Early exposure to an Indigenous heritage language and the transfer of perceptual abilities into a foreign language

Stanislav Mulík[1], Mark Amengual[2], Haydée Carrasco-Ortíz[3]

[1]Universidad Nacional Autónoma de México, Mexico;
[2]University of California, Santa Cruz, USA; [3]Universidad Autónoma de Querétaro, Mexico
stanmulik@gmail.com

ABSTRACT

This study investigates a potential facilitatory effect in the perception of the French vowel contrasts /a-ɔ/ and /ɔ-o/ by Spanish-dominant heritage speakers of Hñäñho (HHSs), an understudied and vulnerable Indigenous language in Mexico, as a result of transferring their perceptual abilities of comparable contrasts from their heritage language (Hñäñho) to a language unknown to them (French). In an AXB task, 12 HHSs and 12 monolingual speakers of Mexican Spanish (MSMs) were presented with minimal pairs containing these vowels in Hñäñho and French. Group comparisons showed similar discrimination patterns for these groups in both Hñäñho and French. However, response time data indicate that only the HHSs exhibited significant correlations between their individual perceptual abilities in Hñäñho and French. These results suggest a possible transfer of perceptual abilities from a native, heritage language to an unknown foreign language, even if the heritage language is not actively used by its heritage speakers.

Keywords: Hñäñho, Indigenous heritage language, non-native phonetic learning, early exposure.

1. INTRODUCTION

Heritage speakers (HSs) are early bilinguals who have been exposed to a minority (i.e., heritage) language and the majority language early in life. These HSs may have grown up speaking both languages since birth (i.e., simultaneous bilinguals), may have been brought up in a monolingual setting in early childhood and become bilingual after starting school in the majority language (i.e., sequential bilinguals), or may have had exposure to their heritage language (HL) during their childhood to acquire native-like comprehension of the language but have no active command in it (i.e., passive bilinguals). The latter scenario is especially common in contexts of language shift, like those of speakers of endangered Indigenous languages, in which HL use is usually limited to their nuclear family.

There has been an increased interest in the phonetic abilities of HSs in recent years [9, 26], especially since there is the general assumption that HSs have a benefit in perceiving and producing sounds in their HL as a result of early exposure to the language [4, 10, 19]. However, fewer studies have investigated if this early exposure is advantageous for the perception and/or production of sounds in another language [3, 25]. In other words, does early exposure to an HL facilitate non-native phonetic learning?

The aim of the present study is to examine the potential transfer of perceptual abilities from a native, HL to an unknown foreign language. More specifically, we focus on the perception patterns of Spanish-dominant, Mexican Indigenous HSs in their HL (Hñäñho) and in a foreign language unknown to them (French). We compare their perception in both languages to those of a control group of Spanish-speaking Mexican monolinguals of similar socioeconomic status and age, who have no knowledge of French nor Hñäñho and may therefore only transfer their perceptual abilities from Spanish.

1.1. Heritage speakers of Hñäñho

Santiago Mexquititlán Otomi (Hñäñho) is an Oto-Manguean language variety spoken in Central Mexico. Hñäñho is the first language (L1) or second language (L2) almost exclusively of the Otomi Indigenous people from the rural community of Santiago Mexquititlán in the state of Querétaro.

Even though the term HS has not traditionally been used in Mexico to refer to Indigenous language speakers, the linguistic reality of these speakers very much aligns with the definition of a HS [23]. For instance, Hñäñho is the minority language used in the household, whereas Spanish is the majority language mostly learned either early or later in life as an L2 [20, 16, 24]. The different degrees of Hñäñho-Spanish bilingualism observed in urban areas span from limited knowledge of Hñäñho, changes in language dominance and an increase in Spanish language use, and an eventual language shift from Hñäñho to Spanish in as few as three generations [8]. The relevance of the Ñäñho culture and a connection to the language have been reported to be experienced even by those who have little or no competence in the Hñäñho language.

1.2. Spanish, Hñäñho, and French vowels

The vowel systems of Spanish, Hñäñho, and French are considerably different. Spanish has a simple five-vowel symmetrical system [18, 27]. Along the height dimension, Spanish has two high vowels (/i/ and /u/), two mid vowels (/e/ and /o/), and one low vowel (/a/); and, along the frontness/backness dimension, there are two front vowels (/i/ and /e/), one central vowel (/a/), and two back vowels (/u/ and /o/). In contrast, Hñäñho has a nine-vowel symmetrical system [17, 21, 22] with an additional contrast in height, distinguishing higher-mid vowels /e/ and /o/ from lower-mid vowels /ɛ/ and /ɔ/, and a high-mid central vowel /ə/ also contrasting with the high central vowel /ɨ/. It is also worth noting that the Hñäñho vowel system has one nasal vowel /ɑ̃/. Finally, the vowel system of Standard French consists of up to 13 vowels (/i, y, u, e, ø, ə, o, ɛ, ɛː, œ, ɔ, a, ɑ/) and four nasal vowels (/ɛ̃, œ̃, ɔ̃, ɑ̃/) [13].

Of relevance to the present study, the Hñäñho and French vowel systems both contain mid-vowel contrasts, even though they may not be acoustically identical. Most importantly, however, the acoustic spaces of the Hñäñho and French pairs /e-ɛ/ and /o-ɔ/ are different from the Spanish mid vowels /e/ and /o/. Therefore, it remains to be seen if the perceptual abilities regarding the mid-vowel contrasts in one language (HL) can transfer to an unknown foreign language, for which the combination of Spanish as the dominant language, Hñäñho as L1/HL, and French as a foreign language is an idoneous setting.

2. METHOD

2.1. Participants

A total of 24 adults participated in the study. Twelve were Hñäñho heritage speakers (HHSs) with Mexican Spanish as their dominant language and 12 were Mexican Spanish monolinguals (MSMs). Both groups were proficient speakers of Spanish, but they differed in their mother tongue: HHSs' native language was Hñäñho and/or Spanish, while MSMs' only native language was Spanish. HHSs learned Spanish simultaneously since birth or sequentially during early childhood as an L2; the average age of Spanish acquisition was 5. The two groups were matched in age (mean age 29.9 for HHSs and 29.4 for MSMs) and low socio-economic status.

2.2. Materials

The experimental stimuli consisted of two Hñäñho minimal pairs /do/ *do* 'rock' - /dɔ/ *dɔ̲* 'eye'; /pa/ *pa* 'day' - /pɔ/ *pɔ̲* 'snake', and one French minimal triplet /ot/ *hôte* 'host' - /ɔt/ *hotte* 'hood' - /at/ *hâte* 'haste'. The stimulus recordings in Hñäñho and French were obtained from three female native speakers of each language in a sound-attenuated booth. The stimuli were recorded using a head-mounted microphone (Shure SM10A) and a solid-state digital recorder (Marantz PMD660), digitized (44 kHz, 16-bit quantization), and computer-edited for subsequent acoustic analysis. All tokens were automatically extracted in *Praat* [7], adjusted to 200ms duration, and normalized in terms of intensity. One acoustic realization per speaker was selected for each Hñäñho and French stimulus and used in the experiment. Table 1 displays the mean vowel formant values for all experimental stimuli.

		F1 (Hz)	**F2** (Hz)	**F3** (Hz)
Hñäñho	/a/	934	1530	2224
	/ɔ/	808	1315	2615
	/o/	626	1078	3021
French	/a/	822	1522	2812
	/ɔ/	589	1172	2602
	/o/	455	819	2598

Table 1: Mean formant values for the vowels used as experimental stimuli.

2.3. Experimental procedure

On the day of the experiment, HHSs filled in the BLP questionnaire [6] and all participants completed the experimental tasks in an individual computerized session. Response times and accurate answers from all tasks were recorded on a Cedrus Response Pad RB740. The AXB task was carried out in a sound-attenuated room, where the participants were comfortably seated in front of a computer screen. Auditory stimuli were delivered by means of earphone inserts and the instructions, as well as other visual aids, were presented at the center of the screen in white font on black background.

There were 24 randomly ordered trials in each AXB categorical discrimination task (Hñäñho and French) consisting of a 500ms fixation cross, followed by the presentation of three auditory Hñäñho/French words (A, X, and B), each pronounced by a different speaker in random order, with a duration of 200ms and 1000ms stimulus onset asynchrony. At the beginning of each task, participants were instructed to pay close attention to the three words and decide whether the vowel in the word they heard second (X) was the same as the vowel in the word they heard first (A) or in the word they heard third (B), and to press the button designated for each scenario. There were four prior AXB training trials on an easy vowel contrast /o-i/ to familiarize the participants with the task.

2.4. Data analyses

Correct answers and corresponding reaction times (RTs) were obtained from all participants for both vowel contrasts in each language. Data from 1 HHS participant were removed, because they failed to follow the instructions. All remaining data were analyzed for outliers. Trials with RTs above 2 standard deviations (SD) from the mean were removed for each participant in each experimental condition (N= 46, 3.3% of the data). Additionally, data from 1 HHS and 1 MSM participant were removed, since their average RTs were above 2SD from the group mean in all 4 experimental conditions. The final dataset consisted of data from 10 HHSs and 11 MSMs.

ANOVAs and Pearson's correlations were used for the statistical analyses of the data, which consisted of accuracy scores and mean RT values per participant and per condition. The factors included in the ANOVAs were participant *Group* (HHSs and MSMs), *Language* (Hñäñho and French), and vowel *Contrast* (/a-ɔ/ and /ɔ-o/).

3. RESULTS

3.1. Group differences

Figures 1 and 2 show the group averages for participants' RTs and accuracy scores in the AXB task, respectively. At the group level, HHSs and MSMs showed similar perceptual patterns for both contrasts in Hñäñho and French, both in terms of RTs and accuracy.

For RTs (Fig. 1), the ANOVA showed no main effect of *Group*, *Language*, or *Contrast* (all *F*s<1). However, there was a significant *Language* Contrast* interaction ($F(1,19)=15.130$, $p<0.001$). Bonferroni-corrected pairwise comparisons showed that participants took longer to identify the /a-ɔ/ contrast than the /ɔ-o/ contrast in Hñäñho, whereas the inverse was true for French (both *p*s<0.05). There were no other significant interactions.

For accuracy scores (Fig. 2), the ANOVA yielded a main effect of *Group* ($F(1,19)=5.791$, $p<0.05$), which did not interact with any other factor. There was a main effect of *Contrast* ($F(1,19)=4.485$, $p<0.05$), but no main effect of *Language* ($F<1$).

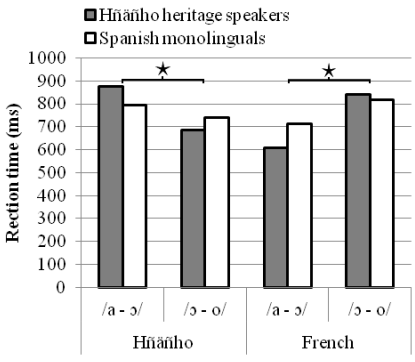

Figure 1: Reaction times in the AXB task, divided by language, vowel contrast, and participant group.

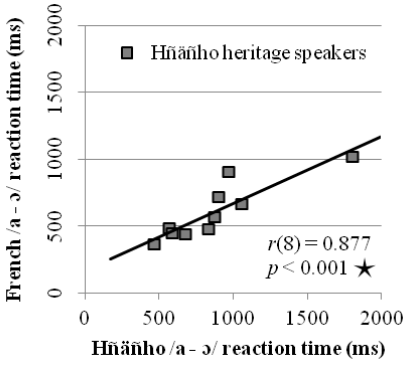

Figure 3: Pearson's correlation between RTs for the /a-ɔ/ contrast in Hñäñho and French for HHSs.

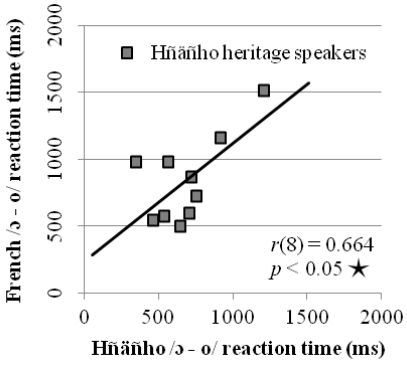

Figure 5: Pearson's correlation between RTs for the /ɔ-o/ contrast in Hñäñho and French for HHSs.

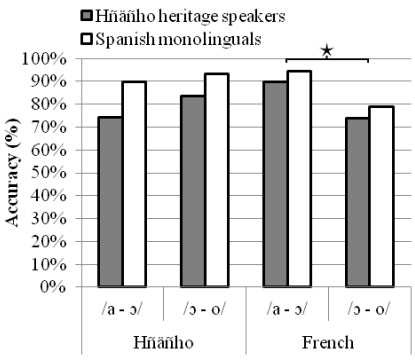

Figure 2: Accuracy scores in the AXB task, divided by language, vowel contrast, and participant group.

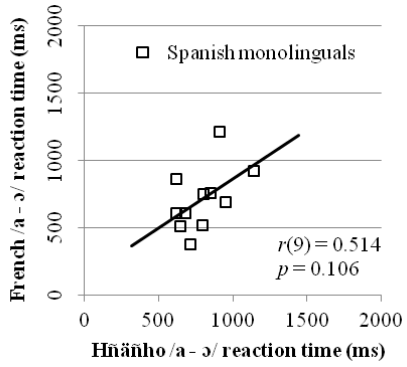

Figure 4: Pearson's correlation between RTs for the /a-ɔ/ contrast in Hñäñho and French for MSMs.

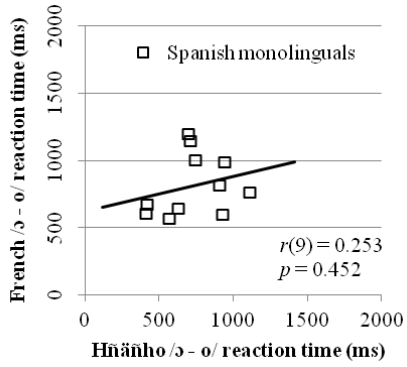

Figure 6: Pearson's correlation between RTs for the /ɔ-o/ contrast in Hñäñho and French for MSMs.

However, there was a significant *Language* Contrast* interaction ($F(1,19)=23.515$, $p<0.001$). Bonferroni-corrected pairwise comparisons showed that participants were more accurate in identifying the /a-ɔ/ contrast than the /ɔ-o/ contrast in French ($p<0.001$), whereas there was an inverse, non-significant trend in Hñäñho ($p=0.072$), with participants being more accurate in identifying the /ɔ-o/ contrast than the /a-ɔ/ contrast. There were no other significant interactions.

In summary, despite MSMs' higher accuracy, the lack of interactions between the participant group and the vowel contrast suggests that there are no group differences between HHSs and MSMs in their patterns of perceptual sensitivity to vowel contrasts /a-ɔ/ and /ɔ-o/ in Hñäñho and French.

3.2. Individual differences

At the individual level, there were no significant correlations between participants' accuracy scores in Hñäñho and French, neither in the HHS group nor in the MSM group, and neither for the /a-ɔ/ nor for the /ɔ-o/ contrast (all *p*s>0.2 except for HHSs' non-significant trend for the /ɔ-o/ contrast, $p=0.063$). However, there were significant correlations between RTs in Hñäñho and French, both for the /a-ɔ/ and for the /ɔ-o/ contrast, but only in the HHS groups and not in the MSM group. These results are shown next in more detail.

Figures 3 and 4 display the relationship between the /a-ɔ/ contrast in Hñäñho and French for the HHS and MSM group, respectively. For this vowel contrast, Pearson's correlation was significant only for the HHS group (Fig. 3) and not for the MSM group (Fig. 4). Similarly, Figures 5 and 6 show the relationship between the /ɔ-o/ contrast in Hñäñho and French for the HHS and MSM group, respectively. For this vowel contrast, too, Pearson's correlation was significant only for the HHS group (Fig. 5) and not for the MSM group (Fig. 6).

4. DISCUSSION AND CONCLUSIONS

The aim of this study was to examine the possible transfer of HHSs' perceptual abilities from their HL (Hñäñho) to a foreign language that was unknown to them (French). HHSs' performance on an AXB categorical discrimination task, using Hñäñho and French vowel contrasts that do not exist in Spanish, was compared to that of a matched group of monolingual Mexican Spanish speakers with no previous exposure to Hñäñho nor French.

The comparison of the speaker groups' RTs and accuracy data revealed similar discrimination patterns for these groups in Hñäñho and French. However, an analysis of the RT data yielded significant correlations between the individual perceptual abilities in Hñäñho and French, but this was only found for the HHSs, and not for the MSMs. These results are interpreted as evidence of a potential link between their perceptual abilities in the HL and in the foreign language. In other words, they may indicate transfer of perceptual abilities from a native, heritage language to a foreign language, even in cases in which the HL is not actively used by the HSs.

Theoretical models of L2 phonetic acquisition, such as the Speech Learning Model (SLM; [14]), the Perceptual Assimilation Model of Second Language Learning (PAM-L2; [5]), and the Second Language Perception Model (L2LP; [12]), have postulated that L2 perception, especially at the initial stages of L2 acquisition, is influenced by L1 perception [5; 15; 11]. These models propose that success in the acquisition of L2 sounds depends on the establishment of new phonetic categories for the L2 segments based on the perceived similarity between the L2 sound and an existing L1 category.

It has been claimed that bilinguals acquire a third language (L3) easier than monolinguals acquire an L2 [1, 25] and, more specifically, bilinguals may acquire certain phonetic features in an L3 easier than monolinguals acquire them in an L2 [2, 3], but phonetic similarities between an unknown foreign language to the native language may also facilitate the perception of universally 'difficult' contrasts [3]. The results of this study suggest that this might also be the case for passive bilinguals (e.g., HHSs) whose HL (Hñäñho) contains similar vowel contrasts as the foreign language (French), but crucially not comparable to the vowel system of their dominant language (Spanish), thus extending the previously reported effects of L1 to heritage bilinguals.

Our results, of course, must be taken with caution because they are based on a relatively small number of participants. Future studies should collect data from a larger participant pool in order to be able to support stronger and generalizable claims about potential bilingual advantages in phonetic learning, and more specifically, the ability of perceiving sounds in an unknown language by HSs. Importantly, these efforts will contribute to a necessary diversification of our field to include Indigenous languages and Indigenous speakers, who have been severely understudied.

5. ACKNOWLEDGMENTS

The authors would like to thank Gloria Avecilla Ramírez for her contribution to the study design, as well as to two anonymous reviewers for their insightful comments.

5. REFERENCES

[1] Abu-Rabia, S., Sanitsky, E. 2010. Advantages of bilinguals over monolinguals in learning a third language. *Bilingual Research Journal, 33*, 173–199.

[2] Amengual, M. 2021. The acoustic realization of language-specific phonological categories despite dynamic cross-linguistic influence in bilingual and trilingual speech. *The Journal of the Acoustical Society of America*, *149*(2), 1271-1284.

[3] Antoniou, M., Liang, E., Ettlinger, M., Wong, P. 2015. The bilingual advantage in phonetic learning. *Bilingualism: Language and Cognition*, *18*(4), 683-695.

[4] Au, T.K., Oh, J.S., Knightly, L.M., Jun, S-A., Romo, L. 2008. Salvaging a childhood language. *Journal of Memory and Language*, *58*, 998-1011.

[5] Best, C., Tyler, M. D. 2007. Nonnative and second-language speech perception: Commonalities and complementarities. In: Munro, M.J., Bohn, O.-S. (eds.), *Language experience in second language speech learning: In honor of James Emil Flege*, 13-34. Amsterdam: John Benjamins.

[6] Birdsong, D., Gertken, L. M., Amengual, M. 2012. Bilingual language profile: An easy-to-use instrument to assess bilingualism. *COERLL, University of Texas at Austin*.

[7] Boersma, P., Weenink, D. 2022. Praat: doing phonetics by computer. http://fon.hum.uva.nl/praat

[8] Canuto Castillo, F. 2015. Otomíes en la ciudad de México. La pérdida de un idioma en tres generaciones. *Lengua y migración 7*(1), 53–81.

[9] Chang, C. B. 2021. Phonetics and phonology of heritage languages. In: Montrul S., Polinsky, M. (eds.), *The Cambridge Handbook of Heritage Languages and Linguistics*, 581-612. Cambridge, UK: Cambridge University Press.

[10] Chang, C.B., Haynes, E., Rhodes, R., Yao, Y. 2008. A tale of two fricatives: consonant contrast in heritage speakers of Mandarin. *University of Pennsylvania Working Papers in Linguistics*, *15*, 37-43.

[11] Elvin, J.,Escudero, P. 2019. Cross-linguistic influence in second language speech: implications for learning and teaching. In: Gutierrez-Mangado, M., Martínez-Adrián, M., Gallardo-del-Puerto, F. (eds) *Cross-linguistic influence: from empirical evidence to classroom practice*, pp. 1-20. Springer, Cham.

[12] Escudero, P. 2005. *Linguistic perception and second language acquisition: Explaining the attainment of optimal phonological categorization*. Netherlands Graduate School of Linguistics.

[13] Fagyal, Z., Kibbee, D., Jenkins, F. 2006. *French: A linguistic introduction*. Cambridge University Press.

[14] Flege, J. E. 1995. Second language speech learning: Theory, findings, and problems. In Strange, W. (ed.), *Speech perception and linguistic experience: Issues in cross-language research*, *92*, 233-277. York Press: Timonium, MD.

[15] Flege, J. E., Bohn, O. S. 2021. The revised speech learning model (SLM-r). In: Wayland, R (ed.), *Second language speech learning: Theoretical and empirical progress*, 3-83. Cambridge University Press.

[16] Guerrero Galván, A. 2009. Otho 'bui. Migrantes otomíes en la ciudad de México. *Lengua y Migración 1*(2), 39–56.

[17] Hekking Sloof, E.F.R., Andrés de Jesús, S., de Santiago Quintanar, P., Guerrero Galván, A., Núñez López, R.A. 2010. *HE'MI MPOMUHÑÄ AR HÑÄÑHO AR HÑÄMFO NDÄMAXEI. DICCIONARIO BILINGÜE OTOMÍ-ESPAÑOL DEL ESTADO DE QUERÉTARO.* México: INALI.

[18] Hualde, J. I. 2005. *The sounds of Spanish*. Cambridge University Press.

[19] Knightly, L.M., Jun, S-A., Oh, J.S., Au, T.K. 2003. Production benefits of childhood overhearing. *J. Acoust. Soc. Am.*, *114*, 465-474.

[20] Martínez Casas, R. 2000. Nuevos espacios para las lenguas y culturas indígenas: los otomíes en Guadalajara. Nueva Antropología. *Revista de Ciencias Sociales*, *57*, 43–55.

[21] Mulík, S., Amengual, M., Avecilla-Ramírez, G., & Carrasco-Ortíz, H. 2019. An acoustic description of the vowel system of Santiago Mexquititlán Otomi (Hñäñho). In: Calhoun S., Escudero P., Tabain M., Warren P. (eds.), *Proc 19th ICPhS* Melbourne, Australia 2019, 1377-1381.

[22] Mulík, S., Amengual, M., Avecilla-Ramírez, G, Carrasco-Ortíz, H. 2021. The vowel system of Santiago Mexquititlán Otomi (Hñäñho). *Journal of the International Phonetic Association.* 1-21.

[23] Mulík, S., Amengual, M., Maldonado, R., Carrasco-Ortíz, H. 2021. Hablantes de herencia: ¿una noción aplicable para los indígenas de México? *Estudios de Lingüística Aplicada*, *73*, 7-37.

[24] Mulík, S., Corona-Dzul, B., Amengual, M., Carrasco-Ortíz, H. 2021. Perfil psicolingüístico de los bilingües otomí (hñäñho)-español, migrantes de Santiago Mexquititlán a Santiago de Querétaro, México. *Cuadernos de Lingüística de El Colegio de México*, 8, e154, 1-50.

[25] Polinsky, M. 2015. When L1 becomes an L3: Do heritage speakers make better L3 learners? *Bilingualism: Language and Cognition*, *18*(2), 163-178.

[26] Polinsky, M., Scontras, G. 2020. Understanding heritage languages. *Bilingualism: Language and Cognition*, *23*(1), 4-20.

[27] Quilis, A., Esgueva, M. 1983. Realización de los fonemas vocálicos españoles en posición fonética normal. In: Esgueva M., Cantero, M. (eds.). *Estudios de fonética*, vol. 1., 159-252. Madrid: Centro Superior de Investigaciones Científicas.