available. Other factors which influenced the progressive substitution of German by Portuguese in their daily life were revealed during the sociolinguistic interview. Peer-pressure, the need to improve the heritage L1 (Portuguese), and in many cases also the parents' attitude, who saw bilingualism as handicap for their children's integration in the Portuguese society, gave rise to a radical decline of contact with German. Following de Bot, Gommans & Rossing (1991), who divide the frequency of use into "frequent" and "infrequent", all speakers can be classified as *infrequent* L2-users. By the time of the recording the participants' productive skills had reduced so dramatically that the whole sociolinguistic interviews had to be conducted in Portuguese.

The age at recording varied between 13 and 22 years. A summary of the participants' ages when they moved to Portugal and the age at recording, as well as the length of stay in Portugal is reported in Table 1.

Two control groups were also tested: eight native speakers of German and eight Portuguese with no previous knowledge of German. The Germans (nGer) were four women and four men, all living in the city of Bamberg, in the state of Bavaria, in the South of Germany. Their ages ranged from 23 to 48 years (mean = 33.2, SD = 8.8 years). Four were university students, one was a secretary, one was a doctor and the other two were German teachers. The Portuguese group (nPt) was also formed by four women and four men, all from the province of Minho, in the north of Portugal. Their ages ranged from 20 to 39 years (mean = 26.9, SD = 6.9 years). They were workers and university students. The choice of the regions and

Table 1. Participants' ages at return to Portugal and at recording, and their length of stay in Portugal

Participant	Age at return	Age at recording	Length of residence
1	8	13	[5;05]
2	6	16	[10;03]
3	5	19	[14;00]
4	7	22	[15;06]
5	8	15	[7;07]
6	9	14	[5;01]
7	10	21	[11;00]
8	6	17	[11;05]
Mean (SD)	7.4 (1.7)	17.1 (3.3)	[10;0] ([3;10])

cities in the two countries was due to availability of participants. No participant in any of the three groups reported having hearing problems.

#### 4.2 Stimuli

In order to investigate the discrimination rate between the vowel pairs, we designed an ABX categorical discrimination test (CDT) based on Flege, Munro & Fox (1994). The stimuli were recorded by four native speakers of German, one man and three women, whose ages ranged from 28 to 43 years (mean = 35 years, SD = 6.8 years), three were born and lived most of their lives in the city of Bamberg and one was born in Amberg, but had already been living in Bamberg for 12 years. Thus, the four German speakers were from the state of Bavaria, in the South of Germany, and all were German as a foreign language teachers. The target vowels were inserted in 'bVk' (V = vowel) structures and the speakers were asked to read the carrier sentence *Ich sage /bVk/*. 'I say [bVk]' with a falling intonation and at a normal pace. The consonants /b/ and /k/ were chosen because they are present in the Portuguese and German phonological inventories, allow easy identification of vowel boundaries<sup>2</sup> to measure vowel length, and result in German nonce words which do not violate phonotactic constraints. When a sentence was read too fast or with a rising intonation the item was reread and the appropriate recording was used. The target vowels inserted in the bVk frame were /a, a:, ɪ, i:, ɔ, u, ʏ, y:/, and since all the participants were German teachers familiarized with phonetic symbols, the transcription of the target word was presented in this

2. We selected the voiced bilabial (/b/) rather than its voiceless counterpart as the initial consonant of the 'bVk' syllable in order to avoid aspiration (a feature not present in the Portuguese phonological system), but this choice did not affect the identification of the vowel onset.

Table 2. Mean duration and standard deviation (SD) in milliseconds of the vowels used as stimuli in the categorical discrimination test

Vowel	/a/	/a:/	/l/	/i:/	/o/	/u:/	/ɣ/	/y:/
Mean	95.1	265.3	60.3	262.3	65.3	227.7	63.3	223.7
SD	7.0	9.3	6.1	4.9	2.8	11.1	7.6	3.2
Difference in length	/a-a:/	170.2	/l-i:/	202.0	/o/-u:/	162.4	/ɣ-y:/	160.4

format: e.g., *Ich sage [ba:k], Ich sage [bɔ:k]*. Table 2 reports the mean duration and standard deviation values in milliseconds of the vowels recorded by the four native speakers of German.

The sentences were recorded in a silent room with an Edirol R-09HR recorder and an Edirol CS-15 unidirectional microphone, with a sample rate of 22 kHz and 16-bit quantization. The target bVt words were segmented and normalized for peak intensity in the software Praat Version 5.0.21 (Boersma & Weenink 2008). Since the objective of the study was to investigate the discrimination between the vowels which differ in terms of duration only (/a-a:/), duration+quality (/i-i:/, /o-u:/), and quality only (/l-ɣ/, /o-ɣ/, /i-y:/, /u-y:/), sequences containing three tokens (trials) were designed so that in each trial there was either an odd item (change trials) or all the items were the same (catch trials). Each token of the trial was pronounced by a different native German speaker. Catch trials were included to test the participants' ability to ignore audible (voice quality) but phonetically irrelevant differences in terms of within-category variation, but these trials were not analyzed in the present paper. The interstimulus interval between the three tokens in all trials was set to 1.3 seconds and the trials were automatically randomized in Praat's Multiple Forced Choice listening experiment each time a new test began. The total number of trials was 88 (8 change trials × 7 contrasts + 4 catch trials × 8 vowels). To these trials, 10 distracter sequences (e.g., [bik] [bak] [bɔk]) were added, so as to help disguise the objective of the study and to check whether the participants were indeed paying attention to the tokens.

#### 4-3 Procedures

All participants were tested individually in a silent room using a laptop computer. The native speakers of Portuguese and the bilinguals were tested in their homes or at the University of Minho, in the city of Braga, Portugal. The native speakers of German were tested in their homes or at a German language institute, in the city of Bamberg, Germany. Instructions to the first two groups were read in Portuguese, and to the native Germans, in German.

The participants of the experimental and control groups heard the stimuli via headphones at a comfortable level. The test was designed and presented in Praat. When the participants heard a trial, they had to click on a button marked '1', '2' or '3' in case the first, second or third token was the odd item, or '4' in case all the items were the same. The next trial was only presented after the participant had already selected an option. Thus, the participants would hear, for instance, the sequence [bak], [ba:k], [bak], and in this case would have to click on the button equivalent to alternative two, since the second token was the odd item. There was no time limit for the participants to choose an alternative, but the items were played only once. A practice session with five of the test trials was conducted before the actual test so that the participants would be familiarized with the test procedures. The control group formed by the native speakers of German tested the reliability of the stimuli: the mean results show that all contrasts but /o/-u:/ were accurately discriminated over 98.5%. The mean rate of accurate discrimination of the high back vowel pair was of 90.9% (see all native Germans' results in Tables 3 and 4).

## 5. Results and discussion

The small number of participants in each group suggests the use of nonparametric tests. However, we used the strategy of computing both parametric and their equivalent nonparametric tests as advised by Fife-Schaw (2006). Given that the conclusions drawn from both sets of tests were the same in all cases, we prefer to report the parametric test results for the analyses that identify the general differences in discrimination between the language groups (One-Way ANOVA), because they are more robust and the number of tests run is reduced.

### 5.1 Vowel pairs that differ in terms of duration

As regards duration only and duration+spectral quality, the results in Table 3 and Figure 1 show the rates of correct discrimination of the vowel pairs by the three listener groups. A One-Way ANOVA reveals that there are significant differences between the speaker groups concerning the discrimination of all vowel pairs (/a-a:/ - F(2,21) = 19.86, p = .001; /i-i:/ - F(2,21) = 24.85, p = .001; /o-u:/ - F(2,21) = 35.65, p = .001). Scheffe post-hoc results show that, as expected, there are significant differences between native speakers of German and native speakers of Portuguese in the perception of each of the three pairs (p < .001). As regards the returnees and the Germans, no significant difference was found for the discrimination of the vowels of the pairs /a-a:/ (p = .051) and /i-i:/ (p = .052), and

Table 3. Mean percentages of accurate discrimination of the target vowel pairs that differ in terms of duration (/a-a:/), and duration+quality (/o-u:/, /i-i:/) (SD in parentheses)

Part	/a-/a:/	/i-/i:/	/o-/u:/
nGer	98.5 (4.2)	100 (0.0)	90.9 (8.7)
Ret	65.9 (31.4)	72.0 (31.9)	56.5 (25.9)
nPT	20.5 (29.2)	25.2 (19.0)	20.6 (9.2)

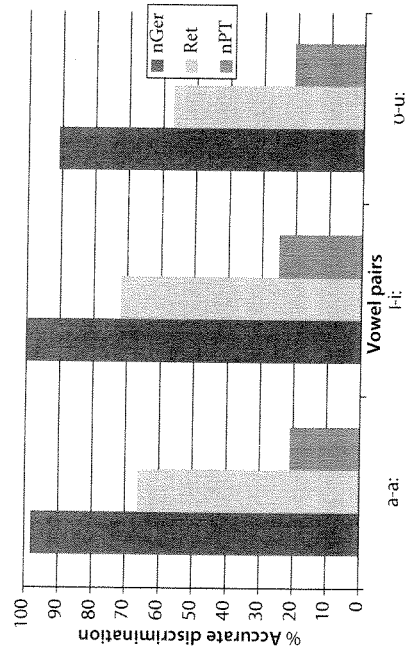


Figure 1. Percentages of accurate discrimination of the vowels which differ in terms of duration (/a-a:/), and duration+quality (/o-u:/, /i-i:/)

significant differences were found for the discrimination of the vowels /o-u:/ ( $p = .002$ ). Compared to the native Portuguese speakers, the returnees' rates of accurate discrimination differed significantly for all vowel pairs: /a-a:/ ( $p = .006$ ), /i-i:/ ( $p = .001$ ), and /o-u:/ ( $p = .001$ ). This shows that the returnees' results are in an intermediate position between those of the Germans and Portuguese, but tend to approximate the Germans' scores for the pairs /a-a:/ and /i-i:/.

In terms of difficulty, the participants of the three groups had the highest discrimination rates for the /i-i:/ contrast, and the lowest for the /o-u:/ contrast. The difficulty which participants from all groups had in discriminating between the vowels in the /o-u:/ contrast may have been due to the smaller duration difference between the two vowels: 162.4 ms compared to 202 ms of the /i-i:/ contrast and 170.2 ms of the /a-a:/ contrast. As regards the native speakers of Portuguese, both /o-u:/ and /a-a:/ had equally low discrimination rates, which indicates that smaller duration differences compromised their discrimination of these similar vowels.

In terms of within-group differences, Friedman tests showed a significant difference between the results of the three pairs only for the native speakers of

German ( $\chi^2(2) = 8.4, p = .015$ ). As revealed by Wilcoxon tests with Bonferroni correction ( $\alpha: .05/3 = .017$ ), there were no significant differences for the /a-a:/-/i-i:/ and /a-a:/-/o-u:/ contrasts, but the reason why the Friedman test revealed significant differences between the scores of the three pairs by the Germans was because of the marginally significant difference for the /i-i:/-/o-u:/ ( $Z = -2.121, p = .034$ ) contrast. Despite this marginally significant difference, it is possible to state that, as far as within-group results are concerned, the three listener groups had similar discrimination scores when the stimuli heard varied in terms of duration and duration+quality. The results confirm Flege's (1987, 1995) equivalence classification claim that L2 sounds are classified according to L1 phonological cues. The Germans, whose phonological inventory has vowels that differ in terms of duration and spectral quality, could easily detect duration and duration+quality differences, while, the native Portuguese, whose vowels differ in terms of spectral quality only, could not perceive duration differences and, since the difference in quality between /i-i:/ and /o-u:/ is subtle in German and nonexistent in Portuguese, it was not detected. However, the returnees' results were in an intermediate position between those of the native German and native Portuguese listeners, revealing that even though they lost contact with German, they are more sensitive to duration and duration+quality differences between the vowels of each contrast.

It is interesting to observe individual differences in the group of returnees (see Figure 2). However these differences appear to be unrelated to factors like length of residence or age at recording. For instance, Participants 5 and 7 discriminated the vowels of the /i-/i:/ contrast 100% correctly, while Participant 8 was not at all sensitive to duration differences in the pairs /a-/a:/ and /i-/i:/, and managed to discriminate only one trial (12.5%) with the /o-/u:/ contrast correctly. We could

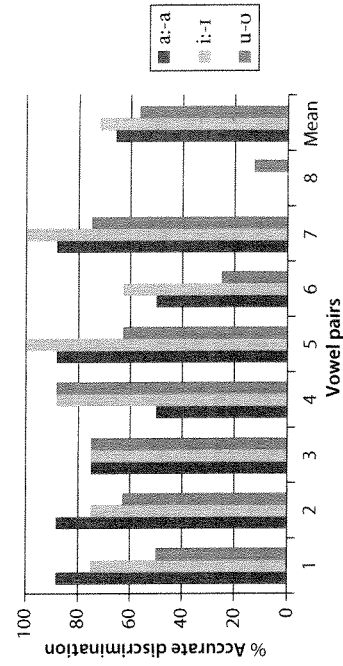


Figure 2. Returnees' percentages of accurate discrimination of the vowels that differ in terms of duration



try to explain these differences by pointing out the different ages at which these girls moved away from Germany. Indeed, Participant 8 had the youngest age of return. She attended kindergarten and 3 months of the first grade in Germany. However, Participants 2 and 3 came to Portugal at ages very similar to that of Participant 8 and present better results. The differences between the participants cannot be explained by language use either, because none of the participants has spoken German in their daily life since the return. Actually, the only participant who has more German input than the others is Participant 6. Even though she refuses to speak German to her bilingual mother, the mother informed us that sometimes she addresses her daughter in German in order to keep the German input available. Participant 6 is also one of the participants with the lowest length of residence. In this sense it is interesting to note that, although these factors could favor better performance, Participant 6 is one of the participants with the lowest perception results. Thus, even though the mean scores reveal that the returnees tended to perform more similarly to the Germans than to the Portuguese, Participant 8 was a very evident exception. However, this exception, like other individual differences, cannot be explained pointing to differences in age of return or length of residence. Bylund, Abrahamsson & Hyltensam (2010) highlight the effects of language aptitude in prepubescent attrition. They demonstrate that attriters with an above-average degree of aptitude tend to exhibit more native-like linguistic knowledge than speakers with a below-average degree of aptitude. Since studies on language aptitude confirm that individuals vary in their (innate) talent to acquire and process language structures, this factor may influence the performance of our participants as well. There might also be other factors, like motivation, which might influence the results, but which were not controlled in our study.

### 5.2 Vowel pairs that differ in terms of quality only

As regards the results for the discrimination of vowels which differ in terms of spectral quality only (see Table 4 and Figure 3), a One-Way ANOVA reveals significant differences between the three groups for the discrimination of all pairs ( $F(2,21) = 5.49, p = .012$ ;  $/u-y/$ : ( $F(2,21) = 9.66, p = .001$ ;  $/u-y/$ :  $F(2,21) = 4.03, p = .033$ ,  $/i-y/$ :  $F(2,21) = 3.69, p = .042$ ). Scheffé post-hoc results show that there are significant differences between the Germans and returnees only for the  $/i-y/$  pair ( $p = .048$ ). No significant difference was found between the discrimination scores of the returnees and Portuguese listeners for any vowel pair. However, the Germans' scores differed significantly from those of the native Portuguese speakers in the perception of the pairs  $/i-y/$  ( $p = .022$ ),  $/o-y/$  ( $p = .001$ ), and  $/u-y/$

Table 4. Mean percentages of accurate discrimination of the target vowel pairs that differ in terms of quality (standard deviation in parentheses)

Participant	/i/-y/	/o/-y/	/i/-y:/	/u/-y:/
nGer	100 (0.0)	98.5 (4.2)	98.5 (4.2)	100 (0.0)
Ret	78.5 (19.7)	84.5 (11.1)	75.1 (22.1)	82.9 (17.6)
nPt	75.4 (20.0)	70.4 (18.7)	76.8 (22.5)	72.1 (31.2)

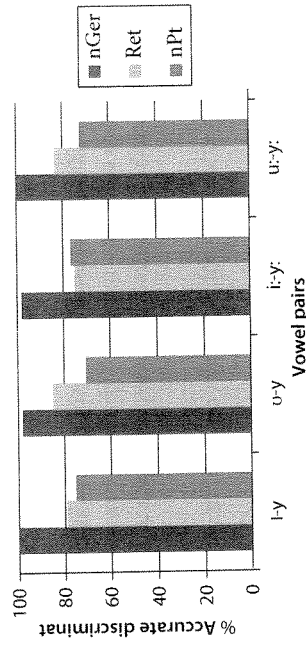


Figure 3. Percentages of accurate discrimination of the vowels which differ in terms of quality

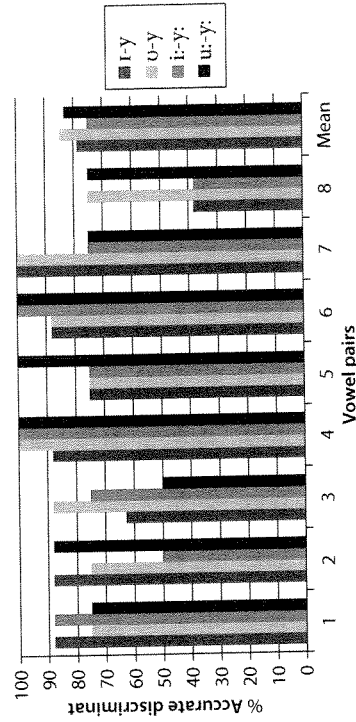


Figure 4. Returnees' percentages of accurate discrimination of the vowels which differ in terms of quality

( $p = .044$ ). Again the returnees' results are in an intermediate position between those of the Germans and Portuguese, except for the  $/i-y/$  pair, in which case the Portuguese outperformed the returnees in 1.7%.

Concerning within-group differences in discrimination rates between the four vowel pairs, although the returnees had slightly higher discrimination scores



for /o-ɤ/ and /u:-y:/ than for /i-ɤ/ and /i:-y:/, Friedman tests revealed no significant difference for any pair discriminated by any listener group. This shows that all the participants (including native speakers of Portuguese) are more sensitive to vowel quality (no matter for which target pair) than to vowel duration and duration+quality differences. The results corroborate the SLM, since the more dissimilar, or 'new', an L2 vowel (/ɤ, y:/), the easier it is discriminated from other L2 identical (in this case, /i:/, /u:/) or similar (/i, u/) vowels.

Individual scores show that Participant 8 had (again) the greatest difficulty to discriminate between the vowels of two pairs (/i-ɤ/ and /i:-y:/, 38% of correct discrimination in both contrasts). However, her results were close to the mean group scores for the other two contrasts. Even though Participant 8 had low scores in general, she is still more sensitive to quality than duration differences, following the general trend.

## 6. Conclusion

In our study, sensitivity to features not present in the vowel inventory of the L1 (duration, roundedness) were tested by means of a discrimination test applied to a group of participants who were born in Germany and returned to Portugal (the home country of their parents) before the age of 11 years. Once in Portugal, the returnees no longer used German and at present show a high degree of attrition in the domains of syntax and morphology (see Flores 2010), being unable to hold any basic conversation in that language. Despite the lack of exposure to what was once their dominant language, our results corroborate those by Hyltenstam et al. (2009) in that in the two studies the returnees/adoptees who are able to discriminate the sounds of the target language (German/Korean) tend to score much higher than the non-native controls. Our group of returnees has results more similar to those by the German native speakers than by the speakers of the current native language (Portuguese). We believe that these results indicate some stable perceptual ability in this group of participants, which contrasts with their low proficiency in other linguistic domains, such as morphology and syntax. Similarly to what Hyltenstam et al. (2009) suggest, our findings reinforce the idea that the phonological domain seems to be more resistant to attrition than other linguistic areas.

As regards the differences between vowel duration, duration+quality and quality, our hypotheses were partially corroborated. The hypotheses predicted that both the returnees and native German speakers would discriminate between the vowels of all contrasts, while the native Portuguese speakers would not discriminate between similar vowels, but would have less difficulty discriminating

between a similar and a new vowel. The results show that the feature roundedness of the new vowels /ɤ/ and /y:/ was more salient than duration, height or tenseness. Thus, the lack of duration as a contrasting feature in the L1 (Portuguese) vowels yielded more difficulties to both returnees and native speakers of Portuguese than did the lack of the rounded front vowels /ɤ/ and /y:/ in the L1 vowel inventory. However, these difficulties are considerably more expressive in the group of the native Portuguese controls, who never had contact with German, than in the group of returnees, who acquired duration as a basic feature of German phonology in childhood.

## Acknowledgements

We would like to thank the two reviewers for their valuable comments, all the volunteer participants, and also the director of *Treffpunkt Sprachinstitut*, in Germany, for gently allowing us to have access to their German teachers and staff.

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