



Acoustic correlates of word-accent in Basque

José Ignacio Hualde & Ander Beristain

University of Illinois at Urbana-Champaign, USA

jihualde@illinois.edu, anderb2@illinois.edu

Abstract

Basque dialects differ substantially in their accentual properties. Previous work has focused mainly on phonological aspects of this prosodic diversity, such as the systems of rules for accent assignment. Less attention has been paid to variation in the acoustic realization of word-accent. Here we examine the realization of lexical accentual prominence in three different local varieties, which represent the three main Basque prosodic types: Azpeitia (in Gipuzkoa), Ondarroa (Northern Bizkaia) and Goizueta (Navarre). We consider the role of differences between syllables in pitch and duration in establishing lexical contrasts in these three Basque dialects. The three varieties examined differ substantially in the use of these acoustic features as correlates of accent, which raises questions about their diachronic development and about the typology of accentual systems.

Index Terms: acoustic cues of accent, Basque phonology, pitch-accent language.

1. Introduction

A remarkable aspect of variation in present-day Basque is the existence of a great diversity of prosodic systems within a relatively small territory [1, 2, 3]. In addition to local varieties without any accentual contrasts, we find three main word-prosodic systems.

Some local dialects have stress-accent systems comparable to those found in many other European languages, where words may contrast in the position of the accent. This is the case in one of the three varieties we examine here, the dialect spoken in Azpeitia (in the Urola Valley of central Gipuzkoa), where, for instance, *básue* ‘the drinking glass’ forms a minimal pair with *basué* ‘the forest’, and the phrase *gizonán etxié* ‘the man’s house’ contrasts in the position of the accent in the first word with *gizónan etxié* ‘the men’s house’ [4]. The main accentual rule in the Azpeitia dialect assigns the stress-accent to the third syllable from the beginning of the word, a typologically very unusual rule [5].

In an area of Northwestern Navarre, including the town of Goizueta, which we also analyze here, both the position of the accent and its tonal shape are contrastive, in a manner reminiscent of languages like Central Swedish [6, 7] and Papiamentu [8]. According to their prosodic properties, there are four classes of words in Goizueta Basque: (a) with rising accent on the second syllable (the majority class), e.g. *gizón* ‘man’, *etxé* ‘house’, *basó* ‘forest’, *alába* ‘daughter’, (b) with rising accent on the first syllable, e.g. *séme* ‘son’, *zéru* ‘sky’ (c) with falling accent in the first syllable, e.g. *bâso* ‘glass’, *zêro* ‘zero’, *àrima* ‘soul’, and (d) with falling accent on the second syllable, e.g. *eskòla* ‘school’, *basèrri* ‘farm’. Singular and plural forms are accented on the same syllable but, for most lexical items, differ in tonal shape, rising in the sg., as in

gizónan etxéa ‘the man’s house’ and falling in the pl., *gizónan etxéa* ‘the men’s house’ [9].

Finally, on the coast of Bizkaia and immediate hinterland we find pitch-accent systems with a contrast between unaccented and accented words, as in Tokyo Japanese. Thus, in the dialect spoken on the coastal town of Ondarroa, which we study in this investigation, the noun phrase *gixonan etxi* ‘the man’s house’, where the first word, in the genitive sg., is unaccented, contrasts with *gixónan etxi* ‘the men’s house’, with two accents [10]. Similarly, the word /baso/ ‘forest’ is unaccented and forms a minimal pair with /bâso/ ‘drinking glass’, e.g. *baso andixé* ‘the big forest’ vs *bâso andixé* ‘the big drinking glass’.

The existence of these three very different accentual systems, including one accentual type without parallels in the languages of Europe (northern Bizkaian), makes Basque a unique case to study prosodic evolution. Notice that in all three accentual systems just reviewed there is an accentual contrast between sg. and pl. forms of nouns, although implemented in different ways. This fact, together with the distribution of words in accentual classes, clearly suggests a relatively recent common origin, even if nowadays these are typologically quite different prosodic systems [11].

To date, research on the acoustic manifestation of accent in Basque, as opposed to its distribution and phonological analysis, has been limited, but it suggests that there are also important differences among varieties in this respect [12, 13, 14]. Differences in methodology, however, make comparison difficult to establish in some cases. Here we contribute to this investigation by examining three phonologically very different varieties, those of Azpeitia, Goizueta and Ondarroa, mentioned in the above paragraphs, using a common methodology for data collection and analysis. Besides its descriptive value, a better knowledge of how the different accentual systems found in Basque differ at the phonetic level may help us understand how prosodic diversification came about.

2. Methods

Language data gathering for this study took place in three different towns, which are among the most strongly Basque-speaking towns in the Basque Country. In Goizueta, which is a small town of less than 800 people, about 95% of the population speaks Basque. In Azpeitia 82% of its about 14800 inhabitants are Basque speakers, and in Ondarroa 76% of its almost 9000 inhabitants speak Basque. Participants in our experiment were all native speakers of the local variety of Basque. They also speak Spanish and Standard Basque, which is used in the school system. They were recruited via the “friend of a friend” method and form a homogeneous group in terms of age. Here we report on data from 18 speakers (all female), 6 per town. Average age = 23.1, range = 18-27. Data collection took place in the three towns whose dialect we are investigating, always in a quiet

room. We used a MicroTrack 24/96 recorder with a SONY F-720 external microphone.

Before taking part in the experiment, participants were provided with a consent form, which they were asked to sign. The experimental task involved producing sentences in the local Basque dialect using written stimuli presented on PowerPoint. The stimuli that were presented to the participants consisted of a phrase in Spanish, *he dicho el de* (TARGET) ‘I said the one of TARGET’, followed by the target word in Basque, either in its uninflected form or with the sg. article (which is the citation form in Basque), and the phrase ‘I said’ in the local Basque variety. Participants were thus requested to orally inflect the word that was provided in the genitive case (either sg. or pl.) and place it in the context of the carrier phrase. Basque is a verb-final language and thus the target word is in preverbal (focus) position. An example of stimulus is (for Azpeitia Bq): *He dicho el del ladrón/ (lapur)_____ esan det.* The expected answer would be *lapurréna esan det* ‘I said the one of the thief’. The list of stimuli included 24 items, which were elicited in both the genitive sg. and the genitive pl.. To avoid potential confusion, all sg. forms were elicited first. Two repetitions of each sentence were obtained.

The words selected as targets for this experiment are all bisyllabic in their uninflected form and end in either a nasal or a rhotic (which were expected to be easier to segment from adjacent vowels than other segments while introducing smaller pitch perturbations than other consonants): e.g. *enbor* ‘log’, *eper* ‘partridge’, *gezur* ‘lie’, *gizon* ‘man’, *piper* ‘pepper’. All target words belong to the regular or unmarked accentual class in all three dialects and are expected to show a difference in accentuation between sg. and pl. On the other hand, the genitive sg. and pl. suffixes are segmentally identical in these three dialects (-*an*-; in Azpeitia -*en*- after a high vowel). Comparison of sg. and pl. forms of the same lexical items thus allows for the observation of accentual effects in words with the same segmental composition.

In Azpeitia Basque, the general accent rule places the stress-accent on the third syllable from the beginning of the word. Words with this pattern in the sg. retract the accent one syllable in the pl., as in *lapurréna* ‘the one of the thief’ vs *lapúrrrena* ‘the one of the thieves’ [4].

In Goizueta, both sg. and pl. forms are expected to be accented on the second syllable, but with a difference in pitch accent, raising in the sg. and falling in the pl., e.g. *lapúrrana* (sg.) vs *lapúrrana* (pl.) [9].

Finally, in Ondarroa the sg. forms of our target items are expected to be unaccented and their pl. to bear an accent on their penultimate syllable. Underlyingly unaccented words, however, only surface as such if not phrase final. In phrase-final position, the accented/unaccented contrast is neutralized in Ondarroa, since another rule places an accent on the penultimate syllable of unaccented phrases [10]. For this reason, in this dialect target words were elicited followed by the copula ‘is’ (so that the word- and phrasal domains do not coincide), e.g. *lapurraná ra* ‘it is the one of the thief’ (phrase-penult accent, underlyingly unaccented) vs *lapurrána ra* ‘it is the one of the thieves’ (word-penult accent).

The sound files were analyzed in Praat [15]. For Azpeitia and Goizueta, the vowels of the first three syllables of all target words (V1, V2, V3) were segmented in the textgrids. For Ondarroa, instead, V2, V3 and V4 were segmented. Measurements of mean pitch of each vowel in Hz (using the autocorrelation algorithm in Praat), duration and mean intensity

of each vowel in dB (with the standard parameter options in Praat) were obtained automatically with a script. The relevant comparison between sg. and pl. forms are different for each dialect, given differences in the location of the accent.

3. Results

We report on acoustic differences between vowels in different syllables of the word as appropriate for each dialect. Linear mixed effects regression analyses (lmer) on mean F0, mean intensity and duration differences between vowels were performed with the package *afex* [16] (using *lme4* [17]) in R [18] with the RStudio interface [19]. P-values were calculated by the Satterthwaite approximation method. In all regressions Sg./Pl. and Repetition were entered as fixed factors and Speaker and Word as random factors [20] (the maximum structure in terms of intercepts and slopes that allowed each model to converge was used).

3.1. Azpeitia

In Azpeitia Basque the accent falls on the third syllable in sg. forms and on the second syllable in the pl. of our target items. Figure 1 contains a sg/pl minimal pair: *lapurréna* ‘the one of the thief’, *lapúrrrena* ‘the one of the thieves’ (to make the figure the target words have been extracted from their frames in the productions by one of our speakers and pasted one after the other). In this context, the accentual contour involves a rise over the accented syllable, LH* [4]. Consider the difference between /u/ and /e/ in the two contours in Fig. 1.

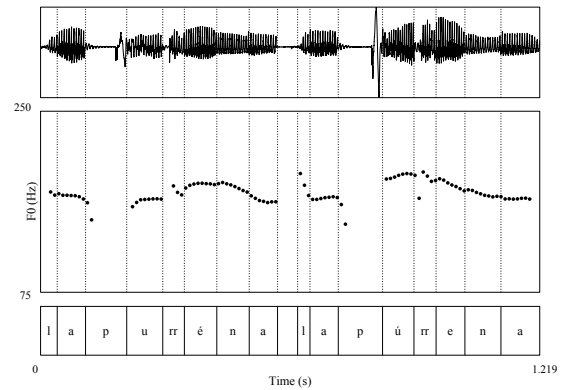


Figure 1: Azpeitia: *lapurréna* (sg), *lapúrrrena* (pl).

We have calculated differences between the vowels in the second and third syllables of each word. To the extent that a given acoustic parameter is used as a cue for accent, we expect the V2–V3 difference to produce positive values in the pl. (where V2 is accented) and negative values in the sg. (where V3 is accented) [4].

Figure 2 shows V2–V3 differences in mean F0 in pl. and sg. forms for each of our six Azpeitia speakers separately. For all six speakers together, V2 – V3 F0, Pl. mean = 16.5 Hz (stdev 11.7), Sg. mean = -15.13 Hz (9.5). As expected mean values are positive in pl. words and negative in sg. words. A linear mixed-effects regression analysis returned a significant effect of Sg./Pl. (with random slopes for Speaker and random intercepts only for Word; $t = -7.36$, $p < 0.0001$, Est. = -31.6 Hz). That is, F0 is a significant correlate of accent.

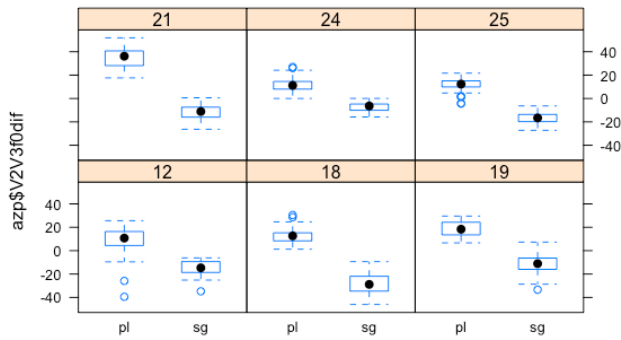


Figure 2: Difference in F0 between V2 and V3 in plural (pl) and singular (sg) forms for six Azpeitia speakers.

Mean durations for the first three vowels of each word are shown in Table 1. Notice that V3 is longer than the other two vowels both in sg. forms, where it is accented, and in pl. forms, where the accent is on V2.

Table 1. Azpeitia. Vowel duration in ms: mean (sd)

| | Plural | Singular |
|----|-------------|-------------|
| V1 | 59.21(16.3) | 53.22(14) |
| V2 | 73.47(17.7) | 63.17(16.7) |
| V3 | 79.45(14.1) | 76.9(13.1) |

Figure 3 shows differences in duration between V2 and V3. From the means and standard deviations in Table 1 and visual inspection of the boxplots in Figures 2 and 3, it is clear that duration does not distinguish between sg. and pl. words in Azpeitia as reliably as pitch, although in Figure 3 for five of the six speakers, there is a larger V2–V3 negative duration difference in the sg. than in the pl. This relatively small difference turns out to be significant in our lmer (random slopes for both Speaker and Word, $t = -3$, $p < 0.01$, $Est. = -7.6$ ms.), contrary to the results in [4], where no significant effect of accent position on duration was found.

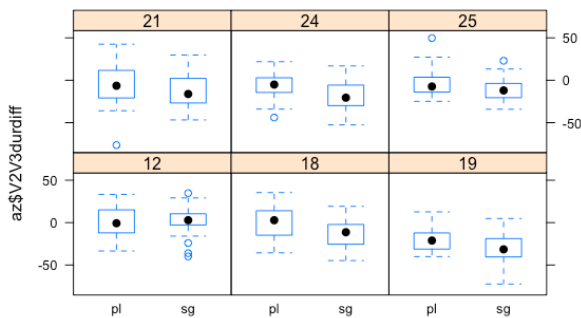


Figure 3: Difference in duration between V2 and V3 in plural (pl) and singular (sg) forms for six Azpeitia speakers

A regression on mean intensity differences between V2 and V3 also returned a significant effect of the sg./pl. contrast (full random effect structure, $t = -5$, $p < 0.001$, $Est. = -2.5$ dB). V2 is more intense in the pl., where it is accented, resulting in a greater difference in pitch between the two syllables.

3.2. Goizueta

In Goizueta Basque the accent falls on the second syllable on both sg. and pl. forms, with a difference in pitch contour, see

Figure 4, *asúnana* ‘the one of the thistle’, *asúnana* ‘the one of the thistles’ (consider the F0 curve over /u/).

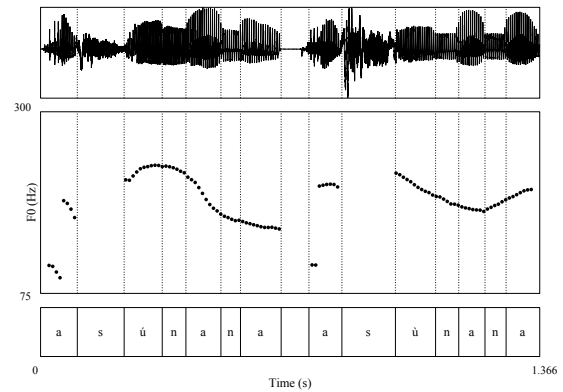


Figure 4: Goizueta: *asúnana* (sg), *asúnana* (pl)

For Azpeitia we compared acoustic differences between vowels because sg. and pl. forms are accented on different syllables. In Goizueta, however, there are no differences in accent placement: the accented second syllable anchors a pitch accent in both sg. and pl. To capture the difference between raising and falling contours, we may measure the average pitch of the vowel in the third syllable, which is expected to be higher when the second syllable has a rising tone, see Figure 4. V3 F0 values for sg. and pl. words are shown in Figure 5. A regression analysis reveals a significant difference in F0 between sg. and pl., $t = 10.7$, $p < 0.0001$, $Est. = 21$ Hz, random slopes for both factors).

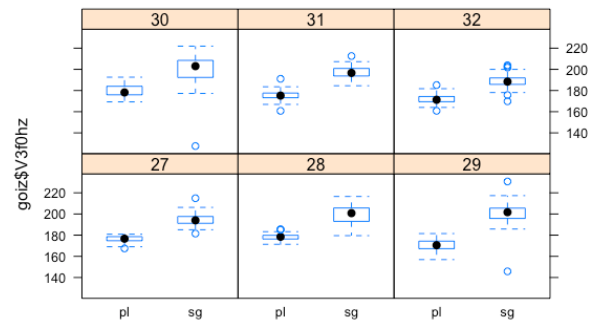


Figure 5: Mean F0 (Hz) in V3 for Goizueta speakers

Regarding duration, both in the sg. and in the pl., the accented V2 is longer than the vowels of the preceding and following syllables, but this lengthening of V2 is greater in the pl., see Table 2 and Figure 6. This difference in the duration of V2 between the pl. and the sg. is significant, $t = -6.1$, $p < 0.001$, $Est. = -20$ ms, random slopes for both factors. An lmer on V2 intensity did not return a significant effect of the Sg./Pl. factor.

Table 2 : Goizueta. Vowel duration in ms: mean(sd)

| | Plural | Singular |
|----|--------------|-------------|
| V1 | 62.93(11.8) | 60.37(12.6) |
| V2 | 102.84(18.8) | 82.74(17.6) |
| V3 | 77.76(12) | 77.7(12) |

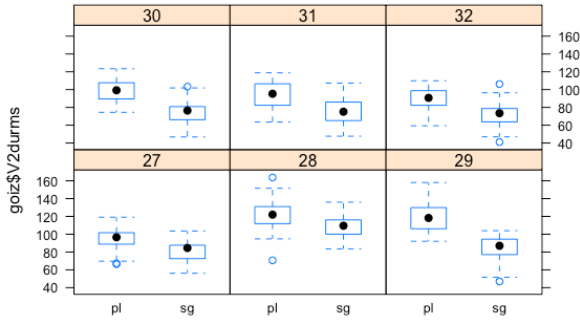


Figure 6: Duration of V2 in singular and plural forms for six Goizueta speakers.

3.3. Ondarra

In our target words we expect the accent to fall on the last syllable of sg. forms (V4), with phrasal accent, and on the penult of pl. forms (V3), see Figure 7.

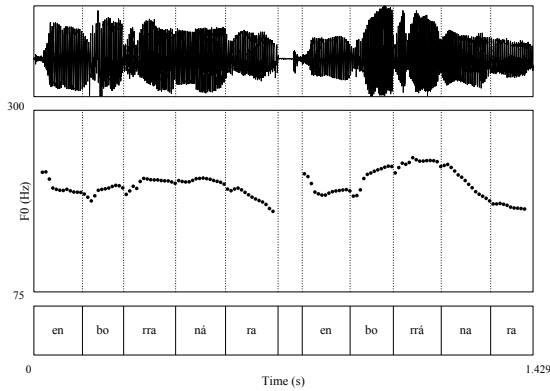


Figure 7: Ondarra: enborraná ra (sg, phrasal accent), enborrána ra (pl, lexical accent)

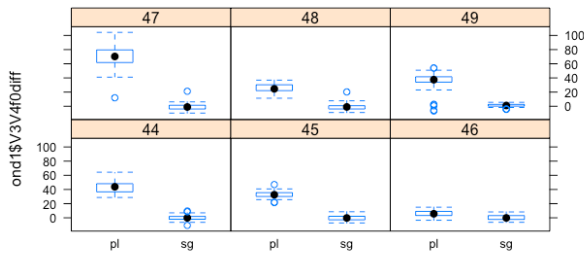


Figure 8: Difference in F0 between V3 and V4 in plural (pl) and singular (sg) forms for six Ondarra speakers.

Pitch accents in Ondarra Basque and other Northern Bizkaian varieties have been described as having a H*L configuration [13, 21]. This should result in positive values in pl. forms when the difference between the accented V3 and the following vowel V4 is calculated and in values close to zero in sg. forms, where the accent is on V4. This is indeed what we find in the data for all six Ondarra speakers, see Figure 8. Sg./Pl. has a significant effect, $t = -4$, $p < 0.001$, Est. = -13.5 Hz, random slopes for both Speaker and Word.

Regarding the role of duration as cue for accent, the boxplots in Figure 9 suggest an effect for only some speakers

(see [14] for the neighboring town of Lekeitio). A regression on the difference in duration between V3 and V4 analysis did not return a significant effect of the Sg./Pl. contrast. On the other hand, a significant effect was found on a regression on intensity ($t = -4.8$, $p < 0.001$, Est. = -2.7 dB, random slopes for Speaker only), with the difference between the two syllables being greater in the pl., where V3 is accented.

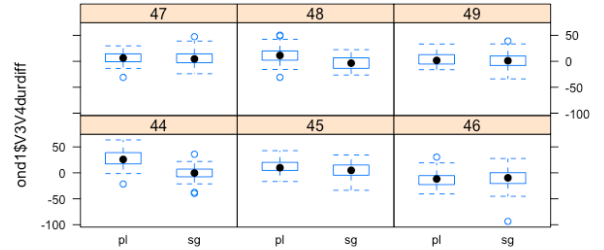


Figure 9: Difference in duration between V3 and V4 in plural (pl) and singular (sg) forms for six Ondarra speakers.

Table 3 : Ondarra. Vowel duration in ms: mean(sd)

| | Plural | Singular |
|----|-------------|-------------|
| V2 | 54.13(12.8) | 51.7(13.8) |
| V3 | 67.86(16.7) | 62.38(11.8) |
| V4 | 59.71(13.3) | 62.52(14.3) |

4. Conclusions

In all three Basque dialects examined, pitch turns out to be the most robust correlate of word-accent. Accentual contours are, however, different in each dialect: LH* in Azpetia, H*L in Ondarra and contrastively LH* or HL* in Goizueta. Dialects differ considerably in the use of duration as a cue to accent. In Goizueta, where rising and falling contours are lexically specified, duration plays an important role in signaling the accented syllable, especially in words with a falling accentual contour. Duration has only a marginal role in Azpetia and is not consistently used as a correlate of accent in Ondarra. The role of intensity is greatest in Azpetia and smallest in Goizueta.

Ondarra plurals (and other lexically accented words) show a H*L accent. A retraction of the peak may account for the fact that in Goizueta the same set of words have a falling accent HL*. The Azpetia accentual system appears to derive from a system like that of Ondarra, the most important development, from a typological perspective, being the reinterpretation of unaccented words as lexically accented on a specific syllable [13, 22]. Such a reinterpretation of unaccented words also appears to have taken place in Goizueta. It is likely that the robust use of duration as a cue for accent is an innovation in Goizueta, as pitch information on the location of the accented syllable is reduced in words with a falling accent. We speculate that in a system where the position of the accent within the word is lexically contrastive an additional lexical contrast in the pitch contour of the accented word would tend to be enhanced by recruiting other acoustic features as accentual correlates.

5. Acknowledgements

We are thankful to our Basque speakers from Azpetia, Goizueta and Ondarra for their collaboration.

6. References

- [1] J.I. Hualde, *Basque Phonology*. London: Routledge, 1991.
- [2] J.I. Hualde, "Basque Accentuation," in H. van der Hulst, ed., *Word Prosodic Systems in the languages of Europe*, pp. 947-993. Berlin: Mouton de Gruyter, 1999.
- [3] J.I. Hualde, "Two Basque accentual systems and word-prosodic typology," *Lingua* 122, pp. 1335-1351, 2012.
- [4] J.I. Hualde and A. Beristain, "Azpeitiko azentuaren gauzatze fonetikoaz", *Fontes Linguae Vasconum* 123, pp. 65-85, 2017.
- [5] H. van der Hulst, "Word accent: terms, typologies and theories", in H. van der Hulst, R. Goedemans and E. van Zanten, eds., *A Survey of Word Accentual Patterns in the Languages of the World*, pp. 3-53. Berlin: Mouton de Gruyter, 2010.
- [6] G. Bruce, *Swedish word accents in sentence perspective*. Travaux de l'institut de linguistique de Lund, 12, 1977.
- [7] T. Riad, "Culminativity, stress and tone accent in Central Swedish". *Lingua*, 112.13, pp. 1352-1379, 2012.
- [8] B. Remijsen and V. van Heuven, "Stress, tone and discourse prominence in the Curaçao dialect of Papiamentu," *Phonology*, pp. 205-235, 2015.
- [9] J.I. Hualde, O. Lujanbio and F. Torreira, "Stress and tone in Goizueta Basque". *Journal of the International Phonetic Association* 38.1, pp. 1-24, 2008.
- [10] J.I. Hualde, "Análisis del sistema acentual de Ondarroa". *ASJU, International Journal of Basque Linguistics and Philology* 29, pp. 319-343, 1995.
- [11] J.I. Hualde, "Two Basque accentual systems and the notion of pitch-accent language". *Lingua* 122, pp. 1335-1351, 2012.
- [12] I. Gaminde. "Gipuzkeraren azentuaren azterketa akustikoa". *Fontes Linguae Vasconum* 69, 297-321, 1995.
- [13] J.I. Hualde, G. Elordieta, I. Gaminde & R. Smiljanić, "From pitch-accent to stress-accent in Basque". In *Laboratory Phonology VII*, ed. by Carlos Gussenhoven & Natasha Warner, 547-584. Berlin: Mouton de Gruyter, 2002.
- [14] G. Elordieta & J.I. Hualde, "Tonal and durational correlates of accent in the context of downstep in Lekeitio Basque". *Journal of the International Phonetic Association* 33: 195-209, 2003.
- [15] P. Boersma and D. Weenink, Praat: doing phonetics by computer, version 6.035, 2018. www.praat.org [computer program]
- [16] H. Singmann, B. Bolker, J. Westfall and F. Aust, "afex: Analysis of Factorial Experiments". R package version 0.18-0, 2017. CRAN.R-project.org/package=afexT.
- [17] D. Bates, M. Maechler, B. Bolker and S. Walker, "Fitting Linear Mixed-Effects Models using lme4". *Journal of Statistical Software*, 67(1), 1-48, 2015. <doi:10.18637/jss.v067.i01>
- [18] R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2017. <https://www.R-project.org/>.
- [19] RStudio Team. RStudio: Integrated Development for R. RStudio, Inc., Boston, MA, 2016. <http://www.rstudio.com/>.
- [20] B. Winter, "Pseudoreplication in phonetic research". In *ICPhS XVII*, Hong Kong, 2011, pp. 2137-2140.
- [21] G. Elordieta, & J.I. Hualde, "Intonation in Basque". In *Prosodic typology II: The phonology of intonation and phrasing*, ed. by S-A Jun, Oxford: Oxford Univ. Press, 2014, pp. 405-463.
- [22] J.I. Hualde, "From phrase-final to post-initial accent in Western Basque". In *Development in prosodic systems*, ed. by P. Fikkert and H. Jacobs, Berlin: Mouton de Gruyter, 2003, pp. 249-281.