What are the contextual phonetic variants of /β, ð, γ/ in colloquial Spanish?[1]

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Abstract

Intensity differences were used to measure the degree of lenition of the voiced approximants /β, ð, γ/ in various contexts in order to contrast them with their stop variants [b, d, g], and in order to investigate the contexts in which they are traditionally thought to appear. 3,011 instances were taken from telephone conversations of eight native Spanish speakers from seven countries. The influence of phonetic context (post-pausal, post-nasal, post-lateral, etc.), stress, word frequency, appearance in a suffix (e.g. -ado, -aba) was determined using multiple regression. In line with traditional analyses, the results show that the voiced approximants are most lenited intervocalically and least lenited after a pause. However, post-nasal and post-lateral instances fall between these extremes. In addition, /β/, /ð/, and /γ/ are also more stop-like when following [s] or [h].

Traditional analyses do not factor in the influence of stress, word frequency, word boundaries, or appearance in a suffix, yet these emerge as significant predictors. Although the distribution of the variants of these three approximants is generally thought to be due to a unitary rule, significant differences between the three suggest otherwise. When followed by a stressed syllable, /β/ and /ð/ exhibit more constriction when compared to /γ/, while all

three phones are less lenited when they fall between two stressed syllables. /β/ and /ð/ are also more constricted when they appear intervocalically in word-initial position when compared to word-internal intervocalic tokens, while the same is not true for /ɣ/. Contra traditional descriptions, /ð/ is no less lenited than /β/ or /ɣ/ following a lateral. Instances of /ð/ are also more lenited when they appear in high frequency words and less lenited in low frequency words. On the other hand, frequency is not a factor for /β/ and /ɣ/.

1. Introduction

The principle alternation between the voiced approximants [β, ð, γ] and their stop counterparts [b, d, g] is traditionally stated in these terms: the stops appear after nasals, pauses, and when /ð/ follows a lateral; the approximants appear intervocalically and in all other positions (Harris 1969; Lozano 1979; Mascaró 1984; Navarro Tomás 1967). The effect of other adjoined consonants on the realization of /β, ð, γ/ varies widely in different varieties of Spanish (e.g. Amastae 1989; Canfield 1981; Fernandez 1982; González 2002; Lipski 1994) and is generally not treated together with the more widespread core alternations conditioned by preceding pauses, nasals, laterals, and vowels.

One thing that makes the traditional distribution of voiced approximants in Spanish suspicious is that it neatly breaks the broad continuum that ranges from complete occlusion to near vowel-like approximants into two categories: stops and approximants. Research on /γ/ by MacLeod (2008), on the other hand, suggests that lenition is quite gradient. One is left to wonder if the break is as clear as it is portrayed when a gradient measure of lenition, closure, or spirantization is applied to the phones in question when they appear in such disparate contexts as following nasals, pauses, vowels, and laterals.

The vast majority of data bearing on the complementary distribution of /β, ð, γ/ appears to be based on impressionistic judgments of words pronounced in isolation. This raises the question as to how these phones are pronounced in running speech. In many analyses it appears that the tokens the study is based on were produced by the researcher him/herself. Such introspective data provide a crucial step toward forming a hypothesis about the distribution of these phones, however, they cannot at the same time provide evidence to support the hypothesis. The danger in using one's own pronunciations as evidence, or in using independently uncorroborated impressionistic transcriptions of another's speech, is that of subconsciously skewing one's pronunciation or perception in favor of one's own theoretical preconceptions.

The best method for avoiding these two issues is by carrying out detailed acoustic analysis.

Such analysis removes the problem created when binary classifications are imposed on gradient data. It also reduces possible experimenter bias, and allows the results of a study to be more easily replicated by other researchers. It is heartening to see that research of this sort has already been initiated (Carrasco & Hualde 2009; Colantoni & Marinescu 2008; Cole, Hualde & Iskarous 1999; Kingston 2008; Ortega Llebaria 2004).

++Insert Figures 1 and 2 here++

The reason why acoustic analysis needs to be brought to bear on the distribution of /β, ð, γ/ in Spanish is evident in the spectrograms of the words *siendo* and *aprendes* in Figures 1 and 2. In both instances, /ð/ is audible following the nasal where it is expected to surface as [d]. A stop pronunciation is more apparent in Figure 1, but in Figure 2 /ð/ is much approximant-like. The background noise is due to the fact that these data are taken from telephone recordings. The horizontal curves indicate the intensity in decibels calculated by PRAAT. The intensity trough where /ð/ appears is marked with a T, and the intensity peak of the following syllable nucleus is marked with a P. If one assumes the stop/approximant dichotomy, the post-nasal approximant in [aprenðes] would be an exception to the rule, an aberration, or phonetic undershoot—the speaker just mispronounced it. However, the majority of postnasal voiced approximants examined in the present study show no obvious breaks or weakening of formants indicative of a stop. Does this mean that nasals do not affect the pronunciation of voiced approximants? No, what it demonstrates is the need for a gradient measure of lenition rather than a binary one.

The present study is a continuation of those carried out by Carrasco & Hualde (2009), Colantoni & Marinescu (2008), Cole, Hualde & Iskarous (1999), and Ortega Llebaria (2004) in which intensity was used to measure the degree of lenition that /β, ð, γ/ demonstrate in various phonetic

contexts. The principal purpose of the study is to investigate the influence of preceding phones that traditional descriptions of Spanish phonology assume, but in naturally occurring speech. Of particular interest is whether /β, ð, γ/ behave similarly in a given context as is commonly held, or if there are significant differences between them. Colantoni & Marinescu (2008) discovered significant differences in lenition between each phone in Argentine Spanish; /ð/ is more lenited than /γ/ which is more lenited than /β/. This suggests that further investigation is needed along these lines.

More recent investigation suggests that factors not traditionally considered may play a part as well. For example, a number of researchers (Amastae 1986; Colantoni & Marinescu 2008; Cole, Hualde & Iskarous 1999; Ortega Llebaria 2004) report that when a stressed syllable precedes /β, ð, γ/ they are more lenited that when preceded by an unstressed syllable. The effect of word frequency has also been observed by Bybee (2001, 2002) who demonstrates that /ð/ is deleted more often when it appears in frequent words. The possible influence of frequency needs to be extended to /β/ and /γ/ as well. Reduction of /ð/ has also been reported to be higher when it appears the past participle suffix (Bybee 2002, Díaz-Campos & Gradoville 2010, Samper Padilla 1996). Surrounding vowels have also surfaced as a factor. Ortega Llebaria (2004) observed more lenition for /γ/ when surrounded by [a], and less when surrounded by [i] or [u]. No such differences between surrounding vowels were found for /β/. Cole, Hualde, and Iskarous (1999) report that /γ/ is more lenited when in contact with [u] and [o] and less lenited when in contact with [i] and [e]. The smallest degree of lenition occurs when /γ/ is next to [a].

The effect of preceding pauses, laterals, and nasals is most often cited in the literature on Spanish phonology. However, stops are reported in Honduran (Amastae 1989), Costa Rican, and Peninsular Spanish (Carrasco & Hualde 2009) after the fricatives [s] and [h], a trend which could turn out to be more pan-Hispanic. Browman & Goldstein (1992) and Byrd (1996) suggest that articulatory gestures are stronger in phones that appear word-initially, even when they appear in running speech and

are not preceded by a pause. Cole, Hualde & Iskarous (1999) report on a pilot study in which /β, ð, γ/ were no more lenited intervocalically in word-internal position than they were intervocalically when word-initial. This contrasts with Amastae's (1989) finding that the word initial position is associated with slightly smaller degrees of lenition, especially for /ð/. This factor, along with the others just mentioned, warrant further investigation, hence the purpose of the present study.

Given the vast amount of research on this particular topic, it may be helpful at the onset to state what questions are not dealt with in the present paper. I follow a number of researchers (e.g. Martínez Celdrán 1991; Martínez Celdrán & Regueira 2008; Santagada & Gurlekian 1989; Widdison 1987)) and refer to /β, ð, γ/ as approximants, but do not enter the debate as to whether it could better to classify them as spirants, continuants, or fricatives. In like manner, I do not take a stance on whether the alternation belongs to phonetics or phonology (e.g. Face 2002). The present paper does not address the question of whether the phones are underlying approximants that undergo fortition (e.g. Barlow 2003), or whether they are underlyingly stops that are modified by a process of lenition (e.g. Harris 1969). Both of these positions assume the existence of a unique underlying phoneme that is molded by rules into a surface form, which I do not subscribe to. Furthermore, I do not dwell on the issue of which formal mechanisms are best equipped to accurately describe the alternation (e.g. Amastae 1989; Barlow 2003; Goldsmith 1981; Harris 1969; Lipski 1994; Núñez-Cedeño & Morales-Front 1999; Piñeros 2002). Lastly, data from speakers of different ages, genders, and national origins were analyzed, but the study was not designed to test the effect of any sociolinguistic factors which are known to play a role in the alternation (e.g. Amastae 1989; Lozano 1979; Zamora & Guitart 1982).

2. Method

2.1. Participants

The data included in the present study were taken from the Callfriend corpus (Canavan & Zipperlen

1996) which consists of informal telephone conversations between native Spanish speakers sampled at 8000 Hz. My initial goal was to include about 400 to 500 tokens of /β, ð, γ/ from six speakers from different Spanish speaking countries in order to make the results somewhat representative of Spanish as a whole. The poor quality of one recording and the short length of another resulted in much less information from two speakers, but I decided to include them as well. Information about the speakers appears in Table 1.

++Insert Table 1 here++

2.2. Acoustic analysis

Instances of /β, ð, γ/ were sought in clear portions of the recordings that did not contain excessive background noise or crosstalk between the two speakers. Two gradient measures of intensity were taken using PRAAT (Boersma 2001). The first was lowest point of the intensity of the approximant and the second of the intensity peak of the next vowel following the approximant. For example, in Figure 1 the intensity trough, which is marked with a T, occurs at 64 dB while the following intensity peak, which is indicated with a P, occurs at 76 dB. The peak provides an index of the intensity of the speech signal in that part of the utterance. Subtracting the intensity trough of the approximant from that of the following peak yields the intensity difference, which in this case is 12. Differences farther from zero indicate an approximant that is more stop-like, while those closer to zero indicates highly lenited (or completely deleted) phones that are more vowel-like. Measuring the lowest point of intensity of an approximant, rather than the average intensity across the entire approximant was done to avoid the complications that arise when one tries to objectively determine where a highly lenited approximant begins and ends.

++Insert Figure 3 here++

In many cases, there is no apparent evidence of any sort of occlusion in the spectrogram. Such is the case for the two instances of [β] in *vivir* as seen in Figure 3 where the horizontal curve indicates the intensity. Impressionistic coding would render them as deleted phones, and complete deletion of approximants yields an intensity difference of zero. Post-pausal approximant intensities were measured at the point where the voicing bar begins. Coding pre-pausal [ð] in this manner provided no meaningful information. This, along with the fact that /β/ and /γ/ are extremely uncommon in this position, is why cases of word-final [ð] were not included in the analysis. Information about the context in which the approximants appeared was also noted. This included the preceding and following phone, the existence of a preceding word boundary, the stress or unstressed status of the surrounding syllables, and the lemma frequency of the word taken from Davies (2006).

3. Data analysis

Statistical analysis was carried out using multiple regression, where the intensity difference served as the dependent variable. The natural log of the lemma frequency was used in the analysis as an independent variable. The preceding and following phones were coded in terms of their degree of closure: [a] =1, [e, o]=2, [i, u]=3, [j, w]=4, consonant or pause=5. In addition, whether [ð] appeared in a past participle suffix, and whether [β] appeared in an imperfect suffix were coded.[2]

Most other dependent variables were nominal with more than two values which required dummy coding into a number of separate variables. For example, four stress patterns appeared in the data: 1) σ́Cσ́ (e.g. *está bién*), 2) σ́Cσ (e.g. *hinchádo*), 3) σCσ́ (e.g. *escribió*), and 4) σCσ (e.g. *levanté*). The latter pattern, in which the approximants appear between unstressed syllables, served as the reference from which the remaining three patterns were compared. Each of the participants was

similarly dummy coded with the 45 year old Peruvian male as the reference.

Seven different phonetic contexts were considered: 1) intervocalic word-internal (e.g. *comido*), 2) intervocalic word-initial (e.g. *la dama*), post-pausal, 3) post-lateral (e.g. *Álvarez*), 5) post-nasal (e.g. *tengo*), 6) post-fricative (e.g. *los días, lo*[h] *días*), 7) all others (e.g. *por blanco, árbol, hombre, el glorioso*). In contexts 1-6 the approximant was always followed by a vowel or glide in order to eliminate the possible influence of another adjoining consonant. Examining approximants following nasals, pauses, and laterals was done in order to compare the results with traditional phonological accounts. The post-fricative context was suggested by Amastae (1989) and Carrasco & Hualde (2009). For these phonetic context variables the word-internal intervocalic context was the reference against which the other contexts were compared.

Separate analyses were run on the 1085 tokens of /β/, the 1526 tokens of /ð/ and the 400 tokens of /ɣ/. The variable that encodes the closure of the vowels surrounding the approximants was found to have high degrees of collinearity with other variables which rendered the resulting regression coefficients uninterpretable. For this reason, these variables were removed from subsequent analyses and are not discussed further.

Individual participants were included as variables for two reasons. First, they demonstrate that sociolinguistic factors such as language variety, gender, and/or age may affect the degree of lenition of the approximants. However, the study was not designed to be sociolinguistic; the data were not taken from a sufficient number of participants that claims about a variety, age, or gender could be tested. The second reason for including them is that they make the model more complete and increase the amount of variance accounted for.

In Tables 2-4, positive standardized regression coefficients indicate that a variable correlates with higher intensity differences, resulting in less lenited (more stop-like) pronunciations of the approximant in comparison with the reference variable. Negative coefficients, on the other hand, mean

that the intensity difference was lower, and show that the variable in question was associated with more lenited (more vowel-like) pronunciations. Variables that are statistically significant appear in boldface in the tables.

++Insert Tables 2-4 here++

4. Results and discussion

4.1. Preceding consonants

The strongest influence on the degree of lenition is what consonant or boundary precedes the approximant (see Tables 2-4). Preceding pauses are associated with the most stop-like realizations of /β/, /ð/ and /γ/. Preceding nasals, fricatives, laterals, word boundaries, and other surrounding consonants also condition more stop-like pronunciations for /β/ and /ð/ (Figures 4-5). For /γ/ on the other hand, only preceding pauses, fricatives, and laterals yielded less lenited pronunciations (Figure 6). When /γ/ follows a nasal, a word boundary, or is in contact with another consonant, its intensity difference does not differ significantly from the intervocalic word-internal instances.

Thus far, the data support some aspects of traditional phonological descriptions. Word-internal approximants between vowels are much more lenited than approximants that follow pauses, and more lenited than post-nasal /β/ and /ð/. The fact that /γ/ does not follow suit casts some doubt on whether the process of spirantization (or fortition) applies equally to all voiced approximants. Traditional accounts also hold that, following a lateral, /ð/ is realized as a stop while /β/ and /γ/ are approximants. This contrasts with the present data that demonstrate that /lβ/ and /lγ/, along with /lð/, have significantly lower intensity differences when compared with their respective intervocalic contexts. However, further analysis is required to determine if there are significant differences between /lβ/, /lγ/, and /lð/, a topic I will address later on in the paper.

The constricting effect of preceding fricatives ([s, z, h]) does not form part of traditional accounts, although its influence has been noted in Honduran, Costa Rican, and Peninsular varieties (Amastae 1989; Carrasco & Hualde 2009). A number of things indicate that this finding may not be limited to particular varieties. First, only 10% of the post-fricative tokens included in the present study were produced by the Nicaraguan speaker and none by the Spaniard. Furthermore, Amastae (1989) notes that Nicaraguans tend to produce stops following /s/ even when /s/ is deleted as in *lo~~s~~ dos*. In such cases, I coded /ð/ as post-vocalic, which means that any possible influence toward stop-likeness would appear in the intervocalic category, not the post-fricative one.

++Insert Figures 4-6 here++

4.2. Preceding word boundary

To my knowledge, the effect of a word boundary preceding /β, ð, γ/ has only been explored by Cole, Hualde & Iskarous (1999). They cite a pilot study in which they record no difference between intervocalic word-internal /β, ð, γ/, and cases in which the approximants appear between vowels, but as the first phone of a word. The data from the present study, in contrast, indicate significantly lower intensity differences for /V#βV/ and /V#ðV/ when compared with /VβV/ and /VðV/. That is, /β/ and /ð/ are more stop-like in running speech when word-initial. Once again, /γ/ differs from the other voiced approximants and exhibits no such difference. This behavior is somewhat unexpected as far as some versions of lexical phonology (Kiparsky 1982) are concerned.[3] Fortition (or spirantization) in Spanish is a process that applies automatically and exceptionlessly. It is not related to word formation and therefore should be a post-lexical process. However, the present data show that it is sensitive to word boundaries, something that is not consistent with a post-lexical process.

4.3. Stress

Although traditional treatments of /β, ð, γ/ do not incorporate stress as a conditioning factor, a number of recent studies do. Cole, Hualde & Iskarous (1999) report a higher degree of lenition when /γ/ appears following a stressed syllable (σ́C) than an unstressed one (σC). This mirrors Ortega-Llebaria's (2004) finding for /β/ and /γ/. Carrasco and Hualde (2009) observed a higher degree of constriction when the voiced approximants precede a stressed syllable. The present study broadens the contextual scope since it is not limited to word-internal instances. As a result, it also contains cases in which the approximants are surrounded on both sides by stressed (σ́Cσ́) and unstressed (σCσ) syllables.

The σ́Cσ stress pattern does not differ significantly from the reference pattern σCσ for /β, ð/ and /γ/; the positive coefficient of the former indicates a trend towards more lenition. Since both contexts have an unstressed following syllable this indicates that higher degrees of lenition occur when approximants are followed by an unstressed syllable. On the other side, approximants that fall between two stressed syllables tend to be more stop-like than when they fall between two unstressed syllables. In the case of /β/ and /ð/, a following stressed syllable is also associated with less lenited approximants than σCσ (see Figures 7-8). Taken together this suggests that a following stressed syllable favors more stop-like pronunciations of /β/ and /ð/. In general, this concurs with previous studies; finding higher degrees of lenition after a stressed syllable is almost the same thing as finding lower degrees of lenition before a stressed syllable. However, /γ/ again appears to follow its own path; less lenited realizations occur only between two stressed syllables, while the remaining patterns do not differ significantly (Figure 9).

++Insert Figures 7-9 here+

4.4. Word frequency

Word frequency also appears to exert an effect on the degree of lenition. The approximant /ð/ is more lenited when it appears in words with higher log lemma frequencies. This mirrors Bybee's (2001) finding for New Mexican Spanish where /ð/ is more often deleted in high frequency words. Surprisingly, frequency only arises as a significant factor for /ð/, but not /β/ or /ɣ/. The fact that *de* is the most frequent Spanish word may skew the results, but when all cases of *de* are removed and the analysis rerun, frequency continues to be a significant factor for /ð/.

One possible explanation for this is that among the highly frequent words /ð/ appears more commonly in intervocalic position, (where lenition is most likely to occur), than /β/ or /ɣ/. As an estimate I considered words with a log lemma frequency of 15 or greater. 75% of these high frequency words with /ð/ appeared intervocalically compared to only 35% of /ɣ/ words. While this bodes well for the hypothesis, the fact that 81% of such words with /β/ are also intervocalic does not support it. Perhaps, a higher proportion of low frequency words with /ð/ appear in non-intervocalic position, where more stop-like pronunciations are expected. An examination of instances with a log lemma frequency of 11 or below revealed that 41% of words with /ð/ are non-intervocalic compared to 40% of the words with /β/ and 44% of the words with /ɣ/. Clearly, another explanation for why frequency only affects /ð/ is warranted.

4.5. /β/, /ð/, and /ɣ/ after laterals

Traditional phonological descriptions hold that /β/ and /ɣ/ are approximants following a lateral in contrast to /ð/, which is realized as a stop in this position. This is presumably due to fact that /l/ assimilates a dental articulation and giving both phones the same place of articulation. However, the intensity difference data indicate that all three voiced approximants are more stop-like after laterals, at least in comparison with their respective intervocalic intensities. Of course, a direct comparison of all

three approximants after laterals is needed which requires two regression analyses: one with /lð/ as the reference variable and another with /lγ/. The analyses were performed only on the post-lateral tokens (Table 5). Given the lack of any significant differences, it is clear that /lð/ is just as stop-like as /lβ/ and /lγ/ clusters which contradicts the traditional notion.

++Insert Table 5 here++

4.6. Morphology

A number of researchers (Bybee 2002, Díaz-Campos & Gradoville 2010, Samper Padilla 1996) have observed that when /ð/ appears in the past participle suffixes *-ado, -ada, -ados,* and *adas* it tends to be more highly lenited or deleted. The present study corroborates these findings. The idea that /β/ may follow suit and be more lenited when it appears in the imperfect suffix *–aba-* was also tested, but with negative results. Instances of /β/ in this suffix do not differ significantly from other intervocalic cases.

5. Conclusions

Following a number of recent studies (Colantoni & Marinescu 2008; Cole, Hualde & Iskarous 1999; Ortega Llebaria 2004), the present study used intensity as a gradient measure of degree of lenition of the voiced approximants in Spanish. The data examined consists of 3,011 tokens taken from spontaneous telephone conversations between native Spanish speakers from a variety of countries. The most lenited instances appear between vowels, and the most consonant-like occur following a pause. Post-pausally the intensity is not only very low, but the occlusive pronunciation is also evident in the spectrograms as complete lack of formants.

In general, approximants following nasals, fricatives, and laterals are less lenited than when they occur intervocalically, given their lower intensities. The study focused on intensity differences which is why I did not keep track of how often a post-consonantal phone appeared as a clear occlusive

in the spectrograms. However, clear occlusives following nasals, fricatives, and laterals were rare. This observation, coupled with intensity differences which are much higher than in the post-pausal context leads me to doubt the common notion that actual stops are the norm following nasals and /lð/ sequences. The fact that there are no significant differences between /β/, /ð/, and /γ/ when these are preceded by a lateral does not support the idea that only /lð/ clusters result in a stop-like pronunciation.

Phonological treatments of the voiced approximants suggest that underlying /β/, /ð/, and /γ/ (or alternatively /b/, /d/, and /g/) are acted upon by the same rule in order to derive their surface forms (with the exception of /lð/). The data from the present study do not support the idea of a unitary rule. /β/ and /ð/ manifest lower intensity differences following nasals, fricatives, word boundaries, and other surrounding consonants. Instances of intervocalic /γ/, on the other hand, do not differ from instances in which /γ/ follows nasals, or is in contact with other consonants or a word boundary. /β/ and /ð/ are also affected by stress in the same way in contrast to /γ/. In addition, word frequency affects /ð/, but not /β/ or /γ/. When /ð/ appears in the past participle suffix it is more lenited than other intervocalic instances of /ð/. In contrast, instances of /β/ in the imperfect suffix are no more lenited than other intervocalic cases. Taken together, this is reminiscent of Bybee & Pardo's (1981) finding that the [o]~[we] alternation, and the [e]~[je] alternation in Spanish are not equally productive in spite of the fact that they are thought to be the result of the same rule.

Recently, a number of studies have pointed out other factors that may influence the degree of lenition that the Spanish approximants manifest. Data from the present study show that a preceding /s/, whether aspirated or not, influences less lenited approximant pronunciations which confirms Amastae's (1989) and Carrasco & Hualde's (2009) findings. Stress also surfaced as a significant factor as Cole, Hualde & Iskarous (1999) and Ortega-Llebaria's (2004) have observed. When /β/ and /ð/ are followed by stressed syllables they are less lenited. Such is not true of /γ/. Browman & Goldstein (1992) and Byrd (1996) hypothesize that word-initial gestures should be more pronounced. This was observed in

that intervocalic word-initial /β/ and /ð/ are less lenited than when in intervocalic word-internal position. This conflicts with the results of Cole, Hualde & Iskarous (1999). The fact that intervocalic /γ/ is not affected by word boundaries needs explanation. Finally, Bybee's (2001) observation that high word frequency corresponds to higher degrees of lenition of /ð/ finds support in the present study, although for reasons I am at a loss to explain, frequency does not affect the intensity differences of /β/ or /γ/.

It is unfortunate that the present study is not able to shed any light on the influence of particular vowels on lenition rates since other researchers have reported such effects (Cole, Hualde & Iskarous 1999; Ortega-Llebaria's 2004). In like manner, the results of the present study strongly suggest variability due to sociolinguistic factors, but cannot determine which of these factors are relevant, nor the direction they move lenition. I trust that future research will be designed to answer these important questions.

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Endnotes

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2 Michael Gradoville suggested considering this variable.
3 I thank Dirk Elzinga for pointing this out. Kenstowicz (1994: ch. 5) notes that Dutch devoicing poses a similar problem for lexical phonology.

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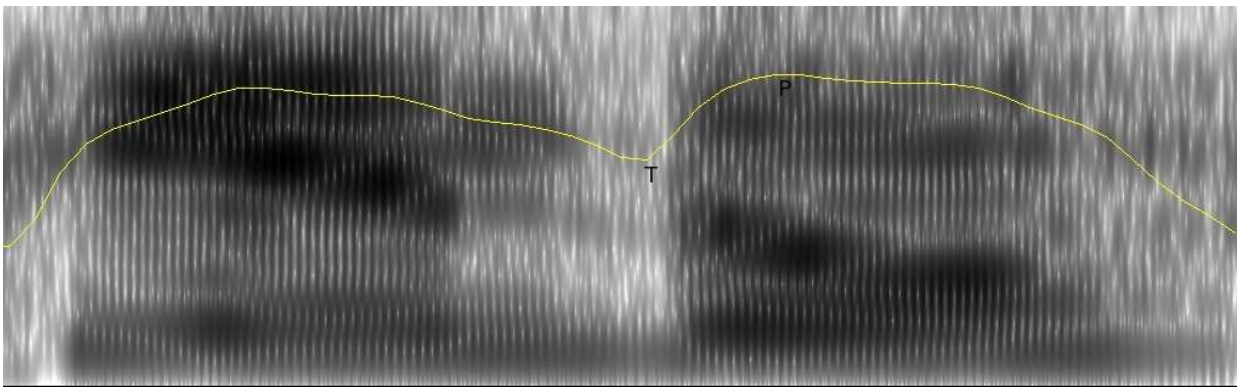

s j e n d o

Figure 1. Clearly apparent stop [d] in *siendo.*

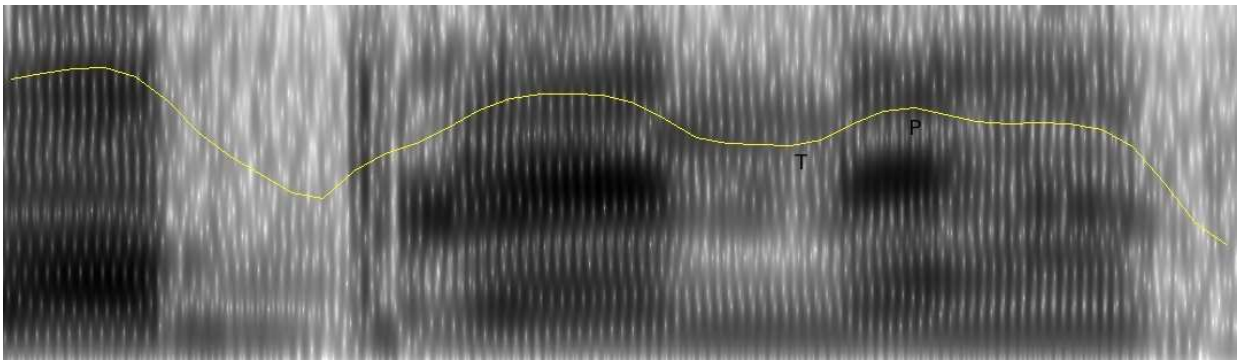

Figure 2. No clearly apparent stop [d] in *aprendes*.

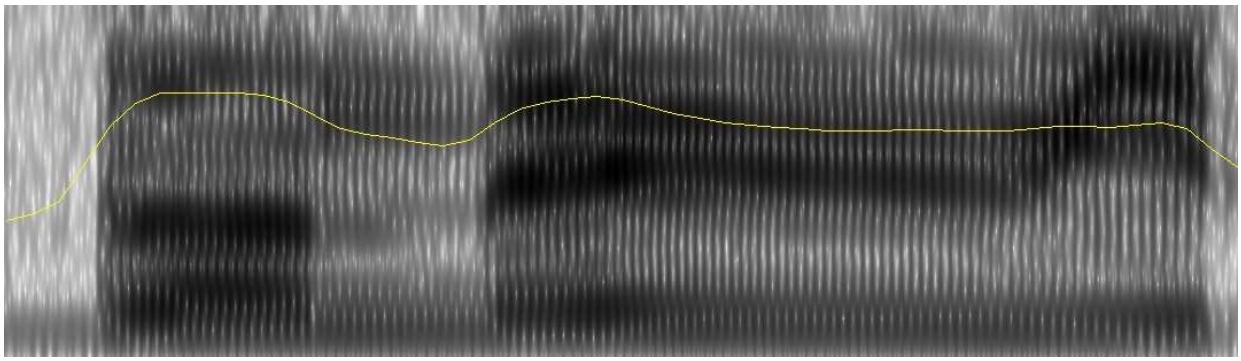

Figure 3. Two completely lenited [β]s in *vivir*.

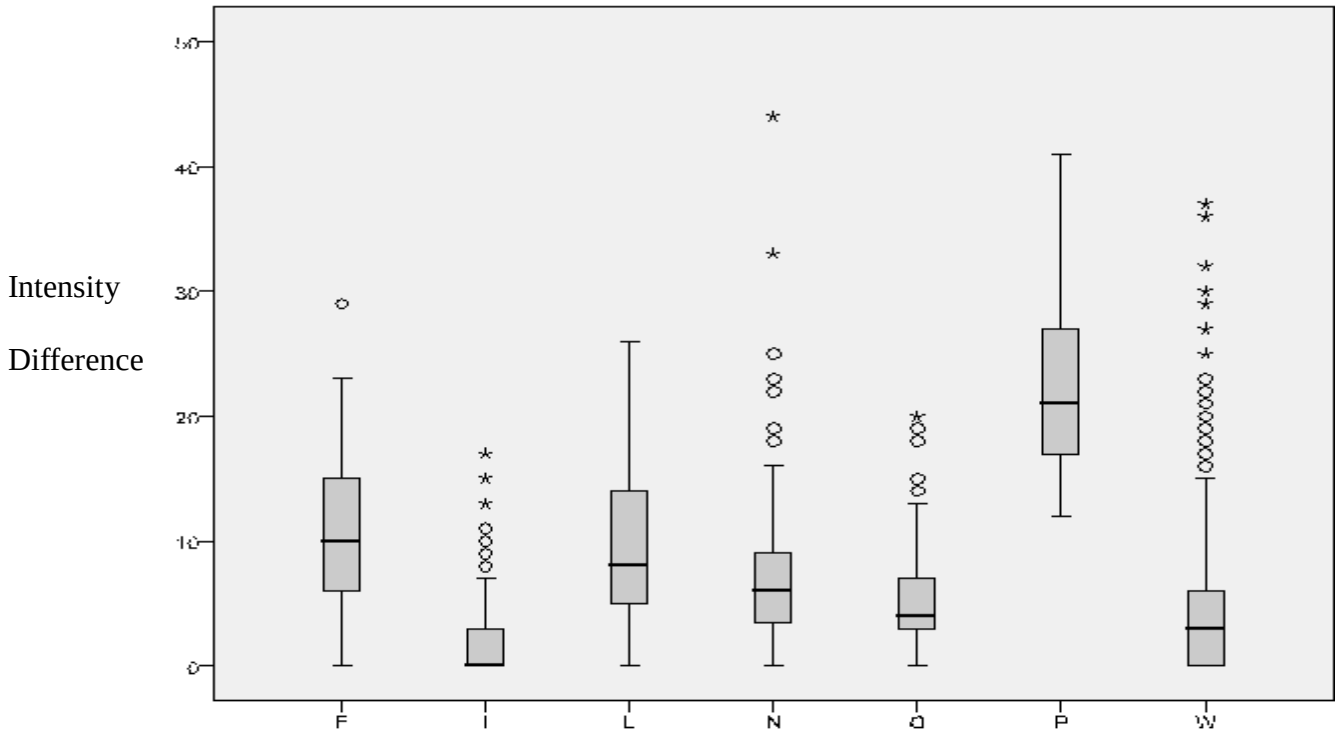

Figure 4. Intensity differences of /β/ in different phonetic environments. F=post-fricative, I=Intervocalic word-internal, L=post-lateral, N=post-nasal, O=contact with other consonant, P=post-pause, W=word initial, intervocalic.

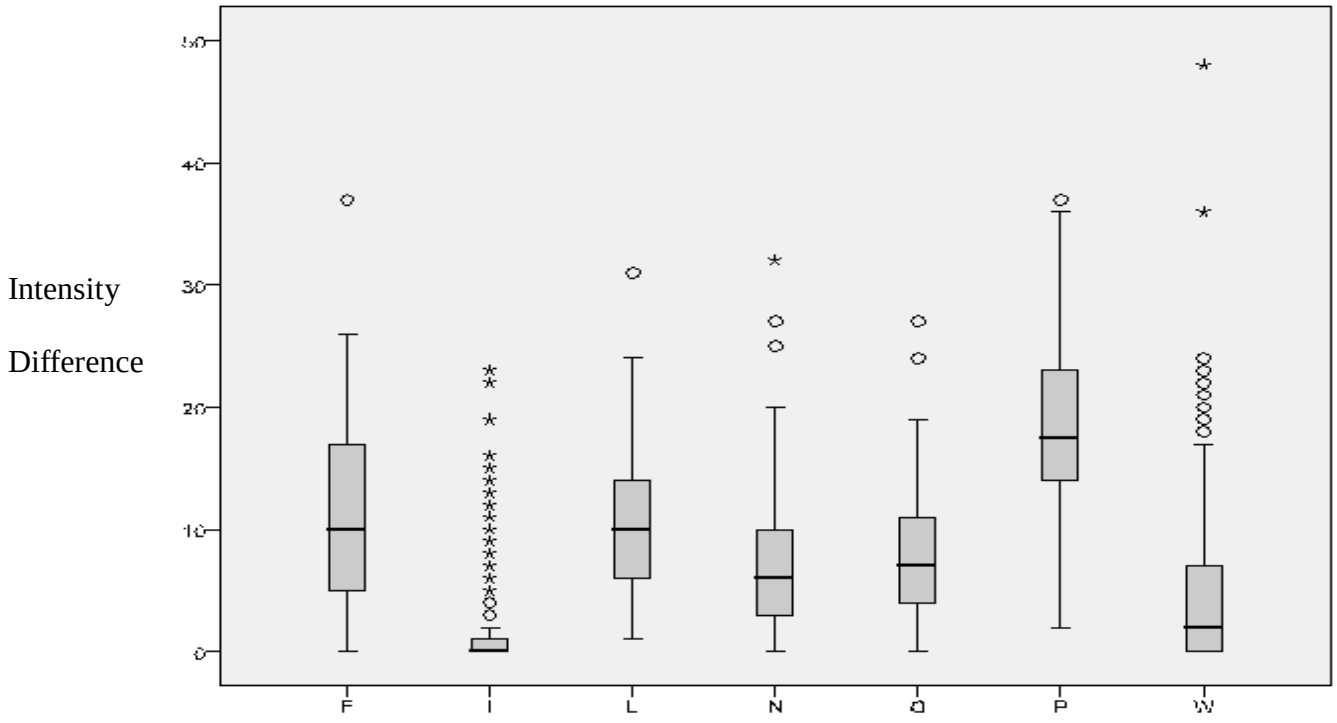

Figure 5. Intensity differences of /ð/ in different phonetic environments. F=post-fricative, I=Intervocalic word-internal, L=post-lateral, N=post-nasal, O=contact with other consonant, P=post-pause, W=word initial, intervocalic.

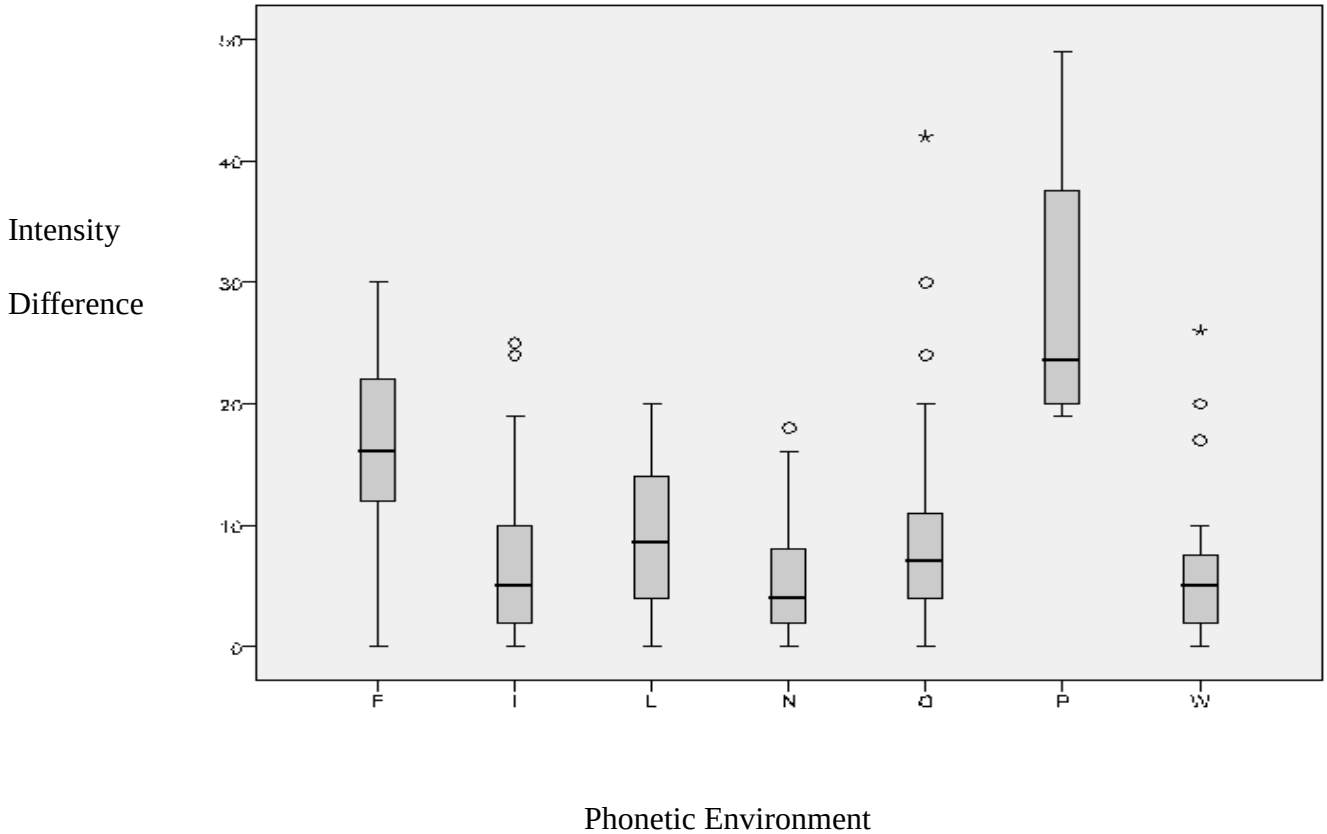

Figure 6. Intensity differences of /γ/ in different phonetic environments. F=post-fricative, I=Intervocalic word-internal, L=post-lateral, N=post-nasal, O=contact with other consonant, P=post-pause, W=word initial, intervocalic.

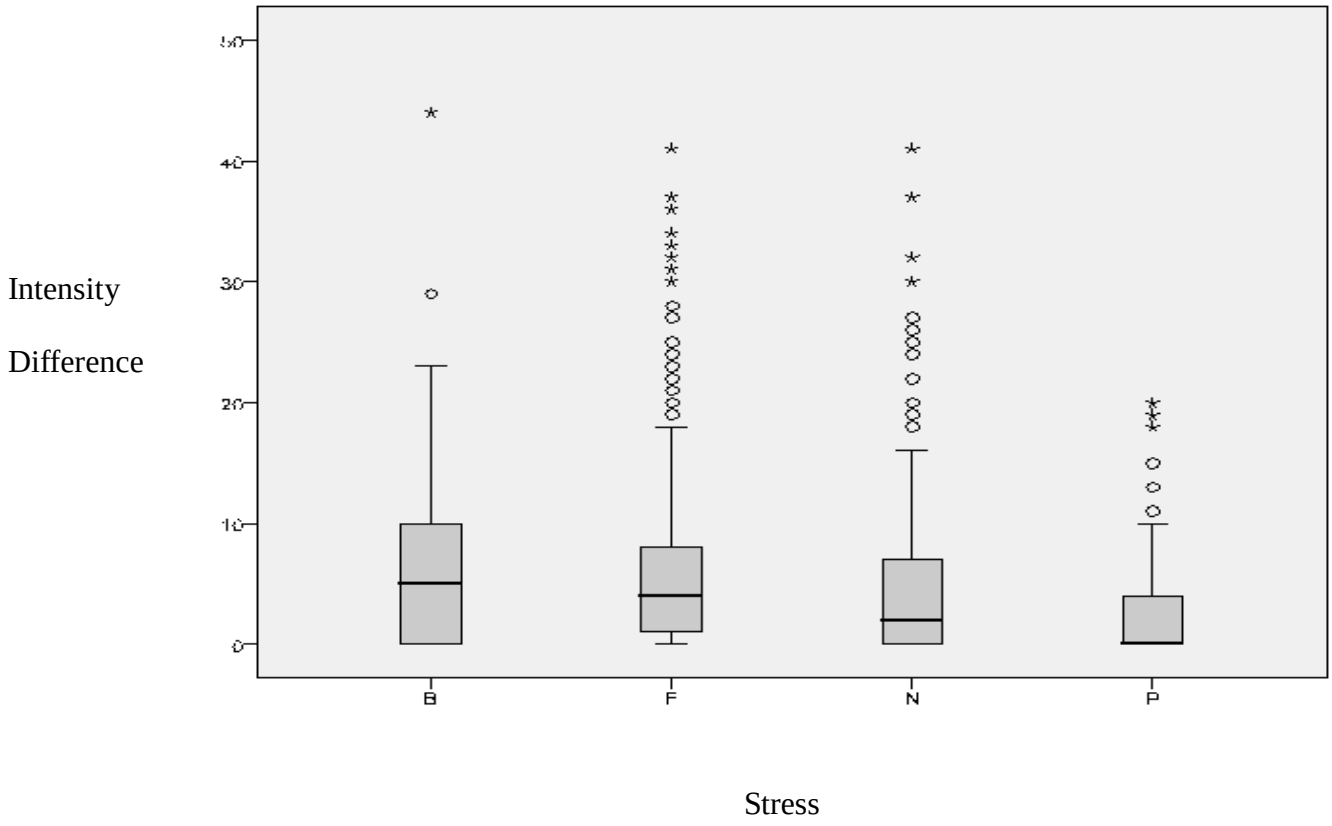

Figure 7. Intensity differences of /β/ according to the stress of preceding and following syllables. B=both syllables stressed, F=following stressed, N=neither stressed, P=preceding stressed.

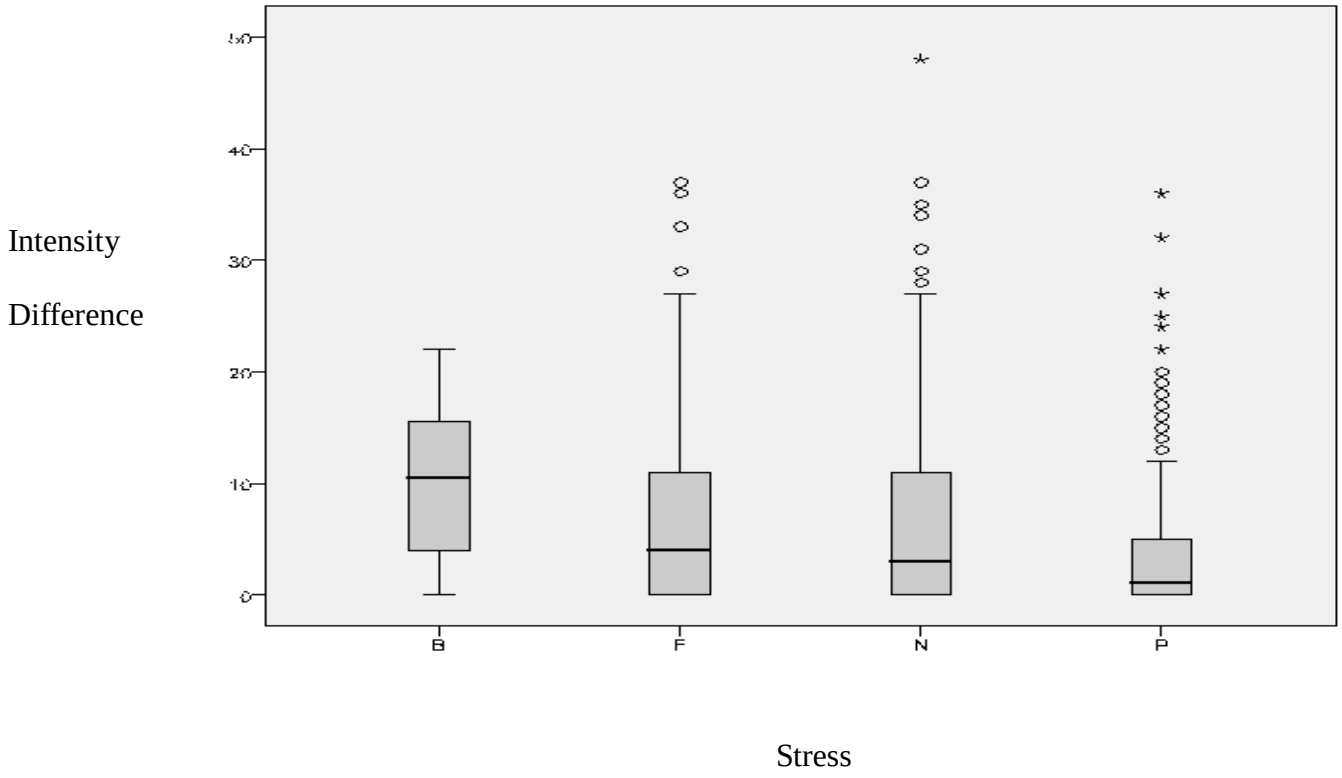

Figure 8. Intensity differences of /ð/ according to the stress of preceding and following syllables. B=both syllables stressed, F=following stressed, N=neither stressed, P=preceding stressed.

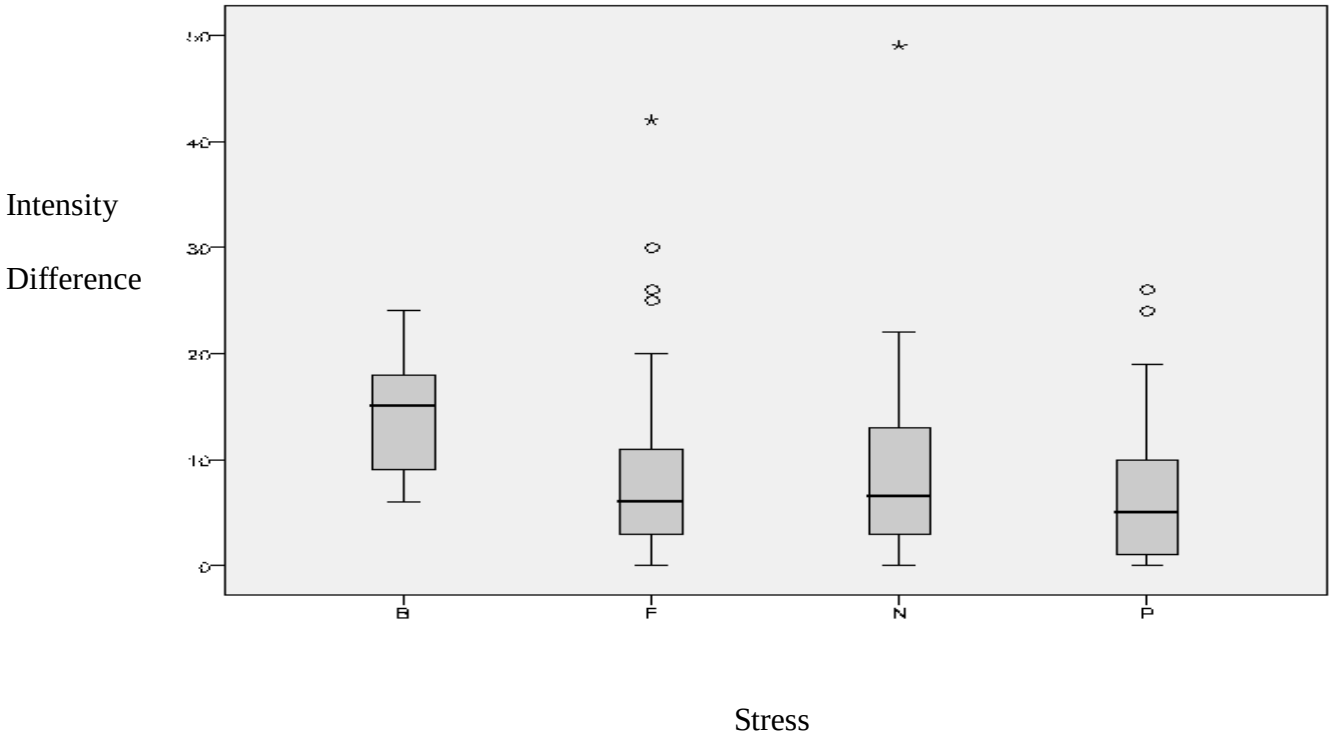

Figure 9. Intensity differences of /γ/ according to the stress of preceding and following syllables. B=both syllables stressed, F=following stressed, N=neither stressed, P=preceding stressed.

Table 1. Participant information.

Country	Gender	Age	# of Tokens
Argentina	F	24	443
Colombia	F	24	503
Ecuador	M	23	59
Nicaragua	M	34	562
Peru	F	24	427
Peru	M	45	520
Spain	F	23	57
Venezuela	F	24	440
		Total	3011

Table 2. Variables that affect the intensity differences of [ð].

Variable	Standardized Coefficient	$p \leq$
Preceding Pause	0.502	0.000
Preceding Nasal	0.280	0.000
Preceding Fricative	0.241	0.000
Preceding Lateral	0.139	0.000
Preceding Word Boundary	0.114	0.000
Other Surrounding Consonant(s)	0.057	0.006
σ́Cσ́ Stress Pattern	0.126	0.000
σCσ́ Stress Pattern	0.118	0.000
σ́Cσ Stress Pattern	-0.037	0.286
34, Male, Nicaragua	0.080	0.003
23, F, Spain	0.057	0.008
24, F, Colombia	0.047	0.067
24, F, Peru	0.030	0.256
24, F, Argentina	-0.012	0.626
23, M, Ecuador	-0.015	0.469
24, F, Venezuela	-0.048	0.065
Word Frequency	-0.050	0.036
Appears in Past Participle	-0.06	0.01

R^2=0.388

Table 3. Variables that affect the intensity differences of [β].

Variable	**0.000**	***p* ≤**
Preceding Pause	0.000	0.000
Preceding Nasal	0.189	0.000
Preceding Fricative	0.176	0.000
Preceding Lateral	0.145	0.000
Preceding Word Boundary	0.000	0.001
Other Surrounding Consonant(s)	0.000	0.000
σ́Cσ́ Stress Pattern	0.088	0.001
σCσ́ Stress Pattern	0.000	0.004
σ́Cσ Stress Pattern	0.000	0.417
34, Male, Nicaragua	0.000	0.370
23, F, Spain	-0.035	0.126
24, F, Colombia	0.000	0.000
24, F, Peru	0.000	0.646
24, F, Argentina	-0.050	0.068
23, M, Ecuador	-0.018	0.446
24, F, Venezuela	0.000	0.002
Word Frequency	-0.030	0.232
Appears in Imperfect	-0.003	0.904

R^2=0.477

Table 4. Variables that affect the intensity differences of [γ].

Variable	Standardized Coefficient	$p \leq$
Preceding Pause	0.357	0.000
Preceding Nasal	0.010	0.844
Preceding Fricative	0.163	0.000
Preceding Lateral	0.163	0.001
Preceding Word Boundary	0.001	0.985
Other Surrounding Consonant(s)	0.094	0.066
σ́Cσ́ Stress Pattern	0.141	0.003
σCσ́ Stress Pattern	0.062	0.432
σ́Cσ Stress Pattern	-0.067	0.436
34, Male, Nicaragua	0.120	0.032
23, F, Spain	0.018	0.701
24, F, Colombia	0.339	0.000
24, F, Peru	0.078	0.145
24, F, Argentina	0.008	0.883
23, M, Ecuador	-0.005	0.912
24, F, Venezuela	0.036	0.510
Word Frequency	-0.020	0.705

R^2=0.280

Table 5. Comparison of the intensity differences of /β, ð, γ/ following laterals.

Comparison	Standardized Coefficient	$p \leq$
/lβ/ to /lγ/	0.049	0.692
/lð/ to /lγ/	0.144	0.246
/lβ/ to /lð/	-0.108	0.430
/lγ/ to /lð/	-0.159	0.246

R^2=0.017

1 I am indebted to Laura Colantoni, Michael Gradoville, Esther Brown, José Ignacio Hualde, and Marta Ortega Llebaria for their input on this paper, some of which was heeded and some of which was not.

2 Michael Gradoville suggested considering this variable.

3 I thank Dirk Elzinga for pointing this out. Kenstowicz (1994: ch. 5) notes that Dutch devoicing poses a similar problem for lexical phonology.