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Programa de Magíster en Lingüística Aplicada**

**Perception and production of English nuclear accent placement  
in Spanish L1 learners: The role of L2 aptitude, musical ability  
and L2 proficiency**

**(Percepción y producción de la colocación del acento nuclear  
en inglés por hablantes nativos de español: el rol de la aptitud  
lingüística en L2, la habilidad musical y la proficiencia en L2)**

POR

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## RESUMEN

Aunque la literatura reconoce la relevancia de los aspectos suprasegmentales en la percepción y producción del inglés como segunda lengua (L2) (Fadilla et al., 2023; Gordon & Darcy, 2018, 2022; Ladegaard & Chan, 2024; Yenkimaleki, 2019, 2021; Zhang & Yuan, 2020), la colocación del acento nuclear ha recibido una atención limitada (Landblom & Ionin, 2022; Nagle & Baese-Berk, 2022). Esta falta de investigación ha dado lugar a una comprensión incompleta de su papel en el procesamiento prosódico del inglés como L2, lo que, a su vez, limita el conocimiento del proceso de adquisición. El siguiente estudio busca acortar esta brecha teórica existente proporcionando hallazgos novedosos en esta área de investigación. El objetivo principal de este estudio fue evaluar la capacidad de aprendientes de inglés como L2, con español como primera lengua (L1), para percibir y producir la colocación del acento nuclear en inglés. Para ello, se evaluó a 53 participantes mediante tareas de percepción (escuchar e identificar) y producción del acento nuclear en una lista de enunciados, considerando contextos no marcados y marcados. Adicionalmente, se analizó el rol de la aptitud lingüística, la habilidad musical y la proficiencia en estas capacidades a través de tres pruebas estandarizadas: La Prueba de Aptitud para Lenguas Modernas (MLAT); la Prueba del Oído Musical (MET); y la prueba de clasificación de Cambridge. En general, los resultados demostraron que la aptitud lingüística fue un predictor débil, mientras que la habilidad musical, específicamente la sensibilidad al ritmo musical, pudo predecir de manera robusta la precisión en la percepción de la colocación del acento nuclear en todos los tipos de oraciones. El efecto de la sensibilidad rítmica se vio positivamente mediado por el incremento en la competencia en inglés. Este estudio profundiza la comprensión del vínculo entre percepción y producción y respalda la inclusión del entrenamiento en prosodia en la adquisición del inglés como L2.

**Palabras clave:** colocación del acento nuclear, percepción y producción, prosodia, aptitud lingüística; habilidad musical; proficiencia

## ABSTRACT

Although the literature acknowledges the relevance of suprasegmental aspects in the perception and production of English as a second language (L2) (Fadilla et al., 2023; Gordon & Darcy, 2018, 2022; Ladegaard & Chan, 2024; Yenkimaleki, 2019, 2021; Zhang & Yuan, 2020), nuclear accent (NA) placement has received limited attention (Landblom & Ionin, 2022; Nagle & Baese-Berk, 2022). This lack of research has resulted in an incomplete understanding of its role in L2 English prosodic processing, which in turn limits insights into the acquisition process. The present study seeks to bridge this existing theoretical gap by providing novel findings in this area of research. The main objective of this study was to evaluate the capacity of L2 learners with Spanish as their first language (L1) to perceive and produce English NA placement. To do so, 53 participants were assessed through NA placement perception (listening and identification) and production tasks involving a list of utterances considering unmarked and marked contexts. Additionally, the role of language aptitude, musical ability, and L2 proficiency in these skills was analysed through three standardized tests: The Modern Language Aptitude Test (MLAT); the Musical Ear Test (MET), and the Cambridge placement test. Overall, the results demonstrated that language aptitude was a weak predictor, whereas musical ability, specifically sensitivity to musical rhythm, robustly predicted accuracy in the perception of NA placement across all sentence types. The effect of rhythmic sensitivity was positively mediated by increased English proficiency. This study deepens our understanding of the perception-production link and supports the inclusion of prosodic training in English L2 acquisition.

**Key words:** Nuclear accent placement; perception and production; prosody; language aptitude; musical ability; proficiency

## CHAPTER I: INTRODUCTION

Broadly speaking, the perception and production of second language (L2) segmental and suprasegmental aspects has attracted the attention of linguists over the recent years (Calhoun et al., 2018; Landblom & Ionin, 2022; Mennen, 2015). The insight obtained hitherto has not only helped them to acknowledge the intricacies of these modalities –perception and production– (Casillas, 2019; Flege, 1995, 2003; Melnik-Leroy et al., 2022; Shultz et al., 2012), but also to recognise the challenging acquisition process L2 learners undergo when perceiving and producing L2 segmental and suprasegmental aspects (Mennen & de Leeuw, 2014; van Maastricht et al., 2016).

There presently is a great deal of information regarding the perception and production of L2 segmental aspects, largely more on vowels than consonants (Gorba & Cebrian, 2021). This understanding has mainly contributed to further the comprehension of the complexities of the perception-production link. And this, in turn, has particularly served as the basis for the creation (Best, 1995; Flege, 1995) and adaptation (Best & Tyler, 2007; Flege & Bohn, 2021) of some speech learning models, e.g. PAM, PAM-L2, SLM, SLM-r, L2LP, amongst others.

According to Nagle and Baese-Berk (2022), however, such models may not be fully representative. This may be due to the scarcity of studies exploring the perception and production relationship of the various L2 suprasegmental aspects, which have proven to be integral parts of pronunciation instruction (Bian, 2013; Bouchhioua, 2017; Fadilla et al., 2023; Gilakjani, 2012; Gordon & Darcy, 2018, 2022; Kang et al., 2010; Ladegaard & Chan, 2024; Lee et al., 2015; Luchini, 2014, 2017; Nakabayashi, 2021; Sonia & Lotfi, 2016; Sung, 2011; Yenkimaleki, 2019; Zhang & Yuan, 2020). Thus, the scope of this study is to explore the L2 speech perception and production of one English suprasegmental aspect –the placement of nuclear accent (NA)– which has been evinced to be pivotal in English and particularly problematic for L2 learners whose first language (L1) is Spanish (Celce-Murcia et al., 2010; del Saz & Grau, 2022; Landblom & Ionin, 2022; Levis & Wichmann, 2015; Nagle & Baese-Berk, 2022; Ortega-Llebaria & Colantoni, 2014; Ubilla-Bravo, 2024; van Maastricht et al., 2016; Zubizarreta & Nava, 2011).

Aside from the learner's mother tongue, L2 learners' motivation, proficiency, age, and exposure, for example, have also been deemed in several pieces of research and, thus, found to either foster or hinder the L2 learning process (Kidd et al., 2018; Lev-Ari, 2018). Other individual differences like foreign language aptitude and musical ability, although having shown strong correlations with language processing, have been scanty explored (Picciotti et al., 2018; Slevc,

2012). Recent findings have indicated that L2 learners with natural foreign language aptitude and/or musical ability may be cognitively better equipped to expedite the L2 learning, outpacing peers with limited capabilities (Götz et al., 2023; Granena & Long, 2012; Gustavson et al., 2021; Cason et al., 2020; Delogu & Zheng, 2020; Jekiel & Malarski, 2021; Kempe et al., 2015; Lee, 2020; Li, 2016; Li & DeKeyser, 2017; Mankel & Bidelman, 2018; Milovanov et al., 2010; Mujtaba et al., 2021; Nayak et al., 2022; Pavlekovic & Roehr-Brackin, 2024; Sok et al., 2021; Swaminathan & Schellenberg, 2019; Thompson et al., 2025; Wesseldijk et al., 2023; Yang et al., 2019).

### **Interface between the Perception and Production of Segmental and Suprasegmental Aspects by Second Language Learners**

Building upon the premisses of Flege's (1995) Speech Learning Model (SLM), many scholars may have embraced the assumption that an accurate L2 segmental perception was a necessary condition for a correct pronunciation (Flege & Bohn, 2021; Kissling, 2014; Nagle, 2018). This belief has been recently challenged by several studies nevertheless, possibly due to methodological concerns (Casillas, 2019; de Leeuw et al., 2021; Flege, 1999; Nagle & Baese-Berk, 2022; Baese-Berk et al., 2024). As a matter of fact, a recent review of the SLM done by Flege and Bohn (2021) has suggested that the L2 segmental

perception and production, as the authors put it, may “coevolve without precedence” bidirectionally (Riquelme et al., 2025).

### ***Successful L2 Segmental Production May Precede Accurate L2 Segmental Perception***

This so-called perception-production asymmetry has been examined, for instance, in a recent study by Kim and Han (2024). In their study, a group of Korean learners of English as an L2 with disparate levels of proficiency (intermediate to advanced) had to perform two perception (prelexical -AX discrimination and pseudoword read-aloud) and two production (lexical -lexical decision and picture-naming) tasks to assess their sensitivity to English consonant clusters and the effect of the epenthetic sound [ɪ]. Naturally, the control group, the English native speakers, executed comparatively well all the perception and production tests. The experimental group’s results, on the other hand, reflected higher L2 production than perception values. In short, this cross-group dissimilarity may attest the possible capacity of non-native speakers to produce L2 segmental aspects within native-like ranges, even before a clear demarcation between native and non-native phonemes has become established in the mental mapping.

Along the same lines, notwithstanding the slightly dissimilar methodology, the study by de Leeuw et al. (2021) yielded similar results. 34 Spanish-English bilinguals, experimental group, and eight English monolinguals, control group, performed an AX discrimination task to measure perception accuracy and a phonemic verbal fluency task, also called letter fluency, for production. First, although some participants within the experimental group could perform as accurately as the control group, the latter, in general, still outperformed the former one in all discrimination tasks, especially in the /spi/ - /espi/ trials. Second, even though the control group could differentiate /spi/ from /espi/ significantly better, both groups, bilinguals and monolinguals, were similarly less successful in discriminating these trials than the /spi/ - /spu/ and /spi/ - /spi/ consonant cluster pairs. This is mainly thought to be because English often favours initial #sC consonant cluster arrangements rather than #VsC ones (Carlson et al., 2016), turning this latter combination into an onerous cluster for English native listeners. And third, despite being readily able to notice English #sC consonant clusters, some L2 learners still produced the Spanish #VsC construction. This cluster repair, interestingly enough, may be partly because L2 learners with Spanish L1 tend to perceptually adjust illicit consonant clusters. This is preferably done with a prothetic /e/ rather than another vowel sound such as /a/+#sC (Cuetos et al., 2011), which might have been unconsciously uttered given the processing constraints pertaining to the production task.

Eventually, further data analyses discarded L2 perception and defined both higher L2 exposure and greater grammatical proficiency as the two predictive factors for the enhanced pronunciation of this precise L2 segmental combination (#sC). De Leeuw et al. (2021) commented that these factors provided L2 learners with heightened metalinguistic awareness. Accordingly, this cognisance, like an acquired habit, may have caused that L2 learners who were acutely conscious of this licit cluster construction in the meta language could have unconsciously refrained from producing this L2 segment (#sC) with Spanish-like articulatory properties (#VsC). So, even when L2 learners' perception may fail to discriminate accurately such contrastive pairs, other individual differences (e.g., sufficient metalinguistic awareness) may still intervene and prompt a thriving L2 segmental production (as suggested by Nagle, 2018).

Lastly, given that the L2 perception and production tasks in their study operated through dissimilar executive control mechanisms, de Leeuw et al. (2021) concluded two things. First, they may be acquired independently (for L2 perception-production link models see Nagle, 2018). And second, it may explain data variance since participants would have had to face both tasks differently (similarly suggested by Hanulíková et al., 2012; Melnik-Leroy et al., 2022). The L2 speech perception task in their study was cognitively low demanding. The requisite was to discriminate between given contrastive cluster pairs. The L2

speech production task, conversely, considered sounds other than /e/ as epenthetic, and required accessing to and retrieving from one's mental lexicon to satisfy stringent selection criteria in a controlled period of time. On balance, apart from evidencing a complex perception-production link, this study also exemplifies a one-to-one non-correspondence between these modalities (Kartushina & Frauenfelder, 2014; Nagle, 2018; Riquelme et al., 2025; Shultz et al., 2012). And thus, a linear correlation, from perception to production, may not be responsible to be ascertained because these modalities might not develop at the same pace systematically or may be influenced independently by external factors (Kartushina et al., 2015; Nagle, 2018).

Likewise, the study published by Kartushina et al. (2015) is supportive of the premiss that a successful L2 segmental production may be achieved irrespective of the maturational status of the L2 segmental perception. In their study, 15 out of 27 French native monolinguals, experimental group, received a novel visual-feedback type of training for five 45-minute sessions. This trial-by-trial intervention depicted participants' articulatory system contrasted with the real (native) F1 and F2 values when enunciating L2 vocalic phones. The study aimed to explore the perception and production of four Danish L2 vowel sounds that form two height contrasts, namely /e/ - /ɛ/ and /y/ - /ø/.

Initial analyses of test results before the training began revealed two things: first, there existed no relationship between participants' L2 perception and production skills. And second, no differences were observed between the control group and the experimental one regarding L2 production. Subsequent analyses of the pre- and post-training scores evidenced a significant increase in the experimental group's L2 production performance for the four contrastive vowel sounds. Although better scores were also registered for perception, they were not straightforwardly associated with gains in production. Kartushina and colleagues posited that this stronger performance could be directly attributed to the impact of the immediate visual intervention (as argued by Hardison, 2012; Saito & Lyster, 2012; Olson, 2014) that was given to participants when their articulatory system (F1 & F2) failed to attain the target L2 characteristics. Crucially, the Dutch vocalic sound /e/, which showed to constitute major L2 perception impediments in the pre-training condition, did not necessarily present significant production problems for the French natives after training.

Unfortunately, not all L2 learners who underwent this visual-feedback training behaved in a similar fashion. Therefore, it seems to be the case that attacking L2 production problems solely on a perceptual basis may not always suffice (Nagle, 2021). The articulatory basis approach helped some L2 learners to reinforce and stabilise a native-like production of L2 segments longitudinally (Huensch & Tremblay, 2015). Indeed, this kind of articulatory-visual training

appeared to foster the ability of creating “more abstract, token-independent phonetic categories for the non-native sounds” (Kartushina et al., 2015) –ability that has been reported to remain fairly active over people’s lifespan (Casillas, 2019, 2020; Flege, 1995; Munro et al., 2013). Hence, Kartushina and colleagues concurred that even though there may be an underdeveloped representation of L2 segments in the L2 learner’s mind, it may not be taken as a clear hindrance to producing them in a native-like manner, albeit it might be fragile for sustainability overall.

Finally, given that the gains made in the L2 production training were unequal and did not transfer analogously to L2 perception across participants, no correlations were able to be established between both modalities. This could be ascribed to the fact that participants, because of their inherent individual capacities or differences, may have reacted in various ways contingent upon the features of the perception or production task (Kissling, 2014). Perrachione et al. (2011), for instance, demonstrated that L2 learners with greater perception skills benefitted substantially from high variability stimuli when exposed to a perceptual treatment. For this reason, the authors also highlighted the relevance of considering individual differences when conducting research; not only may these factors explain discrepancies across comparative studies, but also within-group inconsistencies (as in Melnik-Leroy et al., 2022).

## ***L2 Segmental Perception as a Necessary Condition for L2 Production***

Alternatively, opposite to the studies reported above, the pieces of work carried out by Casillas (2019, 2020) endorsed the feasibility of a linear perception-production development. In 2019, Casillas inspected exclusively the phonetic category formation of Spanish L2 bilabial phones /b/ - /p/, whereas the acquisition of fine phonetic details of Spanish L2 voiced /b/ - /d/ - /g/ and voiceless /p/ - /t/ - /k/ stops was explored in 2020. Further, these studies yielded controversial evidence in relation to the SLM principle of phenetic proximity. Statistical comparisons were drawn between ten English late-learners of Spanish as an L2 and ten simultaneous Spanish-English bilinguals; experimental and control group, respectively. The main finding, overall, exhibited increased language immersion and reduced L1 use to be paramount for an accelerated L2 learning process to occur and to remain constant over time. This is even more the case in the beginning stages of L2 phonological acquisition in which largest gains have been reported to be made (Melnik-Leroy et al., 2022; Munro et al., 2013).

In Casillas (2019), positive changes in the voice onset time (VOT) began from day 30 onwards. Interestingly, some participants within the experimental group registered a VOT relapse in day 37 after reaching a close native-like VOT peak in day 35. This was credited to be due to a school evening celebration held in

day 35 after the testing process took place that day. A high use of L1 was self-reported by the L2 participants; or as Casillas shared, it was “a cathartic experience”. The perception capacity, on the other hand, remained unaltered. This parallels both de Leeuw et al.’s (2021) and Melnik-Leroy et al.’s (2022) distinct mechanisms view and indicates that L1 activation during the early stages of L2 acquisition may become more detrimental to L2 production than it may be for foreign phonological processing, e.g., perception. Naturally, visual articulatory training is not intrinsic to domestic immersion programmes, thus L2 production deviances had to be mainly self-regulated and summarily adjusted on a perceptual basis. In addition, this may be indicative that L2 perception gains may be stored more sturdily in the L2 learner’s mental mapping and, perhaps, acquired before than production ones during the early L2 developmental stages (Melnik-Leroy et al., 2022; Nagle, 2018).

Consecutively, although many L2 productions fell within native-like ranges in Casillas (2020), Spanish-English bilingual participants generally surpassed the other group’s performance. Crucially, in terms of trajectory improvement, there was a mismatch between voiced and voiceless stops (as in Nagle, 2018), with the former being more accurately uttered than the latter. Concretely, the experimental group’s longitudinal data showed significant changes in the VOT after 21 days in the domestic immersion setting, with data distribution tightening over the duration of the programme. Such behaviour was expectably not

attested in the control group who continued under invariable traditional L2 classroom interventions. The incorporation of pre-voicing, albeit uncategorical, was especially true for all the voiced phones. Yet to a lesser degree, this condition within the voiceless set remained true just for the stop phone /p/. This unbalanced L2 production outcome concurs with previous research suggesting that L2 learners' perception and production skills may react differently depending on the voicing properties of L2 phones (Hao & de Jong, 2016; Kartushina et al., 2015; Melnik-Leroy et al., 2022; Nagle, 2018; Sakai & Moorman, 2018).

About the SLM's principle, according to which L2 sounds that are phonetically distinct from the L2 learner's L1 repertoire may be easier to be detected and, as a consequence, stored due to their perceptual aural saliency, the studies of Casillas (2019, 2020) proved otherwise. As a matter of fact, the phonetic proximity of the English sound /p/ to its Spanish equivalent did not seem to hinder L2 learners from grasping fine-detailed differences between them, nor did the L2 voiced consonant phones /b/ - /d/ - /g/ (in accord with Barrios et al., 2016). Actually, Casillas' studies were closer to the Second Language Linguistic Perception Model (L2LP) concerning this phonetic proximity principle. Given the existing deviance in the L2 production tests, with hindsight, Casillas put forward that to determine a sustainable hierarchical perception-production developmental process not only are more longitudinal studies required (Nagle &

Baese-Berk, 2022), but also studies encompassing laterals, nasals or fricatives amongst other sound types (Nagle, 2018). For example, the variability in L2 acoustic cues may influence either the degree or the direction of the relationship between L2 perception and production (Hao & de Jong, 2016; Kartushina et al., 2015; Melnik-Leroy et al., 2022; Nagle, 2018; Sakai & Moorman, 2018). On the whole, these data underscored the fragility of L2 learning at the initial stages of foreign phonetic formation (Melnik-Leroy et al., 2022; Munro et al., 2013), extended results on a behaviour formerly attested in advanced L2 learners (Barrios et al., 2016) and demonstrated the capacity of Spanish speakers to retain English perception gains better than production ones.

The study by Melnik-Leroy et al. (2022) strived to address methodological and statistical limitations found in former research to establish valid comparisons between both modalities. By doing so, they succeeded in establishing a linear relationship (opposite to Levy & Law, 2010). In their study, 19 English-L1 proficient late-learners of French-L2, experimental group, and 11 French native speakers, control group, took one perception and two production tests (ABX discrimination task, pseudoword reading, and picture naming, respectively). These tests considered four control contrasts (/a/ - /i/; /a/ - /e/; /o/ - /i/; /e/ - /o/) and one experimental contrast (/u/ - /y/). On the link of L2 perception and production, it is worth noting that successful L2 production of the contrastive phones /u/ and /y/ was not only dependent upon correct discrimination of the

same pair. Results showed that accurate discrimination of the control sounds (/a/ - /i/; /a/ - /e/; /o/ - /i/; /e/ - /o/) could also predict L2 /u/ and /y/ production accuracy. Consequently, this outcome may support the SLM's claim that perceptual abilities constitute a foundational condition for the development of proficient L2 production skills. In addition, although there were no significant differences between both groups of participants, a clear-cut distinction between the francophone sounds /y/ and /u/ was evidently registered from the performance of the French native speakers.

Initially, from the late L2 learners' standpoint, the fact that some individuals started learning French at the age of four (mean: 12.9 years) and were living in France for more than a year (mean: 4.58 years) when the study was conducted may have caused close native-like values, albeit not identical. This was contradictory, however, in relation to their individual bilingual dominance scale and their self-evaluation scores. A second and more plausible reason may be the inherent rate of speech of French speakers. As expected, a further comparative analysis corroborated that the francophone natives naturally produced faster speech than the late L2 learners. This inevitably generated a more short and central production of the French vowel sounds /y/ and /u/ that was unable to be paralleled by the non-native group. Conversely, concerning perception accuracy, the fact that the late-learners performed poorly in the experimental contrast in comparison to the control one and the French natives

only revealed their phonological categorisation weakness regarding these contrastive L2 sounds.

For all the contrasts, Melnik-Leroy and colleagues were able to establish a robust correlation between the ABX discrimination and the reading accuracy from the pseudoword reading task but not with the picture naming, nevertheless. These tasks conjointly were identical in both items (as in Levy & Law, 2010) and cognitive processing demands (opposite to de Leeuw et al. 2021; Levy & Law, 2010). For Melnik-Leroy et al. (2022), the certainty that reading accuracy was not influenced by the type of vowel contrast (control vs. experimental) or group (native vs. non-native) pondered an interesting implication. Participants' L2 perception and production skills might not be limited by neither the contrastive phonetic properties L2 segments may hold (Hao & de Jong, 2016; Kartushina et al., 2015; Melnik-Leroy et al., 2022; Nagle, 2018; Sakai & Moorman, 2018) nor the participant's level of L2 proficiency (Barrios et al., 2016; Casillas, 2019; 2020). Ultimately, it is important to stress the alignment of task processing levels since they may be a crucial methodological necessity to draw fair comparisons (Casillas, 2019, 2020; de Leeuw et al., 2021; Flege, 1999; Nagle & Baese-Berk, 2022; Baese-Berk et al., 2024).

Another relevant study germane to furthering insight into the perception-production interaction is the one published by Nagle (2018). In his study,

temporal characteristics were explored in connection with gains obtained in both modalities –perception ( $d'$  change) and production (VOT value)– to associate them to a potential developmental model –contemporaneous or synchronous change; delayed or time-lagged change; and asymptotic link. To do so, 20 English-L1 learners of Spanish as an L2 completed five perception and production tests. Nagle (2018) inspected two Spanish stop phones, viz., /b/ and /p/, in initial position during their second, third, and fourth semesters of university training. Altogether, not only did the degree of variability in the L2 learners' production capacity demonstrate that gains in L2 perception may come and consolidate first, but also that an attuned accuracy in the L2 perception capacity, at least for the contrastive Spanish L2 stops /b/ - /p/, may be an insufficient ground for attaining successful L2 production.

Concretely, individual- and group-trajectory analyses confirmed that the L2 learners were able to discriminate the L2 stops after a couple of sessions. However, this progress began diminishing as it gradually soared to native-like values throughout the five data points. In detail, five participants (25%) were within native-like values at the first data point; nine (45%) at the second; 14 (70%) at the third and fourth; and 16 (80%) at the last one. L2 production performance, on the contrary, was far more unstable. In reference to the previously mentioned models, in group trajectory, only the time-lagged one significantly succeeded to relate  $d'$  changes (perception) to reduced VOT values

(production) for L2 /p/ in the subsequent session, whilst various models were permitted within the individual-trajectory analyses.

In relation to the SLM's perspective, for the asymptotic model, according to which a full development in L2 perception accuracy is needed before commencing to observe positive changes in production, only weak support was given. This was vaguely confirmed for L2 /p/ because of the small pre- and post-VOT slope variance (from -5.10 to -6.96, respectively), whilst L2 /b/ had a completely dissimilar behaviour (from -24.93 to -8.60, respectively). Due to insights derived from both individual and group data analyses, Nagle (2018) commented that the SLM may embrace two approaches. That is, the delayed and the asymptotic models, but no single one might offer a solid answer, nevertheless. This is because underlying factors may also modulate the type of relationship L2 perception and production may exhibit; for example, the target structure (Hao & de Jong, 2016; Kartushina et al., 2015; Melnik-Leroy et al., 2022; Nagle, 2018; Sakai & Moorman, 2018) or learners' L1 background (as in Chládková & Podlipsky, 2011; Kartushina & Frauenfelder, 2014; Mayr & Escudero, 2010).

In view of all this, Nagle highlighted that a rigorous approach ought to be followed to obtain comparative measures in both L2 modalities, perception and production (de Leeuw et al., 2021; Melnik-Leroy et al., 2022). While gains in the

former are typically assessed through learners' capacity to identify acoustic boundaries or discriminate L2 segmental contrasts, those in the latter are through output intelligibility (as in Melnik-Leroy et al., 2022). Certainly, despite not always being the case (Kartushina et al., 2015), longitudinal studies have fortunately allowed researchers to observe delayed achievement in L2 production transferred from improved L2 perception (Casillas, 2019; 2020).

### ***L2 Suprasegmental Acquisition and L2 Perception and Production***

L2 segmental research, indubitably, has largely contributed to deepening insight into the types of relationships L2 perception and production may present. Although limited knowledge has been obtained about how L2 suprasegmental aspects may work alongside these modalities (Jackson & O'Brien, 2011; Landblom & Ionin, 2022), segmental implications may lay the groundwork for well-founded principles that might scaffold future speech learning models (Saito et al., 2022).

About the suprasegmental realm exclusively, O'Neal (2010), for example, posed that prosody may be indispensable for both modalities when the segmental information fails to comply articulatorily (accented L2 speech). And thus, becoming aware of those foreign linguistic aspects may be cardinal in L2 acquisition in order to increase language proficiency (Luchini, 2017; Schmidt,

2010) and improve speech clarity (Gordon et al., 2013; Kang et al., 2010). It has been shown, for instance, that L2 learners who are explicitly taught about prosodic differences between their L1 and target L2 may face a reduced processing burden to decode L2 input and encode L2 output (Yenkimaleki & van Heuven, 2020); this has even been demonstrated in short-duration studies (Gordon et al., 2013).

On this topic, the longitudinal study by Yenkimaleki (2021) explored the effectiveness of developing L2 prosodic awareness, or consciousness, in simultaneous interpreting. For this, Yenkimaleki invited 32 interpreting university students (Farsi L1/English L2) who were separated into two groups of 16 participants each (experimental and control group). Before the awareness training commenced, all subjects performed a pre-test to be able to trace their later gains in both L2 modalities, perception and production. For the training sessions, the control group continued to follow the traditional curriculum and syllabus, while the experimental group worked with Farsi and English audio extracts encompassing different topics (political, news-related and social matters) and one suprasegmental divergence at the word and sentence level, stress placement.

Initially, L2 participants in Yenkimaleki's study were found better at interpreting simultaneously from the L2 into their L1 (L2 input perception). Nevertheless,

after the training sessions, it was found that increasing L2 prosodic awareness had positive effects on both L2 interpreters' skills, perception and production. This was also found in de Leeuw et al. (2021), where the explicitness of the prosodic awareness instruction was rather implicit and self-regulated. Therefore, Yenkimaleki (2021) finally noted that gains in L2 perception may not solely transduce into better L2 production skills, but they may eventually ease the cognitive burden of both capacities (Kartushina et al., 2015).

Ultimately, while accented L2 speech may stem from segmental and/or suprasegmental aspects, it is the latter that has most frequently been reported to negatively impact the L2 perception and production comprehensibility and intelligibility (Gordon et al., 2013; Kang et al., 2010; van Maastricht et al., 2021). To date, a plethora of studies has been carried out to evaluate the most effective way L2 perception and production may be successfully trained to mitigate this issue. However, evidence suggests that the type of training may produce varying effects. For instance, perception-focused and production-focused interventions have reported to yield gains in perception, production, or both, depending on the nature of the training (Hazan & Kim, 2010; Huensch & Tremblay, 2015; Kachlika et al., 2019; Kartushina et al., 2015; Lee et al., 2020; Lengeris & Hazan, 2010; Nagle, 2021; Qian et al., 2018; Sakai & Moorman, 2018; Thorin et al., 2018). As formerly stated, the development of these L2 modalities is also dependent on or may interplay to some extent with several

other factors like, for example, learners' individual capacities or task demands (de Leeuw et al., 2021; Kartushina et al., 2015; Kissling, 2014; Melnik-Leroy et al., 2022; Nagle, 2018).

### **Nuclear Accent Placement in English and Spanish**

Over the years, numerous concepts have developed, enabling linguists to gain a better understanding of how sentential or nuclear accent (NA) functions in different languages. As Ladd (1979) established, Spanish, like English, have the capacity to express new or given information within utterances, often referred to as broad or narrow focus, respectively. In the same line, NA is an instrumental prosodic cue in both languages because it helps foreground such information appearance (Cole et al., 2019; del Saz & Grau, 2022; Nilsenová & Swerts, 2012). Cross-linguistic dissimilarities have been observed, however, regarding where and how NA is employed across languages, largely due to either the syntactic flexibility or prosodic rigidity (Aronsson, 2016; Cole et al., 2019; Klassen, 2013; Landblom & Ionin, 2022; Olarrea, 2014; Prieto & Roseano, 2018). As a result, this discrepancy may present obstacles in second language (L2) speech perception and production, particularly for L2 learners whose first language (L1) is Spanish (del Saz & Grau, 2022; Landblom & Ionin, 2022; Ortega-Llebaria & Colantoni, 2014; Ubilla-Bravo, 2024; van Maastricht et al., 2016; Zubizarreta & Nava, 2011).

## ***Broad and Narrow Focus, and Prosodic Rigidity and Syntactic Flexibility***

### ***Overview***

In general terms, there is no real difference behind the constructs of broad and narrow focus across languages. In either case, the attention –focus– is directed towards the importance of salient content in comparison to the less prominent elements within the sentence or the whole sentence; in the case of focused attention to an element in particular, other than the expected one is either because of contrast or emphasis (del Saz & Grau, 2022; Ladd, 1979; O'Brien & Gut, 2010). In other words, focus may be equated with how information is perceived by the listeners. For instance, if all information in an utterance is novel; then, it may be said that it is in broad focus given that the attention is paid to the whole of it. Alternatively, if the utterance presents new and given information, it may be said that the sentence is in narrow focus since only part of the sentence may be relevant, and thus brought to the spotlight (Ladd, 1979). Since the scope of this study is on broad focus utterances, narrow focus ones will not be discussed in detail.

In broad focus utterances, like in narrow ones, the realisation of attention, as mentioned earlier, is by means of NA placement. This suprasegmental marker may be materialised as a falling (↘) or a rising (↗) tone, and it is generally placed on the last lexical item (LLI) of a given utterance, which may usually be

on a noun, verb, adjective or adverb (Cole et al., 2019; del Saz & Grau, 2022; Halliday, 1967; Luchini, 2017; Nilsenová & Swerts, 2012). This optionality in tone represents language-specific intonational patterns rather than free variation (Trimble, 2013; Valenzuela Farías, 2013). That is, although the use of NA placement to mark focus in English and Spanish may coincide in certain syntactic arrangements (see **Examples 1.** and **1a.**, below), there are other instances in which the characteristics of NA placement may differ because of discourse-pragmatic factors. For instance, English speakers, on the one hand, use a final rising intonation exclusively for close-ended questions and a falling one for open-ended queries (see **Examples 2.** and **3.**, below, respectively). On the other hand, Spanish speakers always enunciate questions with a final rising intonation regardless the query type (see **Examples 2a.** and **3a.**, below). This invariable intonational directives that govern English and Spanish may be commonly referred to as the default pattern, unmarked or the LLI rule (del Saz & Grau, 2022; Halliday, 1967). Within these utterances, there also exist syntactic constructions that do not place the nuclear accent on a strictly final constituent, since the utterance may end in grammatical rather than lexical material. Namely, prepositions or other function words lacking independent lexical content. Despite this, these constructions are still considered to fall under the scope of the LLI rule (see **Example 4.**, below) –**Example 4a.** is provided for contrast.

By contrast, there are other types of broad focus utterances in English that may still operate without the engagement of all their lexical elements. In such contexts, it is not the LLI of the whole sentence that draws the main attention but earlier lexical constituents. Under these circumstances, the NA is displaced adopting a more leftward position to mark focus. This process leaves a *de-accented tail* to the right of this new lexical item carrying the NA. This tail does not adopt a different intonational pattern but, instead, continues with the intonational marking of the focused content. These types of sentences, thereby, are known as the marked or exceptions to the LLI rule (see **Examples 5. to 10.**, below). The Spanish translation has been provided for contrast (see **Examples 5a. to 10a.**, below)

The examples below present the default pattern, unmarked or the LLI rule for NA placement in broad focus utterances in English. The Spanish translation has been provided for contrast.

#### **English LLI rule without tail**

1. She needs to pay her (↘)bills.
2. Did she go out for a (↗)drink?
3. Where are you leaving the (↘)note?

#### **English LLI rule with a tail**

4. I need to (↘)think *about it*.

## Spanish LLI rule

- 1a. (Ella) necesita pagar sus (↘)cuentas.
- 2a. ¿Salió (ella) por un (↗)trago?
- 3a. ¿Dónde (tú) dejarás la (↗)nota?
- 4a. (Yo) necesito pen(↘)sar/o.

The examples below present the marked or exceptions to the LLI rule for NA placement in broad focus utterances in English. The Spanish translation has been provided for contrast.

## English

### Event Sentences

- 5. The (↘)shop has been robbed.

### Wh- question with a final verb

- 6. Where is your (↘)mum going?

### Empty words

- 7. You must be (↘)seeing things.

### Final adverbial of place and time

- 8. Will you have (↗)dinner tonight?

### Reflexive pronouns

- 9. She has always been (↘)proud of herself.

## Final vocatives

10. It is great to (↘)see you, doctor.

## Spanish

5a. La tienda ha sido ro(↘)bada.

6a. ¿A dónde tu mamá (↗)va?

7a. (Tú) debes estar viendo (↘)cosas.

8a. ¿Vas (tú) a cenar esta (↗)noche?

9a. (Ella) siempre ha estado orgullosa de si (↘)misma.

10a. Que genial verlo, doc(↘)tor.

Studies examining the influence of learners' L1 on L2 acquisition, commonly known as transfer, have also been instrumental in uncovering phonetic and phonological dissimilarities. About NA realisation, inherent cognitive mechanisms engaged by English speakers, as opposed to Spanish ones, may potentially induce added processing burdens in the perception and production capacities of Spanish learners of English as an L2. The common prevalent paradigm among speakers of Romance languages such as Spanish, Italian, and French is the syntactic flexibility that characterise them (Frota & Prieto, 2015; Klassen, 2013; Landblom & Ionin, 2022; Zubizarreta & Nava, 2011). Speakers of these languages have demonstrated the ability to manipulate chunks of information within utterances fluidly. With this approach, it becomes possible to

place focused elements in phrase-final position and, thus, simply associating it with NA placement (Frota & Prieto, 2015; Klassen, 2013). Parenthetically, this syntactic arrangement may be possible irrespective of the status of the information –new or given information (see **Answers a., b., and c.**, below). Contrarily, languages with Germanic roots like English, German or Dutch, feature a more inflexible syntax (see **Answers d., e., and f.**, below). This rigidity leads to a heightened reliance on pragmatics which, in turn, results in a greater dependence on prosody for in-situ or simultaneous focus realisation (del Saz & Grau, 2022; Hirsch & Wagner, 2011; Hoot & Leal, 2020; Romero-Trillo, 2012; Zubizarreta & Nava, 2011).

The possible answers (**a. to c.**, below) exemplify the syntactic flexibility of Spanish for NA placement realisation to the question: **¿Quién compró el pastel?**

- a.** Juan compró el pas(↘)**tel.**
- b.** El pastel lo compró (↘)**Juan**
- c.** El pastel, Juan lo com(↘)**pró.**

The possible answers (**d.** to **f.**, below) exemplify the prosodic rigidity of English for NA placement realisation to the question: **Who bought the cake?**

- d.** (↘)John *bought the cake.*
- e.** The cake was bought by (↘)John.
- f.** It was (↘)John *who bought the cake.*

On this topic, the study by Zubizarreta and Nava (2011) explored the interrelation between prosody, syntax and discourse-based meaning (theticity). Along the same lines, to offer an insightful explanation of their results, they also provided a Germanic-Romance comparative outlook based on earlier L1 English/L2 Spanish studies. To do so, the authors invited 47 L2 learners of English representing different varieties of Spanish (Spain, Mexico, Argentina, and Paraguay), and 34 English learners of Spanish as an L2. Overall, cross-language comparative analyses exhibited an acquisition asymmetry between English and Spanish L2 learners in regard with theticity and NA placement alignment.

Concretely, despite the evident challenges faced by the Spanish natives, a few L2 learners, notably, succeeded in aligning NA placement with the thetic-categorical distinction in broad focus utterances. Certainly, these results indicate that it may not be impossible for Spanish natives to override their L1 prosodic-

syntactic-link cardinal rule (right dislocation) or acquire English prosodic metrics (*deaccenting*). Thus, the authors argued that the additional processing demands for Spanish natives might not result from the dissimilar syntactic and prosodic value within speech between Germanic and Romance languages, but from the lack of L2 grammatical awareness overall (similarly viewed by de Leeuw et al., 2021). In accord with Zubizarreta and Nava (2011), the pragmatics dependence for NA placement to signal theticity is a defining aspect for the English language. Romance languages, on the other side, do not conventionally encode theticity by means of NA realisation, but through sentence right dislocation as mentioned before. Consequently, the need to activate semantic-identification mechanisms to perceive and produce English NA placement in a more leftward position may impose a major cognitive constrain to this type of English L2 learners.

For the English learners of Spanish as an L2, a different scenario unfolded. Although being readily able to adapt to L2 syntactic processes to mark theticity, labelling with NA rendered a greater problem for this group. Result analysis demonstrated that the prosodic rigidity of their Germanic language prevented them from successfully aligning the focused content with NA. Therefore, it may be said that native speakers of Germanic linguistic roots may encounter more difficulty when acquiring the opposite prosodic system, that is the Romance intonational rhythm, given the distinct mechanisms required by each language.

Since this last issue is beyond the scope of the present study, it does not merit to be discussed further but is most certainly encouraged to be investigated.

In light of this evidence, it may be said that the factors repressing English NA placement perception and production acquisition proceed from the dominant L1 prosodic rhythm which is simultaneously activated in the L2 learners' minds. Given the syntactic flexibility proper of Romance languages, Spanish speakers effortlessly attain NA and focus alignment through right-end dislocation; thus, knowledge on grammatical functionality does not become indispensable. As a result, Spanish speakers may experience hardship in engaging L2 pragmatic-semantic mechanisms, especially in broad focus utterances since such knowledge is instrumental in enabling English natives to encode and decode NA placement. Notwithstanding all this, research has still documented the capacity of Spanish L2 learners to acquire English NA placement canons (del Saz & Grau, 2022; Zubizarreta & Nava, 2011). Ultimately speaking, it may be argued that the Spanish syntactic flexibility, although dominant in nature to the Spanish natives, may not be reluctant to be relegated in favour of nurturing the English prosodic rigidity, but it may eventually obstruct acquisition in the absence of sufficient overall metalinguistic awareness (de Leeuw et al., 2021; Yenkimaleki, 2021).

## **Individual Differences in Second Language Acquisition**

As Flege (2019) argues, although some non-native speech properties (e.g., foreign accent) caused by first language (L1) interference may dissipate during second language (L2) development, other properties (e.g., grammatical patterns) may perdure over many years (Barrios et al., 2016; Kidd & Donnelly, 2020; Li, 2019; Melnik-Leroy et al., 2022). Broadly speaking, this tendency may extend to highly advanced late L2 learners as well as to early bilinguals whose L2 acquisition began in childhood. According to some scholars, L2 acquisition is componential and may rely upon the same pool of L1 cognitive skills. Therefore, if there were any stable individual differences that may influence L1 abilities (e.g., reading comprehension), they would most likely be reflected as an individual difference in the L2 acquisition process (Li, 2019; Sparks et al., 2019; Sparks & Dale, 2023; Sparks et al., 2023). For this reason, it is worth exploring a wide range of intersubject differences in learning as these may interact closely with the various underlying L2 acquisition mechanisms (Flege & Bohn, 2021; Jansen et al., 2023). As agreed by several authors, a ubiquitous individual difference is the quantity and quality of native exposure L2 learners may receive (Flege & Bohn, 2021; Flege & Wayland, 2019; Hazan & Kim, 2010; Lengeris & Hazan, 2010; Saito et al., 2019), particularly for the mastery of L2 prosodic features (del Saz & Grau, 2022; Puga et al., 2017). For example, in the study by Steinlen and Piske (2025), year-4 German L2 learners of English in an

immersion setting, notwithstanding their reading difficulty, outperformed their peers who were enrolled on a regular English as a Foreign Language (EFL) programme (as in Casillas, 2019, 2020). Not only does this study add support to the fragility of L2 learning at early developmental stages mentioned before (Melnik-Leroy et al., 2022; Munro et al., 2013), but it also strengthens the fact that one single individual difference can outweigh a learning challenge and may, ultimately, lead to success.

Expectedly, there certainly are many more individual differences that have been identified, explored and reported in the literature. To name a few, the impact of learners' L1 background on L2 segmental and suprasegmental speech recognition (Chládkova & Podlipský, 2011; Escudero & Williams, 2012; Mayr & Escudero, 2010; Saito et al., 2019), motivation (for a comprehensive review see Wu, 2022), the effect of foreign language aptitude on several aspects of L2 speech perception and production (Hu et al., 2013; Saito, 2017) and more recently, albeit to a lesser extent to our knowledge, musical ability and the perception of L2 prosody (Jansen et al., 2023; Li & DeKeyser, 2017; Vigl et al., 2024). These last two individual differences, viz., language aptitude and musical ability, are of great interest for the present study given the necessity of new methodological approaches from an interdisciplinary perspective to understand better the umbrella of aptitude (Wen et al., 2017) and thoroughly expand insight

into the interconnection between musical and language processing skills (Bhatara et al., 2015; Slevc, 2012).

According to Li's (2019) synthesis, foreign language aptitude has been widely studied in L2 acquisition research, although not to the extent it merits (Chalmers et al., 2021; Saito et al., 2019). Aptitude separates itself from other cognitive variables and is not affected by emotional factors. It has also exhibited to bear a stronger relationship with more explicit rather than implicit instruction –which is the treatment participants in this study coincidentally received. Similarly, studies on musical ability have demonstrated this cognitive aspect to be domain-specific. Jansen et al.'s (2023) meta-analysis, for instance, revealed a medium-sized positive effect between musical ability and L2 prosody speech perception. Although the Perceptual Assimilation Model (PAM) posits that L2 cues are rather mapped onto pre-established L1 categories than stored as novel ones, Jansen et al.'s work implies differently. L2 learners, both musicians and non-musicians endowed with higher musical ability (as shown by Vigl et al., 2024), may leverage these foreign cues, thus not only reducing L1-L2 category convergence but also enhancing L2 prosody perception.

## ***L2 Aptitude***

Although there are a few language aptitude tests such as LLAMA (Meara, 2005), Hi-LAB (Linck et al., 2013) or PLAB (Pimsleur, 1966); to date, the most well-known battery to measure foreign language aptitude is the one created by Carroll and Sapon (1959), the Modern Language Aptitude Test (MLAT) (Wen et al., 2017). Thereafter, this battery has been widely utilised in L2 acquisition research because of its unchallenged reliability and validity (Chalmers et al., 2021; Dale & Sparks, 2023; Li, 2019; Sasaki, 2012; Sparks et al., 2019; Sparks & Dale, 2023; Sparks et al., 2023). Nevertheless, Trofimovich et al.'s (2015) remarks are also worth considering. Despite growing interest in individual differences, limited and methodologically inconsistent research has been done on the relationship between L2 pronunciation acquisition and the aptitude realm (Saito, 2023).

### ***Modern Language Aptitude Test (MLAT) –Carroll and Sapon (1959)***

To predict L2 achievement successfully, the MLAT has proven systematically consistent (Sasaki, 2012; Stansfield & Reed, 2019). In the 3-year longitudinal study by Sparks and Dale (2023), for example, 307 Spanish L2 learners from a US high school took six tests covering L1 and L2 language and literacy skills, and the MLAT. The aim of their study was to explore the predictive role of L1

individual differences and the MLAT in relation to L2 achievement. Overall, L1 individual differences, separately, could significantly predict all L2 gains and the MLAT performance. Concretely, L1 vocabulary was the strongest predictor of L2 listening comprehension (perception) for the first and second year, while L1 word decoding, another literacy skill, explained the positive variance in oral L2 proficiency (production). Consequently, Sparks and Dale argued that the development of literacy skills in the L1 may be relevant for L2 perception and production prior L2 exposure. Finally, concerning the measures of L1 literacy and oral language predicting MLAT's performance, the six variables demonstrated a positive interaction with correlations ranging from .223 to .443. Nevertheless, only four of them became significant in the regression analysis, viz., L1 vocabulary; L1 working memory; L1 language analysis; and L1 word decoding, this latter being the strongest one (Sparks et al., 2023). Drawing on the evidence, the authors posited that skills developed at early stages of the L1, such as literacy and oral language skills, may tap into the same domain measured by the MLAT.

Notwithstanding this, regarding the relationship between the MLAT and L2 achievement, the initial data analysis evinced this test to be a reliable predictor for listening comprehension, reading, and writing success (stronger than in Li, 2019; Stansfield & Reed, 2019). While L1 skills better explained L2 achievement specially during the second year, the MLAT still yielded consistent,

yet moderate, results in the same phase. Hence, not only did the authors concur on the fact that with second-year outcomes researchers may gauge L2 achievement more accurately, but also that the MLAT may be deemed as a reliable predictor of L2 success overall (Dale & Sparks, 2023; Sparks et al., 2019; Sparks et al., 2023). The former notion was based on the idea that, by the end of the second year, L2 learners may develop sufficient metalinguistic awareness to cope more effectively with difficulties encountered at earlier stages of L2 acquisition, such as decontextualised language. Consequently, dependence on more simple skills, like rote learning, may become less essential by this time (Sparks et al., 2023).

Interestingly, when isolating the unique predictive contribution of the MLAT, this test accounted for a modest portion of the variance in the L2 performance ( $\leq 40.4\%$  for all L1 measures collectively; and  $\leq 23.0\%$  for most L1 measures). Sparks and Dale (2023), ultimately, resolved that the MLAT and some L1 tests in their study measured a common set of skills and, thus, the shared positive predictive interaction in relation to L2 achievement (Dale & Sparks, 2023). Nevertheless, given the moderate contribution, two interpretations are offered. First, the L1 skill measures used in their study may not have adequately captured the abilities assessed by the MLAT (e.g., words in sentences subtest). Second, regardless of the interrelation among the skills measured by some L1 tests and the MLAT, the latter, indeed, taps into distinct abilities within the same

domain. That is, the variability in the predictiveness of the MLAT may be dependent upon the shared characteristics of the L1 measures employed (similarly suggested by Saito, 2023; Trofimovich et al., 2015).

An alternate possibility is that with increased metalinguistic awareness, decontextualised language, as found in the MLAT, becomes easier to understand. As a result, the MLAT may have been reflecting developed L1 skills that, eventually, have proven to boost L2 aptitude and acquisition (Li, 2019; Sparks et al., 2019; Sparks et al., 2023; Wen et al., 2017). Although it was not suggested by the authors, from this evidence it may also be inferred that the MLAT, like several L1 measures used in earlier studies, may overlook some L1 individual differences (e.g., musical ability) that may closely interact with L2 metalinguistic aspects that remain under-researched (e.g., prosody). Thus, the limited possibility of the MLAT to contribute higher values. Nevertheless, the fact that the MLAT may add a unique variance continues to be intriguing (Wen et al., 2017), reinforcing the idea of aptitude like a domain-specific variable that may reliably foresee L2 success complementing the various L1 measures (as shown in Sparks et al., 2019).

Concerning the extent of the MLAT's predictiveness, further considerations are worth noting. For instance, in the study by Dale and Sparks (2023), regression commonality analyses exposed relevant interactions between the various MLAT

subtests and L2 abilities. Initial data analyses showed that the MLAT subtests were highly intercorrelated, as using the composite score versus the individual subtests did not yield a significant improvement in the prediction of overall L2 achievement. Nevertheless, when each subtest was analysed in connection with L2 achievement measures in the regression commonality analysis, phonetic script –the one used in the present study– was exposed as the core predictor of L2 reading (30.1% and 33.1% for first- and second-year L2 achievement; respectively), writing (20.7% and 19.9% for first- and second-year L2 achievement; respectively), listening comprehension (11.7% and 16.9% for first- and second-year L2 achievement; respectively) and oral proficiency (19.5%) (Li, 2016). The words in sentences subtest, for L2 oral proficiency, also demonstrated to be relevant individually (13.9%) and in connection with the phonetic script and spelling clues subtests (6.4% and 6.3%; respectively). Moreover, the pair associates subtest demonstrated a similar relative contribution for L2 listening comprehension (15.5%). In the same line, except for L2 oral proficiency, the number learning component –also used in this study– added a relative significant contribution to prediction in most cases; particularly in combination with the phonetic script component, albeit not to the same extent, viz., 7.1% for second-year L2 listening comprehension and 8.8% for second-year writing.

All things considered, despite the shared predictive contribution of the MLAT and the various L1 literacy and oral language skills tests, the former battery has consistently offered a unique and reliable answer to L2 achievement (Chalmers et al., 2021; Dale & Sparks, 2023; Li, 2019; Sasaki, 2012; Sparks et al., 2019; Sparks & Dale, 2023; Sparks et al., 2023). In accord with a number of longitudinal analyses, this scenario may be more evident after two years of L2 formal instruction. By that stage, more sophisticated metalinguistic awareness develops due to the increasingly contrasting nature of L1 and L2 instruction at later intermediate stages of acquisition. Therefore, this ability, as opposed to more foundational ones found at the beginning stages (e.g., rote learning), becomes essential to L2 language processing, particularly to understand decontextualised material as found in the MLAT. To our knowledge, given that the MLAT and L1-skill tests have not covered aptitude in relation to the prosodic domain, interdisciplinary methodologies may certainly enrich these measurements. By doing so, other language-related L1 individual differences (e.g., musical ability) may also appear as important predictors of L2 abilities (e.g., perception and production), hence complementing the existing insight into the domain of aptitude.

## ***Musical Ability***

Rather than representing a unitary skill, musical ability is generally deemed a multidimensional construct given that it may comprise a range of perceptual and cognitive components. Concretely, prior research has identified aspects such as pitch perception, rhythmic processing, temporal sensitivity, and auditory attention as fundamental to musical ability (Patel, 2014; Bidelman et al., 2013; Nayak et al., 2022). Kempe et al. (2015), for example, underscored the role of pitch sensitivity and auditory precision, whilst Turker and Reiterer (2021) and Riquelme et al. (2025) explored memory-related processes involved in musical processing. Despite its multiple components, musical ability is commonly operationalised and measured in empirical research through melodic and rhythmic perception, as reflected in widely used instruments such as the Musical Ear Test (Wallentin et al., 2010; Swaminathan et al., 2021), given their shared underlying mechanisms with language development. On the one hand, rhythm reflects the timing patterns of speech, which may certainly differ across languages. Spanish, for example, tends to have consistent stress intervals, whereas English shows more variation due to the longer duration of individual sounds. Melody, on the other hand, encodes discourse meaning through pitch movement and is mainly realised through NA placement, reflecting how information is structured and interpreted in context (Prieto & Roseano, 2018).

### ***The Musical Ear Test (MET) –Wallentin et al. (2010)***

The MET, since its creation, has proven effective in objectively distinguishing individuals between non-musicians, amateurs, and professional musicians, based on their innate musical and cognitive processing abilities (Correia et al., 2023; Swaminathan et al., 2021; Thompson et al., 2025). For instance, in the paper by Wallentin et al. (2010), despite the small sample size ( $N = 21$ ), the MET could still indicate high Cronbach alpha values (.85) across the three experiments conducted in their study (.82 for melody and .69 for rhythm). Unfortunately, to the best of our knowledge, studies employing the MET to measure musical ability are particularly scarce within the domain of L2 prosodic acquisition research (Slevc, 2012; Thompson et al., 2025; Zeromskaite, 2014). Nevertheless, the few studies available have evidenced this ability to share some properties with language learning perception and production (in line with Christiner & Reiterer, 2018; Thompson et al., 2025). According to Seither-Preisler et al. (2014), there is vast evidence to claim that music and language are at least partly processed within overlapping neural regions. Importantly, both domains may be highly experienced-dependent and undergo continuous shaping through exposure and practice (Herholz & Zatorre, 2012; Thompson et al., 2025; White-Schwoch et al., 2013). In fact, musical expertise has proven to enhance memorisation, recall and imitation ability of a foreign language (Christiner & Reiterer, 2013, 2015, 2016, 2018; Fonseca-Mora et al., 2015).

However, the recent meta-analysis by Thompson et al. (2025) has shown that the robustness of musical ability in relation to L2 acquisition is still ambiguous (Ghaffarvand & Werner, 2018; Schellenberg et al., 2023). Additionally, musical ability has been reported to be more indicative of early-stage L2 perception and production abilities than predicting ultimate long-term L2 achievement. Nevertheless, research has still suggested that musical skills may facilitate the perception and production of (non-)native linguistic aspects (Chobert & Besson, 2013; Patel, 2014).

In the research by Swaminathan et al. (2021), results of a large and diverse sample of undergraduate students ( $N > 500$ ) who took the MET and a digit span forward test were analysed. Overall, although the latter test could strongly predict MET performance ( $p < .001$ ) and was specially associated with the rhythm subtest ( $p < .001$ ) given the similarity in task demands –as confirmed by the Raven's test ( $p < .001$ )– the MET still evidenced to be a reliable measure of general cognitive skills (Correia et al., 2023). Interestingly, there were two L1 individual differences that seemed to have an influence on MET results in their study, viz., amount of private music training and participants' L1 (Correia et al., 2023; Toh et al., 2023; Wallentin et al., 2010; Wong et al., 2012).

Concretely, longer intervals of musical training, on the one hand, demonstrated a positive close association with the MET performance. This behaviour has been

documented even among non-musicians without musical training (Correia et al., 2023). Notably, this occurred regardless the age-of-onset of music training. That is, the group that began music training later in life paralleled the MET performance of the early-trained group. Given the matched advantage, data analysis exhibited the amount of music training, and not the age-of-onset, to be in fact a more predictive variable. Indeed, such acquired gain –that is, music plasticity– has also been reported to remain partially active even after practice has been discontinued (Toh et al., 2023). On the other hand, higher melody results were also observed among participants with similar L1 backgrounds (Bhatara et al., 2015; Toh et al., 2023; Wong et al., 2012; Zhang et al., 2020). As explained by Bidelman et al. (2013), refined music perception does not only involve low-level auditory processing skills like pitch discrimination sensitivity and processing speed, but also more sophisticated mechanisms such as tonal memory and melodic discrimination. Therefore, it appears that speakers from tonal languages like Chinese or Thai, perhaps because of their given experience, are more attuned to perceive differences and changes in pitch cues than speakers from non-tonal languages (e.g., Spanish or French). Expectedly, the same individuals did not exhibit a comparable behaviour on the rhythm task. This may be because this portion engages cognitive mechanisms related to temporal structure, as opposed to pitch-related features. In sum, these findings highlight a dissociation between the factors influencing melody and rhythm processing (as argued by Bhatara et al., 2015; Correia et al., 2023; Zhang et al.,

2020). While melody perceptual skills may be shaped by both training and language, rhythm may be depended upon a dissimilar set of cognitive resources.

The literature review ultimately underscores the relevance of the MET as a reliable and objective instrument for assessing auditory and cognitive processing across diverse populations. While earlier studies emphasised the MET's psychometric strength even with broad samples in terms of linguistic characteristics, more recent large-scale analyses have identified two notable L1-related individual differences that may influence the multidimensional design of the MET, viz., participants' L1 and the amount of music training. Unlike melody processing, rhythm perception seems to be more driven by domain-general cognitive factors such as working memory, as reflected in its correlation with the digit span forward test, shedding light on the observed disparity in performance between the two portions. Finally, the MET's ability to predict early-stage L2 perception and production highlights the importance of auditory processing skills during the initial phases of L2 acquisition. Its limited predictive power for ultimate L2 achievement, however, suggests that language processing, that is perception and production, may be shaped by a complex interplay of various factors over time (see Casillas, 2019, 2020; de Leeuw et al., 2021). Consequently, further research is undoubtedly needed to deepen our understanding of how individual

differences (e.g., language/musical experience) may modulate the perception-production link and how this may be used to accelerate the process.

### ***L2 Development and the Perception and Production of L2 Suprasegmental Features***

L2 proficiency has been shown to be a core aspect of L2 acquisition, particularly in shaping phonological development. According to some scholars, L2 proficiency constitutes a multidimensional individual difference, integrating interdependent components such as complexity, accuracy, and fluency (CAF) that may vary over time (Li & Sui, 2025; Şahin Kizil, 2024; Skehan, 1998; Vercellotti, 2017). Whereas earlier pronunciation research emphasised the link between developed L2 segmental accuracy and high levels of L2 proficiency (Chakraborty et al., 2011; Wong, 2015), subsequent work has underscored the importance –particularly at early acquisition stages (del Saz & Grau, 2022; Puga et al., 2017)– of gaining suprasegmental competence for communicative success; especially the role of stress, rhythm, and intonation in L2 perception and production (Gordon & Darcy, 2022; Saito & Plonsky, 2019; Sonsaat-Hegelheimer & Levis, 2025; Suzukida & Saito, 2022). From a developmental perspective, evidence suggests that as L2 learners advance in proficiency, they may demonstrate increased sensitivity to prosodic features and, consequently, a heightened ability to align phonological structure with pragmatic meaning

(Bachman & Palmer, 2010; Levis & Wichmann, 2015; Mennen, 2015; Ortega & Wu, 2025). In addition, they may become better able to form new phonological correspondences, thereby minimising the influence of L1 prosodic interference (Flege, 1995; Best & Tyler, 2007).

### ***Nuclear Accent Placement and L2 Proficiency***

Regarding NA placement perception and production and L2 proficiency, to the extent of our knowledge, Riquelme et al. (2025) constitute the only study to comprehensively address this issue; other research engages with it only to a limited extent (del Saz & Grau, 2022; Perticone, 2022). Effective use of L2 intonational cues (e.g., rising or falling) entails the accurate deployment of prominence (e.g., NA placement) to signal information status (e.g., focus). This interplay requires adequate integration of linguistic (e.g., lexical and grammatical knowledge) and pragmatic resources (Levis & Wichmann, 2015), which may typically stabilise at intermediate levels of L2 proficiency and further consolidate at advanced levels (Graham & Post, 2018). Unfortunately, Riquelme et al.'s work (2025) found no significant link between NA perception, production, and L2 proficiency. Although a plethora of authors have concurred on the relevance of prosodic training in L2 instruction, research on NA placement perception and production involving L2 learners with various proficiency levels remains limited. Examining intermediate-level L2 learners in the present study may offer

valuable insight into whether NA knowledge develops gradually with overall L2 proficiency or constitutes a separate stage in the maturation of L2 prosodic competence. Taken together with musicality and general L2 aptitude, L2 proficiency may closely interact with other individual differences to shape learners' sensitivity to prosodic features, highlighting the multifaceted nature of L2 prosodic development (Li & Sui, 2025; Şahin Kizil, 2024; Skehan, 1998; Vercellotti, 2017).

## CHAPTER II: METHOD

The current research received formal approval from the appropriate institutional Bioethics Committee and adhered to institutional ethical guidelines governing research with human participants (see **Appendix A**). This study employed a quantitative, cross-sectional, observational design. It focused on the perception and production of English nuclear accent (NA) placement in second language (L2) learners with Spanish as first language (L1). Additionally, it examined individual differences in L2 aptitude, musical ability, and L2 proficiency –this last one as a covariate– and explored possible relationships and interactions between these factors and learners’ prosodic performance. Research questions, objectives, and hypotheses guiding the methodology are presented below.

## **Research Questions**

- 1.** To what extent are English L2 learners with Spanish L1 able to perceive and produce English nuclear accent placement?
- 2.** What is the relationship between the capacity to perceive English nuclear accent placement and foreign language aptitude?
- 3.** What is the relationship between the capacity to produce English nuclear accent placement and foreign language aptitude?
- 4.** What is the relationship between the capacity to perceive English nuclear accent placement and musical ability?
- 5.** What is the relationship between the capacity to produce English nuclear accent placement and musical ability?

## **General Objective**

Assess English L2 learners' perception and production of English nuclear accent placement and their relationship with language aptitude and musical ability.

## **Specific Objectives**

1. To determine the extent to which L2 learners with Spanish L1 can perceive and produce English nuclear accent placement.
2. To measure the foreign language aptitude and musical ability capacities of L2 learners.
3. To compare L2 learners' capacity to perceive and produce English nuclear accent placement.
4. To explore the relationship between foreign language aptitude and the perception and production of English nuclear accent placement.
5. To explore the relationship between musical ability and the perception and production of English nuclear accent placement.

## **Hypotheses**

**H1:** L2 learners' perception correlates with production of English nuclear accent placement.

**H2:** L2 learners' perception of English nuclear accent placement correlates with foreign language aptitude.

**H3:** L2 learners' production of English nuclear accent placement correlates with foreign language aptitude.

**H4:** L2 learners' perception of English nuclear accent placement correlates with musical ability.

**H5:** L2 learners' production of English nuclear accent placement correlates with musical ability.

## Participants

All subjects ( $N = 53$ ) in this study were recruited from an English teaching programme in a Chilean university. Some undergraduate students ( $n = 9$ ) were trained in a campus located in a different city; nevertheless, they followed the same course syllabus. Virtually all participants were third-year students enlisted in an intonation course during the second semester (August to December), 2024 –This course provided students with theoretical knowledge and practical experience on English NA including summative assessments and feedback focusing equally on perception like in production. In addition, the invitation to participate in the present study was also extended to fourth-year students who had already passed the intonation course. Before the testing phase, all subjects read and signed an informed consent, hence participation was voluntary and the right to withdraw at any time was preserved (see **Appendix B**). Participants' overall level of English proficiency was measured to secure greater sample homogeneity. Specific inclusion and exclusion criteria were also applied to maintain sample consistency and the validity of the results. Consequently, L2 participants who spoke Spanish as an L1, did not report to suffer from any sensory or cognitive impairment, and completed the five tests were retained.

## Instruments

There were five computer-based tests given in three different sessions (see **Table 1**, below): The Cambridge general English proficiency examination; a NA placement perception test; a NA placement production test, the Modern Language Aptitude Test (MLAT) –number learning (Part I) and phonetic script (Part II); and the Musical Ear Test (MET) –melody and rhythm sensitivity. As mentioned earlier, L2 proficiency measured through the Cambridge examination –although reported as an individual variable to avoid confusion– was included as a covariate to control for baseline language ability and ensure that observed effects of musical ability and L2 aptitude reflect unique predictive variance. For the MLAT and MET subsections, an answer sheet was provided by the invigilators. Namely, an answer sheet for the number learning, phonetic script, melody, and rhythm. (see **Appendix C, D, E, and F**, respectively).

**Table 1** displays the order of presentation of the tests across the different sessions.

ORDER	TEST	SESSION
First	Cambridge Examination	1
Second	NA Placement Production	2
Third	NA Placement Perception	2
Fourth	MLAT	3
Fifth	MET	3

### ***General Procedure for all Instruments***

Similar testing conditions were ensured to all participants: Namely, fully functional computers (laptops or desk computers); headsets with microphones to be able to listen to and verbally produce the stimuli (all equipment was supplied by the university); freedom to adjust the volume; and number of invigilators (two per test). All L2 participants had an individual computer with the tests displaying on the screen. The testing was administered across multiple days to minimise or mitigate participant fatigue. The testing sequence was identical for all subjects. Participants performing two tests on the same session were permitted a five-to-ten-minute break in between. Only the MLAT and MET included instructions in English. For all the other tests, instructions were given in English by one of the invigilators (highly proficient non-native speakers of English). Before entering the computer lab, participants were asked to turn off and store any mobile or electronic devices they had with them. They were neither allowed to speak among themselves nor discuss any of the questions during the completion of the test. Participants were allowed to leave the testing site only after a period of time had passed, which was established and informed before commencing the test. Participants were also instructed to leave the testing site in a quiet and orderly fashion in order to reduce or avoid any disruptions to other test takers.

### ***Cambridge Examination.***

**Description.** This computer-based test is composed of 25 compulsory items (1 pt. each) and measures the general English proficiency through multiple choice exercises. That is, each item is either a two-way conversation exchange or an incomplete utterance, and various sentences or words (one to three), respectively, are given as possible fillers. The initial five conversation exchanges are given three sentences each as viable choices. The remaining 20 fill-in-the-gap items had four potential options consisting of one-to-three words each; very few contain two or three words. There is only one correct answer per item. Answers can only be fully correct (1 pt.) or incorrect (0 pt.). Once the test is submitted, participants are able to see their final score on the screen. This result is translated to their corresponding English proficiency level in accord with the Common European Framework of Reference for Languages (CEFR). Furthermore, this score is contextualised alongside other standardised assessment of English proficiency (e.g., Linguaskill, IELTS, amongst others). This test does not consider L2 writing, speaking or reading (comprehension as in lengthier texts). This test was retrieved from: <https://www.cambridgeenglish.org/es/test-your-english/general-english/>

**Procedure.** Beyond the general procedures, participants were required to finalize this test and leave the final tab with their score open for registration.

### ***Production of English Nuclear Accent Test***

**Description.** The aim of this test is to measure the L2 learners' capacity to produce accurately the English nuclear accent placed in a number of given utterances. The production test uses 35 broad focus utterances, each one containing from five to seven words on average. 19 (54.29%) utterances are representative of the Last Lexical Item rule (LLI) –with tail and no tail– while the remaining 16 (45.71%), the six possible exceptions to the LLI considered for this study. Namely, (1) event sentences; (2) wh-questions ending with a verb; (3) empty words; final adverbials of (4) time and (5) place; (6) reflexive pronouns; and (7) final vocatives. All sentences were created and checked by a team of three experienced researchers. Answers can only be fully correct (1 pt.) or incorrect (0 pt.), partial or unclear answers are taken as incorrect. All stimuli are randomised for each test presentation. Each stimulus must be rehearsed and clearly produced within 30 seconds. After this time, the stimulus disappears and participants are automatically redirected to the following item.

**Procedure.** This test was given before the English NA placement perception test so that all the stimuli is novel information preventing any form of oral rehearsal or priming. This decision was based on Nagle's (2018) rationale. The platform used for this test had an internal memory storage. Therefore, during each 30-second window, participants were permitted to rehearse aloud multiple

times, while an automatic recording tool was simultaneously activated to collect responses. Only the last fully read sentence of each trial was retained as L2 output material for analysis. The audio files were recorded in mono WAV format at a sampling rate of 44.100 Hz and 16-bit depth.

### ***Perception of English Nuclear Accent Test***

**Description.** The aim of this test is to measure the L2 learners' capacity to listen and identify the English nuclear accent placed in a number of recorded utterances. The perception test consists of 35 broad focus utterances with equal characteristics as the production test described above. Each trial had six possible answers. Three words from the sentence are selected and presented with either tone, viz., a rising or a falling one (e.g., “dog-rise” “dog-fall”). Answers can only be fully correct (1 pt.) or incorrect (0 pt.). Any alternative selected (clicked) but not officially submitted within the 30-second window, is nonetheless recorded by the platform. Contrarily, if no alternative is registered (clicked) by the participant, the stimulus is considered incorrect. All stimuli are randomised for each test presentation. Each stimulus is automatically reproduced only once as soon as the trial begin. Participants cannot listen to the sentence a second time, but they can still read it on the screen together with the answer options. After the 30-second window, the stimulus disappears and participants are automatically redirected to the following item.

**Procedure.** This test was given after the English nuclear accent production test in order not to provide temporary enhancement in participants' oral performance (Nagle, 2018). The audio files were recorded in mono WAV format at a sampling rate of 44.100 Hz and 16-bit depth.

### ***L2 Aptitude –Modern Language Aptitude Test (MLAT)***

The Modern Language Aptitude test (Carroll & Sapon, 2002) is composed of five parts. Each part measures a core skill related to foreign language learning. For the present study, and to secure construct validity, only part I and II were administered. This decision was based on Véliz-Campos (2018) rationale since this portion of the exam does not tap into L2 achievement nor L2 proficiency, but L2 aptitude and sound exclusively. Each correct answer had a value of one point. There are no deductions in cases of error or omission. The final score of this test may be valid for up to five years. Participants may sit for the test a second time only after the lapse of one year has passed, since there are no other versions of this test. If that is the case, examiners may either accept the more recent outcome for further analysis or may calculate an average of the last and more recent results. Both test were presented in a computer-based format and both tests' answers had to be registered in an answer sheet provided by the invigilators.

**Description.** MLAT –Part I– is known as number learning and focuses on testing the sound-meaning relationship, particularly the auditory and memory ability. 15 points is the maximum score a test taker may obtain within this portion. The instructions come with the test, and they are presented by a native speaker of English.

**Description.** MLAT –Part II– is known as phonetic script and measures the ability to learn and associate speech sounds to written phonetic symbols (non-international phonemic alphabet). This section is divided in three sets. Each set is composed of five subsets presenting four different syllables each (nonsense syllables). Some of the input may resemble English phonetic symbols, while others may not. 29 points is the maximum score a test taker may obtain within this part. The instructions come with the test, and they are presented by a native speaker of English.

***Musical Ability –Musical Ear Test (MET)***

**Description.** In the broad sense, the Musical Ear Test (Wallentin et al., 2010) measures musical expertise. It has become one of the most reliable and used musical ability tests since it encompasses distinct linguistic areas and may be performed by all types of learners. Namely, it may distinguish clearly among different types of test takers, viz., professionally trained, amateurs and non-

trained musicians, with virtually no attenuation effect (ceiling or floor effect), even when the sample is small. It also correlates with the imitation test and the amount of musical practice. Therefore, it has been adopted in several academies as part of the entry exam, and as a way of conducting formative and summative assessments. It is composed of two subsets –melody and rhythm– of 52 trials each, 104 pairs in total. Participants had to mark either yes or no depending on whether the input heard was identical. Each correct answer had a value of one point. Half of the trials in each subset (26) are identical, while the other half are unidentical. All trials are randomised in each subset, thus, the difficulty order is unknown. The first subset contains 52 pairs of short piano melodies that measure pitch and contour. Each melody lasts one measure and is made of three to eight tones reproduced at 100 bpm (beats per minute). Half (13) of the unidentical melodies (26) apart from having one pitch violation also comprises a contour violation. From the total 52 trials, 25 are non-diatonic tones, 20 are in Major key and seven are in Minor. The second subset has 52 short pair of rhythmic sequences played with wood blocks. This subset is administered to measure rhythm. Each sequence is made of four to 11 beats lasting one measure, each reproduced at 100 bpm. Each subset begins with two unscored stimuli. These are to give feedback to test takers before commencing the trials. There are two seconds between each stimulus. No feedback is given during the realisation of the actual test. The test takes approximately 20 minutes to perform and is played non-stop.

## ***Data Analysis***

Scores for the Cambridge Examination were retrieved directly from the official web platform on which the examination was administered. Production data were independently evaluated by two proficient raters –experienced teachers of L2 English. Production performance was independently evaluated by two experienced L2 English teachers. Interrater reliability was estimated using a two-way random-effects intraclass correlation coefficient with absolute agreement (ICC[2,1]). This approach was selected to assess exact agreement between raters while treating them as representative of a wider population of evaluators. A single-measure ICC was reported because scores were not averaged across raters. Perception data were automatically recorded by the online platform used to administer the task, yielding dichotomous outcomes (correct/incorrect). The MLAT's and MET's results were scored according to their respective answer keys. Statistical analyses were conducted using multiple linear regression models to examine the predictive role of L2 aptitude, musical ability, and L2 proficiency on NA placement perception and production, including the exploration of interaction effects among predictors. The relationship between NA placement perception and production performance was analysed separately using a paired-samples t-test.

## CHAPTER III: RESULTS

### Descriptive Results

The descriptive statistics (see **Table 2**, below) shows that the data sample ( $N = 53$ ) had an intermediate level of English (B1 - B2) according to the Common European Framework of Reference for Language (CEFR). Additionally, group performance results demonstrated that the participants' capacity to produce English nuclear accent (NA) placement, albeit low, was slightly higher than their capacity to perceive it in all contexts.

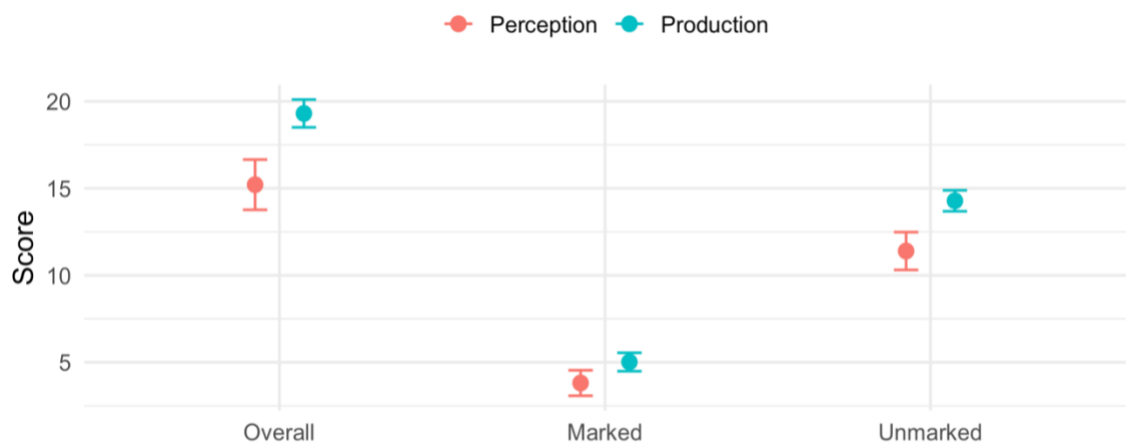
**Table 2** displays the descriptive statistics of all dependent and independent variables.

Variable	N	Mean (%)	SD	Min	Max	Shapiro W	p
<b>L2 proficiency</b>	53	18.3 (73)	2.89	8	23	0.940	< .05
<b>Overall musical ability</b>	53	69 (66)	9.07	45	88	0.984	= 0.714
<b>Melody sensitivity</b>	53	33.3 (64)	4.84	21	45	0.977	= 0.412
<b>Rhythm sensitivity</b>	53	35.7 (68)	5.68	24	46	0.971	= 0.222
<b>Overall L2 aptitude</b>	53	31.9 (72)	5.54	21	41	0.954	< .05
<b>Number learning</b>	53	7.43 (49)	4.66	0	15	0.917	< .01
<b>Phonetic script</b>	53	24.4 (84)	2.24	19	28	0.946	< .05
<b>Overall NA perception</b>	53	15.2 (43)	5.36	5	27	0.980	= .505
<b>Perception unmarked</b>	53	11.4 (59)	4.04	3	18	0.967	= .142
<b>Perception marked</b>	53	3.81 (23)	2.72	0	11	0.912	< .001
<b>Overall NA production</b>	53	19.3 (55)	2.97	13	25	0.975	= .320
<b>Production unmarked</b>	53	14.3 (75)	2.24	9	18	0.954	< .05
<b>Production marked</b>	53	5.02 (31)	1.97	2	11	0.925	< 0.01

## Inferential Results

In the present study, an initial paired-samples t-test was performed to determine whether there were significant differences between NA placement perception and production scores across all contexts. For *overall NA perception* and *overall NA production*, results show that production scores were significantly higher than perception scores,  $t(52) = 5.07$ ,  $p < .001$ , with a moderate to large effect

size,  $d = 0.70$  (95% CI [0.39, 0.99]). This suggests that production performance was consistently better than perception for most participants. Equally, production performance followed a similar tendency in unmarked contexts. NA placement production scores in unmarked utterances were significantly higher than perception scores,  $t(52) = 4.50$ ,  $p < .001$ , with a moderate effect size,  $d = 0.62$  (95% CI [0.32, 0.91]). Finally, although the small to moderate effect size,  $d = 0.38$  (95% CI [0.10, 0.66]), NA placement production scores were also significantly higher than perception ones in marked stimuli,  $t(52) = 2.75$ ,  $p < .01$  (see **Figure 1.**, below).



**Figure 1.** Mean NA placement perception and production accuracy across overall, unmarked, and marked sentence types.

**Table 3** presents the Pearson correlation matrix (z-scores) for the principal variables included in the present study: *L2 proficiency*, *overall musical ability*, *overall L2 aptitude*, and measures of nuclear accent placement perception and production (overall, marked, and unmarked contexts). The table reports zero-

order correlations, allowing for an initial examination of the strength and direction of associations among cognitive, aptitude-related, and performance-based variables. Statistically significant coefficients are indicated at three conventional thresholds ( $p < .05$ ,  $**p < .01$ ,  $***p < .001$ ). Overall, the matrix provides a descriptive overview of the interrelationships among L2 proficiency, musicality, L2 aptitude, and both receptive and productive dimensions of nuclear accent placement performance prior to more complex inferential analyses.

**Table 3** Correlations among the main variables (z-values).

Variable	1	2	3	4	5	6	7	8	9
1. L2 proficiency	—								
2. Overall musical ability	.14	—							
3. Overall L2 aptitude	.37**	.28*	—						
4. Perception (Overall)	.36**	.37**	.31*	—					
5. Production (Overall)	.06	-.18	-.16	.09	—				
6. Perception (Marked)	.16	.34*	.10	.68***	.13	—			
7. Production (Marked)	.21	-.23	.05	.12	.66***	.10	—		
8. Perception (Unmarked)	.37**	.26	.35*	.87***	.04	.23	.09	—	
9. Production (Unmarked)	-.10	-.04	-.25	.02	.75***	.08	-.01	-.03	—

**Note.** Pearson correlation coefficients.  $p < .05$ ,  $**p < .01$ ,  $***p < .001$ .

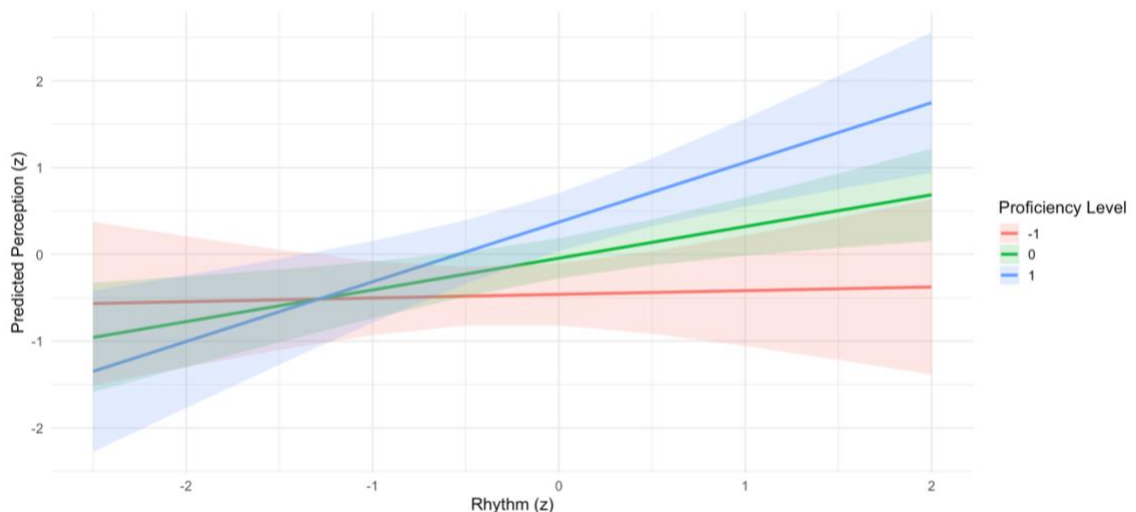
To examine the factors that may influence L2 participants' English NA placement perception and production performance a series of multiple linear regression analyses were conducted. Interaction terms were tested only after establishing significant main effects for the corresponding predictors. This stepwise model reduction approach allowed us to assess not only the individual contribution of each predictor, but also whether the effect of one variable (e.g., *rhythm sensitivity*) varied depending on the level of another (e.g., L2

*proficiency*). All variables were standardized (*z-scores*) prior to analysis to facilitate interpretation of effect sizes and interactions. Model fit was assessed using F-tests and changes in explained variance ( $R^2$ ), and only statistically significant predictors ( $p < .05$ ) were retained in the final reported models. The first model for NA placement perception, likewise for NA placement production, encompassed the covariate and both independent variables. That is, *L2 proficiency*; *overall musical ability* composite score (*melody* and *rhythm sensitivity*); and *overall L2 aptitude* composite score (*number learning* and *phonetic script*), respectively. Additionally, equal analyses were run again for *overall NA perception* and *overall NA production* but disaggregated by sentence type, *Unmarked* and *Marked*, to inspect potential differences across prosodic contexts. Finally, further models were constructed to assess whether ability in one domain (e.g., perception) served as a predictor of performance in the other (e.g., production). Hereafter, *L2 proficiency* –originally treated as a covariate– will be reported as an independent variable for the sake of conceptual and analytical clarity.

## Nuclear Accent Placement Perception Results

The initial perception model including all independent variables was statistically significant ( $F(3, 49) = 5.30, p < .01$ ), explaining 20% of the variance in the NA placement perception performance. Nevertheless, only *L2 proficiency* and *overall musical ability* proved significant predictors of overall NA placement perception accuracy ( $\beta = 0.27, t = 2.04, p < .05$ ;  $\beta = 0.29, t = 2.25, p < .05$ , respectively), whilst *overall L2 aptitude* did not emerge as a significant predictor in this model ( $\beta = 0.13, t = 0.93, p = .357$ ). Thus, a second model was built to explore the interaction between *L2 proficiency* and *overall musical ability*. The new model also proved statistically significant ( $F(3, 49) = 5.72, p < .01$ ), explaining 21% of the variance, but the interaction term, nevertheless, was not ( $\beta = 0.21, t = 1.35, p = .182$ ), suggesting that the effect of the latter variable does not depend on the level of the former. A subsequent third model was made to explore the predictive power of each sub-skill of the MET (*melody* and *rhythm sensitivity*). This model was statistically significant ( $F(2, 50) = 6.19, p < .01$ ) explaining 17% of the variance. Concretely, only *rhythm sensitivity* significantly demonstrated to be able to predict overall NA placement perception whereas *melody sensitivity* did not ( $\beta = 0.47, t = 3.26, p < .01$ ;  $\beta = -0.06, t = -0.42, p = .677$ , respectively). Hence, this outcome indicates that rhythm sensitivity, rather than melody sensitivity, contributes to the perception of L2 prosodic features such as NA placement. In the fourth and final model, the interaction between

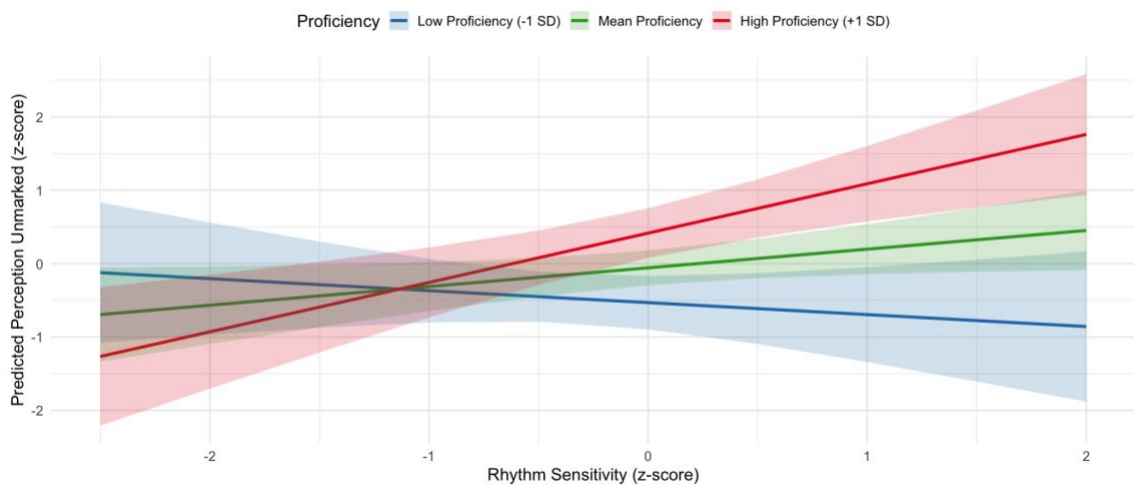
*rhythm sensitivity* and *L2 proficiency* was explored. Not only was this model statistically significant ( $F(3, 49) = 8.75, p < .001$ ), explaining 31% of the variance, but also was the interaction between variables ( $\beta = 0.32, t = 2.15, p < .05$ ), which demonstrates that the effect of rhythm sensitivity on overall NA placement perception increases with higher levels of English proficiency (see **Figure 2.**, below).



**Figure 2.** Interaction effect of rhythm sensitivity and L2 proficiency on overall NA placement perception accuracy. Error bars show 95% confidence intervals.

Given the strong associations between the individual variables and *overall NA perception*, a new similar set of multiple linear regression analyses were run for NA perception, but separated by sentence type on this occasion, viz., *perception unmarked* and *perception marked*. Namely, for contexts that followed the LLI rule, *L2 proficiency* ( $\beta = 0.28, t = 2.03, p < .05$ ) could significantly predict NA placement perception performance in the first model ( $F(3, 49) = 4.46, p <$

.01), explaining 17% of the variance in unmarked contexts. However, *overall musical ability* nor *overall L2 aptitude* reached significant values ( $\beta = 0.17, t = 1.25, p = .216$ ;  $\beta = 0.20, t = 1.41, p = .164$ ; respectively). Then, a second model, which explained 9% of the variance, was built to analyse specifically what sub-skill of the MET, melody and/or rhythm, may have a greater predictive power on this capacity ( $F(2, 50) = 3.68, p < .05$ ). Results evidenced that *rhythm sensitivity*, and not *melody sensitivity*, was statistically significant ( $\beta = 0.40, t = 2.64, p < .05$ ;  $\beta = -0.11, t = -0.73, p = .471$ ; respectively). Finally, the third model ( $F(3, 49) = 8.02, p < 0.001$ ), which accounted for 29% of the variance, confirmed a significant statistical interaction between *L2 proficiency* and *rhythm sensitivity* ( $\beta = 0.42, t = 2.74, p < .01$ ) (see **Figure 3.**, below).



**Figure 3.** Interaction between rhythm sensitivity and L2 proficiency predicting NA placement perception accuracy in unmarked contexts. Error bars represent 95% confidence intervals.

In the same line, for exceptions to the LLI rule, the first perception model encompassing all variables proved marginally significant ( $F(3, 49) = 2.37, p = .082$ ), explaining 7% of the variance in marked contexts. In this case, *overall musical ability* could significantly predict NA placement perception performance in marked contexts ( $\beta = 0.33, t = 2.36, p < .05$ ), but *L2 proficiency* and *overall L2 aptitude* did not ( $\beta = 0.13, t = 0.89, p = .377$ ;  $\beta = -0.04, t = 0.28, p = .777$ ; respectively). Thus, a further model, accounting for 10% of the variance, detailed the extent of this ability on the perception of NA placement in marked sentence types ( $F(2, 50) = 3.75, p < .05$ ). This second model evinced that only *rhythm sensitivity* could significantly predict NA placement perception in marked contexts, meanwhile *melody sensitivity* did not ( $\beta = 0.34, t = 2.24, p < .05$ ;  $\beta = 0.04, t = 0.29, p = .776$ ; respectively). Ultimately, the interaction between *L2 proficiency* and *rhythm sensitivity* in the third and final model, which explained 9% of the variance, was not found significant this time ( $\beta = 0.02, t = 0.10, p = .924$ ), contrary to former perception models.

## Nuclear Accent Placement Production Results

Interrater reliability for the NA placement production assessment was evaluated using a two-way random-effects intraclass correlation coefficient with absolute agreement (ICC[2,1]). The data analysis demonstrated excellent agreement between the two independent raters (experienced L2 English teachers),  $ICC(2,1) = .962$ , 95% CI [.935, .978]. The mean difference between raters was not statistically significant,  $M_{diff} = 0.019$ ,  $t(52) = 0.17$ ,  $p = .868$ , indicating no evidence of systematic bias. Finally, Bland-Altman limits of agreement ranged from -1.589 to 1.626, suggesting minimal disagreement across the scoring range. Overall, these findings demonstrate a high degree of scoring reliability.

The first production model considering all independent factors, accounting for 1% of the variance, did not find any variable to be a significant predictor of overall NA production ( $F(3, 49) = 1.09$ ,  $p = .362$ ). Namely, *L2 proficiency* ( $\beta = 0.14$ ,  $t = 0.97$ ,  $p = .335$ ); *musical ability* ( $\beta = -0.15$ ,  $t = -1.07$ ,  $p = .290$ ); and *overall L2 aptitude* ( $\beta = -0.17$ ,  $t = -1.08$ ,  $p = .283$ ). For this reason, subsequent models for unmarked and marked production contexts were developed. For *production unmarked*, on the one hand, the model ( $F(3, 49) = 1.13$ ,  $p = .344$ ), which explained 1% of the variance, only exposed *L2 aptitude* to have a marginally significant effect ( $\beta = -0.26$ ,  $t = -1.68$ ,  $p = .099$ ), but no variable ultimately revealed to be statistically significant, nevertheless. Namely, *L2*

*proficiency* ( $\beta = -0.01, t = -0.08, p = .936$ ); and *overall musical ability* ( $\beta = 0.03, t = 0.23, p = .820$ ). For marked sentence types ( $F(3, 49) = 2.05, p = .119$ ), on the other hand, the model, accounting for 6% of the variance, could only exhibit *overall musical ability* to have a marginally significant effect ( $\beta = -0.27, t = -1.93, p = .060$ ), whilst *L2 proficiency* and *overall L2 aptitude* did not ( $\beta = 0.23, t = 1.60, p = .115$ ;  $\beta = 0.04, t = 0.28, p = .780$ ; respectively).

Finally, to investigate the bidirectional predictive relationship between NA placement perception and production, two further models were developed; unfortunately, neither model proved significant. Consequently, these results indicate that perceptual sensitivity to NA placement ( $\beta = 0.09, t = 0.67, p = .504$ ) may not be a robust predictor of productive behaviour ( $F(1, 51) = 0.45, p = .504$ ), and that the reciprocal predictive relationship ( $\beta = 0.09, t = 0.67, p = .504$ ) is similarly nonsignificant ( $F(1, 51) = 0.45, p = .504$ ).

## CHAPTER IV: DISCUSSION

The main aim of this research was to explore the general capacity of second language (L2) learners with Spanish as first language (L1) to perceive and produce nuclear accent (NA) placement in English utterances. In addition to that, three individual differences, viz., L2 aptitude, musical ability, and L2 proficiency (covariate), were incorporated to investigate their impact on the aforementioned modalities, and to survey possible interactions. We scaffolded our work around five research questions that will be addressed in order. Concurrently, the five hypotheses proposed will be addressed in accord with the results presented earlier in this study.

Generally speaking, production performance was significantly higher across all contexts; that is, overall NA production, production unmarked, and production marked. Regarding independent variables, overall L2 aptitude –measured by the Modern Language Aptitude Test (MLAT)– did not emerge as a predictor in the present study. Conversely, both L2 proficiency and overall musical ability – measured through the Cambridge English placement test and the Musical Ear Test (MET), respectively– contributed to the perception of NA placement across settings individually, and their interaction also showed significant effects.

**To what extent are English L2 learners with Spanish L1 able to perceive and produce English nuclear accent placement?**

Overall, the results indicated that L2 participants had limited but non-negligible ability to both perceive and produce English NA placement, with performance strongly conditioned by syntactic markedness, prosodic alignment constraints, and task-related aspects.

Viewed developmentally, the present findings may be partially attributed to L2 participants' intermediate proficiency profile (B1 - B2). To date, L2 proficiency is generally regarded as a multidimensional and dynamic construct shaped by metalanguage complexity, accuracy, and fluency (CAF), which evolve over time through sustained exposure and practice (Li & Sui, 2025; Şahin Kizil, 2024; Skehan, 1998; Vercellotti, 2017). Within this framework, L2 prosodic competence is expected to stabilise incrementally insofar as phonological and pragmatic systems mature (Gordon & Darcy, 2022; Saito & Plonsky, 2019). Therefore, the moderate performance observed in the present study may indicate an evolving developmental stage rather than an enduring deficit.

As expected, L2 learners' NA placement perception and production performance diminished when utterances slightly conflicted with Spanish intonational rhythmic rules (unmarked utterances with tail). Further, it was even lower when

utterances deviated syntactically from commonly preferred Spanish patterns (marked utterances) since they naturally entailed a more leftward relocation of NA placement. Not only may these results have been shaped by the influence of entrenched L1 prosodic routines that can temporarily hinder L2 production even when L2 perceptual discrimination is partially robust –a pattern frequently observed in segmental studies (Casillas, 2019, 2020; Melnik-Leroy et al., 2022)– but also by the degree of L2 prosodic awareness which, even if implicit, may positively adjust L2 perception and production (Yenkimaleki, 2021; Yenkimaleki & van Heuven, 2020). As noted by numerous authors, although NA placement may function similarly in English and Spanish, the mechanisms governing perception and production NA placement in broad focus utterances may differ between Germanic and Romance language families (Aronsson, 2016; Cole et al., 2019; del Saz & Grau, 2022; Frota & Prieta, 2015; Klassen, 2013; Landblom & Ionin, 2023; Zubizarreta & Nava, 2011). Concretely, Germanic languages tend to rely more heavily on pragmatic cues and, consequently, on prosody for in-situ or simultaneous focus realisation. Thus, certain syntactic arrangements may adopt a more leftward NA position. Meanwhile Romance languages are characterised by their syntactic flexibility which enables them to align the focused content directly with NA in right-final position. Along these lines, given the unavailability of rightward focus-NA alignment in the marked utterances, these results may be indicative of less readily available semantic-identification mechanisms typically exploited in Germanic languages to encode and decode

NA prosodically. Accordingly, the need to recruit these mechanisms for leftward NA realization likely imposed a substantial cognitive burden on the intermediate-L2 learners of English in the present study (Trimble, 2013; Valenzuela Farías, 2013; Zubizarreta & Nava, 2011). Notwithstanding this, the partial success observed among L2 participants may have two interpretations. First, participants' L1 prosodic system, albeit stronger in nature even for experienced L2 learners, might not be reluctant to change or progressively integrate the L2 prosodic system (in line with del Saz & Grau, 2022; Liu et al., 2025; Mennen, 2015; Riquelme et al., 2025; Zubizarreta & Nava, 2011). And second, other underlying L1 processing mechanisms may remain accessible. Both explanations imply that further gains may be feasible, highlighting the value of longitudinal research on this topic (Casillas, 2019, 2020; Nagle & Baese-Berk, 2022). Taken together, these findings lend support to the view that English NA placement perception and production is particularly challenging for L2 learners with Spanish L1 (del Saz & Grau, 2022; Landblom & Ionin, 2022; Ortega-Llebaria & Colantoni, 2014; Ubilla-Bravo, 2024; van Maastricht et al., 2016; Zubizarreta & Nava, 2011).

Relatedly, regarding the perception-production link, the multiple linear regression analyses showed a non-linear correspondence between these capacities (in line with Kartushina & Frauenfelder, 2014; Nagle, 2018; Riquelme et al., 2025; Shultz et al., 2012). Namely, neither capacity was a reliable

predictor of the other. This non-correspondence may partially reflect the delayed or time-lagged nature of perception-to-production transfer (Nagle, 2018; Casillas, 2019, 2020). That is, performance might improve in production after further exposure or extended training. Certainly, higher L2 proficiency seems to foster heightened sensitivity to prosodic organisation, leading to stronger links between the L2 phonological and pragmatic systems (Bachman & Palmer, 2010; Mennen, 2015; Ortega & Wu, 2025). In this light, the absence of strong perception–production alignment may represent a transitional reorganisation rather than a stable divide.

When considered in relation to established models of L2 speech learning, however, these findings warrant further discussion. While many studies have commonly documented that perceptual gains may precede or be more longitudinally retained than production ones (Casillas 2019, 2020; de Leeuw et al., 2021; Melnik-Leroy et al., 2022; Nagle, 2018), the current study provided only limited evidence for this pattern, challenging predictions by well-known speech learning models, e.g., SLM and PAM (in accord with de Leeuw et al., 2021; Kartushina et al., 2015; Kim & Han, 2024). To illustrate, in overall and unmarked contexts, the t-test showed moderate to high levels of significance in the NA placement production performance in comparison to the perception capacity. While in marked utterances the effect was small to medium, it was still significant. Therefore, contrary to initial expectations, these results did not

support the first hypothesis (**H1: L2 learners' perception correlates with production of English nuclear accent placement**). Nevertheless, this must be interpreted carefully, particularly when integrated with prior research and theoretical accounts. For example, the present results extend a behaviour formerly attested in a longitudinal study by Kartushina et al. (2015). Namely, the presence of problematic (supra)segments may not necessarily be a straightforward hindrance to producing them successfully (de Leeuw et al., 2021; Melnik-Leroy et al., 2022). Thus, in agreement with former research, this study supports the notion that the perception-production link may be mediated by underlying phonological characteristics attributed to the (supra)segmental target (Hao & de Jong, 2016; Kartushina et al., 2015; Kato & Baese-Berk, 2020; Melnik-Leroy et al., 2022; Nagle, 2018; Sakai & Moorman, 2018). Furthermore, the non-parallel patterning of performance in this study indicates that these capacities rely on distinct, though potentially interacting, underlying executive control mechanisms (de Leeuw et al., 2021; Melnik-Leroy et al., 2022; Slevc, 2012). This dissociation may be further shaped by experimental conditions since processing mechanisms recruited for NA placement perception may differ from those in NA placement production across tasks; thus, the need for rigorous and comparable measures (de Leeuw et al., 2021; Melnik-Leroy et al., 2022; Nagle, 2018). For example, lower NA placement perception scores may be explained by the influence of echoic memory limitations and the load of auditory processing, despite their fundamental role. Consequently, these capacities, as

observed in this study, may mature or be acquired at distinct rates as improvements in one domain might not transfer to the other equally (Kartushina et al., 2015; Nagle & Baese-Berk, 2022). As argued by Yenkimaleki (2021) and Yenkimaleki and van Heuven (2020), this dissociation may undergo additional influence from L2 prosodic awareness training which has shown to enhance both NA placement perception and production in L2 learners. For instance, in a similar study by Riquelme et al. (2025), it was reported that advanced L2 learners' perception of NA placement was higher in unmarked utterances, whilst an opposite behaviour occurred in the marked ones as production overlapped. Ultimately, these findings suggest that the perception-production link reflects a complex and time-sensitive interplay of multiple linguistic factors that extends beyond a simple bidirectional relationship (de Leeuw et al., 2021; Hale & Kissock, 2021; Nagle, 2018; Nagle & Baese-Berk, 2022; Riquelme et al., 2025; Wang, 2020).

Finally, an alternative explanation for the asymmetry attested between NA placement perception and production performance and, thus, their relationship, might be attributed to some extent to task constraints and/or participants' individual differences, such as L2 prosodic and grammatical awareness, musical ability, and L2 proficiency (these latter two aspects will be addressed in the following research questions), among many other external factors (de Leeuw et al., 2021; Kartushina et al., 2015; Kissling, 2014; Melnik-Leroy et al., 2022;

Nagle, 2018; Yenkimaleki, 2021; Yenkimaleki & van Heuven, 2020). For example, in Kato and Baese-Berk (2020), higher production performance resulted from the exposure to orthographic prompts rather than auditory stimuli, yet higher perception performance was strongly correlated to scores from the latter type –as it was the case in this study. Beyond stimulus features, NA placement perception and production performance may have also been influenced by test design (Llompert, 2024; Peperkamp & Bouchon, 2011). On one side, the 30-second rehearsal period might have successfully primed NA placement production. Had the NA placement perception test been administered first, it is likely that the priming effect might have become stronger due to increased exposure to target-like auditory input. The single auditory track presentation, on the other side, might have placed greater demands on echoic memory, thereby revealing its relative perceptual immaturity; especially on marked utterances where the processing, as noted earlier, may have required more sophisticated L2 mechanisms or L2 experience/proficiency, as evidenced by the decreasing scores in the production test. As argued by de Leeuw et al. (2021), the elevated scores of NA placement perception might also be attributed to increased prosodic awareness. That is, L2 learners, regardless of their perception capacity, might have restrained themselves from producing illicit patterns as an acquired habit.

Overall, the findings indicate that L2 learners of English with Spanish L1 show limited but systematic ability to perceive and produce NA placement, with performance varying depending on syntactic markedness, prosodic alignment, and task-related factors. Perceptual and productive accuracy declined in utterances that diverged from L1-preferred syntactic and prosodic patterns, reflecting cross-linguistic dissimilarities in the processing of information structure. The absence of a robust perception-production correspondence indicates that these capacities may develop asynchronously and be mediated by partially distinct, though interacting, processing cognitive mechanisms. Given the importance of NA placement in denoting information structure and discourse prominence, persistent difficulties in its perception and production are likely to affect L2 speech intelligibility and pragmatic appropriateness.

## **What Is the Relationship between the Capacity to Perceive English Nuclear Accent Placement and Foreign Language Aptitude?**

## **What Is the Relationship between the Capacity to Produce English Nuclear Accent Placement and Foreign Language Aptitude?**

Results in the present study demonstrated that domain-general skills measured by the MLAT –focusing on L2 aptitude and sound processing– may not be significant predictors of the degree of success in the perception and production of English NA placement. For this reason, the second and third hypotheses are not supported (**H2: L2 learners’ perception of English nuclear accent placement correlates with foreign language aptitude; H3: L2 learners’ production of English nuclear accent placement correlates with foreign language aptitude**). Notably, given the multifaceted nature of L2 proficiency (CAF; Li & Sui, 2025; Şahin Kizil, 2024; Skehan, 1998; Vercellotti, 2017) and the effect it had on NA placement perception suggests that traditional L2 aptitude measures –like the MLAT– may not thoroughly capture aspects of L2 phonological development. Actually, perceptual accuracy seemed to be more dependent on rhythm sensitivity, particularly when L2 learners showed higher levels of L2 proficiency (this will be addressed in detail in the following research question).

Equally, the effect of cognitive skills such as number learning and phonetic decoding did not transfer successfully to the productive prosodic control in L2 learners. Certainly, the requirement to align L2 prosodic patterns with syntactic structures and to integrate phonological planning, and articulatory coordination is not captured by the MLAT. Therefore, the fact that NA placement production was higher than the perception capacity implies that other domain-specific abilities (e.g., auditory and motor abilities) or other individual differences (e.g., working memory) may have compensated, easing the cognitive burden. This finding suggests that although L2 learners may readily perceive NA placement, its production nonetheless goes beyond rhythmic perceptual control and may require more sophisticated mechanisms. As argued by some authors, although perception gains might not be foundational for production, its adequate development, nonetheless, may serve for an accelerated and longitudinal L2 acquisition process to occur (Casillas, 2019, 2020; Kartushina et al., 2015; Yenkimaleki, 2021).

Taken together, these results exhibited a limited association between the MLAT as a measurement of general L2 aptitude and the perception and production of English NA placement. Although the MLAT may reliably predict general L2 achievement (Sparks & Dale, 2023; Wen et al., 2017), its link with the phonological perceptual and productive capacities is somewhat limited or indirect. One alternate explanation for the present results is that the MLAT

partially gauges L1 literacy and oral skills but may overlook individual capacities that might tap into L2 prosodic sensitivity, like rhythm perception, which has proven relevant for the accurate perception and production of English NA placement.

## **What Is the Relationship between the Capacity to Perceive English Nuclear Accent Placement and Musical Ability?**

## **What Is the Relationship between the Capacity to Produce English Nuclear Accent Placement and Musical Ability?**

It is widely accepted that individual differences contribute greatly to variability in L2 acquisition, specifically perception and production (Li et al., 2022). Lately, musical ability has represented a particularly relevant factor within this field, given that shared processing mechanisms are involved in both realms (Reiterer, 2018; Seither-Preisler et al., 2014; Thompson et al., 2025; Turker & Reiterer, 2021). As Thompson et al. (2025) argued, exploring their relationship may help us understand the underlying mechanisms that enable L2 learners to acquire new phonological contrasts and to extract their functional load. Generally speaking, the present data indicates that musical ability, particularly rhythm sensitivity as measured by the MET, may be related to learners' capacity to perceive L2 suprasegmental features such as NA placement. For instance, rhythm sensitivity appears to predict NA placement perception accuracy even when L2 learners may not yet have fully developed language-specific prosodic processing mechanisms. This observation motivates the use of the MET as a potentially informative measure in the study of individual differences in L2 prosodic acquisition, especially with respect to English NA placement. Additionally, the strength of this relationship in certain circumstances may

increase with higher levels of English proficiency. In contrast, neither overall musical ability nor its constituents individually, rhythm and melody, exerted an effect on L2 learners' NA placement production capacity.

In accord with our research questions (4 and 5), the multiple linear regression analyses showed that rhythm sensitivity, and not melody, could significantly predict L2 learners' accuracy of NA placement perception across all contexts. However, no production model reached significance, even when disaggregated by sentence type. Together, these results demonstrate that rhythm sensitivity is robustly and selectively related to the overall perception of NA placement rather than to its production, in contrast to findings emphasising production-related effects of rhythm ability (e.g., Cason et al., 2020; Thompson et al., 2025). Hence, in relation to this study's hypotheses, only the fourth hypothesis may be partially supported (**H4: L2 learners' perception of English nuclear accent placement correlates with musical ability**), while the fifth hypothesis was not (**H5: L2 learners' production of English nuclear accent placement correlates with musical ability**). This pattern aligns with evidence for a non-linear correspondence between perception and production capacities as these appear to be mediated by partially distinct cognitive processing mechanisms (de Leeuw et al., 2021; Kartushina & Frauenfelder, 2014; Melnik-Leroy et al., 2022; Nagle, 2018; Riquelme et al., 2025; Shultz et al., 2012; Slevc, 2012). Parenthetically, this distinction might also account for our earlier finding that

production performance can exceed perception without the two being predictively linked. In this study, musical rhythm sensitivity successfully scaffolded the perceptual processing of L2 prosodic prominence. However, it was insufficient to sustain productive control of NA placement. Nevertheless, L2 learners could still achieve moderate accuracy, likely by means of other linguistic or general mechanisms. Consequently, the perception of English NA placement seems to need refined auditory-attentional mechanisms for processing temporal structure, meanwhile the production capacity might rely more firmly on articulatory planning processes.

Building on the general finding that rhythm sensitivity supports NA placement perception, a more granular analysis showed that its functional significance was not uniform across settings (unmarked vs. marked). That is, the effect of rhythm sensitivity was modulated by contextual factors. The interaction between rhythm and L2 proficiency, on the one hand, arose solely in unmarked utterances. This finding shows that L2 learners are enabled to integrate rhythm information with evolving L2 prosodic knowledge insofar as sufficiently transparent phonological cues are available. Consistent with developmental accounts, increased L2 proficiency may encourage the creation of novel phonological categories while gradually reducing cross-linguistic prosodic interference (Flege, 1995; Best & Tyler, 2007). As metalinguistic–pragmatic knowledge matures—particularly at intermediate levels—L2 learners may more accurately integrate rhythm

perceptual sensitivity within emerging L2-specific prosodic representations (Graham & Post, 2018). That is, rhythm sensitivity may ease the perceptual burden as L2 proficiency consolidates. To some extent, this effect might have been greater given the syntactic-prosodic resemblance/proximity to Spanish canons (rightward NA-focus alignment).

In marked utterances, on the other hand, rhythm sensitivity was recruited as a domain-general auditory-attentional perceptual strategy. In cases where syntactic-prosodic cues are ambiguous, L2 proficiency may not suffice to leverage rhythm sensitivity, resulting in its use as an auxiliary perceptual strategy in marked contexts. The present findings contend that higher rhythm sensitivity provided a compensatory perceptual scaffold in the presence of reduced syntactic-prosodic transparency, facilitating early perceptual access to NA placement before L2-specific mechanisms were fully operative. Taken together, these findings evinced rhythm sensitivity to have a flexible role in the perception of L2 suprasegmental aspects such as NA placement, which is shaped by prosodic and syntactic complexity. Future research is warranted to determine whether the effect of rhythm sensitivity extends to advanced (Spanish L1/English L2) or other types of L2 learners (e.g., different L1 backgrounds). Equally, the dissociation of the melodic subcomponent of the MET from NA placement perception is particularly theoretically compelling. Given the phonological nature of NA placement, these results strengthen the explanatory

plausibility of the MET rhythm effect as a key contributor to L2 prosody perception and consistent musical predictor. Ultimately, we may argue that rhythm sensitivity is increasingly beneficial provided L2 learners acquire sufficient L2 proficiency, challenging the idea that music may similarly help everyone.

While rhythm sensitivity was a robust predictor of NA placement perception, its limited effect in production further underscores the dissociation between perception and production capacities, which suggests developmental constraints in L2 prosodic acquisition. Accurate production of NA placement seems to require more than sensitivity to temporal structure alone. NA production likely places heavier demands on executive control, syntactic integration, phonological planning, and articulatory coordination. Therefore, it appears that these demands may have attenuated the advantages conferred by rhythm sensitivity, particularly in L2 learners who have not yet entrenched suprasegmental encoding.

To sum up, musical ability, specifically rhythm sensitivity, was a significant predictor of L2 learners' NA placement perception capacity, but not of production. Certainly, the effect of rhythm sensitivity was shown to vary contingent upon utterance characteristics (unmarked vs. marked). Nevertheless, its robustness increased with higher levels of English proficiency. While rhythm

sensitivity operated as a compensatory strategy in default patterns (unmarked), supporting automatised prosodic knowledge (L2 proficiency), it served more as a general perceptual scaffold in marked settings. In contrast, successful oral realisation of NA placement seems to depend more heavily on cognitively demanding mechanisms, such as integrating syntactic and prosodic information. Overall, these findings highlight the dissociation between perception and production and raise further questions in relation to the musical processing mechanisms that may be involved in the production of L2 prosodic aspects.

## **Concluding Remarks**

In summary, the present study revealed that English learners with Spanish L1 have limited, yet systematic, ability to perceive and produce English NA placement. In fact, L2 learners' performance varied depending on syntactic markedness, prosodic alignment, and task-related constraints. In contexts that diverged from Spanish prosody, NA placement perception and production were notably lower. This finding indicates that intermediate-level L2 learners may face special challenges to comply intonationally as their L1 expectations are still robust at this acquisition stage. While L2 proficiency significantly predicted NA placement perception, general L2 aptitude failed to do so, suggesting that common L2 aptitude measures may not fully explain L2 prosodic attainment. Interestingly, rhythm sensitivity –rather than overall musical ability– was significantly associated with English NA placement perception, and its effect was positively mediated in the presence of enhanced L2 proficiency. Even though NA placement production performance was consistently higher across contexts, the observed dissociation supports the idea that they rely on distinct cognitive processing mechanisms. While production demands more sophisticated mechanisms, such as executive control, phonological planning, and articulatory coordination, perception relies more on auditory-attentional skills. This interpretation, therefore, aligns with former scholars advocating for a non-linear correspondence between perception and production. However, since the

present study is cross-sectional, longitudinal studies are needed to evaluate whether the degree or type of relationship changes insofar as exposure and practice remains constant. Overall, this study demonstrates that L2 prosodic development may challenge current L2 speech learning models, underscoring the relevance of rhythm sensitivity for perceptual gains, whilst production may engage more refined cognitive processes. Ultimately, this research opens avenues for exploring likely connections between musicality, suprasegmental awareness, and L2 proficiency in the L2 acquisition process.

## CHAPTER V: CONCLUSION

The present research explored the perception and production of nuclear accent (NA) placement of second language (L2) learners with Chilean Spanish as first language (L1). In addition, the role of L2 aptitude, musical ability and L2 proficiency as individual variables was also examined. Broadly speaking, L2 learners exhibited limited NA placement perceptual and productive capacities. The present study showed that perception and production performance is heavily influenced by syntactic markedness, prosodic alignment constraints, and task-related factors. Results evinced that both capacities decreased in accuracy insofar that utterances differed from Spanish syntactic-prosodic canons. This pattern was more notorious in marked contexts since they required a further leftward NA-focus displacement. Furthermore, this finding extends the insight into the persistent cross-linguistic differences between English and Spanish prosodic systems. In relation to the perception-production link, this study contradicts the claim that accurate perception of L2 phonology is foundational for production given that the production of NA placement frequently exceeded perception performance. These results, therefore, demonstrate that these capacities may develop asynchronously and rely on partially distinct processing mechanisms. Regarding individual variables, L2 Aptitude (MLAT) failed to predict NA placement perception and production. Whereas rhythm sensitivity robustly predicted perception accuracy, with effects mediated by syntactic

transparency and strengthened by higher L2 proficiency. The fact that rhythm sensitivity did not produce an effect on the production capacity suggests that accurate production is dependent upon various factors, viz., syntactic integration, phonological planning, and articulatory control. Taken together, the present findings emphasised the challenges Spanish-L1 learners of English face during L2 prosodic acquisition, the selective and facilitative role of rhythm sensitivity in perceptual processing, and the importance of L2 proficiency in facilitating both perceptual and productive development.

## **Theoretical and Methodological Limitations and Future Directions**

Several limitations should be acknowledged. The present study consisted of a small sample ( $N = 53$ ) and was focused on intermediate L2 learners of English with Chilean Spanish as an L1 (B1 - B2). Thus, generalisability to other types of learners, viz., proficient L2 learners from similar or different L1 backgrounds, is limited. In the same line, the restricted analysis to broad focus utterances also restricts the extension of the findings to other discourse contexts (e.g., narrow focus). In addition, the cross-sectional nature of the present study limits inferences about developmental change and causality, especially considering the dissociation between perception and production. Moreover, task-related factors must also be deemed, since the rehearsal time in the NA placement production test or the single audio track in the perception one may have influenced scores. Finally, even though the MLAT and the Musical Ear Test (MET) are reliable measures, they may fall short in capturing prosody-specific cognitive abilities that facilitate NA placement perception and production acquisition.

Future research could build on the present study by developing longitudinal designs. This would help track developmental gains in NA placement perception and production, and thus, elucidate the perception-production relationship. Similarly, expanding participants profiles may give ground to more solid

inferences, while varying task constraints may shed light into the effect of experimental design on L2 learners' performance. Certainly, the analysis of a wider range of discourse contexts would also provide further insight into how L2 learners encode and decode NA placement. Ultimately, the present findings underscore the relevance of prosody training in L2 acquisition.

## CHAPTER VI: REFERENCES

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## CHAPTER VII: APPENDICES

### Appendix A. Institutional Bioethics Approval Certificate



Universidad de Concepción  
Vicerrectoría de Investigación y Desarrollo  
Comité de Ética, Bioética y Bioseguridad

CEBB 1805-2024

Concepción, diciembre de 2024.

#### CERTIFICADO

El Comité de Ética, Bioética y Bioseguridad de la Vicerrectoría de Investigación y Desarrollo de la Universidad de Concepción ha revisado y evaluado el **PROYECTO DE TESIS** titulado **"PERCEPTION AND PRODUCTION OF ENGLISH NUCLEAR ACCENT BY LEARNERS WITH SPANISH AS FIRST LANGUAGE: RELATIONSHIP WITH LANGUAGE APTITUDE AND MUSICAL ABILITY"** ("PERCEPCIÓN Y PRODUCCIÓN DEL ACENTO DE FRASE EN INGLÉS POR APRENDIENTES CON ESPAÑOL COMO PRIMERA LENGUA: RELACIÓN ENTRE LA HABILIDAD LINGÜÍSTICA Y APTITUD MUSICAL") presentado por el Profesor de Inglés **SR. CHRISTOPHER FELIPE BARRA GARCÍA** en calidad de Investigador Responsable, alumno regularmente matriculado en el Programa de Magíster en Lingüística Aplicada, junto a su Profesor Guía, **DR. MAURICIO ALEJANDRO FIGUEROA CANDIA**, docente adscrito al Departamento de Español de la Facultad de Humanidades y Arte de la Universidad de Concepción, y ha comprobado que cumple con las normas y principios éticos y bioéticos establecidos nacional e internacionalmente para investigación que considera la participación de personas, en este caso estudiantes universitarios.

El objetivo general del Proyecto de Tesis es evaluar la capacidad de percepción y producción del acento oracional en aprendientes de inglés como lengua extranjera y su relación con la aptitud lingüística y la capacidad musical.

El desarrollo de la propuesta de investigación se estructura en 05 (cinco) objetivos específicos que describen actividades para (1) determinar la precisión de los estudiantes de Inglés como segunda lengua (L2) para percibir y producir acento nuclear inglés; (2) medir la capacidad de aptitud lingüística y la capacidad de habilidad musical de los estudiantes de L2; (3) comparar la percepción y la producción del acento nuclear inglés; (4) explorar la relación entre la aptitud lingüística y la percepción y producción del acento nuclear inglés, y (5) explorar la relación entre la habilidad musical y la percepción y producción del acento nuclear inglés.

El abordaje metodológico de la investigación considera la aplicación de tres pruebas por ordenador y dos pruebas en papel, siendo una prueba de percepción, una prueba de producción, el *Modern Language Aptitude Test* (MLAT) parte I y II únicamente, el *Musical Ear Test* (MET) y un examen de Cambridge, disponible en versión digital en la *webpage* de Cambridge University Press & Assessment.

La muestra contempla la participación de estudiantes de pregrado (tercer año) del Programa de Enseñanza de Inglés en una universidad chilena matriculados en un curso de entonación. Para el análisis de los datos, solo se incluirán participantes que hablen español como primera lengua (L1) y que no reporten tener ningún deterioro sensorial o cognitivo.

La participación de cada sujeto estará basada en los procesos de Consentimiento Informado, que será documentado, conforme modelo presentado a este Comité institucional, y regularmente aplicado y firmado, aceptando sus términos.



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Para los análisis de los datos se empleará el programa estadístico adecuado para obtener los resultados con lo cual responder al objetivo planteado, estando todo lo anterior detallado en el Proyecto De Tesis para optar al grado de Magíster en Lingüística Aplicada por la Universidad de Concepción.

El Investigador Responsable, Sr. Christopher Felipe Barra García, mantendrá la custodia de toda la información y los resultados de los estudios enmarcados en el proyecto en pauta.

La ejecución de las actividades descritas en esta propuesta de investigación asegura que no vulnera los derechos y la dignidad de los sujetos participantes en el estudio, garantizando la libertad, la voluntariedad y la privacidad de los mismos, presentando para ello los métodos de protección que aseguran la confidencialidad de los datos de investigación y de custodia de la información obtenida, con estricta observancia de todas las características formales y necesarias para su validez.

El Comité de Ética, Bioética y Bioseguridad de la Vicerrectoría de Investigación y Desarrollo de la Universidad de Concepción, considera que el Proyecto de Tesis presentado observa los derechos y principios de la Declaración Universal de los Derechos Humanos y de la Declaración Universal sobre Bioética y Derechos Humanos, las normas éticas de la Organización Panamericana de la Salud para Investigaciones con Sujetos Humanos, la Constitución Política de la República de Chile, la Ley Nº 20.120 "Sobre la Investigación Científica en el Ser Humano, su Genoma y Prohíbe la Clonación Humana", la Ley Nº 19.628, "Sobre Protección de la Vida Privada", la Ley Nº 20.393, que establece la responsabilidad penal de las personas jurídicas en los delitos que indica, y Ley Nº 21.369, que Regula el Acoso Sexual, la Violencia y la Discriminación de Género en el ámbito de la Educación Superior. Así también, sigue las Sugerencias para Escribir un Consentimiento Informado en Estudios con Personas, del Comité Asesor de Bioética FONDECYT/CONICYT.

En atención a todo lo anterior y dado que el **PROYECTO DE TESIS** titulado "**PERCEPTION AND PRODUCTION OF ENGLISH NUCLEAR ACCENT BY LEARNERS WITH SPANISH AS FIRST LANGUAGE: RELATIONSHIP WITH LANGUAGE APTITUDE AND MUSICAL ABILITY**" ("**PERCEPCIÓN Y PRODUCCIÓN DEL ACENTO DE FRASE EN INGLÉS POR APRENDIENTES CON ESPAÑOL COMO PRIMERA LENGUA: RELACIÓN ENTRE LA HABILIDAD LINGÜÍSTICA Y APTITUD MUSICAL**") presentado por el Profesor de Inglés **SR. CHRISTOPHER FELIPE BARRA GARCÍA** en calidad de Investigador Responsable, alumno regularmente matriculado en el Programa de Magíster en Lingüística Aplicada, no muestra elementos que puedan transgredir las normas y principios éticos y bioéticos de la investigación que considera la participación de personas, así como también pautas éticas y bioéticas rectoras de nuestra Institución Universitaria los principios rectores de nuestra Institución Universitaria, los delineados en la Declaración de Singapur sobre la Integridad en la Investigación (Resolución Exenta Nº 157, de 2013, CONICYT) y las normas relativas adoptadas por la Agencia Nacional de Investigación y Desarrollo - ANID del Ministerio de Ciencia, Tecnología, Conocimiento e Innovación del Gobierno de Chile, este Comité **resuelve aprobarlo**, confiriendo el presente Certificado.

  
**DRA. M. ANDREA RODRÍGUEZ TASTETS**

**PRESIDENTA**

**COMITÉ DE ÉTICA, BIOÉTICA Y BIOSEGURIDAD  
VICERRECTORÍA DE INVESTIGACIÓN Y DESARROLLO  
UNIVERSIDAD DE CONCEPCIÓN**



Barrio Universitario s/n,  
Edificio Empreudec  
Fono (56-41) 2204302  
Casilla 160 C – Correo 3, secrevrld@udec.cl  
Concepción, Chile



Este documento ha sido firmado electrónicamente por:  
**Maria Andrea Rodríguez Tastets** <andrea@udec.cl>  
Certificado por E-Sign S.A. en conformidad a la Ley 19.799

## Appendix B. Informed Consent Form and Participant Information



### CONSENTIMIENTO INFORMADO DE PARTICIPACIÓN EN PROYECTO DE INVESTIGACIÓN

#### Dirigido a: Estudiantes

Mediante la presente, se le solicita su autorización para participar en el proyecto de investigación denominado **"Perception and production of English nuclear accent by learners with Spanish as first language: Relationship with language aptitude and musical ability"**, enmarcado en el programa de **"Magister en Lingüística Aplicada"**, cuyo(a) Investigador(a) Responsable es el(la) profesor(a) **"Mauricio Alejandro Figueroa Candia"**, Departamento de Español perteneciente a la **Universidad de Concepción**.

Dicho Proyecto tiene como objetivo principal medir la capacidad de percepción y producción del acento oracional en aprendientes de inglés como lengua extranjera. Además, se explorará la aptitud lingüística y la habilidad musical, y su influencia en estas capacidades. En función de lo anterior es pertinente su participación en el estudio, por lo que, mediante la presente, se le solicita su consentimiento informado.

Al colaborar usted con esta investigación, deberá asistir a 5 sesiones en las cuales se tomará una prueba por sesión: (1) Prueba de percepción, (2) prueba de producción, (3) prueba de aptitud lingüística, (4) prueba de habilidad musical y (5) prueba de proficiencia lingüística, las cuales se realizarán en modalidad presencial. Todas las pruebas serán en computador. Algunas de las pruebas requieren grabación de voz, las cuales se harán en el mismo computador, y otras requieren traspasar las respuestas a una hoja física que será facilitada por los celadores. Cada actividad durará aproximadamente entre 20 a 30 minutos y será realizada en la misma universidad, durante los horarios de clases u horarios especiales para aquellos participantes que no coincidan con el horario indicado.

Los alcances y resultados esperados de esta investigación es lograr un mayor grado de comprensión respecto a cómo estas variables individuales, aptitud lingüística y habilidad musical, moderan las capacidades de percepción y producción del acento oracional. Además, su participación en este estudio no implica ningún riesgo de daño físico ni psicológico para usted, y se tomarán todas las medidas que sean necesarias para garantizar la **salud e integridad física y psíquica** de quienes participen del estudio.

Todos los datos que se recojan serán estrictamente **anónimos y de carácter privados**. Además, los datos entregados serán absolutamente **confidenciales** y sólo se usarán para los fines científicos de la investigación. El responsable de esto, en calidad de **custodio de los datos**, será el(la) Investigador(a) Responsable del proyecto, quien tomará todas las medidas necesarias para catelear el adecuado tratamiento de los datos, el resguardo de la información registrada y la correcta custodia de estos en un formato digital privado sin acceso por terceros.

El(La) Investigador(a) Responsable del proyecto y la Universidad de Concepción aseguran la **total cobertura de costos** del estudio, por lo que su participación no significará gasto alguno.



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HUMANIDADES  
y ARTE

Si presenta dudas sobre este proyecto o sobre su participación en él, puede hacer preguntas en cualquier momento de la ejecución del mismo. Es importante que usted considere que su participación en este estudio es **completamente libre y voluntaria**, y que tiene derecho a negarse a participar o a dejar inconclusa su participación cuando así lo desee, sin tener que dar explicaciones ni sufrir consecuencia alguna por tal decisión.

Ya que la investigación ha sido certificada en aspectos bioéticos por el Comité de Ética, Bioética y Bioseguridad de la Universidad de Concepción, si usted considera que se han vulnerado sus derechos, le pedimos se comunique con el Comité al correo [cebb@udec.cl](mailto:cebb@udec.cl) o al teléfono (+56)412204302.

Desde ya le agradecemos su participación.

.....  
NOMBRE  
Investigador(a) Responsable



Universidad de Concepción



Fecha \_\_\_\_\_

Yo \_\_\_\_\_ (NOMBRE COMPLETO), en mi calidad de alumno regular del programa de Pedagogía en Inglés de la Universidad de Concepción, en base a lo expuesto en el presente documento, acepto voluntariamente participar en el proyecto titulado **“Perception and production of English nuclear accent by learners with Spanish as first language: Relationship with language aptitude and musical ability”** cuyo(a) Investigador(a) Responsable es el(la) Profesor(a) Mauricio Alejandro Figueroa Candia del Departamento de Español de la Universidad de Concepción.

He sido informado(a) de los objetivos, alcance y resultados esperados de este estudio y de las características de mi participación. Reconozco que la información que provea en el curso de esta investigación es estrictamente confidencial y anónima. Además, esta no será usada para ningún otro propósito fuera de los de este estudio.

He sido informado(a) de que puedo hacer preguntas sobre el proyecto en cualquier momento y que puedo retirarme del mismo cuando así lo decida, sin tener que dar explicaciones ni sufrir consecuencia alguna por tal decisión.

De tener preguntas sobre mi participación en este estudio, puedo contactar al Comité de Ética, Bioética y Bioseguridad de la Universidad de Concepción ([cebb@udec.cl](mailto:cebb@udec.cl); (+56) 412204302).

Entiendo que una copia de este Consentimiento me será entregada, y que puedo pedir información sobre los resultados de este estudio cuando haya concluido. Para esto, puedo contactar al(a) Investigador(a) Responsable del proyecto al correo electrónico [maufigueroa@udec.cl](mailto:maufigueroa@udec.cl)

\_\_\_\_\_  
Nombre y firma del(la) participante

\_\_\_\_\_  
Investigador(a) responsable

## Appendix C. Answer Sheet for the Number Learning Section of the MLAT

Your name \_\_\_\_\_ FORM A  
Last (surname) First

**PRACTICE EXERCISE SHEET**  
for the  
**MODERN LANGUAGE APTITUDE TEST**  
John B. Carroll and Stanley M. Sapon

**PART I. NUMBER LEARNING**

Instructions: In this test you will learn the names of numbers of a new language. After you have learned these names, you will be given numbers in this language to be written down. For example, suppose you heard someone say the number 'two hundred thirteen' in English. You would then write down 2 1 3. But in this test, you will hear the numbers in a new language. First you will be taught the names of the numbers you need to know in this new language. You will need to know the names for 1, 2, 3, and 4; for 10, 20, 30, and 40; and for 100, 200, 300, and 400. If you learn these numbers well, you will be able to write down numbers like 213 or 431.

Practice  
Exercise 1

- a. 3
- b. \_\_\_
- c. \_\_\_
- d. \_\_\_
- e. \_\_\_
- f. \_\_\_

Practice  
Exercise 2

- a. 2 0
- b. \_\_\_
- c. \_\_\_
- d. \_\_\_
- e. \_\_\_
- f. \_\_\_

Practice  
Exercise 3

- a. 1 0 4
- b. \_\_\_
- c. \_\_\_

MODERN LANGUAGE APTITUDE TEST  
(MLAT)

ANSWER SHEET

FULL NAME: \_\_\_\_\_

PART I – Number Learning

EXAMPLE

4 0 2 ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

a. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

b. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

c. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

d. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

e. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

f. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

g. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

h. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

i. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

j. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

k. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

l. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

m. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

n. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

o. \_\_\_\_\_ ... 100 200 300 400 | 00 10 20 30 40 | 0 1 2 3 4

## Appendix D. Answer Sheet for the Phonetic Script Section of the MLAT

### PART II – Phonetic Script

1. tik	tiyk	tis	tiys
2. tis	tiys	tiz	tiyz
3. kas	kis	tas	tis
4. kas	kaws	kaz	kawz
5. kas	kis	kiys	kaws
6. tiš	tis	tiys	tiyš
7. kaš	kas	kaws	kawš
8. tiš	tiž	tawš	tawž
9. šiyk	žiyk	žak	šak
10. kiyš	kiž	kaz	kaws
11. tig	tij	tiyg	tiyj
12. teg	teyg	tej	teyj
13. geš	geys	geyž	geyz
14. žak	žek	šeyk	šawk
15. keyj	keyž	keyg	keyk
16. šeyk	šayk	jeyk	jayk
17. šayk	šak	čayk	čak
18. čayt	čiyt	jayt	jıyt
19. žayk	žik	šik	šayk
20. tayč	teyč	tiyč	tič
21. dəs	dəz	des	dez
22. jæg	jag	gæg	gag
23. šek	šak	šawk	šek
24. teg	tæg	tæg	tag
25. šæž	žaws	jayš	čeys
26. θayk	θiyk	θayk	θiyk
27. dæd	ðæd	ðæd	θæd
28. taz	θawz	daws	θas
29. šəd	šəθ	šəð	šet
30. tayd	tayθ	tayð	tiθ

## Appendix E. Answer Sheet for the Melody Sensitivity Section of the MET

TEST DE OÍDO MUSICAL (MET)

MELODÍA

Test II: Comparación de frases melódicas

Nombre del sujeto: \_\_\_\_\_

Fecha \_\_\_\_\_

### EJEMPLOS

Ejemplo A      SÍ    NO  
                  

Ejemplo B      SÍ    NO  
                  

### EL TEST MISMO

	SÍ	NO		SÍ	NO		SÍ	NO		SÍ	NO
1	<input type="checkbox"/>	<input type="checkbox"/>	14	<input type="checkbox"/>	<input type="checkbox"/>	27	<input type="checkbox"/>	<input type="checkbox"/>	40	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	15	<input type="checkbox"/>	<input type="checkbox"/>	28	<input type="checkbox"/>	<input type="checkbox"/>	41	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	29	<input type="checkbox"/>	<input type="checkbox"/>	42	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	17	<input type="checkbox"/>	<input type="checkbox"/>	30	<input type="checkbox"/>	<input type="checkbox"/>	43	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	18	<input type="checkbox"/>	<input type="checkbox"/>	31	<input type="checkbox"/>	<input type="checkbox"/>	44	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	19	<input type="checkbox"/>	<input type="checkbox"/>	32	<input type="checkbox"/>	<input type="checkbox"/>	45	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	20	<input type="checkbox"/>	<input type="checkbox"/>	33	<input type="checkbox"/>	<input type="checkbox"/>	46	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	21	<input type="checkbox"/>	<input type="checkbox"/>	34	<input type="checkbox"/>	<input type="checkbox"/>	47	<input type="checkbox"/>	<input type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	22	<input type="checkbox"/>	<input type="checkbox"/>	35	<input type="checkbox"/>	<input type="checkbox"/>	48	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	23	<input type="checkbox"/>	<input type="checkbox"/>	36	<input type="checkbox"/>	<input type="checkbox"/>	49	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	24	<input type="checkbox"/>	<input type="checkbox"/>	37	<input type="checkbox"/>	<input type="checkbox"/>	50	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	25	<input type="checkbox"/>	<input type="checkbox"/>	38	<input type="checkbox"/>	<input type="checkbox"/>	51	<input type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="checkbox"/>	26	<input type="checkbox"/>	<input type="checkbox"/>	39	<input type="checkbox"/>	<input type="checkbox"/>	52	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix F. Answer Sheet for the Rhythm Sensitivity Section of the MET

TEST DE OÍDO MUSICAL (MET)  
Test II: Comparación de frases rítmicas

RITMO

Nombre del sujeto: \_\_\_\_\_

Fecha \_\_\_\_\_

### EJEMPLOS

Ejemplo A      Sí    NO  
                  

Ejemplo B      Sí    NO  
                  

### EL TEST MISMO

	SÍ	NO		SÍ	NO		SÍ	NO		SÍ	NO
1	<input type="checkbox"/>	<input type="checkbox"/>	14	<input type="checkbox"/>	<input type="checkbox"/>	27	<input type="checkbox"/>	<input type="checkbox"/>	40	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	15	<input type="checkbox"/>	<input type="checkbox"/>	28	<input type="checkbox"/>	<input type="checkbox"/>	41	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	29	<input type="checkbox"/>	<input type="checkbox"/>	42	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	17	<input type="checkbox"/>	<input type="checkbox"/>	30	<input type="checkbox"/>	<input type="checkbox"/>	43	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	18	<input type="checkbox"/>	<input type="checkbox"/>	31	<input type="checkbox"/>	<input type="checkbox"/>	44	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	19	<input type="checkbox"/>	<input type="checkbox"/>	32	<input type="checkbox"/>	<input type="checkbox"/>	45	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	20	<input type="checkbox"/>	<input type="checkbox"/>	33	<input type="checkbox"/>	<input type="checkbox"/>	46	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	21	<input type="checkbox"/>	<input type="checkbox"/>	34	<input type="checkbox"/>	<input type="checkbox"/>	47	<input type="checkbox"/>	<input type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	22	<input type="checkbox"/>	<input type="checkbox"/>	35	<input type="checkbox"/>	<input type="checkbox"/>	48	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	23	<input type="checkbox"/>	<input type="checkbox"/>	36	<input type="checkbox"/>	<input type="checkbox"/>	49	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	24	<input type="checkbox"/>	<input type="checkbox"/>	37	<input type="checkbox"/>	<input type="checkbox"/>	50	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	25	<input type="checkbox"/>	<input type="checkbox"/>	38	<input type="checkbox"/>	<input type="checkbox"/>	51	<input type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="checkbox"/>	26	<input type="checkbox"/>	<input type="checkbox"/>	39	<input type="checkbox"/>	<input type="checkbox"/>	52	<input type="checkbox"/>	<input type="checkbox"/>